2023 ICGET-TW
綠色電化學科技國際學術研討會
暨 2023台灣電化學學會年會

The 2023 International Conference on Green Electrochemical Technologies &
The 2023 Annual Meeting of Electrochemical Society of Taiwan

PROGRAM
大會手冊

National Science and Technology Council

Department of Information and Tourism, Taipei City Government

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Welcome Address

Message from the Chairman

Prof. Fu-Ming Wang (NTUST)
ECS-Tw Executive Director

Welcome to the ICGET 2023 Meeting. We have assembled an outstanding offering of seminars, address, presentations, and events to feed your appetite for learning. The schedule of oral and poster presentations with over 370 abstracts is in the program on **page 23-59**; maps to guide you through the meeting are on **pages 73-74**. Event staff are happy to help if needed. Look for staff wearing ICGET2023 shirts or go to Meeting Registration.

Keep these highlights in mind as you plan your schedule:

- Hear Arumugam Manthiram (University of Texas at Austin) present a Plenary Lecture, "***A Path Toward Sustainable Battery Chemistries***" on Thursday 0940 at IB101. Masashi Ishikawa (Kansai University) presents a Plenary Lecture, "***Development of Carbon Electrode Materials and Electrolytes for Lithium Sulfur Batteries***" on Thursday 1330 at IB101. Atsuo Yamada (The University of Tokyo) presents a Plenary Lecture, "***Electrolyte Energetics beyond Debye-Hückel Theory***" on Friday 0900 at IB101. Ru-Shi Liu (National Taiwan University) presents a Plenary Lecture, "***Development of Solid-State Li-ion and Metal-Air Batteries***" on Friday 1430 at IB101. Jong-Sung Yu (Daegu Gyeongbuk Institute of Science and Technology) presents a Plenary Lecture, "***Ordering Degree-Dependent Oxygen Reduction Performance in Highly Durable Cobalt Nitride-Planted Pt–Co Intermetallic Catalysts***" on Saturday 0900 at IB101.
- Discover our exciting lineup of industry-leading exhibition in NTUST gallery. Browse the wealth of presentation in the Poster Sessions (Thursday and Friday).

On behalf of the ECS-Tw, all committee members, and all sponsors, thanks you again for joining us.

Organizing Committee

Name	Institute / Academy, School
Prof. Fu-Ming Wang Chairman, 2023 ICGET-TW	Applied Science and Technology, **NTUST**
Prof. Chi-Chang Hu Co-Chair, 2023 ICGET-TW	Chemical Engineering, **NTHU**
Prof. Yung-Tin Pan	Chemical Engineering, **NTHU**
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Prof. Wei-Ren Liu	Chemical Engineering, **CYCU**
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Prof. Chia-Chin Chang	Greenergy, **NUTN**
Prof. Tzu-Ho Wu	Chemical and Materials Engineering, **NYUST**
Prof. Yu-Sheng Su	Semiconductor Technology, **NYCU**
Prof. Tsu-Chin Chou	Chemistry, **NTHU**
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Agenda

Thursday, October 26, 2023					
08:30～	**Register**				
	IB 101 conference hall				
09:30～09:40	**Opening Remark（Prof. F. M. Wang）**				
09:40~10:20	**Plenary Lecture I. Prof. Arumugam Manthiram**（Chaired by **Prof. Fu-Ming Wang**）				
	IB 101 - *Batteries*	**IB 201 - *Photoelectrochemistry/ Electroplating***	**IB 202 - *Electrochemical Conversion***	**1F / 2F Lobby**	
10:20～12:00	**Chair：Li-Hsien Yeh** KL-1. Bing-Joe Hwang KL-2. Soorathep Kheawhom IL-1. Chun-Chen Yang IL-2. Hsing-Yu Tuan	**Chair：Tzu-Chien Wei** KL-1. Seigo Ito KL-2. Chih-Ming Chen IL-1. Cheng-Liang Liu IL-2. Tung-Han Yang	**Chair：Chen-Hao Wang** KL-1. Byungchan Han IL-1. Tsan-Yao Chen IL-2. Heng-Liang Wu IL-3. Chun-Yi Chen	Poster preparing	
12:00～13:30	**Lunch**				
	IB 101 conference hall				
13:30～14:10	**Plenary Lecture II. Prof. Masashi Ishikawa**（Chaired by **Prof. Chi-Chang Hu**）				
	IB 101 - *Batteries*	**IB 201 - *Photoelectrochemistry/ Electroplating***	**IB 202 - *Electrochemical Conversion***	**1F Lobby**	**2F Lobby**
14:10～15:10	**Chair：Wei-Nien Su** KL-3. Nae-Lih Wu IL-3. Yuan-Yao Li IL-4. Gen Inoue	**Chair：Hyeonseok Lee** IL-3. Phuong Tuyet Nguyen IL-4. Chieh-Ting Lin IL-5. Chih-Ping Chen	**Chair：Tsan-Yao Chen** IL-4. Yung-Tin Pan IL-5. Tsu-Chin Chou IL-6. Wen-Hui Cheng	Poster competition preparing	**Poster**
15:10～16:10	**Chair：Hisng-Yu Tuan** IL-5. Wei-Nien Su IL-6. She-Huang Wu IL-7. Li-Hsien Yeh	**Chair：Tzu-Chien Wei** IL-6. Yung-Jung Hsu IL-7. Hyeonseok Lee IL-8. Tzu-Sen Su	**Chair：Yung-Tin Pan** IL-7. Sung-Fu Hung IL-8. Wei-Hung Chiang Oral-1. Yu-Jen Shih (0002)		
16:10～16:40	**Coffee break**			**Poster competition (16:00~17:00)**	
16:40～18:00	**Chair：Yuan-Yao Li** KL-4. Peter Axmann Oral-1. Masashi Kotobuki (0033) Oral-2. Tzu-Yu Kuo (0214)	**Chair：Hyeonseok Lee** Oral-1. Ahmed Fouad Musa (0327) Oral-2. Jia-En Li (0138)	**Chair：Sung-Fu Hung** Oral-2. Chi-Ping Li (0003) Oral-3. Sofiannisa Aulia (0241) Oral-4. Wesley Jen-Yang Chang (0303) Oral-5. Dhayanantha Prabu Jaihindh (0329)		

Friday, October 27, 2023							
08:30～	**Register**						
09:00~09:40	**IB 101 conference hall**						
	Plenary Lecture III. Prof. Atsuo Yamada（Chaired by **Prof. Fu-Ming Wang**）						
09:50～10:50	**IB 101 - *Batteries***	**IB 201 - *Basic electrochemistry***	**IB 202 - *Capacitors and High power energy storage***	**IB 301 - *Industrial***	**IB 302 - *Oral competition for students***	**1F Lobby**	**2F Lobby**
	Chair：Wei-Ren Liu IL-8. Sheng-Heng Chung IL-9. Ching-Yuan Su IL-10. Changhee Lee	**Chair：Zong-Hong Lin** IL-1. Ren-Jei Chung IL-2. Tso-Fu Mark Chang IL-3. Mei-Jywan Syu	**Chair：Han-Yi Chen** KL-1. Lee Pooi See IL-1. Masashi Okubo	**Chair：Chia-Chin Chang** KL-1. E-one Moli KL-2. China Steel Chemical	Program see website	Poster competition preparing	**Poster**
10:50～11:10	**Coffee break**						
11:10～12:10	**Chair：Ching-Yuan Su** KL-5. Hsi-Sheng Teng IL-11. Atsushi Inoishi	**Chair：Tso-Fu Mark Chang** KL-1. Shen-Ming Chen IL-4. Min-Hsin Yeh Oral-1. Pravanjan Malla (0295)	**Chair：Lee Pooi See** IL-2. Hiroki Habazaki KL-2. Chi-Chang Hu	**Chair：Chia-Chin Chang** KL-3. BenQ Materials KL-4. SIMPLO Tech.	Program see website		
12:10～13:30	**Lunch**						
13:30～14:30	**IB 201**					**1F Lobby**	
	ECS-Tw Annual Meeting					**Poster Competition**	
14:30～15:10	**IB 101 conference hall**						
	Plenary Lecture IV. Prof. Ru-Shi Liu（Chaired by **Prof. Chi-Chang Hu**）						
15:10～16:10	**IB 101 - *Batteries***	**IB 201 - *Basic electrochemistry***	**IB 202 - *Capacitors and High power energy storage***	**IB 301 - *Industrial***	**IB 302 - *Oral competition for students***	**2F Lobby**	
	Chair：Chih-Hung Chen IL-12. Wei-Ren Liu IL-13. Yu-Sheng Su IL-14. Elise Yu-Tzu Li	**Chair：Min-Hsin Yeh** KL-2. Ching-Chou Wu IL-5. Min-Chieh Chuang Oral-2. Nattharika Runprapan (0117)	**Chair：Daniel Chua** IL-3. Hirotomo Nishihara IL-4. Jarn-Horng Lin IL-5. Pei-Hsin Young	**Chair：Chia-Chin Chang** KL-5. GSMC Corp. KL-6. SYNergy Corp.	Program see website	**Poster**	
16:10～16:30	**Coffee break**						
16:30～17:30	**Chair：Yu-Sheng Su** IL-15. Chih-Hung Chen (0292) Oral-3. John Lai (0088) Oral-4. Yi-Shiun Chen (0356)	**Chair：Min-Chieh Chuang** KL-3. Shih-Kang Lin KL-4. Zong-Hong Lin	**Chair：Hirotomo Nishihara** IL-6. Daniel Chua KL-3. Jae-Jin Shim	**Chair：Fu-Ming Wang** IL-1. Anton Paar TW KL-7. GUS Tech. KL-8. Croslene Chem.	Program see website		
17:30～17:50	**Transfer to banquet stadium by bus**						
18:10～20:30	**Banquet at Howard Hotel**						

Saturday, October 28, 2023				
08:30～	**Register**			
09:00~09:40	**IB 101 conference hall**			
	Plenary Lecture IV. **Prof. Jong-Sung Yu** (Chaired by Prof. Cheng-Hao Wang)			
09:50～10:50	**IB 101 - *Batteries***	**IB 201 - *Photoelectrochemistry/ Electroplating***	**IB 202 - *Electrochemical Conversion***	**2F Lobby**
	Chair：Chung-Wei Kung IL-16. Kuan-Zong Fung IL-17. Mozaffar Abdollahifar IL-18. Tzu-Ho Wu	**Chair：Tzu-Chien Wei** IL-9. Yuh-Lang Lee IL-10. Cheng-En Ho IL-11. Ming-Der Ger	**Chair：Heng-Liang Wu** KL-2. Ichiro Yamanaka KL-3. Akichika Kumatani	**Poster**
10:50～11:10	**Coffee break**			
11:10～12:10	**Chair：Kuan-Zong Fung** IL-19. Shih-Chieh Liao IL-20. Chung-Wei Kung IL-21. Martin Ihrig	**Chair：Tzu-Chien Wei** IL-12. Ming-Hung Lin IL-13. Wei-Yen Wang Oral-3. Da-Wei Lin (0136)	**Chair：Wei-Hung Chiang** IL-9. He-Yun Du IL-10. Kiho Nishioka IL-11. Hsin-Chih Huang	
12:10～13:30	**Lunch**			
13:30～14:30	**IB 101 - *Batteries***	**IB 201 - *Basic electrochemistry***	**IB 202 - *Capacitors and high power energy storage***	**2F Lobby**
	Chair：Han-Yi Chen KL-6. Hikari Sakaebe IL-22. Shu-Hao Chang	**Chair：Liang-Yin Kuo** IL-6. Yu-Ching Weng IL-7. Szu-Chia Chien Oral-3. Muhammad Faiza (0278)	**Chair：Jeng-Yu Lin** IL-7. Che-Ning Yeh IL-8. Panitat Hasin IL-9. Lu-Yin Lin	**Poster**
14:30～15:30	**Chair：Tzo-Ho Wu** IL-23. Han-Yi Chen Oral-5. Mohamad Afiefudin (0308) Oral-6. Leyela Hassen Adem (0087)	**Chair：Szu-Chia Chien** IL-8. Liang-Yin Kuo IL-9. Peng-Wei Chu	**Chair：Panitat Hasin** KL-4. Jeng-Kuei Chang Oral-1. Hoang Long Ngo (0322)	
15:30～16:00	**IB 101 conference hall**			
	Closing & Awards Ceremony			

Lecture

Plenary Speakers

Arumugam Manthiram

McKetta Department of Chemical Engineering, University of Texas at Austin, USA

A Path Toward Sustainable Battery Chemistries
IB-101 Conference room, Oct. 26th, 09:40 ~ 10:20

Masashi Ishikawa

Materials and Bioengineering Department of Chemistry and Materials Engineering, Kansai University, Japan

Development of Carbon Electrode Materials and Electrolytes for Lithium Sulfur Batteries
IB-101 Conference room, Oct. 26th, 13:30 ~ 14:10

Atsuo Yamada

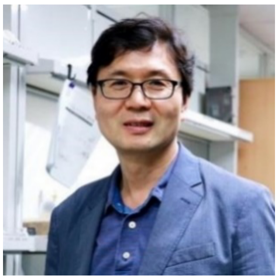
Department of Engineering, The University of Tokyo, Japan

Electrolyte Energetics beyond Debye-Hückel Theory
IB-101 Conference room, Oct. 27th, 09:00 ~ 09:40

Ru-Shi Liu

Department of Physics, National Taiwan University, Taiwan

Development of Solid-State Li-ion and Metal-Air Batteries
IB-101 Conference room, Oct. 27th, 14:30 ~ 15:10



Jong-Sung Yu

Department of Energy Science & Engineering, DGIST, Republic of Korea
Ordering Degree-Dependent Oxygen Reduction Performance in Highly Durable Cobalt Nitride-Planted Pt–Co Intermetallic Catalysts
IB-101 Conference room, Oct. 28th, 09:00 ~ 09:40

Keynote and Invited Speakers

Batteries	**October *26***

IB-101 conference room

Bing-Joe Hwang **10:20 to 10:50**

Department of Chemical Engineering, National Taiwan University of Science and technology, Taiwan

Recent Progress of Anode-free Lithium Metal Batteries in SEED

Soorathep Kheawhom **10:50 to 11:20**

Department of Chemical Engineering, Chulalongkorn University, Thailand

Synergizing MOF-Derived FeNiO Porous Networks with Ti3C2Tx Nanosheets: Advancing Oxygen Electrocatalysis in Rechargeable Zinc-Air Batteries

Chun-Chen Yang **11:20 to 11:40**

Department of Chemical Engineering, Ming Chi University of Technology

Improved electrochemical performance of solid-state lithium metal batteries enabled by in-situ techniques constructed stable interface

Hsing-Yu Tuan **11:40 to 12:00**

Department of Chemical Engineering, National Tsing Hua University, Taiwan,

Design, Optimization, and Construction of High-Performance Potassium-Ion Battery Electrodes

Nae-Lih Wu **14:10 to 14:40**

Department of Chemical Engineering, National Taiwan University, Taiwan

Investigating Composite NCM811 Cathodes containing Halide-based Solid Electrolyte for ALL-Solid-State Li-Ion Batteries under Low Operation Stacking Pressure

Yuan-Yao Li **14:40 to 15:00**

Department of Chemical Engineering, National Chung Cheng University, Taiwan

Activated carbon for Li-Cl2 battery

Gen Inoue **15:00 to 15:20**

Department of Chemical Engineering, National University Corporation Kyushu University, Japan

Computer Simulation Technology for Design of Electrode Structure

Wei-Nien Su **15:20 to 15:40**

Graduate Institute of Applied Science and Technology, National Taiwan University of Science and technology, Taiwan

Enhancing Lithium Argyrodite Sulfide Electrolytes: Doping Strategies and Beyond

She-Huang Wu **15:40 to 16:00**

Battery Research Center of Green Energy, National Taiwan University of Science and technology, Taiwan

An In-situ Diagnostic Method for the Capacity Fading Mechanism of Lithium-ion Cells

Li-Hsien Yeh **16:00 to 16:20**

Department of Chemical Engineering, National Taiwan University of Science and technology, Taiwan

Towards High-Performance Osmotic Power Battery by Ultrathin Sub-2 nm-Scale Framework Membranes

Peter Axmann **16:40 to 17:00**

Zentrum für Sonnenenergie-und Wasserstoff-Forschung Baden-Württemberg, Germany

Towards more Sustainable Cathode Materials

Batteries	**October** *27*
IB-101 conference room	

Sheng-Heng Chung **09:50 to 10:10**

Department of Materials Science and Engineering, National Cheng Kung University, Taiwan

Lean-electrolyte Lithium–Sulfur Cells adopting High-loading Sulfur Cathodes

Ching-Yuan Su **10:10 to 10:30**

Department of Mechanical Engineering, National Central University, Taiwan

The porous scaffold as anode modifier assembly of the fluorinated graphene composite structure for high-performance lithium-metal battery

Changhee Lee **10:30 to 10:50**

Department of Energy and Hydrocarbon Chemistry, Kyoto University, Japan

Electrochemical Behaviors of Carbon-based Cathodes Using Reversible Fluoride Anion (De)Insertion

Hsi-Sheng Teng **11:10 to 11:40**

Department of Chemical Engineering, National Cheng Kung University, Taiwan

Decoupling ion-conductive mechanism in polymer electrolytes for lithium batteries

Atsushi Inoishi **11:40 to 12:00**

Department of Advanced Device Materials, National University Corporation Kyushu University, Japan

High capacity negative electrode by in-situ formed electrolytes for all-solid-state lithium batteries

Wei-Ren Liu **15:10 to 15:30**

Department of Chemical Engineering, Chung Yuan Christian University, Taiwan

High capacity SiOx/C anode materials for Lithium-ion battery

Yu-Sheng Su **15:30 to 15:50**

International College of Semiconductor Technology, National Yang Ming Chiao Tung University, Taiwan

Advancing Performance of Lithium Metal Anodes in Rechargeable Batteries through a Lithium Silicate-Based Protective Coating

Elise Yu-Tzu Li **15:50 to 16:10**

Department of Chemistry, National Taiwan Normal University, Taiwan

A First-Principles Design and Investigation on Li-Based Battery Materials: Bridging Experimental Observations and Theoretical Mechanisms

Chih-Hung Chen **16:30 to 16:50**

Institute of Applied Mechanics, National Taiwan University, Taiwan

The Influence of Lithium-Ion Migration within the Solid Electrolyte Interphase (SEI) on Mossy Lithium Formation

Batteries | October *28*

IB-101 conference room

Kuan-Zong Fung **09:50 to 10:10**

Department of Materials Science and Engineering, National Cheng Kung University, Taiwan

Understanding of Ni-rich Layered Oxides Cathode from Polycrystals to Single Crystal

Mozaffar Abdollahifar **10:10 to 10:30**

Department of Material Science Faculty of Engineering, Christian-Albrechts-Universität zu Kiel, Germany

Battery Electrode Production: Focused on the Calendering Process

Tzu-Ho Wu **10:30 to 10:50**

Department of Chemical and Materials Engineering, National Yunlin University of Science and Technology, Taiwan

Controlling Crystal Structures of Vanadium Oxides via pH Regulation and Understanding *Structure–Performance Relationships on Zn Storage Behaviors*

Shih-Chieh Liao **11:10 to 11:30**

Material and Chemical Research Lab, Industrial Technology Research Institute, Taiwan

Lithium Manganese Iron Phosphate (LMFP) and Lithium Nickel Manganese Cobalt (NMC) Oxide Composite Cells

Chung-Wei Kung **11:30 to 11:50**

Department of Chemical Engineering, National Cheng Kung University, Taiwan,

Chemically Stable and Ion-Conducting Metal–Organic Frameworks

Martin Ihrig **11:50 to 12:10**

Department of Chemical Engineering, National Taiwan University of Science and Technology, Taiwan,

Oxide-Electrolyte-Based All-Solid-State Li Batteries

Hikari Sakaebe **13:30 to 14:00**

Department of Advanced Device Materials, National University Corporation Kyushu University, Japan,

Development of nano-*composite electrode materials in All-Solid-State Batteries*

Shu-Hao Chang **14:00 to 14:20**

Department of Chemical Engineering, Chung Yuan Christian University, Taiwan,

Leveraging the Breath Figure Technique: Integration of Porous Nanostructured Matel Sulfide in Lithium-*Sulfur Batteries*

Han-Yi Chen **14:20 to 14:40**

Department of Materials Science and Engineering, National Tsing Hua University, Taiwan

In-situ X-ray Studies for Understanding Charge Storage Mechanisms of Advanced Electrode Materials for Lithium and Sodium-Ion Batteries

Photoelectrochemistry / Electroplating | October *26*

IB-201 conference room

Seigo Ito **10:20 to 10:50**

Graduate School of Engineering, University of Hyogo, Japan

Fully-Printed Cabon-based Multi-Porous-Layered-Electrodes Perovskite Solar Cells for High Stability and Commercialization

Chih-Ming Chen **10:50 to 11:20**

Department of Chemical Engineering, National Chung Hsing University, Taiwan

Interfacial composite engineering for metal adhesion and diffusion barrier in microelectronic heterojunctions

Cheng-Liang Liu **11:20 to 11:40**

Department of Materials Science and Engineering, National Taiwan University, Taiwan

Spray-Coating Process for Perovskite Solar Cells Application

Tung-Han Yang **11:40 to 12:00**

Department of Chemical Engineering, National Tsing Hua University, Taiwan

Construction and Catalytic Application of a Nanocrystal Library of High-Entropy Alloys

Phuong Tuyet Nguyen **14:10 to 14:30**

University of Science, Vietnam National University, Vietnam

Novel Eco-friendly Electrolytes based on Deep Eutectic Compounds for Dye-sensitized Solar Cells

Chieh-Ting Lin **14:30 to 14:50**

Department of Chemical Engineering, National Chung Hsing University, Taiwan

Water-Resistant Organic Photovoltaics and Their Potential for Photoelectrochemical Devices

Chih-Ping Chen **14:50 to 15:10**

Department of Materials Engineering, Ming Chi University of Technology, Taiwan,

Enhancing Perovskite Photovoltaics through the Defect Passivation of A–D–A Molecules

Yung-Jung Hsu **15:10 to 15:30**

Department of Materials Science and Engineering, National Yang Ming Chiao Tung University, Taiwan

Core-Shell and Yolk-Shell Nanocrystals for Hydrogen Production

HyeonSeok Lee **15:30 to 15:50**

Department of Photonics, National Sun Yat-Sen University, Taiwan

Nanostructured SnS-based photocatalysts for efficient, selective, and long-term stable production of solar fuels from CO2

Tzu-Sen Su **15:50 to 16:10**

Graduate Institute of Energy and Sustainability Tech, National Taiwan University of Science and Technology, Taiwan

Crown Ether as a Versatile Host-Guest Complex for Perovskite Solar Cells

Photoelectrochemistry / Electroplating October *28*

IB-201 conference room

Yuh-Lang Lee **09:50 to 10:10**

Department of Chemical Engineering, National Cheng Kung University, Taiwan

Effects of Cell Structures on the Power Conversion Efficiencies of Dye-sensitized Solar Cells

Cheng-En Ho **10:10 to 10:30**

Department of Chemical Engineering and Material Science, Yuan Ze University, Taiwan

High-speed Electrodeposition for Cu Pillar Fabrication and Its Reliability

Ming-Der Ger **10:30 to 10:50**

Department of Chemical and Materials Engineering, National Defense University, Taiwan

Study on the performance and reaction mechanism of electroplated nickel-boron alloy coatings with different electroplating solution components

Ming-Hung Lin **11:10 to 11:30**

Taiwan Uyemura, Taiwan

Surface finishing Trend evolution For PCB industry

Wei-Yen Wang **11:30 to 11:50**

Industrial Technology Research Institute, Taiwan

Wet-Process Technology for High Adhesion Glass Metallization

Electrochemical Conversion	**October *26***

IB-202 conference room

Byungchan Han **10:20 to 10:50**

Department of Chemical and Biomolecular Engineering, Yonsei University, South Korea

Machine Learning approach integrated with first-principles calculations toward Core Materials Design for efficient electrochemical energy conversion systems

Tsan-Yao Chen **10:50 to 11:10**

Department of Engineering and System Science, National Tsing Hua University, Taiwan

Oxygen vacancy in atomic metal oxide clusters demonstrate outstanding oxygen reduction activity

Heng-Liang Wu **11:10 to 11:30**

Center for Condensed Matter Sciences, National Taiwan University, Taiwan

Vibrational Spectroscopy at Electrified Interfaces: Electrochemical CO2 reduction reaction

Chun-Yi Chen **11:30 to 11:50**

Institute of Innovative Research, Tokyo Institute of Technology, Japan

Ti-Nb-Ta-Zr-O Nanotubes Array by Anodization and Its Application for Photoelectrochemical Water Splitting

Yung-Tin Pan **14:10 to 14:30**

Department of Chemical Engineering, National Tsing Hua University, Taiwan

Membrane Electrode & Electrode Materials' Engineering for Improved Performance Towards Water and CO2 Electrolysis

Tsu-Chin Chou **14:30 to 14:50**

Institute of Analytical and Environmental Sciences, National Tsing Hua University, Taiwan

Gas Permeability of Gas Diffusion Electrode and Its Impact on the Selectivity of Electrocatalytic CO2 Reduction

Wen-Hui Cheng **14:50 to 15:10**

Department of Materials Science and Engineering, National Cheng Kung University, Taiwan

From CO2 Capturing to CO2 Reduction

Sung-Fu Hung **15:10 to 15:30**

Department of Applied Chemistry, National Yang Ming Chiao Tung University, Taiwan

Selective and Efficient Carbon Dioxide Reduction Reaction to Carbon Monoxide and C2 Products

Wei-Hung Chiang **15:30 to 15:50**

Department of Chemical Engineering, National Taiwan University of Science and Technology, Taiwan

Microplasma-Enabled Electrochemical Synthesis of Nanomaterials

Electrochemical Conversion October *28*

IB-202 conference room

Ichiro Yamanaka **09:50 to 10:20**

Department of Applied Chemistry, Tokyo Institute of Technology, Japan

SPE Electrolysis and Catalysis to Realize Future Chemical Process

Akichika Kumatani **10:20 to 10:50**

The Graduate School of Engineering, The University of Tokyo, Japan

Electrochemical Microscopic Analysis on Energy Conversion Materials

He-Yun Du **11:10 to 11:30**

Department of Chemical Engineering, Ming Chi University of Technology, Taiwan

Investigation of Van der Waals heterostructures as electrochemical catalyst using scanning electrochemical microscopy

Kiho Nishioka **11:30 to 11:50**

Department of Materials Science and Engineering, Kyoto University, Japan

The Mitigation of Charging Overvoltages in Lithium-Oxygen Batteries Equipped with Amide-Based Electrolytes

Hsin-Chih Huang **11:50 to 12:10**

Department of Materials Science and Engineering, National Formosa University, Taiwan

Structure-Controlled Nanocatalysts for Oxygen Evolution Reaction

Basic electrochemistry	**October *27***

IB-201 conference room

Ren-Jei Chung **09:50 to 10:10**

Department of Chemical Engineering and Biotechnology, National Taipei University of Technology, Taiwan

Preparing composite electrodes for the electrochemical immunosensors of cancer biomarkers

Tso-Fu Mark Chang **10:10 to 10:30**

Institute of Innovative Research, Tokyo Institute of Technology, Japan

Design of Electrodeposited Materials for MEMS Sensors

Mei-Jywan Syu **10:30 to 10:50**

Department of Chemical Engineering, National Cheng Kung University, Taiwan

Impedimetric Detection of Serum Albumin with the Magnetic-Nanomaterial Modified Au Electrode

Shen-Ming Chen **11:10 to 11:40**

Department of Chemical Engineering and Biotechnology, National Taipei University of Technology, Taiwan

Recent Advancements in Nanomaterials for the Electroanalysis (Sensors), Electrocatalysis, and Electrochemical Energy applications

Min-Hsin Yeh **11:40 to 12:00**

Department of Chemical Engineering, National Taiwan University of Science and Technology, Taiwan

Towards Continuous Health Monitoring Platforms by Noninvasive Enzyme-free Biosensors and Triboelectric Sensors

Ching-Chou Wu **15:10 to 15:40**

Department of Bio-industrial Mechatronics Engineering, National Chung Hsing University, Taiwan,

Microfluidic Chips Integrating with Dissolved Oxygen Ultramicroelectrodes for Estimating Mitochondrial Activity of Cells

Min-Chieh Chuang **15:40 to 16:00**

Department of Chemistry, Tunghai University, Taiwan

Achieving Sustainable Catalysis: Unveiling the Potential of Amorphous Iridium Oxide

Shih-Kang Lin **16:30 to 17:00**

Department of Materials Science and Engineering, National Cheng Kung University, Taiwan

Low-temperature sintering and in situ formed protective layer for oxide-based composite cathode in all-solid-state Li batteries

Zong-Hong Lin **17:00 to 17:30**

Department of Biomedical Engineering, National Taiwan University, Taiwan

Triboelectric nanosensor: a prototype of self-powered sensor based on surface triboelectrification

Basic electrochemistry October *28*

IB-201 conference room

Yu-Ching Weng **13:30 to 13:50**

Department of Chemical Engineering, Feng Chia University, Taiwan

Enhanced Photocatalytic Activity Performance of Single-walled Carbon Nanohorn-In0.2Cd0.8S Composites for Water Splitting

Szu-Chia Chien **13:50 to 14:10**

Department of Chemical and Materials Engineering, National Central University, Taiwan

Studying the Effects of Interstitial Elements on Corrosion Resistant Alloys using DFT Calculations

Liang-Yin Kuo **14:40 to 15:00**

Department of Chemical Engineering, Ming Chi University of Technology, Taiwan

Surface coating and grain boundary modification in Ni-rich active cathode materials with alien doping

Peng-Wei Chu **15:00 to 15:20**

Department of Engineering and System Science, National Tsing Hua University, Taiwan

Microscopic Aspects of Localized Corrosion Behavior of Mg Alloys

Capacitors and High-power energy storage October 27

IB-202 conference room

Pooi See Lee **09:50 to 10:20**

School of Materials Science and Engineering, Nanyang Technological University, Singapore

Rapid charge transfer driven electrochemical energy storage and electrochromic devices

Masashi Okubo **10:20 to 10:40**

Department of Electrical Engineering and Bioscience, Waseda University, Japan,

MXene/Solid Electrolyte Interface for Charge Storage

Hiroki Habazaki **11:10 to 11:30**

Department of Engineering Applied Chemistry Functional Materials Chemistry, Hokkaido University, Japan

Toward Increasing the Withstand Voltage of Solid Aluminum Capacitors for Power Electronics Applications

Chi-Chang Hu **11:30 to 12:00**

Department of Chemical Engineering, National Tsing Hua University, Taiwan

Amorphous Carbons for The High-Voltage Supercapacitor Application: Interactive Effects of Crystallinity and Electrochemical Activation

Hirotomo Nishihara **15:10 to 15:30**

Advanced Institute for Materials Research, Tohoku University, Japan

High-voltage supercapacitors using three dimensional graphene frameworks

Jarrn-Horng Lin **15:30 to 15:50**

Department of Materials Science, National University of Tainan, Taiwan

One-step generation of hollow graphitic carbon nanospheres as conductive additives for highly stable EDLC electrodes

Pei-Hsin Young **15:50 to 16:10**

Department of Chemical and Materials Engineering, National Yunlin University of Science and Technology, Taiwan

Nanoarchitecture of Functional Porous Materials from Metal-Organic Frameworks (MOFs) for Electrochemical Applications

Daniel Chua **16:30 to 16:50**

Department of Materials Science and Engineering, National Singapore University, Singapore

Multifunctional Carbon-based Supports for Applications in Supercapacitors and other Electrochemical Reactors

Jae-Jin Shim **16:50 to 17:20**

School of Chemical Engineering, Yeungnam University, South Korea

Effect of Doping on Supercapacitor Performance

Capacitors and High-power energy storage	October *28*
IB-202 conference room	

Che-Ning Yeh **13:30 to 13:50**

Department of Materials Science and Engineering, National Tsing Hua University, Taiwan

Title

Panitat Hasin **13:50 to 14:10**

Department of Chemistry, Kasetsart University, Thailand,

Engineering Transition Metals-Decorated Heteroatomic-Doped Carbon Materials for Energy Storage Applications

Lu-Yin Lin **14:10 to 14:30**

Department of Chemical Engineering and Biotechnology, National Taipei University of Technology, Taiwan

Designing ZIF67 Derivatives Using Ammonia-based Fluorine Complex as Structure-directing Agent for Energy Storage Applications

Jeng-Kuei Chang **14:30 to 15:00**

Department of Materials Science and Engineering, National Yang Ming Chiao Tung University, Taiwan

Mitigation of Self-Discharge of Electric Double-Layer Supercapacitors Through Binder Engineering

Industrial	October *27*
IB-301 conference room	

E-one Moli **09:50 to 10:20**

Ultra-high Power Lithium Ion Battery

China Steel Chemical **10:20 to 11:50**

Development Strategies to Improve Fast-Charging Performance of Anode Materials for LIBs

BenQ Materials **11:10 to 11:40**

Amped Up on Power and Safety for Battery Separators - ArmaratorTM

SIMPLO Tech. **11:40 to 12:10**

The coming opportunities and the challenges for the latest Li-ion battery industry

Giga Solar Materials **15:10 to 15:40**

Development of Novel Battery Materials for Lithium-ion Batteries and Sodium - ion Batteries:An Industrially Feasible Approach

SYNergy Corp. **15:40 to 16:10**

High-performance and facile solution with in-situ semi-solid electrolyte for lithium-ion batteries

Anton Paar TW **16:30 to 16:50**

title

GUS Tech. **16:50 to 17:20**

title

Croslene Chem. **17:20 to 17:50**

Synthetic Latexes as Binders for Lithium Ion Batteries

Oral presentation and competition program

Oral presentation	**October *26***

IB-101 conference room

Masashi Kotobuki（Abstract no. 0033） **17:10 to 17:30**

Ming chi university of technology, Taiwan

All-solid-state Na battery with novel flexible solid electrolyte

Tzu-Yu Kuo（Abstract no. 0214） **17:30 to 17:50**

National Yang Ming Chiao Tung University, Taiwan

Composite Solid Electrolyte with a Commercial Polyethylene Separator Scaffold for High-Energy-Density Lithium Batteries

IB-201 conference room

Ahmed Fouad Musa（Abstract no. 0327） **16:40 to 17:00**

National Tsing Hua University, Taiwan

Attaining Long-term Stability, Pure Phase, and High Efficiency Beyond 22% in FAPbI3 Perovskite Solar Cells via CsSCN Additives

Jia-En Li（Abstract no. 0138） **17:00 to 17:20**

National Chung Hsing University

Preparation of Antiperovskite Co3CuN and Metal-Organic Framework Composites for Photoelectrochemical Properties

IB-202 conference room

Yu-Jen Shih（Abstract no. 0002） **16:10 to 16:30**

National Sun Yat-sen University, Taiwan

Reduced graphene oxide-encapsulated silver nanoparticles (Ag/rGO) for direct electro-oxidation of ammonia toward N2 selectivity

Chi-Ping Li（Abstract no. 0003） **16:40 to 17:00**

National United University, Taiwan

Electrochromic Performance of Nanocrystalline, Mesoporous Tungsten Oxide Films

Sofiannisa Aulia（Abstract no. 0241） **17:00 to 17:20**

National Taiwan University of Science and Technology, Taiwan

Developing Carbon Nitride Quantum Dots (CNQDs) Supported by Graphene for an Efficient 2-electron Oxygen Reduction Electrocatalyst in Alkaline Media

Wesley Jen-Yang Chang（Abstract no. 0303） **17:20 to 17:40**

National Tsing Hua University, Taiwan

The Effect of Ag-Cu Tandem Catalyst Layer Structure on CO2RR

Dhayanantha Prabu Jaihindh（Abstract no. 0329） **17:40 to 18:00**

Academia Sinica, Taiwan

Chlorine doped CuO On electrochemical CO2 Reduction to C2+ Value Added Products

Oral presentation October *27*

IB-101 conference room

John Lai（Abstract no. 0088） **17:00 to 17:20**

UL TAIWAN, Taiwan

Identification of Battery Past Usage by Machine Learning

Yi-Shiun Chen（Abstract no. 0356） **17:20 to 17:40**

Simplo Technology Co., Ltd., Taiwan

The coming opportunities and the challenges for the latest Li-ion battery industry

IB-201 conference room

Pravanjan Malla（Abstract no. 0295） **12:10 to 12:30**

Chang Gung University, Taiwan

Ultrasensitive electrochemiluminescence biosensor for simultaneous detection of dual micro-RNAs

Nattharika Runprapan（Abstract no. 0117） **16:10 to 16:30**

National Taiwan University of Science and technology, Taiwan

A novel ultrasensitive immunosensor based on MOF-derived materials for ovarian cancer using Fe-N-C single-atom material.

Oral presentation October *28*

IB-101 conference room

Mohamad Afiefudin（Abstract no. 0308） **15:00 to 15:20**

Bandung Institute of Technology, Indonesia

Invigorate a Nickel-Intercalated Manganese Dioxide Cathode with Flower-Like Morphology for Zinc Ion Batteries

Leyela Hassen Adem（Abstract no. 0087） **15:20 to 15:40**

National Taiwan University of Science and Technology, Taiwan

In situ DRIFTS Analysis of the Moisture–Induced Degradation of L6PS5Cl Solid State Electrolyte and its Recovery via Heat Treatment

IB-201 conference room

Da-Wei Lin（Abstract no. 0136） **12:10 to 12:30**

National Chung Hsing University

Preparation of Anti-perovskite Ni3FeN Particles and their Photoelectrochemical Properties

Muhammad Faizan（Abstract no. 0278） **14:30 to 14:50**

Chang Gung University, Taiwan

Developing a Bimetallic MMOF-based Electrochemiluminescence Genosensor for Simultaneous Detection of Dual Micro RNAs

IB-202 conference room

Hoang Long Ngo（Abstract no. 0322） **15:00 to 15:20**

NTT Hi-Tech Institute, Nguyen Tat Thanh University, Vietnam

A low-cost and eco-friendly fabrication of an MCDI-utilized poly(vinylalcohol) ion exchange membrane

Oral competition – by Topic	IB-302

Batteries

Ching-Hsun Wu（Abstract no. 0279） **11:20 to 11:30**

National Cheng Kung University, Taiwan

Combining the Effect of Polymer Networks and Inorganic Filler as a Novel Solid-State Electrolyte for Lithium Batteries

Pavitra Srivastava（0Abstract no. 209） **10:00 to 10:10**

National Taiwan University, Taiwan

Robust and Intimate Interface Enabled by Silicon Carbide as an Additive to Anodes for Lithium Metal Solid-State Batteries

Wen-Yang Jao（Abstract no. 0191） **9:50 to 10:00**

National Tsing Hua University, Hsinchu, Taiwan

Non-aqueous Calcium-based Dual-ion Batteries with an Organic Electrode of High-rate Performance

Le-Yen Lin（Abstract no. 0139） **15:10 to 15:20**

National Taiwan University, Taiwan

Mixed Ion-Electron Transport in Composite Electrodes

Daniel Chang（Abstract no. 0093） **11:30 to 11:40**

National Tsing Hua University, Taiwan

Structured Garnet LLZO Composite Solid Electrolyte Prepared by Freeze Drying with Graphene Oxide as a Template

Yi-Xiu Chen（Abstract no. 0085） **15:20 to 15:30**

National Cheng Kung University, Taiwan

Improvement of Stability and High-Rate Capability for Silicon-based Lithium Thin-film Battery Through Multiple Patterned Strategies

Zih-Jhong Huang（Abstract no. 0080） **15:30 to 15:40**

National Taiwan University of Science and Technology, Taiwan

Improving the Performance of Electrode by CoSnO3/rGO for Vanadium Redox Flow Battery

Tripti Agnihotri（Abstract no. 0075） **16:30 to 16:40**

National Taiwan University of Science and Technology, Taiwan

3D crosslinked Composite Gel Polymer Electrolyte for Enhancing the safety and Performance of Anode-free Li metal batteries

Rio Akbar Yuwono（Abstract no. 0066） **16:40 to 16:50**

National Taiwan University of Science and Technology, Taiwan

Novel Oligomer as an Artificial Cathode Electrolyte Interphase (ACEI) on Ni-rich Cathode Material

Capacitor and High-power energy storage

Hao-Yu Ku（Abstract no. 0228） **11:40 to 11:50**

National Tsing Hua University, Taiwan

Design of Polyimide-based Separators for Effective Suppression of Self-discharge in Non-aqueous Electrical Double Layer Capacitors

Xiang-Yu You（Abstract no. 0063） **10:20 to 10:30**

National Taipei University of Technology, Taiwan

Ligand and Solvent-dependent Energy Storage Ability of Cobalt Compounds Derived from Cobalt Tetrafluoroborate Hexahydrate as Efficient Active Materials of Supercapacitor

Meng-Dian Tsai（Abstract no. 0038） **16:00 to 16:10**

National Cheng Kung University, Taiwan

Fabrication of Conducting Polymer on Sulfonate-Grafted Two-Dimensional Zirconium-Based Metal–Organic Frameworks for Pseudocapacitor

Ting-Jun Lai（Abstract no. 0235） **16:50 to 17:00**

Providence University, Taiwan

Development of Stretchable, Self-Healing, and Antifreeze Ion Gel Electrolyte for Electrochemical Capacitors Research

Electrochemical conversion

Mia Rinawati（Abstract no. 0255） **11:50 to 12:00**

National Taiwan University of Science and Technology, Taiwan

Evoking the Dynamic Fe-Nx Active Sites of Molecular Fe Catalyst on NGQDs for the Efficient Electroreduction of Nitrate to Ammonia

Chih-Chieh Cheng（Abstract no. 0183） **17:00 to 17:10**

National Tsing Hua University, Taiwan

Mo and W Binary Single-Atoms Anchored NiFe-Based Metal-Organic Frameworks as Overall Water Splitting Electrocatalysts

Yu-Chueh Lu（Abstract no. 0218） **15:40 to 15:50**

National Tsing Hua University, Taiwan

Exploring Catalyst Support Interaction: Tungsten Oxide-Based Materials for Enhanced Oxygen Evolution Reaction Catalysts

Yuta Inoue（Abstract no. 0202） **10:30 to 10:40**

Kyoto University, Kyoto, Japan

Analysis of Perovskite Oxide/Electrolyte Interface during Oxygen Evolution Reaction via 3D Electrochemical Impedance Spectroscopy

Photoelectrochemistry and electroplating

Zhi-Qing Lim（Abstract no. 0273） **12:00 to 12:10**

National Cheng Kung University, Taiwan

Preparation of quasi-solid-state electrolytes with copper redox couple for dye-sensitized solar cells

An Hsueh（Abstract no. 0252） **17:20 to 17:30**

National Taiwan University of Science and Technology, Taiwan

A Solar-driven Photoelectrochromic device with the bifunctional PANI/Prussian Blue Hybrid Film

Nideesh Perumbalathodi（Abstract no. 0232） **15:50 to 16:00**

National Tsing Hua University, Taiwan

Bi-directional Passivation for CuSCN-based Perovskite Solar Cell using a Thio-silane Compound

Cheng-Tai Lee（Abstract no. 0180） **10:40 to 10:50**

National Taiwan University of Science and Technology, Taiwan

Hierarchical CoxSy Nanoneedles for the Photocatalysis of CO2 Reduction

Chih-Chen Kuo（Abstract no. 0009） **17:10 to 17:20**

National Taiwan Ocean University, Taiwan

Enhanced photoelectrochemical performance of hetero-phase TiO2 hybrid

Basic electrochemistry

Chia-An Lung（Abstract no. 0154） **10:10 to 10:20**

National Taiwan University of Science and Technology, Taiwan

Two-Dimensional Membranes Based on Covalent-Organic Framework for Controllable Ion Transport and Efficient

Hung-Yi Huang（Abstract no. 0035） **11:10 to 11:20**

National Tsing Hua University, Hsinchu, Taiwan

Dopant-designed conducting polymers for constructing a high-performance, electrochemical deionization system achieving low energy consumption and long cycle life

Oral competition – by Chronological order IB-302

09:50 to 10:50

Wen-Yang Jao **Abstract no. 0191**

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Poster competition program

Date：Oct. 26th
Location：1F - Lobby
Posting time：14:10～18:00
Competition starts at 16:00

****Please remove your poster after the competition session****

TOPIC：Photo Electrochemistry / Electroplating

Serail no.	Paper no.	Abstract	Presenter
PC-01-**001**	0007	Design and fabrication of Bi2O3/WO3 composites with high efficiency in photo-electrochemistry	Shang-Hao Chen
PC-01-**002**	0090	Covalent Organic Frameworks Decorated with Metal Nanoparticles for Dye-Sensitized Solar Cells	Yu-Hsuan Chen
PC-01-**003**	0106	Nanostructured TiO2 Photocatalysts with Consecutive deposition of NiO and CQD Nanoparticles for Efficient CO2 Conversion	Tarek Fawzi
PC-01-**004**	0152	Self-Assembled Silane Treatment of Hole Transporting Layer for Perovskite Solar Cells	Ying-Jung Lu
PC-01-**005**	0162	Desgin and Fabrication of P3HT/AZO/ZnO-based Optoelectronic Device Using Electrochemical Deposition Techniques	Yu-Ren Yang
PC-01-**006**	0166	Degradation Analysis on Dye-sensitized Solar Cells Fabricated using PVP- and PVP/VA-Pt Electrodes: Electrochemical and Electrochemical Impedance Approach	Xin-Ru Lin

PC-01-**007**	0176	Bilayer semi-transparent electrode for large-area perovskite solar cells	Chia-Feng Li
PC-01-**008**	0181	Efficient Photocatalysis of CO2 Reduction Using Co3O4 Nanoneedles	Cheng-Tai Lee
PC-01-**009**	0215	The mechanism study and quantification of stress formation in copper with different orientations in direct current electroplating	Shih-Hua Chen
PC-01-**010**	0217	Rapid Silicon Carbide Thinning via Electrochemical Etching	Chun-Huang Wu
PC-01-**011**	0267	Electroepitaxy of ZnO using a rotating electrode method	Yu-Hsuan Hsiao
PC-01-**012**	0284	Electrodeposition of nickel coatings containing a high density of nanotwins	Hao-Ping Chen
PC-01-**013**	0306	Electrodeposited Zn-doped TiO2 Mesoporous Electron Transporting Layer For Efficient Perovskite Solar Cells	Ha-Phuong Ngo Thi

TOPIC：Batteries

Serail no.	Paper no.	Abstract	Presenter
PC-02-**001**	0043	Unveiling Accelerated Desolvation Kinetics Enabled by Polyimide Nanofabric for Zinc Metal Electrodes	Chi-Yu Lai
PC-02-**002**	0044	Universal Alkali-ion Storage in Closed Pore-rich Hard Carbon towards Nonflammable High Voltage Dual-ion Batteries	Liang-Chieh Tseng
PC-02-**003**	0045	An Investigation of Solid Polyelectrolyte To a Binder Additive And Its Affection On Lithium-Ion Battery	Ruben Foeng
PC-02-**004**	0051	Temperature effects on sodium-ion storage behaviors of hard carbon microspheres derived from phenolic resin as prospective anode materials for sodium ion batteries	Zhi-Ting Liu
PC-02-**005**	0053	An Electrospun Sandwiched – Structural Separator/Electrolyte for the Lithium–Sulfur Battery	Tzu-Ching Chan
PC-02-**006**	0060	Comparative Study of Biomass-derived Carbons as Sulfur Hosts for Lithium-Sulfur Batteries	Yung-Hsun Chu

PC-02-**007**	0073	Well-controlled Compositional Homogeneity in NMC Cathodes for Li-ion Batteries	Zheng-Ying Huang
PC-02-**008**	0074	The Comparison of Ionic/Electronic Conductor in the Cathode for High-loading Lithium-Sulfur Batteries	Bo-Xian Ye
PC-02-**009**	0081	Low Self-discharged High-loading Polysulfide Cathode Design for Lithium–Sulfur Battery	Cheng-Che Wu
PC-02-**010**	0082	Application of Copper Nitride Foil Films Prepared by Atmospheric Plasma Sputtering in Reducing Dendrite Formation in Anode Free Li-ion Batteries	Fu-Ming Wang (Peng-Xuan Yu)
PC-02-**011**	0084	Multilayer and Annealing Strategy Enabling Fluorinated Garnet-type LLZO Solid Electrolyte to improve Li-ion transportation and Interfacial Chemistry	Hoong-Zheng Siew
PC-02-**012**	0095	Ab-initio Interfacial Chemical Stability between Cathodes and Solid-state Electrolytes in Solid-state Lithium Batteries	Chao-Hsiang Hsu
PC-02-**013**	0101	Li1.3Al0.3Ti1.7(PO4)3 solid electrolytes synthesized by microwave-assisted hydrothermal reaction for Li all-solid-state battery	Cheng-En Yu
PC-02-**014**	0109	Metal-Organic Frameworks Derived Tungstate Zirconia Catalyst for High-Performance All Vanadium Redox Flow Battery	Chun-Hong Kuo
PC-02-**015**	0114	A Study on Electrochemical Properties of Modified Lithium-rich Cathode Materials with Surface Coating	Zong-Xiao Jiang
PC-02-**016**	0116	Improving Propylene Carbonate Tolerance for Natural Graphite Anode via artificial SEI of Functionalized Sulfonted Chitosan	Heng-Li Wang
PC-02-**017**	0120	Electrochemical kinetics of polycrystalline and single-crystalline NMC811 cathode powder for Li-ion batteries	Chen-Hao Tu
PC-02-**018**	0123	Application of a Nickel/Sulfur Composite Energy-storage Materials in Developing Long-live Lithium–Sulfur Cells	Yu-Pei Chiang

PC-02-**020**	0129	Silicon/hard carbon composite anode derived from phenolic resin as anode materials for lithium-ion batteries	Yu-Hsuan Li
PC-02-**021**	0144	2D NiFe MOF/N-doped rGO as Bifunctional Catalyst for Rechargeable Zinc Air Batteries	Yi-Pin Chan
PC-02-**022**	0158	Synchronous regulation of Schottky/p-n dual junction in Prussian blue-derived Janus heterostructures: a path to ultrafast long life potassium ion batteries	Jia-Sheng Lin
PC-02-**023**	0179	Lithium-ion Storage Mechanism in Closed Pore-rich Hard Carbon with Ultrahigh Extra Plateau Capacity	Chen-Wei Tai
PC-02-**024**	0193	Achieving superior lithium-Ion battery performance with a high-efficiency oxygen plasma modification of hard carbon derived from phenolic resin.	Wei-Chu Hsu
PC-02-**025**	0194	An Effective Hybrid Solid Electrolyte Membrane Based on LiTa2PO8 for High-Performance Quasi-Solid-State Lithium-Sulfur Batteries	Ammaiyappan Anbunathan
PC-02-**026**	0204	Understanding Capacity Roll-Over on Cathode Material for Lithium Ion Battery	Salva Salshabilla
PC-02-**027**	0223	Polypyrrole//Zn electrode with specially designed zinc ion gel electrolyte for fast chemically self-charging and smart electrochromic flexible electrochemical battery.	Wan-Tien Huang
PC-02-**028**	0229	Tailoring of gold nanoparticles and pre-lithiated sulfonic acid group on functionalized boron-doped silicon as anode for high-energy-density lithium-ion batteries	Sanjana K.
PC-02-**029**	0234	Ag Decorated Layered MnO2 for Enhanced Energy Storage Performance in Zn-Ion Batteries	Shao-Chun Liao
PC-02-**030**	0236	In Situ XRD and Electrochemical Performance of Gallium Infused Mesoporous Carbon CMK-3 as an Anode for Lithium-Ion Batteries	Ajayan Mano

PC-02-**031**	0237	Quaternary Prussian blue analogs as Cathode materials for Sodium-ion Batteries	Hao-Hsiang Chang
PC-02-**032**	0243	Solvent-free UV-crosslinked Polymer Electrolyte with Semi-interpenetrating network for All-Solid-State Lithium Batteries	Ghufira Ghufira
PC-02-**033**	0245	Enhancing the Cycling Stability of Anode-Less Lithium-Metal Batteries Using Thermal-treated Copper Current Collectors	Kainat Darwaish
PC-02-**034**	0246	Graphene coating by Chemical Vapor Deposition on Graphite Felt for Vanadium Redox Flow Batteries	Feng-Li Tea
PC-02-**035**	0259	Si-doped Li7La3Zr2O12 Filler Incorporated Composite Solid Electrolyte Membrane for All-Solid-State Lithium Metal Batteries	Ajith K
PC-02-**036**	0260	Inhibition of Shuttle Effect in Aqueous Zinc-Iodine Batteries Using Conductive Polymers	Ya-Syuan Wu
PC-02-**037**	0262	Li1.2Ni0.13Mn0.54Co0.13O2 decorated with Li3PO4 layer as a high-voltage cathode material for lithium-ion batteries	Chih-Han Wang
PC-02-**038**	0282	Microstructure and Evolution of Sulfur Cathode along Cycling in a Nucleophilic Electrolyte for Rechargeable Magnesium-Sulfur (Mg-S) Battery	Wei-Hsiang Tsai
PC-02-**039**	0289	Improved Ionic Conductivity of PEO Composite Electrolyte by Bi-Doped BaTiO3 Nanofillers	Yu-Yao Huang
PC-02-**040**	0309	Long-cycled Lithium Metal Batteries with Additive Incorporated Lithium Salt Deep Eutectic Electrolyte	Cian-Ping Lin
PC-02-**041**	0311	Zinc-Lithium-Urea Deep Eutectic Mixture as Electrolyte for Rechargeable Zinc-based Hybrid Batteries	Sin-Yi Syu
PC-02-**042**	0377	Preparation of composite solid-state electrolyte for lithium-ion batteries	Sheng-Lun Chou
PC-02-**043**	0378	Research on recycling of lithium iron phosphate cathode materials from spent lithium-ion batteries	Hao-Chin Chiu

TOPIC：Electrochemical Conversions

Serail no.	Paper no.	Abstract	Presenter
PC-03-**001**	0025	Photoelectrochemical Reaction Activity of Two-dimensional Materials by Microdroplet Analysis Method	Pin-Syuan Haung
PC-03-**002**	0037	Yttrium Doped Nickel Hydroxide Catalysts for Electro-Oxidation of Urea	Yi-Ying Lee
PC-03-**004**	0089	Harnessing Ni SACs on cogently designed nanofiber-based catalysts for CO2 electroreduction	Varad A. Modak
PC-03-**005**	0103	Copper Installed Metal–Organic Framework-Derived Materials for Electrocatalytic Nitrate-to-Ammonia Reduction	Shang-Cheng Yang
PC-03-**006**	0110	Ru decorated CuO heterostructure with NiMn layered double hydroxides for Electrochemical Urea Oxidation	Madhuri S. Birare
PC-03-**007**	0118	Nickel Single Atom Catalyst for Efficient CO2 Reduction Reaction under Acidic Medium	Mengstu E. Ashebir
PC-03-**008**	0127	Ozone-Assisted Hydrothermal Synthesis Method of Sb-Doped SnO2 Conductive Nanoparticles for Carbon-free ORR Catalysts in Proton-Exchange-Membrane Hydrogen Fuel Cells	Takeshi Fukuda
PC-03-**009**	0143	The study of micro-patterned non-enzymatic glucose sensor	Wen-Ya Lee
PC-03-**010**	0149	Effect of Gold Modification on Platinum Catalyst Electrocatalysis of Dimethoxymethane	Wen-Li Chen
PC-03-**011**	0155	Pulsed Potential CO2 Electroreduction of Cuprous Oxide Nanocubes Boosts the Ethanol Selectivity	Yi-Yu Chen
PC-03-**012**	0156	Cr and Fe Decorating Chemical-Vapor-Deposited ZIF67 Derivatives for Neutral Seawater Electrolysis in Membrane Electrode Assemblies	Jian-Jie Ma
PC-03-**013**	0163	Spatial Confinement Enhancement of Copper-Aluminum Alloys inside the Carbon Nanofiber for Carbon Dioxide Reduction Reaction	Kang-Shun Peng

PC-03-**014**	0165	Carbon Nanofiber-supported Neatly-Arranged Nickel Single Atom Catalyst for CO2-to-CO Conversion	Meng-Cheng Chen
PC-03-**015**	0168	First-Principles Studies on the Impact of Ruthenium on the Hydrogen Evolution Reaction Activity for Pt-Ru-based Nanoparticles in Alkaline Condition	Haeshik Lee
PC-03-**016**	0210	Low Temperature Anodization: A Route to Directly Fabricate Low-Resistivity Silicon Nanocrystals	Yu-Sheng Chiou
PC-03-**017**	0216	Enhanced N-type Si Anodization via Temporary PN Junction Bonding	Shu-Cheng Li
PC-03-**018**	0238	High-Entropy Prussian blue analogues derivative on Functional CNT as Bifunctional Oxygen Electrocatalyst for Rechargeable Zinc-Air Batteries	Wuttichai Tanmathusorachai
PC-03-**019**	0258	MgO/(OH)2: A Sacrificial Booster for Cu-based Cathodes in Anion MEA CO2 Electrolysis	Ding-Huei Tsai
PC-03-**020**	0272	Advancing Acidic PGM-Free OER Catalysis: The Role of Stable Element Doping in Co3O4 Crystalline Structures	Shin-Yu Hung
PC-03-**021**	0287	Platinum Single-Atom on Defective and Highly- conductive Layered MXene for Enhanced Electrocatalytic Hydrogen Production	Wei-Sheng Liao
PC-03-**022**	0299	Catalyst Layer Engineering by Varying Ink Concentration Under Different Catalyst Loadings	Zun-Wei Wang
PC-03-**023**	0312	Tuning the Primary and Secondary Coordination Sphere of Transition Metal-Single Atom Catalysts for Electrochemical Hydrogen Peroxide Synthesis in an Acidic Medium	Saravanakumar Muthusamy
PC-03-**024**	0331	Electrochemically-assisted method to synthesize single-atom catalysts with N4 sites applied to CO2 reduction reaction	Chia-Yu Chang

Date：Oct. 27th
Location：1F - Lobby
Posting time：11:10～17:30
Competition starts at 13:30

TOPIC：Capacitor and High-Power Energy Storage

Serail no.	Paper no.	Abstract	Presenter
PC-04-**001**	0019	High proportional 1T phase nitrogen-doped MoS2/HPAC nanocomposites: electrochemical performance and Li+-storage mechanism	Mohamed M. Abdelaal
PC-04-**002**	0028	Construction of a multifunctional composite layer for efficient protection of zinc anode	Rene Mary Amirtha
PC-04-**003**	0054	Novel Synthesis of Copper Sulfide Plate-assembled Hollow Cages as Efficient Electrocapacitive Material of Battery Supercapacitor Hybrids	Yu-Hsuan Chiu
PC-04-**004**	0062	Constructing metal organic framework derived manganese cobalt layered double hydroxide nanosheets on Ni foam as cost-effective binder-free electrodes of high-performance supercapacitors	Yi-Lin Hsu
PC-04-**005**	0065	Active sites-induced decoration of nickel hydroxide nanosheets on copper oxide nanocubes as electroactive material of battery supercapacitor hybrids	Pin-Chun Lee
PC-04-**006**	0067	Facile Synthesis of Ammonium Hydrogen Fluoride and Ammonia Borane Fluoride Induced Zeolitic Imidazolate Framework 67 Derivatives as Efficient Active Materials of Supercapacitor	Shen-Fa Dung
PC-04-**007**	0070	Empowering Remote Communities: An Eco-friendly, Portable, Self-powered Integrated Desalination System	Zi-Fan He

PC-04-**008**	0102	Cerium-Based Metal–Organic Framework-Conducting Polymer Nanocomposites as Pseudocapacitive Materials	Yan-Ling Chang
PC-04-**009**	0113	Systematic Designs of Single Metal Compounds Synthesized Using Ammonia Fluoride-based Complex as Structure Directing Agents for Energy Storage	Yu-Cheng Cao
PC-04-**010**	0184	Intercalation of Hydrogen in Perovskite Oxide for Pseudocapacitive Energy Storage	Meng-Hua Lin
PC-04-**011**	0205	Bioinspired Prolonged Lifespan Enhancement of Wearable Batteries with Chemically Self-Powered and Smart Color-Changing Capabilities by Utilizing Sulfonated Polyaniline (SPANI)//Zn Electrodes and Ion Gel Electrolyte	Yi-Ting Huang
PC-04-**012**	0212	Flourinated Graphite Nanoparticles Synthesis via Electrochemical Etching of Silicon Carbide	Wei-Chi Huang
PC-04-**013**	0242	Honeycomb-shaped porous carbon as a lithium-ion capacitor electrode	Nurulhuda Shah
PC-04-**014**	0249	Palm waste-derived carbon dots as a performance booster for aqueous supercapacitors	Gayathry Ganesh
PC-04-**015**	0251	Constructing carbon nanomaterials derived from organic compounds for supercapacitors	Han-Wei Chang
PC-04-**016**	0264	Optimization of dimethyl sulfoxide-based deep eutectic solvent hybrid electrolytes for high-voltage supercapacitors	Han-Lin Wang
PC-04-**017**	0265	Iron sulfide microspheres supported on cellulose-carbon nanotube conductive flexible film as an electrode material for aqueous-based symmetric supercapacitors with high voltage	Tzu-Ting Chen
PC-04-**018**	0293	Ni-Co-O nanosheets grown on 3D porous Ni template for solid-state symmetric supercapacitor	Han-Wei Chang

PC-04-**019**	0333	Combining Flexible V2O5 Energy Storage Electrodes with Novel Piezoelectric Electrolytes for Self-Powering Electrochemical Capacitor Applications	Yi-Ni Jhang
PC-04-**020**	0365	Nanostructured MoO2/MoS2/MoP Heterojunction and N/S Dual-Doped Reduced Graphene as High-Performance Electrode for Supercapacitors	Kasira Kaewplod
PC-04-**021**	0366	The Fabrication of Ru2P Nanoparticle Decorated P-doped Vegetable Root-derived Hierarchical Porous Carbon for Supercapacitors with Ultrahigh Capacitance	Sudarat Laihang

TOPIC：Batteries

Serail no.	Paper no.	Abstract	Presenter
PC-02-**044**	0027	Metal-Organic Frameworks-Based Heterogeneous Membranes with High Pore Geometry Gradient for Boosting Lithium Ion Transport and Efficient Osmotic Energy Generation in Organic Solutions	Fery Prasetyo
PC-02-**045**	0031	High-entropy two-dimensional metal phosphorus trichalcogenides boost high-performance potassium ion storage devices via electrochemical reconstruction	Kai-Siang Jhang
PC-02-**046**	0036	Ammonium Ion Preintercalated MnO2 for Aqueous Zinc-ion Batteries	Jian-Xue Huang
PC-02-**047**	0039	Regulating Li deposition with different morphology of fibers	Ai-Ling Huang
PC-02-**048**	0040	Highly Electrically Conductive VO2(P)/MWCNTs for High-Rate Aqueous Zn-ion Batteries	Cao-Feng Chen
PC-02-**049**	0042	Revealing Bimetallic Synergy in van der Waals AgInP2Se6 Nanosheets for Alkali Metal Ion Battery Electrodes	Tzu-Chi Lin

PC-02-**050**	0046	Study of Cathode-Electrolyte Interphase (CEI) Formation by Adding Fluorinated Benzimidazole Salt Additive in Spinel LiNi0.5Mn1.5O4 High Voltage Cathodes	Chusnul Khotimah
PC-02-**051**	0050	Microstructure of Magnesium Metal Negative Electrode after Discharge/Charge Cycles at Different Current Densities for Rechargeable Magnesium Batteries	Ying-Chen Wu
PC-02-**052**	0055	A Simple and Highly Stable TiO2\PVDF Coating Strategy for Zinc Anodes in Aqueous Zinc-ion Batteries	Yi-Xiang Zeng
PC-02-**053**	0071	Structure-Directing Agent Mediated Synthesis of SnS2 Coupled with UltrapheneTM as Highly Stable Anode Material for Sodium-ion Battery	Po-Chun Tai
PC-02-**054**	0091	Layered CuInP 2 S 6 electrodes: ferroelectric-driven enhanced ion and charge transport for superior potassium ion storage devices	Yen-Yang Tseng
PC-02-**055**	0092	A Novel High Valence based Ti-alloy Coated Single Crystal NMC83 for High Energy Density Batteries.	Shadab Ali Ahmed
PC-02-**056**	0094	Binder-Free Manganese Iron Nitrides/N-doped rGO Elastic Cathode for Lithium-Sulfur Batteries	Yi-Jie Wang
PC-02-**057**	0100	Modulating the Chemical Stability and Electronic Conductivity of Li2FeS2 Cathode Material Through Anion Doping	Adane Gebresilassie Hailemariam
PC-02-**058**	0112	A High-Loading Cement/Polysulfide Cathode in Developing Lean-Electrolyte Lithium–Sulfur Cells	Yu-Jun Wang
PC-02-**059**	0119	Lithium–Sulfur Batteries with a High-loading Sulfur Cathode Derived from Biomass Porous Carbon	Peng-Chih Yu
PC-02-**060**	0122	Elucidating the Structural and Chemical Evolution of Lithium Storage in BHET-Based Metal-Organic Frameworks	Chun-Yen Yang

PC-02-**061**	0125	First-principles study on the facile of Li-ion diffusion by tunning the anion rotation in halide and sulfide solid-state electrolyte	Suseong Hyun
PC-02-**062**	0160	High Entropy Spinel Oxides Catalyst for High-Performance Vanadium Redox Flow Battery	Jui-Wen Su
PC-02-**063**	0164	3D space-confined Co0.85Se architecture with effective interfacial stress relaxation as anode material reveals robust and highly loading potassium-ion batteries	Chi-Wei Chou
PC-02-**064**	0169	Nitrogen-doped Copper Sulfide as a Cathode for Zinc-air Battery System: A First-Principles Study	Yong-Hak Park
PC-02-**065**	0175	Anisotropic Ionic Transport in PEO-LiTFSI Electrolytes	Shun-Jhih Yang
PC-02-**066**	0177	Synergistic promotion of sodiophilicity and conductivity by in-situ growth of CuGa2 on the 3D conductive host for stable sodium metal batteries	Wei Tao
PC-02-**067**	0178	NASICON-type electrolyte for lithium-ion batteries	Yen-Lin Chen
PC-02-**068**	0190	Modified PEO-LiTFSI Electrolyte with UiO-66 Based MOF Fillers	Yu-Chi Wang
PC-02-**069**	0207	Structural Design to Improve the Performance of Ni-Rich Layered Li[Ni0.92Co0.04Mn0.04]O2 Cathode Materials through Full-Concentration Gradient Strategies	Yola Bertilsya Hendri
PC-02-**070**	0208	Suppression of Polysulfides by Carbonized Poly-acrylonitrile Modified PP Separator for Lithium-Sulfur Battery.	Gokul Raj Deivendran
PC-02-**071**	0211	Metal-Organic Framework Derived Structured Copper/Carbon Current Collector for Low Nucleation Lithium Plating in Anode-Free Metal Batteries	Karthic Natarajan
PC-02-**072**	0244	Ultralong Cycle-Life LiFePO4 Cathode Materials via Incorporation with Foam-like Reduced Graphene Oxide Nanoribbon Additive	Jian-Tong Ke

PC-02-**073**	0257	Computational Screening of Imidazolium-based Ionic Liquid Electrolytes in Zinc-air Battery	Geuna Kim
PC-02-**074**	0261	Cyclodextrin-Assisted Hydrothermal Synthesis of Manganese Oxides as Cathode Materials for Aqueous Zinc-Ion Batteries	Zhi-Ting Huang
PC-02-**075**	0271	Application of Freestanding Sulfide-Based and Polymer Composite Solid-State Electrolyte Sheet	Tsung-I Yeh
PC-02-**076**	0280	Networked Solid Polymer Electrolyte for Lithium Batteries	Minh Le Nguyen
PC-02-**077**	0285	Electroepitaxial growth of zinc on copper substrate	Yun-Chi Tung
PC-02-**078**	0304	Revolutionizing Solid-State Lithium Batteries with Polymer Electrolytes	Hanh T. T. Nguyen
PC-02-**079**	0305	Polyaromatic Hydrocarbons as a Potential Organic Anode Material for Lithium-ion Batteries	Avi Arya
PC-02-**080**	0320	Enhancing LiFePO4 Electrodes via Creating Low-Tortuosity Micro-channels in Semi-dry State	Chun-Yang Kang
PC-02-**081**	0321	Lowering Li Transport Barrier in Li6PS5Cl by Anion Site-exchange	Jing-Sen Yang
PC-02-**082**	0332	Lithium-Sulfur Battery with Argyrodite Sulfide Solid Electrolytes	Yee-Jun Quay
PC-02-**083**	0335	The electrochemical performance of LiNi0.5Mn1.5O4 cathode materials with recycled Li2CO3 from spent Lithium-ion batteries	Yi-De Tsai
PC-02-**084**	0353	Synthesis and characterization of Na3SbS4 solid electrolytes via Machanochemical and sintered solid state reactions: A comparative study	Celastin Bebina Thairiyarayar

TOPIC：Basic Electrochemistry

Serail no.	Paper no.	Abstract	Presenter
PC-06-**001**	0041	Synthesis of W-Ni(OH)2 via One-Step Electrodeposition for Urea Oxidation	Chung-Sheng Lin
PC-06-**002**	0059	Enhanced Light-Driven Photoelectrochemical Catalysis of Water Splitting by TiO2 Nanotubes Grown on Acid-etched Titanium Foils	Bo-Yang Chuang
PC-06-**003**	0077	Electrochemical Process of Metal Carbonates to Hydroxides for Net-Zero Emissions	Wei-Cheng Lai
PC-06-**004**	0078	Chemically bonded Au nano particle on carbon nanotube as a composite material for CA125 detection	Pei-Yun Kao
PC-06-**005**	0086	Heterogenous electro-Fenton treatment of tannery wastewater using Ti/TiO2-NT/SnO2-Sb/PbO2 anode and CoFe3O4 supported graphite felt cathode: Batch and continuous operations	Devendra Rai
PC-06-**006**	0115	Effects of Metal Ratios and Post Treatments on Energy Storage Ability of Cobalt Manganese Metal Organic Frameworks	Yi-Chun Lai
PC-06-**007**	0140	Mixed Proton-Electron Conduction of Metal-Organic Frameworks	An-Rong Huang
PC-06-**008**	0142	Space Charge Storage at Heterogeneous Junctions	Shu-Han Chen
PC-06-**009**	0153	Stability Study of Complex Inhibitors on Copper Corrosion	Po-Cheng Chou
PC-06-**010**	0170	The Effect of Polyetherimide for Oxygen Evolution Reaction on Alkaline Water Electrolysis	Rui-En Li
PC-06-**011**	0185	Enhancement of Electrochemical Desalination Performance of CNT-Doped Copper Hexacyanoferrate (CuHCF) and the Effect of Voltage on Selectivity	Yu-Hsiang Yang
PC-06-**012**	0224	Co and Sn codoped Ni3S2 catalyst for electro−oxidation of urea	Ming-Jie Zhang

PC-06-**013**	0230	Supercritical CO2-Assisted Surface Modification on LiFePO4 Cathode with Nitrogen-Doped Carbon Coating for Lithium-Ion Batteries	Jen-Wei Teng
PC-06-**014**	0231	Design and Synthesis of Sulfonated Polyethersulfone Membrane with Asymmetric Porous Structure for High-Performance Lithium Metal Batteries	Meng-Wen Chiu
PC-06-**015**	0266	Improved performance and long-term stability of activated carbon doped with nitrogen for capacitive deionization	Wei-Lin Lee
PC-06-**016**	0269	Bimetallic modified carbon nanotube-based for low-concentration formaldehyde sensing	Yu-Han Shiu
PC-06-**017**	0290	Study of potentiometric and galvanostatic control on PEDOT-based ion-selective electrodes through in situ optoelectrochemical analysis	Yi-Min Wu
PC-06-**018**	0301	Exploring electro-optical properties and redox behavior of electrochromic species using density functional theory	Gaurav Kumar Silori
PC-06-**019**	0326	Microplasma Nanoengineering of Plasmonic Nanostructures for Ultrasensitive Surface-Enhanced Raman Scattering Sensing	Yi-Jui Yeh
PC-06-**020**	0328	Probing Defect with AC Admittance Spectroscopy	Ting-Wei Chen

Poster

Date：Oct. 26th
Location：2F - Lobby (in front of IB-201)
Posting time：14:10～18:00

**** For posters belonging to "Electrochemical Conversion" and "Photoelectrochemistry / Electroplating", please remove your poster before 6 pm.****

TOPIC：Batteries

Serail no.	Paper no.	Abstract	Presenter
PO-02-**001**	0008	Oxygen Vacancy-Tailored Schottky Heterojunction Activates Interface Dipole Amplification and Carrier Inversion for High-Performance Potassium Ion Batteries	Yi-Yen Hsieh
PO-02-**002**	0011	Copper telluride nanotube as promising anode material for potassium ion storage	Che-Bin Chang
PO-02-**003**	0047	Stabilizing and propelling performance of LiCoO2 thin-film battery by appropriate Mg doping	Bin-Chuang Chao
PO-02-**004**	0048	Enhancements with the electrochemical performance of SiOx Using Carbon Coating for Lithium-ion Battery	Yan-Xiong Liao
PO-02-**005**	0061	Glutamine as electrolyte additives and electrode binder for high capacity and stability in lithium-sulfur batteries	Chaehyeong Lee
PO-02-**006**	0072	Maleimide Based Additive in using CEI Formation on Ni-rich Cathode Material in Li-ion Battery	Laurien Merinda

PO-02-**007**	0083	Investigation on Recovering Failed NCA Cathodes through Hydrothermal + Short Annealing with LiOH	Lester Pei-Wan Tiong
PO-02-**008**	0098	Study of aging behavior of parallel-series connection batteries	David Chao
PO-02-**009**	0104	Aqueous Organic Redox Flow Battery Based On Structurally Modified Quinoxaline Anolyte	Surya Prakash
PO-02-**010**	0105	Novel Gel Polymer Electrolyte Preparation method for Anode-Free Lithium Metal Battery	Yosef Nikodimos
PO-02-**011**	0124	Electrophoretic preparation of binder-free LiFePO4 cathode of lithium ion batteries	Hyeonggyu Jo
PO-02-**012**	0145	Environmental Friendly Iron-Titanium Redox Flow Batteries Operating at Neutral Conditions	Tzu-Yang Lan
PO-02-**013**	0147	Prediction of the Electrochemical Performances of Conductive Carbon Additives Using a Structural Index in LiFeO4 Cathodes for Lithium-ion Battery	Yao-Yang Chang
PO-02-**014**	0148	Quasi-solid Polymer Electrolytes for Lithium Ion Batteries Prepared from in-situ Polymerization toward Sub-zero Temperature Applications	Wen-Han Su
PO-02-**015**	0157	Bi-functional Covalent Organic Frameworks (COFs) Containing Imine and Boroxine for Electrolyte Additives to Improve Lithium Metal Battery Stability	Chin-Hao Kuo
PO-02-**016**	0159	New Prelithiation Strategies of SiOx Anodes by Surface Prelithiation for Improving Energy Density and High-rate Lithium Ion Cells	Afif Thufail
PO-02-**017**	0167	Investigating the Mechanism of Enhanced Moisture Stability and Li-ion Diffusion of Li-argyrodite via Aliovalent Cation Doping: a First-principles Study	Jae Eun Kim
PO-02-**018**	0182	Improved Electrochemical Performance of Spinel Coated Nickel-rich Cathode Material in Lithium Batteries	Chun-Ting Chang

PO-02-**019**	0188	Immobilization and Catalytic Conversion of Polysulfide by In Situ Generated Nickel in Hollow Carbon Fibers for High-Rate Lithium–Sulfur Batteries	Mingxu Li
PO-02-**020**	0192	Hierarchical Interlayer Architecture of Fe3O4 Encapsulated in Hollow Graphitic Carbon Fibers for High-Rate Lithium-Sulfur Batteries	Ying Liu
PO-02-**021**	0195	Enhancing the Long Cycle Life and Stable Cycle Performance for Lithium-Sulfur Polymer Batteries by Utilizing Honeycomb-like Porous Carbon Derived from Waste Coffee Grounds	Zabrian Dirfan
PO-02-**022**	0198	High Performing LiTa2PO8-based Lithium-ion Conductor Hybrid Solid Electrolytes for Solid-State Lithium-Metal Batteries	Kumlachew Zelalem Walle
PO-02-**023**	0199	A hydrated eutectic electrolyte with chelating solvent enabling long-life zinc metal anodes for zinc ion batteries	Yu-Chun Huang
PO-02-**024**	0200	Achieving the improved high-temperature cyclability and interfacial stability of zinc metal anodes for zinc ion batteries by regulating zinc perchlorate/dimethyl sulfoxide hybrid electrolytes	Yu-Chun Huang
PO-02-**025**	0203	Composite Cathode with Carbon Coated Li7La3Zr2O12 for Solid-State Lithium Batteries	Yu-Hua Lai
PO-02-**026**	0213	Binders for High Entropy Oxide Anodes of Lithium-Ion Batteries	Jagabandhu Patra
PO-02-**027**	0220	H2O Wash: A Simple Method Toward Eliminating Discharge Products and Regenerating the Cathodes of Li–O2 Batteries	Kevin Iputera
PO-02-**028**	0221	Engineering Cathode-Electrolyte Interface of High-voltage Spinel LiNi0.5Mn1.5O4 via Halide Solid-state Electrolyte Coating	Jheng-Yi Huang
PO-02-**029**	0227	Functionalized Graphene Fillers for Solid-State Lithium Batteries	Ananya Panda
PO-02-**030**	0233	Neural Network Parametrization of Analytical Bond-order Potential for Simulating Atomic Decomposition of Electrolyte	Minjoon Hong

PO-02-**031**	0253	Low-temperature symmetrical solid oxide fuel cells with LNCA-SDC composite semiconductor electrolyte	Wen-Chang Wu
PO-02-**032**	0256	Novel Fe3V3O8 Material as an Efficient Anode for Energy Storage Applications	Rasu Muruganantham
PO-02-**033**	0263	Application of MOF-74@La1-xSrxCoO3-δ (X=0 or 0.5) as cathode materials for lithium-air batteries	Yi-Hsi Chu
PO-02-**034**	0283	Improving Electrochemical Activity in a Cerium/Iron Redox Flow Battery by Using Composite Electrodes	Yu-Qi Wang
PO-02-**035**	0291	Development of a Large Size Area Cerium/Iodine Redox Flow Battery	Shu-Ling Huang
PO-02-**036**	0294	Lowering the Overpotential via Excess Oxygen Molecules on Fe/C3N4 Nanotubes for Oxygen Reduction Reaction	Chi-You Liu
PO-02-**037**	0298	Influence of Oxygen-containing atmosphere on Crystallinity and Performance of Ni-rich Layered Oxides Cathode	Yu-Fan Chen
PO-02-**038**	0315	Investigation of Improving Recycling Efficiency from Waste Nickel-Rich Cathodes Reducing Lithium in the formation of Lithium Carbonate	Ching-Kai Chang
PO-02-**039**	0316	Porous/Thick Lithium Titanate Oxide Anode for Li Ion Batteries	Ze-Ren Jhang
PO-02-**040**	0318	Novel Electrophoretic Deposition (EPD) Method for Preparation of Nickel-rich Layered Cathodes	Kuan-Zong Fung
PO-02-**041**	0323	Stabilization of the electrochemical performance of Li metal batteries using MWCNT fabrics	Je-Nam Lee
PO-02-**042**	0325	Synthesis of Ni-rich Single-crystal Layered Oxides for Lithium ion Battery	Yu-Hsuan Chen
PO-02-**043**	0334	Recycling and Recovery of Components from Spent Batteries: A Review of LiMn2O4 Batteries	Tracy Asamoah

PO-02-**044**	0336	Synthesis of single crystal LiNi0.6Mn0.2Co0.2O2 cathode material using Laminar Continuous Taylor Reactors (LCTR) for lithium-ion batteries applications	Ho-Cheng Chang
PO-02-**045**	0338	Enhanced Electrochemical Performance of Li1.2Ni0.2Mn0.6O2 Cathode Material via Morphology Modification by a Spray-Drying Method	Jue-Jie Xu

TOPIC：Electrochemical Conversions

Serail no.	Paper no.	Abstract	Presenter
PO-03-**001**	0056	High selectivity C3+ multi-carbon fuel production from CO2 electrolysis	Minjun Choi
PO-03-**002**	0161	Optimization of dispersion process for a Cyclohexanol majority-based Pt-C catalyst paste for Proton Exchange Membrane Fuel Cells produced by screen-print method	Kassim Mendoza
PO-03-**003**	0173	Enhanced Catalytic Performance of Heterodimensional WS2-Enriched MoS2 Nanocatalyst for Hydrogen Evolution Reaction and Dye Degradation	Da-Ren Hang
PO-03-**004**	0248	Analysis of Electrodeposition and Self-Heating Effect under Different Gate Insulator Processes of Dual-Gate InGaZnO TFTs	Kuan-Wei Lu
PO-03-**005**	0310	Regulating the Selectivity of Ag-In Binary Catalysts to C1 Products in CO2 Reduction Reaction	Shih-Hsuan Chen
PO-03-**006**	0319	Revealing the Synergistic Effect of CuO-SnO2 Interface on Electrochemical CO2 Reduction Reaction Performance	Ting-Wei Kuo
PO-03-**007**	0330	Potassium Tantalate with rod-like structure coated with reduced graphene oxide as long term durability catalyst for fuel cell	Chieh-Hao Wan
PO-03-**008**	0057	The induce of P and S composition of Cu metal catalyst for enhancing Electrochemical Ammonia Synthesis	Mokyeon Cho

TOPIC：Photo Electrochemistry / Electroplating

Serail no.	Paper no.	Abstract	Presenter
PO-01-**001**	0010	High-efficiency photoelectrochemical properties of hetero-phase Bi2O3 composite crystals	Keng-Wei Liang
PO-01-**002**	0133	Effect of Sulfidation on Arrayed ZnO@ZnS Nanorods for Enhanced Photoelectrochemical Properties	Yu-Zhe Wu
PO-01-**003**	0137	Synthesis, Photoelectrochemical Performance and Capacitive Behavior of Arrayed TiO2 Nanorods Grown by a Microwave Method	Bo-Lin Chen
PO-01-**004**	0186	Ag-Incorporated g-C3N4 Prepared by Gel-Like Networks for Photocatalytic H2 Evolution	Zi-Jun Lin
PO-01-**005**	0268	Photoelectrochemical Detection of Serotonin with Graphene Oxide Nanoribbon	Chia-Liang Sun
PO-01-**006**	0286	Synthesis of BaTiO3 Thin Films with Different Preferred Orientations by a Hydrothermal-Galvanic Method on TiN-coated Substrates for Photoelectrochemical and Piezoelectric Evaluations	Xin-Xian Yang
PO-01-**007**	0300	Enhancement of Photoelectrochemical Response for SrTiO3/TiO2/TiN Heterostructure Thin Films Produced by Hydrothermal-Galvanic Couple Synthesis with Annealing in Reducing Atmosphere	Yu-Tone Chien
PO-01-**008**	0354	Photocatalytic Activity of Gold with Cuprous Oxide Co-loaded on Hydrogenated TiO2	Tsai-Te Wang

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Posting time：09:50-17:30

TOPIC：Batteries

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PO-02-**001**	0008	Oxygen Vacancy-Tailored Schottky Heterojunction Activates Interface Dipole Amplification and Carrier Inversion for High-Performance Potassium Ion Batteries	Yi-Yen Hsieh
PO-02-**002**	0011	Copper telluride nanotube as promising anode material for potassium ion storage	Che-Bin Chang
PO-02-**003**	0047	Stabilizing and propelling performance of LiCoO2 thin-film battery by appropriate Mg doping	Bin-Chuang Chao
PO-02-**004**	0048	Enhancements with the electrochemical performance of SiOx Using Carbon Coating for Lithium-ion Battery	Yan-Xiong Liao
PO-02-**005**	0061	Glutamine as electrolyte additives and electrode binder for high capacity and stability in lithium-sulfur batteries	Chaehyeong Lee
PO-02-**006**	0072	Maleimide Based Additive in using CEI Formation on Ni-rich Cathode Material in Li-ion Battery	Laurien Merinda
PO-02-**007**	0083	Investigation on Recovering Failed NCA Cathodes through Hydrothermal + Short Annealing with LiOH	Lester Pei-Wan Tiong
PO-02-**008**	0098	Study of aging behavior of parallel-series connection batteries	David Chao
PO-02-**009**	0104	Aqueous Organic Redox Flow Battery Based On Structurally Modified Quinoxaline Anolyte	Surya Prakash

PO-02-**010**	0105	Novel Gel Polymer Electrolyte Preparation method for Anode-Free Lithium Metal Battery	Yosef Nikodimos
PO-02-**011**	0124	Electrophoretic preparation of binder-free LiFePO4 cathode of lithium ion batteries	Hyeonggyu Jo
PO-02-**012**	0145	Environmental Friendly Iron-Titanium Redox Flow Batteries Operating at Neutral Conditions	Tzu-Yang Lan
PO-02-**013**	0147	Prediction of the Electrochemical Performances of Conductive Carbon Additives Using a Structural Index in LiFeO4 Cathodes for Lithium-ion Battery	Yao-Yang Chang
PO-02-**014**	0148	Quasi-solid Polymer Electrolytes for Lithium Ion Batteries Prepared from in-situ Polymerization toward Sub-zero Temperature Applications	Wen-Han Su
PO-02-**015**	0157	Bi-functional Covalent Organic Frameworks (COFs) Containing Imine and Boroxine for Electrolyte Additives to Improve Lithium Metal Battery Stability	Chin-Hao Kuo
PO-02-**016**	0159	New Prelithiation Strategies of SiOx Anodes by Surface Prelithiation for Improving Energy Density and High-rate Lithium Ion Cells	Afif Thufail
PO-02-**017**	0167	Investigating the Mechanism of Enhanced Moisture Stability and Li-ion Diffusion of Li-argyrodite via Aliovalent Cation Doping: a First-principles Study	Jae Eun Kim
PO-02-**018**	0182	Improved Electrochemical Performance of Spinel Coated Nickel-rich Cathode Material in Lithium Batteries	Chun-Ting Chang
PO-02-**019**	0188	Immobilization and Catalytic Conversion of Polysulfide by In Situ Generated Nickel in Hollow Carbon Fibers for High-Rate Lithium–Sulfur Batteries	Mingxu Li
PO-02-**020**	0192	Hierarchical Interlayer Architecture of Fe3O4 Encapsulated in Hollow Graphitic Carbon Fibers for High-Rate Lithium-Sulfur Batteries	Ying Liu

PO-02-**021**	0195	Enhancing the Long Cycle Life and Stable Cycle Performance for Lithium-Sulfur Polymer Batteries by Utilizing Honeycomb-like Porous Carbon Derived from Waste Coffee Grounds	Zabrian Dirfan
PO-02-**022**	0198	High Performing LiTa2PO8-based Lithium-ion Conductor Hybrid Solid Electrolytes for Solid-State Lithium-Metal Batteries	Kumlachew Zelalem Walle
PO-02-**023**	0199	A hydrated eutectic electrolyte with chelating solvent enabling long-life zinc metal anodes for zinc ion batteries	Yu-Chun Huang
PO-02-**024**	0200	Achieving the improved high-temperature cyclability and interfacial stability of zinc metal anodes for zinc ion batteries by regulating zinc perchlorate/dimethyl sulfoxide hybrid electrolytes	Yu-Chun Huang
PO-02-**025**	0203	Composite Cathode with Carbon Coated Li7La3Zr2O12 for Solid-State Lithium Batteries	Yu-Hua Lai
PO-02-**026**	0213	Binders for High Entropy Oxide Anodes of Lithium-Ion Batteries	Jagabandhu Patra
PO-02-**027**	0220	H2O Wash: A Simple Method Toward Eliminating Discharge Products and Regenerating the Cathodes of Li–O2 Batteries	Kevin Iputera
PO-02-**028**	0221	Engineering Cathode-Electrolyte Interface of High-voltage Spinel LiNi0.5Mn1.5O4 via Halide Solid-state Electrolyte Coating	Jheng-Yi Huang
PO-02-**029**	0227	Functionalized Graphene Fillers for Solid-State Lithium Batteries	Ananya Panda
PO-02-**030**	0233	Neural Network Parametrization of Analytical Bond-order Potential for Simulating Atomic Decomposition of Electrolyte	Minjoon Hong
PO-02-**031**	0253	Low-temperature symmetrical solid oxide fuel cells with LNCA-SDC composite semiconductor electrolyte	Wen-Chang Wu
PO-02-**032**	0256	Novel Fe3V3O8 Material as an Efficient Anode for Energy Storage Applications	Rasu Muruganantham
PO-02-**033**	0263	Application of MOF-74@La1-xSrxCoO3-δ (X=0 or 0.5) as cathode materials for lithium-air batteries	Yi-Hsi Chu

PO-02-**034**	0283	Improving Electrochemical Activity in a Cerium/Iron Redox Flow Battery by Using Composite Electrodes	Yu-Qi Wang
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PO-02-**036**	0294	Lowering the Overpotential via Excess Oxygen Molecules on Fe/C3N4 Nanotubes for Oxygen Reduction Reaction	Chi-You Liu
PO-02-**037**	0298	Influence of Oxygen-containing atmosphere on Crystallinity and Performance of Ni-rich Layered Oxides Cathode	Yu-Fan Chen
PO-02-**038**	0315	Investigation of Improving Recycling Efficiency from Waste Nickel-Rich Cathodes Reducing Lithium in the formation of Lithium Carbonate	Ching-Kai Chang
PO-02-**039**	0316	Porous/Thick Lithium Titanate Oxide Anode for Li Ion Batteries	Ze-Ren Jhang
PO-02-**040**	0318	Novel Electrophoretic Deposition (EPD) Method for Preparation of Nickel-rich Layered Cathodes	Kuan-Zong Fung
PO-02-**041**	0323	Stabilization of the electrochemical performance of Li metal batteries using MWCNT fabrics	Je-Nam Lee
PO-02-**042**	0325	Synthesis of Ni-rich Single-crystal Layered Oxides for Lithium ion Battery	Yu-Hsuan Chen
PO-02-**043**	0334	Recycling and Recovery of Components from Spent Batteries: A Review of LiMn2O4 Batteries	Tracy Asamoah
PO-02-**044**	0336	Synthesis of single crystal LiNi0.6Mn0.2Co0.2O2 cathode material using Laminar Continuous Taylor Reactors (LCTR) for lithium-ion batteries applications	Ho-Cheng Chang
PO-02-**045**	0338	Enhanced Electrochemical Performance of Li1.2Ni0.2Mn0.6O2 Cathode Material via Morphology Modification by a Spray-Drying Method	Jue-Jie Xu

TOPIC：Capacitor and High-Power Energy Storage

Serail no.	Paper no.	Abstract	Presenter
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PO-04-**002**	0134	Preparation of VS2/g-C3N4 heterostructured composite for supercapacitor electrodes with superior performance and stability	Da-Ren Hang
PO-04-**003**	0225	Preparation of MoS2/TiO2 thin films on activated carbon spheres by hydrothermal method for flow-electrode capacitive deionization system	Jung-Jie Huang
PO-04-**004**	0317	Tailoring hierarchical structures in cellulose carbon aerogels from sugarcane bagasse using different crosslinking agents for enhancing electrochemical desalination capability	Thai Hoang Nguyen

TOPIC：Basic Electrochemistry

Serail no.	Paper no.	Abstract	Presenter
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PO-06-**002**	0013	Effect of 1, 2, 4-triazole and glycine on galvanic corrosion of copper and molybdenum during chemical mechanical polishing	Xuan-Mao Huang
PO-06-**003**	0021	A Study on Fe Separation from Selectively Oxidized Nd-Fe-B Magnet Waste in Sulfate Electrolyte by Electrorefining Process	Hyunjae Heo
PO-06-**004**	0022	Function of Complexing Agent on Seedless Electrodeposition of Cu Thin Film for Microelectronic Application	Yunhwa Jung
PO-06-**005**	0023	Electrorefining of Fe from Selectively Oxidized Nd-Fe-B Magnet Waste with Electrolyte Additive Control	Hyeonsan Jo

PO-06-**006**	0068	An investigation of cell death induced by electrochemical stimulation in ovarian cancer	Zong-Yu Yang
PO-06-**007**	0128	Preparation and Characterization of ZnO Films by Two-Step Electrodeposition	Jian-Yeh Chen
PO-06-**008**	0135	A Bimetallic Metal-Organic Framework Electrochemical Sensor for Simultaneous Detection of Ascorbic Acid, Uric Acid, and Dopamine	Da-Ren Hang
PO-06-**009**	0196	An operando Lab-on-a-chip biosensor system for ovarian cell observation	Ching-Tzu Liu
PO-06-**010**	0222	Honeycomb-shaped carbon nanotubes decorated with molybdenum trioxide as a non-enzymatic electrochemical sensor for glucose	Chun-Chieh Chou
PO-06-**011**	0277	Effect of electrodeposition solvent on morphology and electrocatalytical properties of PEDOT	Wei-Li Shih

Poster position

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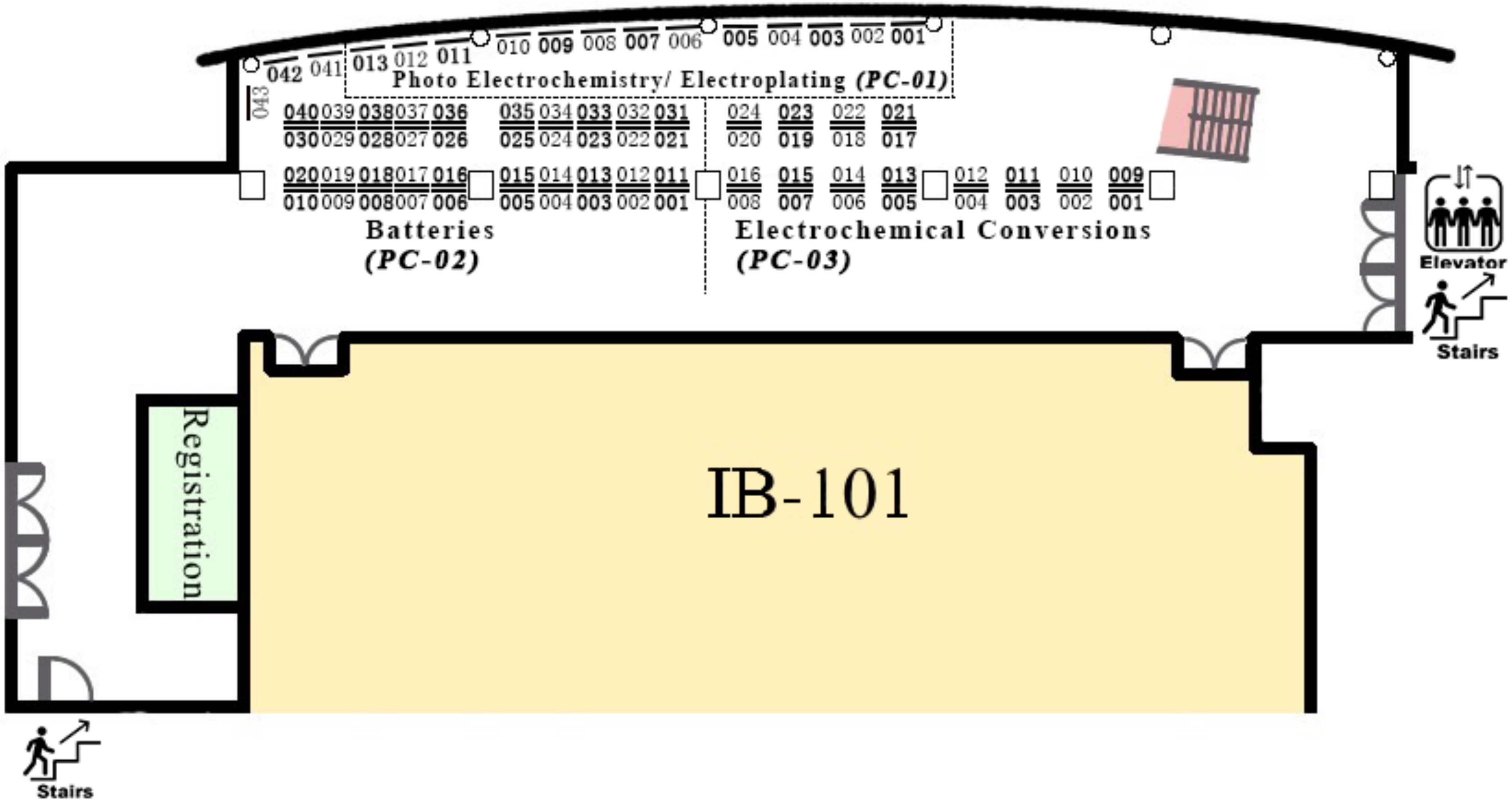
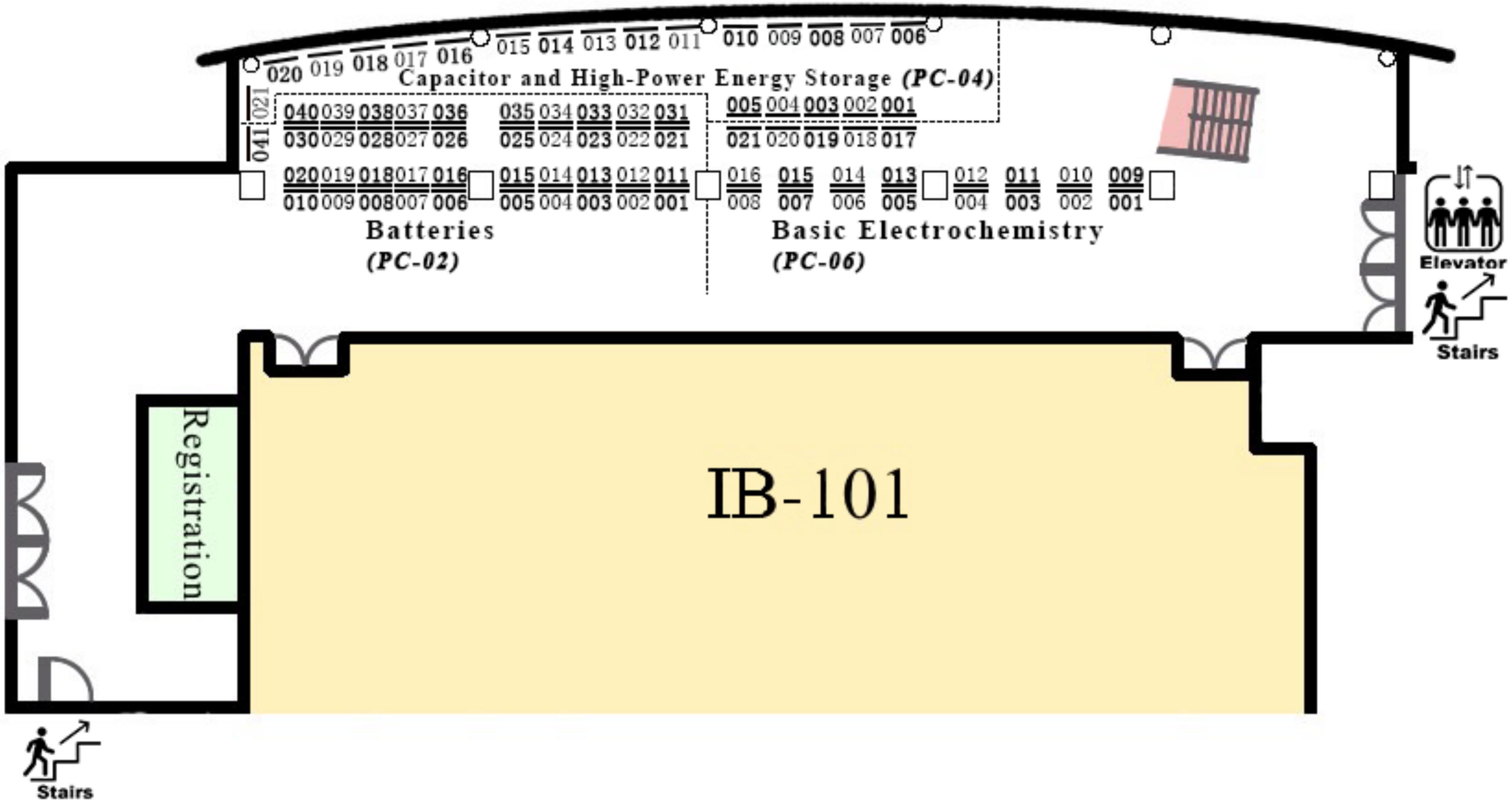
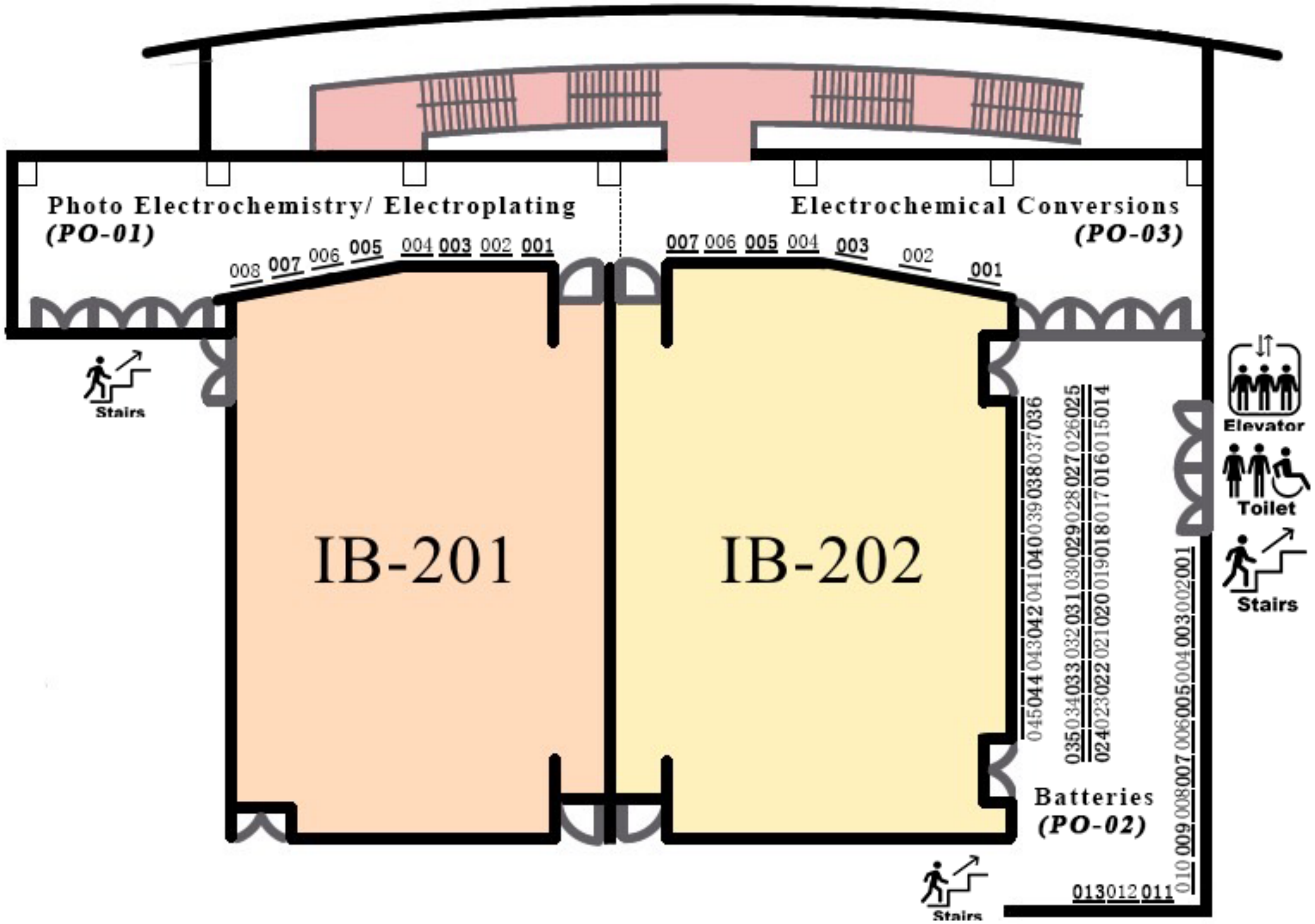


1st Floor Oct. 27th

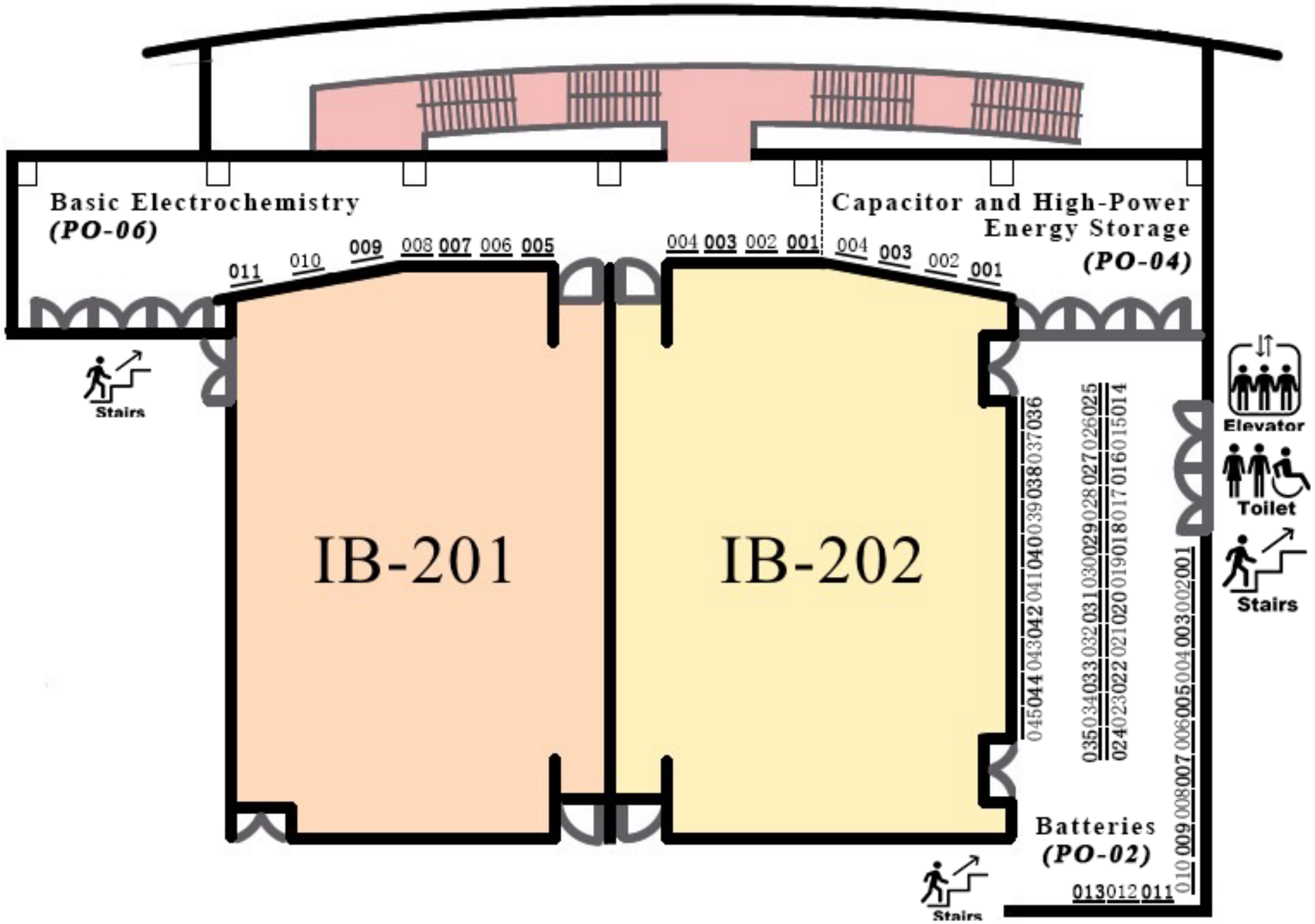


2nd Floor

Oct. 26th



2nd Floor Oct. 27th



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*How to read：

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Ajith K (0259)	PC-02-035	Oct.26, 16:00, 1F-Lobby
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Atsuo Yamada (0240)	Speaker	
Atsushi Inoishi (0348)	Speaker	
Avi Arya (0305)	PC-02-079	Oct.27, 13:30, 1F-Lobby
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Bo-Lin Chen (0137)	PO-01-003	Oct.26, 14:10-18:00, 2F-Lobby
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Cheng-En Yu (0101)	PC-02-013	Oct.26, 16:00, 1F-Lobby
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Chih-Han Wang (0262)	PC-02-037	Oct.26, 16:00, 1F-Lobby
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Chun-Huang Wu (0217)	PC-01-010	Oct.26, 16:00, 1F-Lobby
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Chun-Yang Kang (0320)	PC-02-080	Oct.27, 13:30, 1F-Lobby
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Dhayanantha Prabu Jaihindh (0329)	Oral presentation	
Ding-Huei Tsai (0258)	PC-03-019	Oct.26, 16:00, 1F-Lobby
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He-yun Du (0014)	Speaker	
Hikari Sakaebe (0302)	Speaker	
Hiroki Habazaki (0111)	Speaker	
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Hao-Ping Chen (0284)	PC-01-012	Oct.26, 16:00, 1F-Lobby
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Lester Tiong Pei Wan (0083)	PO-02-007	Oct.26, 14:10, 2F-Lobby
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Li-Hsien Yeh (0359)	Speaker	
Lu-Yin Lin (0064)	Speaker	
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Madhuri Birare (0110)	PC-03-006	Oct.26, 16:00, 1F-Lobby
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Masashi Ishikawa (0357)	Speaker	
Masashi Kotobuki (0033)	Oral presentation	
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Minh Le Nguyen (0280)	PC-02-076	Oct.27, 13:30, 1F-Lobby

Author/Speaker（Abstract no.）	Serial no.	Author Index
Min-Hsin Yeh (0032)	Speaker	
Minjoon Hong (0233)	PO-02-030	Oct.26, 14:10, 2F-Lobby
Minjun Choi (0056)	PO-03-001	Oct.26, 14:10-18:00, 2F-Lobby
Mohamad Afiefudin (0308)	Oral presentation	
Mohamed M. Abdelaal (0019)	PC-04-001	Oct.27, 13:30, 1F-Lobby
Mokyeon Cho (0057)	PO-03-008	Oct.26, 14:10-18:00, 2F-Lobby
Mozaffar Abdollahifar (0020)	Speaker	
Muhammad Faizan (0278)	Oral presentation	
Nae-Lih Wu (0367)	Speaker	
Nattharika Runprapan (0117)	Oral presentation	
Nideesh Perumbalathodi (0232)	Oral competition	
Nurulhuda Shah (0242)	PC-04-013	Oct.27, 13:30, 1F-Lobby
Panitat Hasin (0360)	Speaker	
Pavitra Srivastava (0209)	Oral competition	
Pei-Hsin Young (0344)	Speaker	
Pei-Yun Kao (0078)	PC-06-004	Oct.27, 13:30, 1F-Lobby
Peng-Chih Yu (0119)	PC-02-059	Oct.27, 13:30, 1F-Lobby
Peng-Wei Chu (0079)	Speaker	
Peter Axmann (0341)	Speaker	
Phuong Tuyet Nguyen (0351)	Speaker	
Pin-Chun Lee (0065)	PC-04-005	Oct.27, 13:30, 1F-Lobby
Pin-Syuan Haung (0025)	PC-03-001	Oct.26, 16:00, 1F-Lobby
Po-Cheng Chou (0153)	PC-06-009	Oct.27, 13:30, 1F-Lobby
Po-Chun Tai (0071)	PC-02-053	Oct.27, 13:30, 1F-Lobby
Pooi See Lee (0016)	Speaker	
Pravanjan Malla (0295)	Oral presentation	
Rasu Muruganantham (0256)	PO-02-032	Oct.26, 14:10, 2F-Lobby
Rene Mary Amirtha (0028)	PC-04-002	Oct.27, 13:30, 1F-Lobby
Ren-Jei Chung (0069)	Speaker	
Rio Akbar Yuwono (0066)	Oral competition	
Ruben Foeng (0045)	PC-02-003	Oct.26, 16:00, 1F-Lobby
Rui En Li (0170)	PC-06-010	Oct.27, 13:30, 1F-Lobby
Ru-Shi Liu (0097)	Speaker	
Salva Salshabilla (0204)	PC-02-026	Oct.26, 16:00, 1F-Lobby
Sanjana K. (0229)	PC-02-028	Oct.26, 16:00, 1F-Lobby
Saravanakumar Muthusamy (0312)	PC-03-023	Oct.26, 16:00, 1F-Lobby
Seigo Ito (0347)	Speaker	
Shadab Ali Ahmed (0092)	PC-02-055	Oct.27, 13:30, 1F-Lobby
Shang-Cheng Yang (0103)	PC-03-005	Oct.26, 16:00, 1F-Lobby
Shang-Hao Chen (0007)	PC-01-001	Oct.26, 16:00, 1F-Lobby
Shao-Chun Liao (0234)	PC-02-029	Oct.26, 16:00, 1F-Lobby
She-Huang Wu (0350)	Speaker	
Shen-Fa Dung (0067)	PC-04-006	Oct.27, 13:30, 1F-Lobby
Sheng-Heng Chung (0197)	Speaker	
Sheng-Lun Chou (0377)	PC-02-042	Oct.26, 16:00, 1F-Lobby
Shen-Ming Chen (0030)	Speaker	
Shih-Chieh Liao (0297)	Speaker	

Author/Speaker（Abstract no.）	Serial no.	Author Index
Shih-Hsuan Chen (0310)	PO-03-005	Oct.26, 14:10-18:00, 2F-Lobby
Shih-Hua Chen (0215)	PC-01-009	Oct.26, 16:00, 1F-Lobby
Shih-kang Lin (0132)	Speaker	
Shin-Yu Hung (0272)	PC-03-020	Oct.26, 16:00, 1F-Lobby
Shu-Cheng Li (0216)	PC-03-017	Oct.26, 16:00, 1F-Lobby
Shu-Han Chen (0142)	PC-06-008	Oct.27, 13:30, 1F-Lobby
Shu-Hao Chang (0288)	Speaker	
Shu-Ling Huang (0291)	PO-02-035	Oct.26, 14:10, 2F-Lobby
Shun-Jhih Yang (0175)	PC-02-065	Oct.27, 13:30, 1F-Lobby
Sin-Yi Syu (0311)	PC-02-041	Oct.26, 16:00, 1F-Lobby
Sofiannisa Aulia (0241)	Oral presentation	
Soorathep Kheawhom (0239)	Speaker	
Sudarat (0366)	PC-04-021	Oct.27, 13:30, 1F-Lobby
Sung-Fu Hung (0130)	Speaker	
SuryaPrakash (0104)	PO-02-009	Oct.26, 14:10, 2F-Lobby
Suseong Hyun (0125)	PC-02-061	Oct.27, 13:30, 1F-Lobby
Szu-Chia Chien (0150)	Speaker	
Takeshi Fukuda (0127)	PC-03-008	Oct.26, 16:00, 1F-Lobby
Tarek Fawzi (0106)	PC-01-003	Oct.26, 16:00, 1F-Lobby
Thai Hoang Nguyen (0317)	PO-04-004	Oct.27, 09:50, 2F-Lobby
Ting-Jun Lai (0235)	Oral competition	
Ting-Wei Chen (0328)	PC-06-020	Oct.27, 13:30, 1F-Lobby
Ting-Wei Kuo (0319)	PO-03-006	Oct.26, 14:10-18:00, 2F-Lobby
Tracy Asamoah (0334)	PO-02-043	Oct.26, 14:10, 2F-Lobby
Tripti Agnihotri (0075)	Oral competition	
Tsai-Te Wang (0354)	PO-01-008	Oct.26, 14:10-18:00, 2F-Lobby
Tsan-Yao Chen (0247)	Speaker	
Tso-Fu Mark Chang (0005)	Speaker	
Tsu-Chin Chou (0108)	Speaker	
Tsung-I Yeh (0271)	PC-02-075	Oct.27, 13:30, 1F-Lobby
Tung-Han Yang (0307)	Speaker	
Tzu-Chi Lin (0042)	PC-02-049	Oct.27, 13:30, 1F-Lobby
Tzu-Ching Chan (0053)	PC-02-005	Oct.26, 16:00, 1F-Lobby
Tzu–Ho Wu (0024)	Speaker	
Tzu-Sen Su (0015)	Speaker	
Tzu-Ting Chen (0265)	PC-04-017	Oct.27, 13:30, 1F-Lobby
Tzu-Yang Lan (0145)	PO-02-012	Oct.26, 14:10, 2F-Lobby
Tzu-Yu Kuo (0214)	Oral presentation	
Varad Modak (0089)	PC-03-004	Oct.26, 16:00, 1F-Lobby
Wan-Tien Huang (0223)	PC-02-027	Oct.26, 16:00, 1F-Lobby
Wei Tao (0177)	PC-02-066	Oct.27, 13:30, 1F-Lobby
Wei-Cheng Lai (0077)	PC-06-003	Oct.27, 13:30, 1F-Lobby
Wei-Chi Huang (0212)	PC-04-012	Oct.27, 13:30, 1F-Lobby
Wei-Chih Chen (0352)	Industrial forum	
Wei-Chu Hsu (0193)	PC-02-024	Oct.26, 16:00, 1F-Lobby
Wei-Hsiang Tsai (0282)	PC-02-038	Oct.26, 16:00, 1F-Lobby

Author/Speaker（Abstract no.）	Serial no.	Author Index
Wei-Hung Chiang (0349)	Speaker	
Wei-Li Shih (0277)	PO-06-011	Oct.27, 09:50, 2F-Lobby
Wei-Lin Lee (0266)	PC-06-015	Oct.27, 13:30, 1F-Lobby
Wei-Nien Su (0374)	Speaker	
Wei-Ren Liu (0362)	Speaker	
Wei-Sheng Liao (0287)	PC-03-021	Oct.26, 16:00, 1F-Lobby
Wei-Ting Yeh (0379)	Industrial forum	
Wei-Yen Wang (0370)	Speaker	
Wen-Han Su (0148)	PO-02-014	Oct.26, 14:10, 2F-Lobby
Wen-Hui Cheng (0368)	Speaker	
Wen-Li Chen (0149)	PC-03-010	Oct.26, 16:00, 1F-Lobby
Wen-Ya Lee (0143)	PC-03-009	Oct.26, 16:00, 1F-Lobby
Wen-Yang Jao (0191)	Oral competition	
Wesley Jen-Yang Chang (0303)	Oral presentation	
Wuttichai Tanmathusorachai (0238)	PC-03-018	Oct.26, 16:00, 1F-Lobby
Xiang-Yu You (0063)	Oral competition	
Xin-Xian Yang (0286)	PO-01-006	Oct.26, 14:10-18:00, 2F-Lobby
Xuan-Mao Haung (0013)	PO-06-002	Oct.27, 09:50, 2F-Lobby
Yun-Chi Tung (0285)	PC-02-077	Oct.27, 13:30, 1F-Lobby
Yu-Hsuan Hsiao (0267)	PC-01-011	Oct.26, 16:00, 1F-Lobby
Yan-Ling Chang (0102)	PC-04-008	Oct.27, 13:30, 1F-Lobby
Yan-Xiong Liao (0048)	PO-02-004	Oct.26, 14:10, 2F-Lobby
Yao-Yang Chang (0147)	PO-02-013	Oct.26, 14:10, 2F-Lobby
Yee Jun Quay (0332)	PC-02-082	Oct.27, 13:30, 1F-Lobby
Yen-Lin Chen (0178)	PC-02-067	Oct.27, 13:30, 1F-Lobby
Yen-Yang Tseng (0091)	PC-02-054	Oct.27, 13:30, 1F-Lobby
Yi-Lin Hsu (0062)	PC-04-004	Oct.27, 13:30, 1F-Lobby
Yi-Chun Lai (0115)	PC-06-006	Oct.27, 13:30, 1F-Lobby
Yi-De Tsai (0335)	PC-02-083	Oct.27, 13:30, 1F-Lobby
Yi-Hsi Chu (0263)	PO-02-033	Oct.26, 14:10, 2F-Lobby
Yi-Jie Wang (0094)	PC-02-056	Oct.27, 13:30, 1F-Lobby
Yi-Jui Yeh (0326)	PC-06-019	Oct.27, 13:30, 1F-Lobby
Yi-Min Wu (0290)	PC-06-017	Oct.27, 13:30, 1F-Lobby
Ying Liu (0192)	PO-02-020	Oct.26, 14:10, 2F-Lobby
Ying-Chen Wu (0050)	PC-02-051	Oct.27, 13:30, 1F-Lobby
Ying-Jung Lu (0152)	PC-01-004	Oct.26, 16:00, 1F-Lobby
Yi-Ni Jhang (0333)	PC-04-019	Oct.27, 13:30, 1F-Lobby
Yi-Pin Chan (0144)	PC-02-021	Oct.26, 16:00, 1F-Lobby
Yi-Shiun Chen (0356)	Oral presentation	
Yi-Ting Huang (0205)	PC-04-011	Oct.27, 13:30, 1F-Lobby
Yi-Xiang Zeng (0055)	PC-02-052	Oct.27, 13:30, 1F-Lobby
Yi-Xiu Chen (0085)	Oral competition	
Yi-Yen Hsieh (0008)	PO-02-001	Oct.26, 14:10, 2F-Lobby
Yi-Ying Lee (0037)	PC-03-002	Oct.26, 16:00, 1F-Lobby
Yi-Yu Chen (0155)	PC-03-011	Oct.26, 16:00, 1F-Lobby
Yola Bertilsya Hendri (0207)	PC-02-069	Oct.27, 13:30, 1F-Lobby
Yonghak Park (0169)	PC-02-064	Oct.27, 13:30, 1F-Lobby

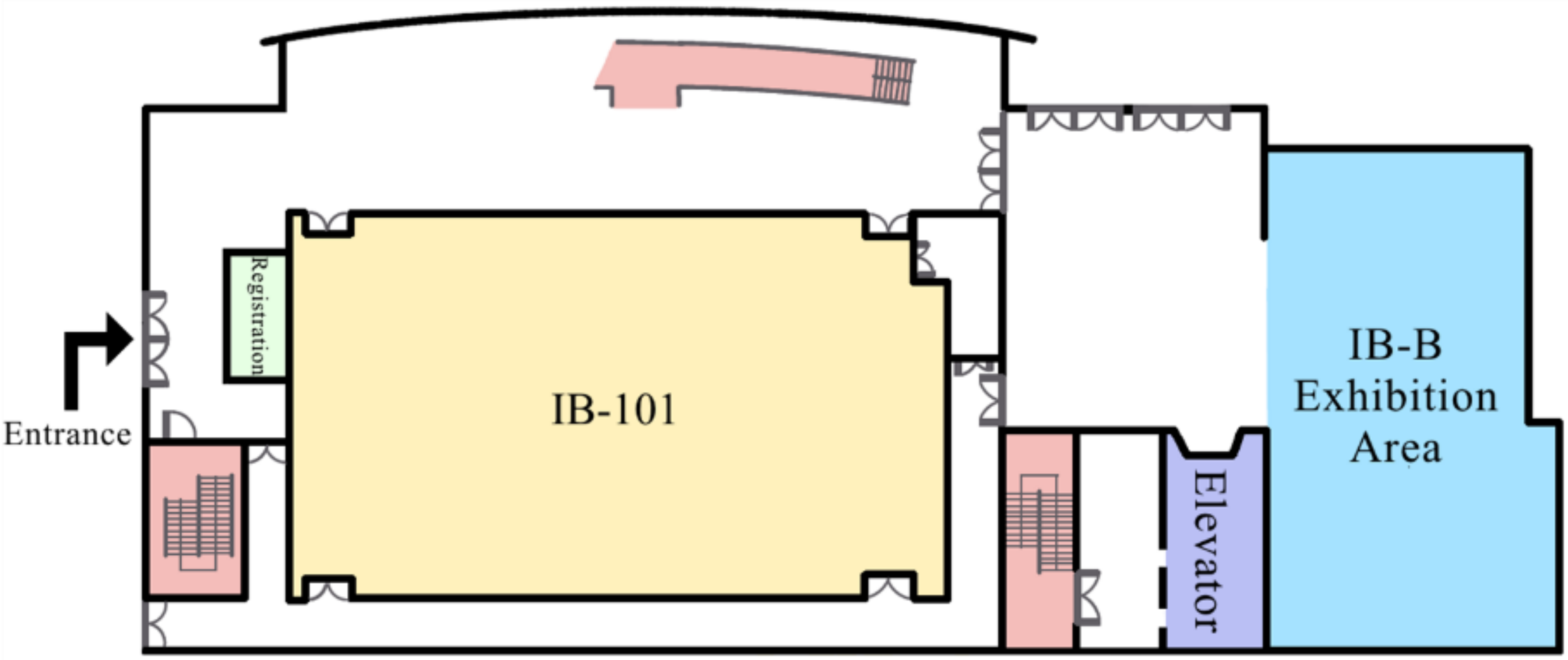
Author/Speaker（Abstract no.）	Serial no.	Author Index
Yosef Nikodimos (0105)	PO-02-010	Oct.26, 14:10, 2F-Lobby
Yuan-Yao Li (0219)	Speaker	
Yu-Cheng Cao (0113)	PC-04-009	Oct.27, 13:30, 1F-Lobby
Yu-Chi Wang (0190)	PC-02-068	Oct.27, 13:30, 1F-Lobby
Yu-Ching Weng (0029)	Speaker	
Yu-Chun Huang (0199)	PO-02-023	Oct.26, 14:10, 2F-Lobby
Yu-Chun Huang (0200)	PO-02-024	Oct.26, 14:10, 2F-Lobby
Yu-Fan Chen (0298)	PO-02-037	Oct.26, 14:10, 2F-Lobby
Yu-Han Shiu (0269)	PC-06-016	Oct.27, 13:30, 1F-Lobby
Yuh-Lang Lee (0339)	Speaker	
Yu-Hsiang Yang (0185)	PC-06-011	Oct.27, 13:30, 1F-Lobby
Yu-Hsuan Chen (0325)	PO-02-042	Oct.26, 14:10, 2F-Lobby
Yu-Hsuan Chiu (0054)	PC-04-003	Oct.27, 13:30, 1F-Lobby
Yu-Hsuan Chen (0090)	PC-01-002	Oct.26, 16:00, 1F-Lobby
Yu-Hua Lai (0203)	PO-02-025	Oct.26, 14:10, 2F-Lobby
Yu-Jen Shih (0002)	Oral presentation	
Yu-Jun Wang (0112)	PC-02-058	Oct.27, 13:30, 1F-Lobby
Yung-Hsun Chu (0060)	PC-02-006	Oct.26, 16:00, 1F-Lobby
Yung-Jung Hsu (0369)	Speaker	
Yung-Tin Pan (0226)	Speaker	
Yunhwa Jung (0022)	PO-06-004	Oct.27, 09:50, 2F-Lobby
Yu-Pei Chiang (0123)	PC-02-018	Oct.26, 16:00, 1F-Lobby
Yu-Qi Wang (0283)	PO-02-034	Oct.26, 14:10, 2F-Lobby
Yu-Ren Yang (0162)	PC-01-005	Oct.26, 16:00, 1F-Lobby
Yu-Sheng Chiou (0210)	PC-03-016	Oct.26, 16:00, 1F-Lobby
Yu-Sheng Su (0151)	Speaker	
Yuta Inoue (0202)	Oral competition	
Yu-Tone Chien (0300)	PO-01-007	Oct.26, 14:10-18:00, 2F-Lobby
Yu-Yao Huang (0289)	PC-02-039	Oct.26, 16:00, 1F-Lobby
Yu-Zhe Wu (0133)	PO-01-002	Oct.26, 14:10-18:00, 2F-Lobby
Zabrian Dirfan (0195)	PO-02-021	Oct.26, 14:10, 2F-Lobby
Ze-Ren Jhang (0316)	PO-02-039	Oct.26, 14:10, 2F-Lobby
Zhi-Qing Lim (0273)	Oral competition	
Zhi-Ting Huang (0261)	PC-02-074	Oct.27, 13:30, 1F-Lobby
Zhi-Ting Liu (0051)	PC-02-004	Oct.26, 16:00, 1F-Lobby
Zi-Fan He (0070)	PC-04-007	Oct.27, 13:30, 1F-Lobby
Zih-Jhong Huang (0080)	Oral competition	
Zi-Jun Lin (0186)	PO-01-004	Oct.26, 14:10-18:00, 2F-Lobby
Zong-Hong Lin (0270)	Speaker	
Zong-Xiao Jiang (0114)	PC-02-015	Oct.26, 16:00, 1F-Lobby
Zong-Yu Yang (0068)	PO-06-006	Oct.27, 09:50, 2F-Lobby
Zun-Wei Wang (0299)	PC-03-022	Oct.26, 16:00, 1F-Lobby
吳文昌 Wen-Chang Wu (0253)	PO-02-031	Oct.26, 14:10, 2F-Lobby
吳亞璇 Ya-Syuan Wu (0260)	PC-02-036	Oct.26, 16:00, 1F-Lobby
李郁宣 Yu-Hsuan Li (0129)	PC-02-020	Oct.26, 16:00, 1F-Lobby

Author/Speaker（Abstract no.）	Serial no.	Author Index
林千平 Cian-Ping Lin (0309)	PC-02-040	Oct.26, 16:00, 1F-Lobby
林明宏 Ming-Hung Lin (0254)	Speaker	
林昕儒 Xin-Ru Lin (0166)	PC-01-006	Oct.26, 16:00, 1F-Lobby
張漢威 Han-Wei Chang (0251)	PC-04-015	Oct.27, 13:30, 1F-Lobby
陳建燁 Jian-Yeh Chen (0128)	PO-06-007	Oct.27, 09:50, 2F-Lobby
黃政穎 Zheng-Ying Huang (0073)	PC-02-007	Oct.26, 16:00, 1F-Lobby
楊景森 Jing-Sen Yang (0321)	PC-02-081	Oct.27, 13:30, 1F-Lobby
趙斌全 Bin-Chuang Chao (0047)	PO-02-003	Oct.26, 14:10, 2F-Lobby

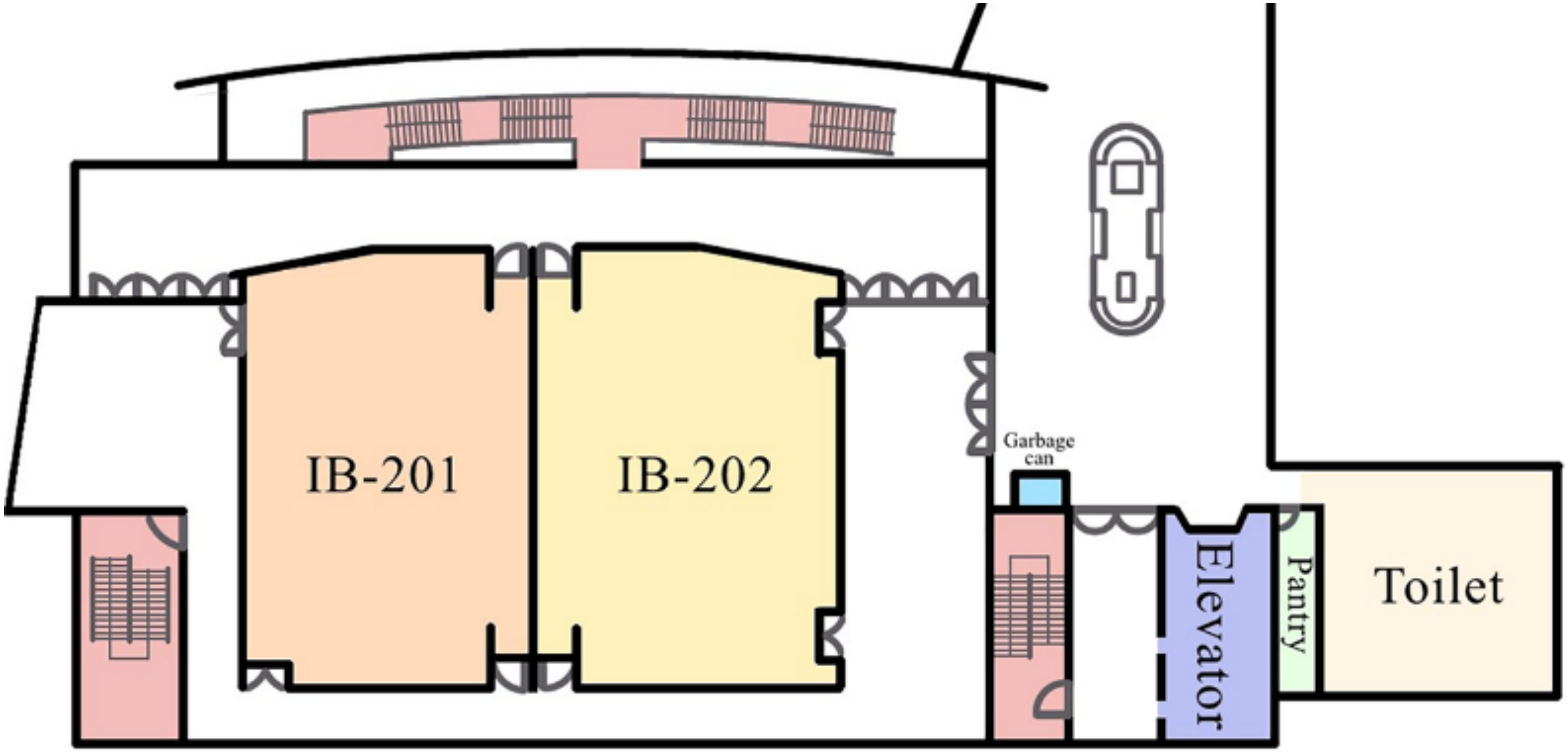
MAP

Campus Map

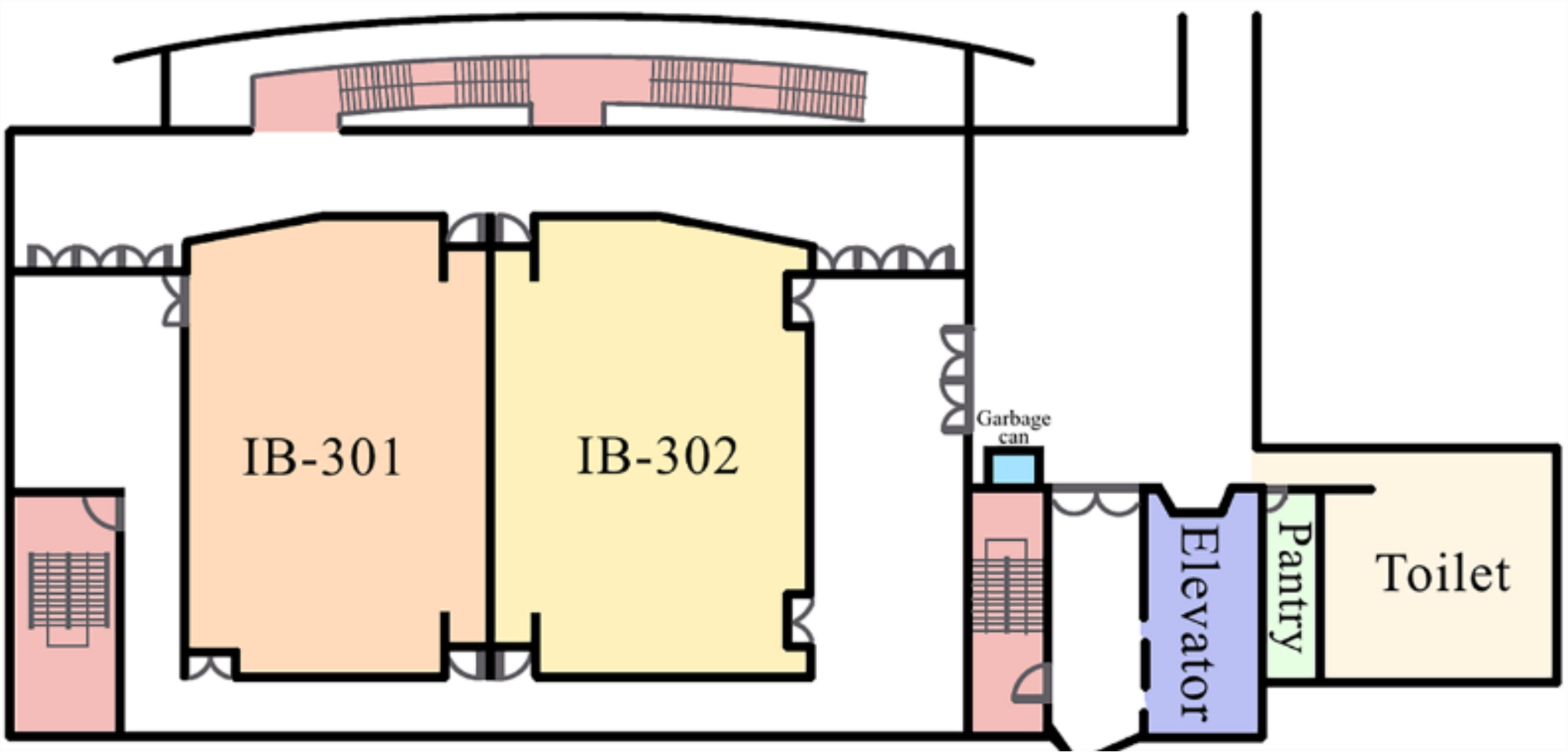
International Building – 1F



International Building – 2F



International Building – 3F



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鋰離子電池, 超級電容及等方性石墨塊材之高性能碳材料

Advanced Carbon Materials for Li-ion Battery, Supercapacitor and Isotropic Graphite Block

產品介紹 Product Description

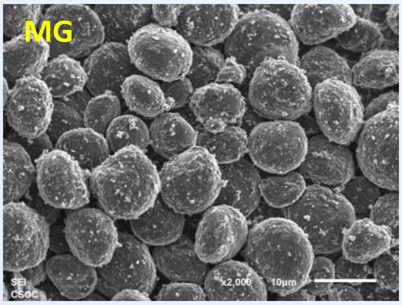
中鋼碳素化學股份有限公司(簡稱中碳)，是台灣唯一的煤化學產品製造廠，自產的煤焦油瀝青可製成鋰離子電池用負極材料及超級電容與鉛酸電池用碳材料。利用熱處理與獨特化工製程將瀝青製成具光學異方性的介相碳微球(**GP 系列: Green Mesophase Powder**)，再經石墨化處理後，可得到具優秀循環壽命及倍率性能的介相石墨碳微球(**MG 系列:** Mesophase Graphite Powder)。此外，經由活化製程還可將瀝青轉變成具極高比表面積且低阻值之先進碳材料(**ACS 系列: Advanced Carbon Series**)，可應用於超級電容及鉛酸電池。等方性石墨(**GB 系列: Graphite Block Series**)開發已邁入量產階段，因應未來國內高純度碳粉與長晶坩堝應用市場快速成長，石墨坩堝成品已達實用尺寸且於 2022 年建置全台第一座鹵素純化爐，提供 5N 級碳材料。

China Steel Chemical Corporation (CSCC) is the only coal chemical treatment company in Taiwan. We produce high performance Li-ion battery anodes and advanced carbon for supercapacitor and lead-acid battery from coal tar pitch. Green Mesophase Powders (GP-series) was manufactured from coal tar pitch via thermal treatment and unique chemical engineering processes and then it can be further transferred into Meso-Graphite Powders (MG-series) after carbonization and graphitization. In addition, Advanced Carbon (ACS-series) can be produced from coal tar pitch by activation processes. Isotropic Graphite (GB-Series) can be mass-production for the rapid growth of the market of the high-purity carbon powder and graphite crucible in the future.

產品特性 Product characteristics

A. 介相碳微球 GP 系列 *Green Mesophase Powders*

Products	D_{50} < 15μm	16 < D_{50} < 30μm	D_{50} > 35μm
	GP12	*GP24*	*GP40*
D_{50} (μm)	12±2	25±2	40±3
Fixed Carbon (%)	> 90		
V.M. (%)	8±2		

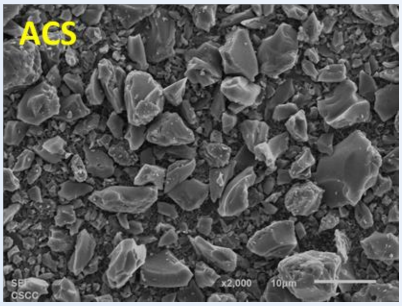


B. 超高倍率型介相石墨負極系列 *Meso-Graphite series for Ultra-power cells*

Products	*D_{50} (μm)*	*BET (m^2/g)*	*Tap D (g/cm^3)*	*True D (g/cm^3)*	*Capacity (mAh/g, Rev)*
UF1	3±2	< 6.0	≧ 0.70	≧ 2.20	> 330
UF2	6±2	< 5.0	≧ 0.80	≧ 2.20	> 340

C. 倍率型介相石墨負極系列 *Meso-Graphite series for power cells*

Products	*D_{50} (μm)*	*BET (m^2/g)*	*Tap D (g/cm^3)*	*True D (g/cm^3)*	*Capacity (mAh/g, Rev)*
MG10	9±2	< 2.5	≧ 1.22	≧ 2.20	> 335
MG11	11±3	< 2.2	≧ 1.25	≧ 2.20	> 345
MG11-A	10±3	< 3.0	≧ 0.95	≧ 2.20	> 345

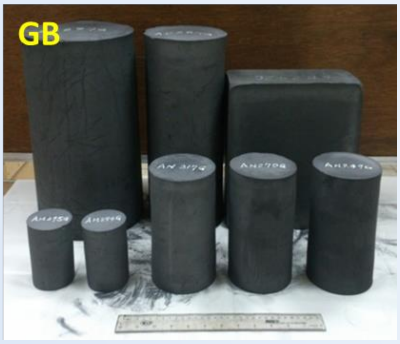


D. 高容量介相石墨負極系列 *Meso-Graphite series for high energy design*

Products	*D_{50} (μm)*	*BET (m^2/g)*	*Tap D (g/cm^3)*	*True D (g/cm^3)*	*Capacity (mAh/g, Rev)*
MG12	18±3	< 1.5	≧ 1.30	≧ 2.20	> 350
MG13	20±3	< 1.7	≧ 1.30	≧ 2.20	> 355

E. 先進碳材料系列 *Advanced Carbon series for supercapacitor*

Products	*BET (m^2/g)*	*D_{50} (μm)*	*Ash (%)*	*Moisture (%)*	*Capacitance (F/g)*
ACS15	1500±200	6.5±1.5	< 1.0	≦3.0	>110
ACS20	2000±200	6.5±1.5	< 1.0	≦3.0	>130



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DNA小片段產生器

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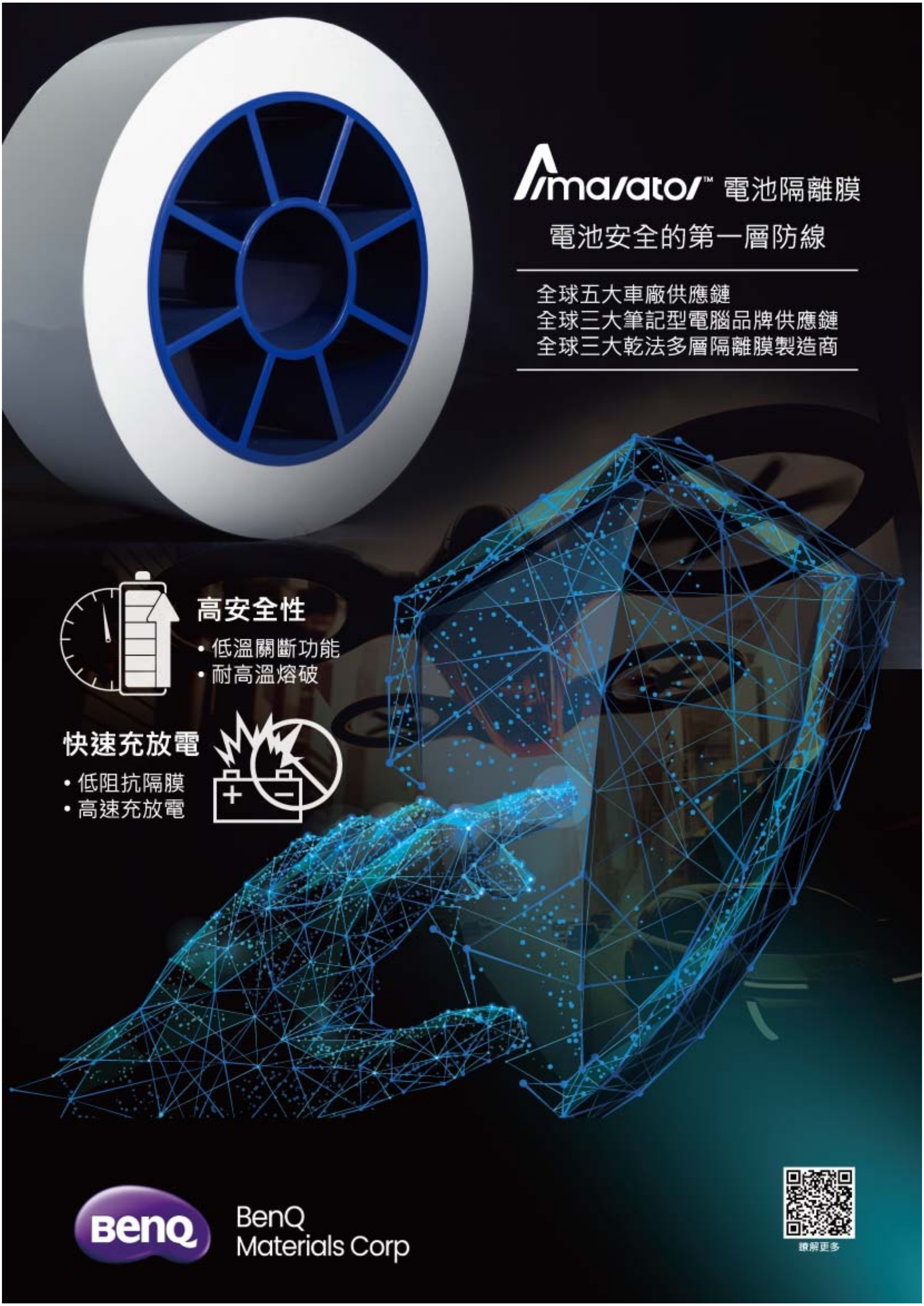

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- 全自動 Touch panel 控制
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狹縫塗佈機

ScalarSC

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- 可使用小量材料
- 實驗室桌上型，操作便利
- 可使用流量及塗佈參數
  奈米級塗佈精度
- 可使用至20,000cP (Viscosity)
- 可整合至手套箱並提供
  H_2O,O_2 <1PPM 環境
- 可與IR oven, dry system 整合

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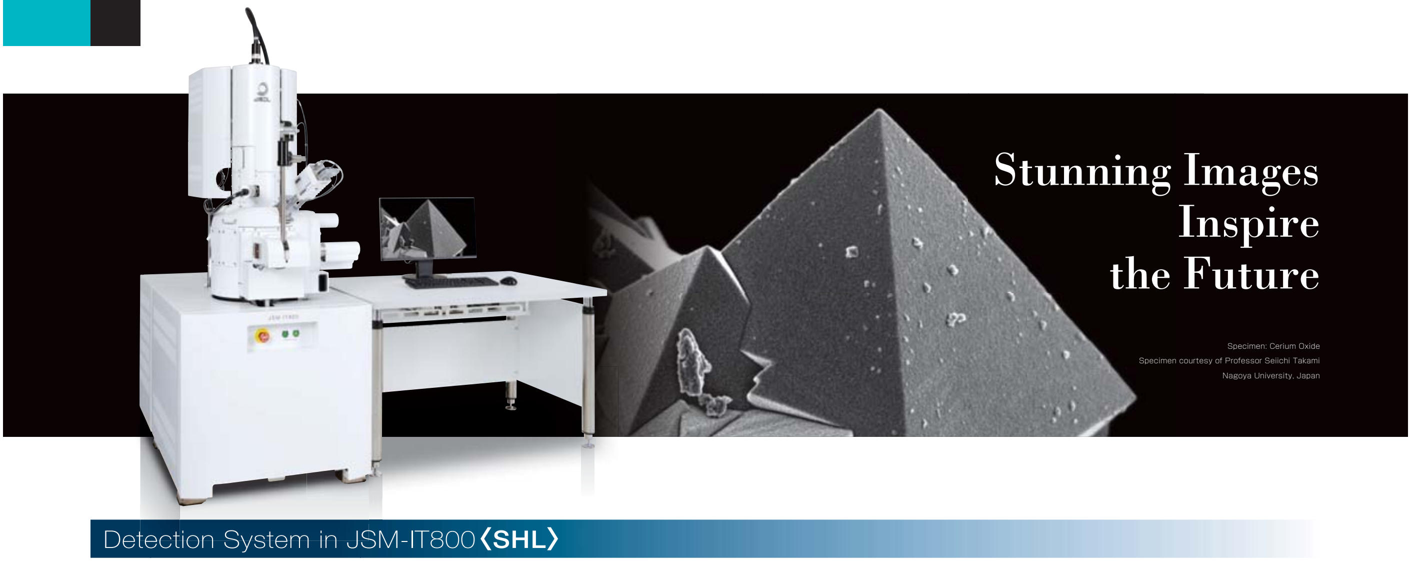
Schottky Field Emission Scanning Electron Microscope

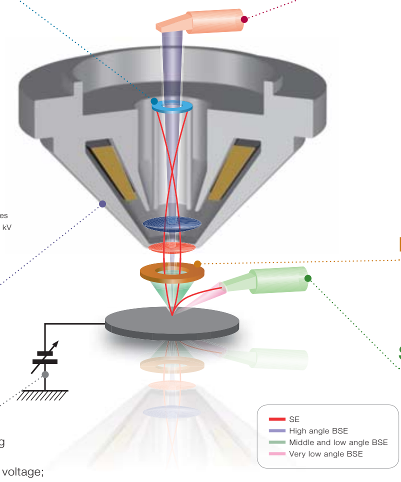
Scientific / Metrology Instruments

JSM-IT800 Super Hybrid Lens 〈SHL〉



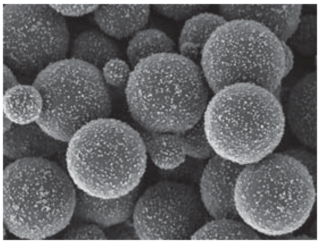
Specimen: Cerium Oxide
Specimen courtesy of Professor Seiichi Takami
Nagoya University, Japan

Detection System in JSM-IT800 **〈SHL〉**



UHD (Upper Hybrid Detector)

- JSM-IT800〈SHL〉features a new UHD detector.
- Improve the detection efficiency of the electrons generated from the specimen by placing this detector into the objective lens.


100 nm

Specimen: Acrylic particles
Accelerating voltage: 0.7 kV
Observation mode: BD
Detector: UHD

SHL (Super Hybrid Lens)

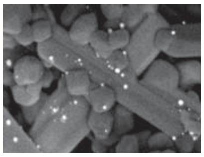
- An electromagnetic/electrostatic field superposed objective lens by combining magnetic lens and electrostatic lens.
- A new objective lens design to achieve much higher spatial resolution for observation and analysis by enhancing the Hybrid Lens.

BD mode (Beam Deceleration: BD)

- Enables deceleration of the beam before it lands on the specimen by applying a bias voltage up to **−5 kV** to the specimen stage.
- Improves the spatial resolution and S/N significantly even at low accelerating voltage; highly effective in observing the outermost surface of specimen, easily charged or beam damaged specimen.

UED (Upper Electron Detector)

- Collects electrons that are emitted at high angle.
- Enables collection of compositional images by selection of backscattered electrons (BSE).
- Observation of surface morphology when selectively capturing the secondary electrons (SE).


100 nm

Specimen: Ag nanoparticles
on the surface of titanium dioxide
Accelerating voltage: 2.0 kV
Observation mode: SHL
Detector: UED
＊Obtain the high angle BSE.

BED (BSE Detector)

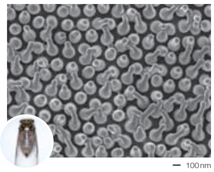
- Suited for obtaining compositional, topographic and channeling contrast.
- Several types of BSE detectors are available to users.

SED (SE Detector)

- Detection of the SE and very low angle BSE signals to obtain the topographic information of specimen.

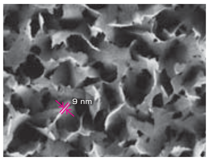
The newly designed **UHD**

The newly designed UHD combined SHL is appropriate to obtain the stunning SE images with high S/N at low accelerating voltage.


100 nm

Specimen: Cicada wing (osmium coating),
Accelerating voltage: 1.0 kV

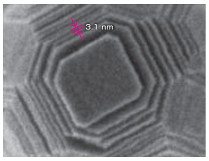
The surface structure of biological specimen can be clearly observed.



100 nm

Specimen: Aluminum Boehmite
Accelerating voltage: 0.3 kV

The thin nanosheet-structure with less than 10 nm thickness can be clearly observed.



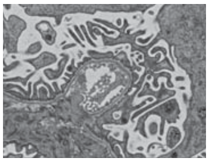
10 nm

Specimen: Aluminium Oxide particles
Accelerating voltage: 0.5 kV

The amazing step-structure on the surface of particles can be observed.

NEW BSE Detectors

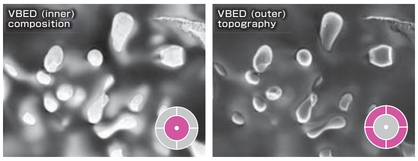
SBED
(Scintillator BSE Detector)


0.5 μm

Specimen: ultra thin section of mouse kidney (contrast reversion)
Accelerating voltage: 5.0 kV
Scan speed: 0.04 μsec/pixel (5,120 × 3,840)

Observe the biological ultra thin section through high speed scanning

VBED
(Versatile BSE Detecto)



1 μm

Specimen: phosphor
Accelerating voltage: 3.0 kV

According to the different detection angles of BSE, the signals are selectively obtained from different detection area of these 5 sections.

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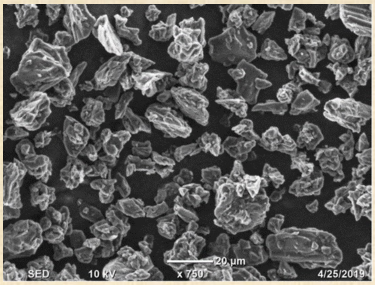
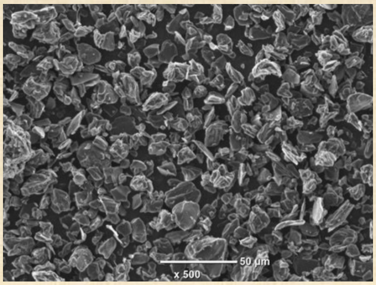
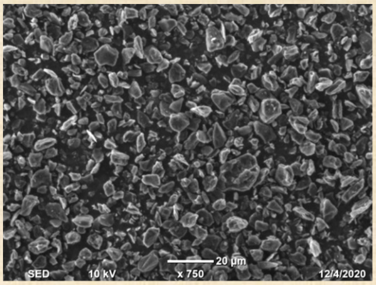


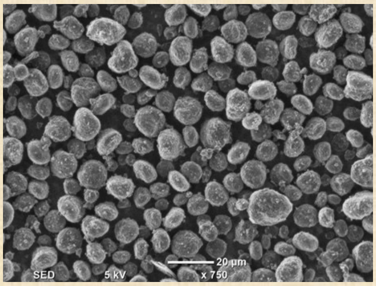
人造石墨(石油焦)
LT-6ED



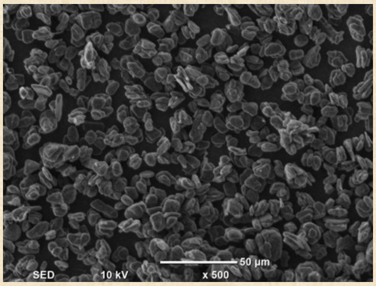
人造石墨(針狀焦)
LT-9HB



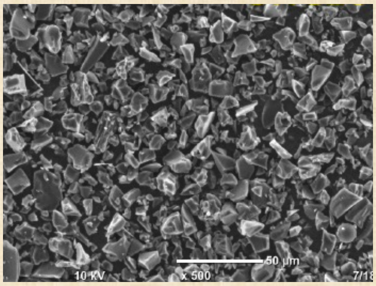
人造石墨(瀝青焦)
LT-6K



人造石墨(碳微球)
LT-7H



天然石墨
LT-8E



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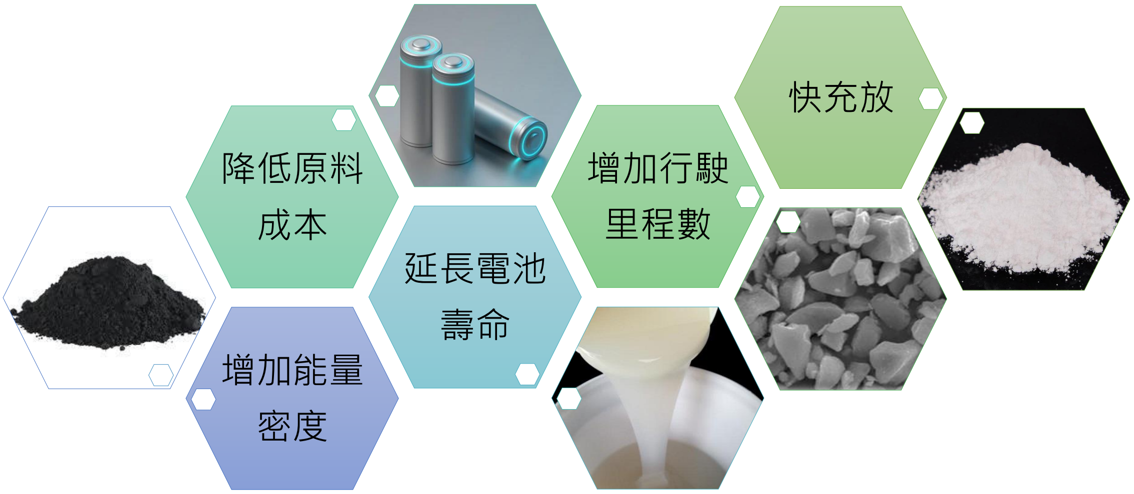

降低原料成本

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快充放

增加能量密度

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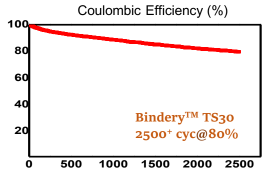
- 充電速度提高0.5C
- 高黏著力
- 多維結構能有效抑制活物膨脹
- 黏度、添加劑客製化


Coulombic Efficiency (%)

矽氧負極

- 提高容量
- 奈米矽使電池保持良好的循環
- 預鋰化矽氧提高首圈效率
- 粒徑客製化

	OSS-6M	OSS-6C	OSS-6M1	OSS-6M2
首圈容量 (mAh/g)	≥ 1600	≥ 1600	≥ 1500	≥ 1400
首效 (%)	≥ 80	≥ 80	≥ 87	≥ 90
粒徑 (um)	5-9	5-9	5-9	5-9
比表面積 (m^2/g)	≤ 1.3	≤ 1.8	≤ 1.3	≤ 1.3
振實密度 (g/cm^3)	≥ 1.2	≥ 0.9	≥ 0.9	≥ 0.9

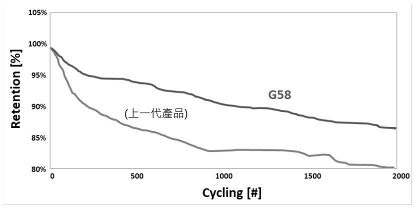
矽碳負極

- 提高容量、提升快充性能
- 奈米矽使電池保持良好的循環
- 粒徑客製化

	GSS	市售矽氧
首圈容量 (mAh/g)	≥ 1700	≥ 1500
首效 (%)	≥ 88	≥ 79
粒徑(um)	5-9	5-9
振實密度 (g/cm3)	≥ 0.95	≥ 1

快充石墨

- 超快速充放電
- 可支援10°C充電(6分鐘充飽)
- 可支援-10°C低溫2C充電



能源電池產業人才及技術培育基地
Talent and Technology Cultivation Base for Energy Battery Industry

明志科技大學榮獲教育部計畫補助，建置全台首座「能源電池產業人才及技術培育基地」，培育能源電池產業之專業人才

為使台灣成為未來全球經濟的關鍵力量，政府極力推動六大核心戰略產業，綠電及再生能源產業包含其中。另一方面，政府為達到「2050 淨零排放」目標，設定十二項關鍵戰略，電力系統與儲能、運具電動化及無碳化等均包含在內。「建立台灣自主之鋰電池產業」，對上述之政策成敗具有關鍵之地位。因此，教育部為推動國家綠能產業的發展，培育能源電池產業專業人才及技術，結合明志科技大學綠色能源電池研究中心長期致力於鋰電池技術之研發技術，共同投入資源與人才，建置此人才及技術培育基地，整合產學研資源共同為台灣鋰電池產業競爭力奠基，期許能為產業及社會做出貢獻。

本基地將建置鈕扣及軟包型鋰電池技術人才之相關實作教室，包含材料合成、極片製備，電芯組裝、材料分析、電化學分析、安全性分析等實作教室。在材料合成場域，可以學習沉澱及鍛燒兩項電池材料常見之合成技術。極片製備場域則包含攪漿、塗佈、乾燥、輾壓、裁(膜)切等設備讓學生(員)學習。電芯組裝區域則有疊片、壓片、點焊、側封、注液、頂封、二封等設備，置於手套箱內可以製作軟包型高分子固態鋰離子電池。所屬教學設備可以接軌鋰電池之生產製程與生產作業現場環境。

本基地協同台灣電池協會、工研院、台灣科技大學、長庚大學、龍華科技大學、淡江大學、中原大學及國內鋰電池相關之企業，共同開授相關課程及合作鋰電池領域的產業實務技術。配合產學研各界之專業師資，建立完整且涵蓋理論及實作兼具之各項專業課程，提供學分學程供學生修習，並鼓勵學生參與相關的產學研發主題，提早培養學生對鋰電池產業之認識與興趣，不僅能縮短學用落差亦能培養其日後進入產業服務所需之專業能力和創新潛力。另外，此基地也提供訓練課程培訓產業學員及提供企業包班培訓服務，配合公司之需求，提供現地實習之訓練，讓學員通過考核即可就業，有效協助產業界提升員工之專業素質及企業在產業界之競爭力。

本基地也將做為產學研界之交流及工作媒合平台，舉辦校際間之跨校師生交流活動，邀請跨校師生共同參與基地之人才及技術培育工作，增進學校間的合作與基地設施之有效運用及資源整合。本基地亦會積極與國內各團體舉辦能源電池相關之研討會和論壇等交流活動，邀請學者和業界專家參與，促進領域知識的交流、共享及合作。積極與產業界共同合作發展新的技術與材料，讓基地設施之跨校資源整合不僅要能包含產業界，也必須符合產業發展之需求。

本基地預計在 113 年第 4 季建置完成，誠摯邀請各位產學研先進能夠前來指導，多多利用本基地之各項設施，能更及時也更有效的完成大家所要進行的工作。大家共同為建立台灣自主的鋰電池產業一起努力。

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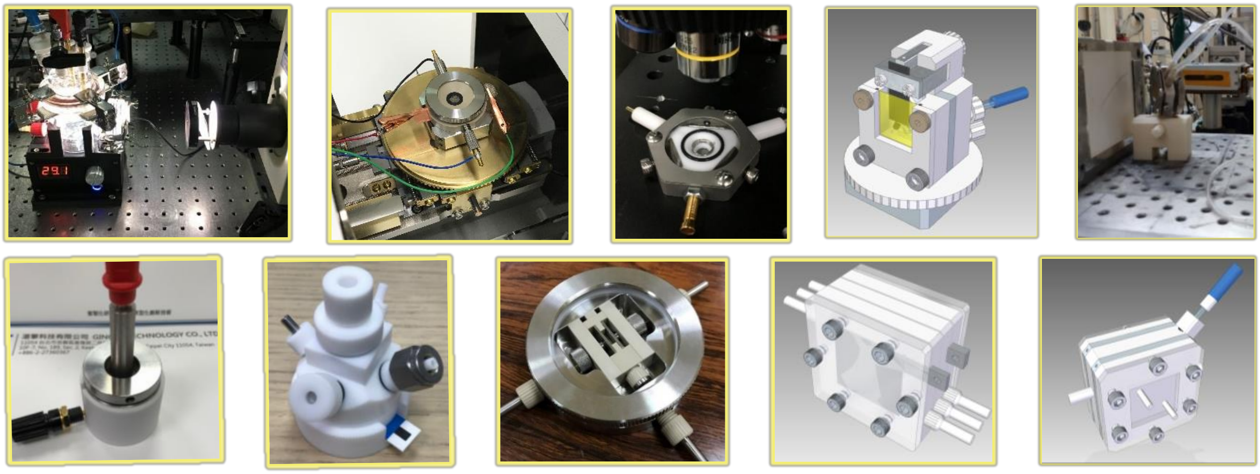

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Portable USB powered

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±10V/±30mA
FRA/EIS :10µHz-1MHz

CompactStat.h

Portable Electrochemical Analyzer

The CompactStat.h is delivered in a protective hardcase that holds all cables, power adapter, test cell, electrode clips and has extra space for your accessories. Optionally, a Pelican® all weather case is also available.

Available in ±30mA/±10V, ±800mA/±10V, ±250mA/±20V, ±30mA/±100V configuration
FRA/EIS: 10µHz - 3MHz

Ivium-n-Stat

Multi-channel Potentiostat/Galvanostat Analyzer

The instrument is designed for a wide range of applications, such as battery/fuel cell-testing, electrode development, biotechnology and other Electrochemical Research applications.

Single-channel modules:		**Dual-channel modules:**
±2.5A / ±10V	**±20A / ±2V**	**2 x ±1A / ±20V**
±5A / ±10V	**±2A / ±20V**	**2 x ±2.5A / ±10V**
±10A / ±5V	**±1A / ±50V**	

Integrated impedance analyser in each channel as standard: 10µHz - 250kHz (1MHz optional).

IviumStat

High Power Potentiostat/Galvanostat Analyzer

The IviumStat is well suited for applications requiring a wide dynamic range, such as battery testing, corrosion measurements and electrochemical research applications. It has a high power of ±5A and low current ranges, down to 1pA full scale.

Available in ±5A/±10V or ±2A/±50V configuration. **FRA/EIS: 10µHz to 8MHz.**

Vertex

Potentiostat/Galvanostat Analyzer

The Vertex is an entry level potentiostat/galvanostat with optional FRA/EIS. Its price easily matches its application in educational and applied electrochemistry.

Available in ±100mA/ 10V, ±1A/±20V, ±1A/±50V, ±5A±10V, ±10A/ ±5V
Current ranges: 100pA up to 10A. **Optional FRA/EIS: 10µHz to 1MHz.**
Optional True Linear Scan generator.

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TEL(02)7728-6607 FAX(02)7727-0881
EMAIL:poquan@poquan.com.tw

Vigor Gloveboxes

Specifications:

＊Main Chamber : SUS304
＊Model:(A)SG1200X750mm(LXW)
(B)SG1200X1000mm(LXW)
(C)SG2400X750mm(LXW)
(D)SG2400X1000mm(LXW)
＊Antechamber : SUS304 370mm(D)X600mm(L)
＊Mini Antechamber : SUS304 100mm(D)X300mm(L)
＊Support Frame : Height adjustable from 917mm~975mm
＊Feedthrough Connectors : 4 standard KF40 Connectors
＊Control Panel : Color touch Screen
＊Oxygen & Mositure Analyzer : PLC intergrated enablling auto-circulation of the purifier
＊Impurity Level : $H_2O<1ppm,O_2<1ppm;H_2O<0.1ppm,O_2<0.1ppm$
＊Over Leak Rate:<0.001 vol%/h or <2ppm O_2/hr
＊Upgrade Gas Purification System:$O_2<0.1ppm,H_2O<0.1ppm$

Vigor's Advantages

	Vigor's Standard Glovebox	Typical Competitor's Standard Glovebox
Leak Rate	＜0.001vol％/h or ＜1 L O2/month for a single box	＜0.05vol％h or ＜56 L O2/month for a single box
Auto Daily Leak Test	Automatic daily test to alert the user to damaged gloves or seals	Not available
Seals	Patented no-leak seal, a double seal with a central vacuum channel	Traditional seals
On-Demand Gas Circulation	Controlled by O2/H2O sensor, circulates for 5 min every hour	Not available, continuous circulation
Automatic Evacuation/Refill	Automatic antechamber evacuation/refill cycles	Not a standard feature
Purifier Capacities	O2: 40-60 Liters H2O: 1.0-1.5 kg Requires regeneration once a year	O2: 20-30 Liters H2O: 0.8-1.5 kg
Chemistry Software	Calculates mol. Wt., reactant requirements, reaction yields	Not available
Freezer	30 Liters(H450xW300xD220mm)	18 Liters(H430xW275xD150mm)
Water Cooling	The box stays cool without water cooling	May require water cooling or the box may run warmer than ambient
Designer's Background	Designed by chemists with gas purification expertise and longtime glovebox using experience	Unknowm

A.E.T.C
Advanced Education Technology Corporation

地址：新竹縣竹北市光明六路東一段245號11樓
TEL：03-658-9866
FAX：03-658-9068

Advanced Education Technology Corporation
11F., No.245, Dong Sec. 1, Guangming 6th Rd.,
Zhubei City, Hsinchu County 302, Taiwan (R.O.C.)
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HIDEN ANALYTICAL

英國–專注42年的質譜分析

★ 不需要Column漫長等待
★即時的告訴你目前氣體生成/反應狀態
★真實的追蹤期待的氣體發生/變化
★氣體質譜就是如此的簡單又容易的操作！

HPR20 (EGA、R&D) 即時氣體質譜儀
1/8” (1/16”)卡套 加熱式毛細管取樣接口
直接取樣分析所以過程的氣體反應/變化。

HPR40–DEMS 電化學分析儀
多種取樣口配件更換，可量測溶液中的氣體、
催化反應之產出氣體、電化學反應、 電池反應...等


單薄層電化學反應池


雙薄層電化學反應槽


電池反應治具

HPR30 製程過程氣體分析儀
合適低真空壓力(<5mbar)環境的腔體
可搭配不同等級的RGA(四極柱質譜)系統
移動推車模式，可以自由串接不同設備

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讓科傳服務檢測服務成為您推進研究的一大助力

James Ku, Sheng-Chia Lu, Tanya Chang, Vincent Le, Russell Clemente

Inspection and Analysis Department, Scientific Gear Service Co. Ltd.,
Miaoli county 35047, Taiwan

關於我們

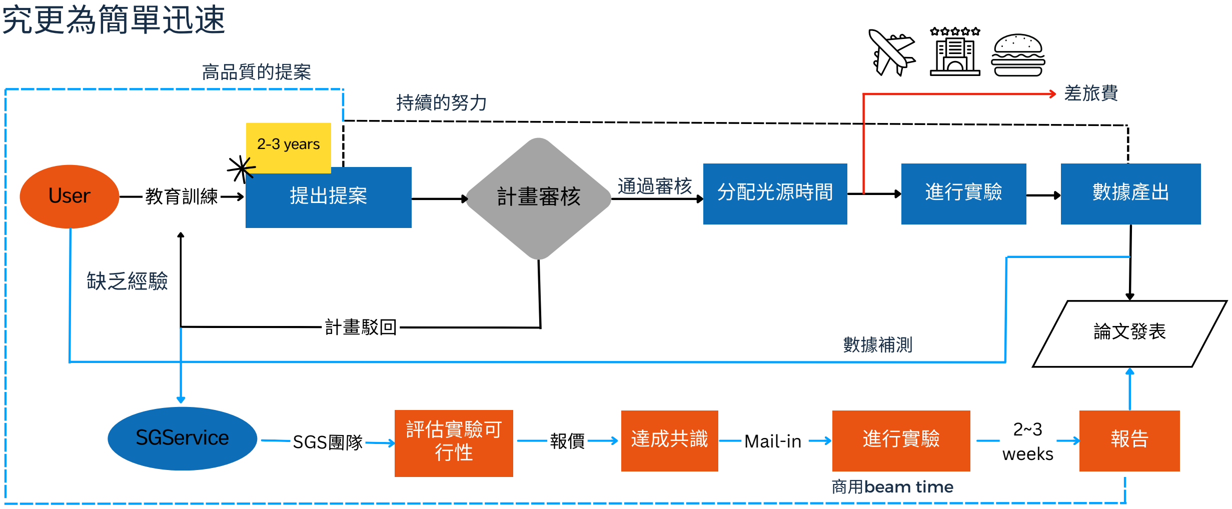
EST. 2021

SCService設立於2021年，致力於提供多項X光技術及分析服務與相關機台的設計規劃。將自身化為橋樑，協助各界運用世界尖端的同步輻射光源，為顧客提供更直接、省時且高效率的方法。目前主打X光吸收光譜、同步輻射粉末繞射、電腦斷層掃描。

論文產出

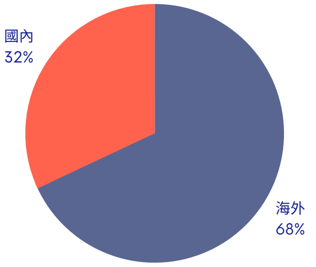
7 七篇論文使用本公司服務

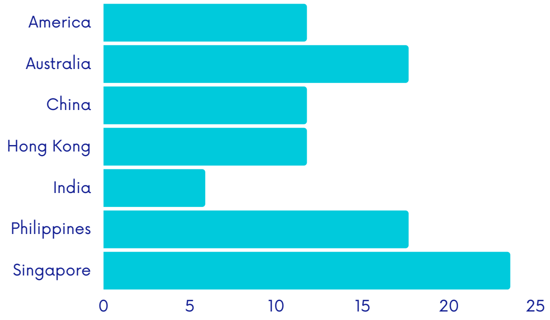
讓研究更為簡單迅速



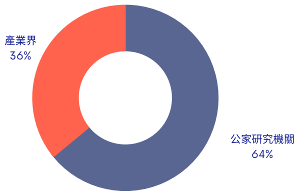
68%

海外顧客比例





公家研究機關 VS 產業界



研究使用的同步輻射設施

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National Synchrotron Radiation Research Center

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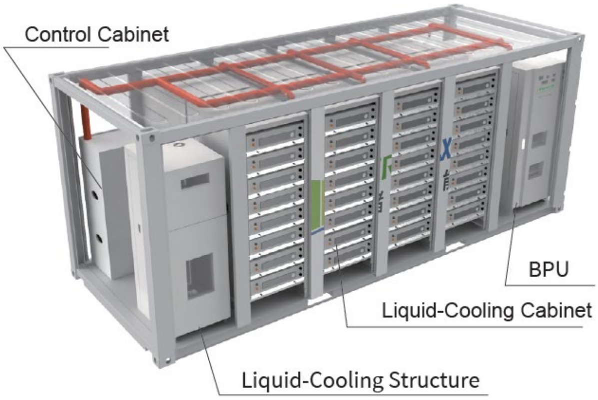
Grid-Level Energy Storage System - Aurora



The product is composed of a battery cabinet (Rack), a battery management system (BMS), and an environmental control system (ECS). The battery management system uses a high-precision BMS for data acquisition and monitoring of the battery packs. The BMS has external communication functions and can transmit data to the supporting PCS, HMI, EMS, water cooler (only applicable to liquid cooling systems), fire protection and other equipment. Long-term continuous safe and stable operation.

*Image shown is for illustration purposes only. Actual product may vary.

Aurora-One(1C)

Nominal voltage	1228.8 V
Voltage range	1036.8-1382.4 V
Capacity	2064 kWh
Container Quantity	1
Rack Quantity	6
Dimension	20 - foot

Aurora-Two(0.5C)

Capacity	5504 kWh
Container Quantity	2
Rack Quantity/Single Container	8
Dimension	20 - foot

844V Energy Storage System - Alice

The product is composed of a battery cabinet (Rack), a battery management system (BMS), and an environmental control system (ECS). The battery management system uses a high-precision BMS for data acquisition and monitoring of the battery packs. The BMS has external communication functions and can transmit data to the supporting PCS, HMI, EMS, water cooler (only applicable to liquid cooling systems), fire protection and other equipment. Long-term continuous safe and stable operation.

*Image shown is for illustration purposes only. Actual product may vary.

Nominal Voltage	844.8V
Working Voltage Range	710.16V – 953.04V
Capacity	168.96kWh
Standard Charging Current	60A
Max. Charging Current	100A
Standard Discharging Current	189A
Max. Discharging Current	189A
Dimension (WxHxD)	1450x2100x800mm
Weight (± 0.5kg)	1850kg

FRANCE ETUVES

高精密烘箱&真空烘箱

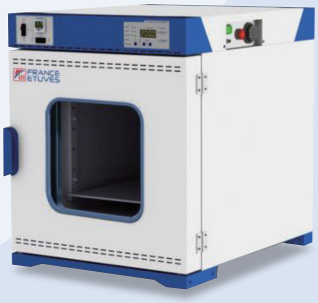
高精密的溫度準確跟強悍的完整功能，您現在可以輕鬆的同時擁有
來自法國優異血統，實驗室及工業烘箱的專家France-Etuves

- 全系列烘箱標配C3030智慧型控制器
- 錶頭精確度高達0.1°C
- 內建4組各8段程式及溫度梯度控制並可串連
- 即時監控目前程序進度及剩餘時間
- 設定溫度跟實際溫度同時顯示
- 內建蜂鳴器及靜音鍵
- 加熱功率百分比、時間、日期顯示

精密全能型定溫烘箱 : XUE系列

- 標配最高溫度 : 300°C
- 內容積由32L~980L共8種規格可選
- 側面內建20mm管線孔，方便伸入外部偵測sensor
- 可提供原廠3Q確效文件及執行確效工程
- 單或雙風扇渦流均溫機制，帶來最優異的空間均溫性
- 具換氣孔且可調整換氣流量及均溫風扇的風力大小
- 合乎CLASS 3.1等級機械式安全過溫保護機制

可調真空度型程控真空烘箱 : XFL系列



- 標配最高溫度 : 200°C，(可選配至300°C)
- 真空度可達-1000 mbar (相對壓力)
- 內容積由20L~512L共6種規格可選
- 獨家可程式控制真空度的真空烘箱
- 內建管線孔可放入最高四支感測管線
- 合乎CLASS 3.1等級機械式安全過溫保護機制
- 另有高真空款(10-2 mbar)及超高真空款(10-6 mbar)可選購

另有高精密微生物培養箱，工業量產型特殊烘箱，歡迎洽詢

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MILLING SIEVING ASSISTING

溫控及低溫型球磨機

溫控型高能球磨機 Emax

- 轉速可達2000rpm，TiO_2可磨至D50<80nm
- 最大樣品量：2 x 45ml
- 可做乾磨及濕磨等應用
- 不銹鋼、氧化鋯及碳化鎢球磨罐可選擇
- 特殊水冷設計確保樣品不會過熱
- 特殊球磨罐設計使樣品粒徑更集中

奈米快速球磨機 MM500

- 振動頻率可達35Hz，TiO_2可磨至D50<100nm
- 最大樣品量：2 x 45ml
- 可做乾磨、濕磨及低溫研磨等應用
- 不銹鋼、氧化鋯及碳化鎢球磨罐可選擇
- 特殊夾具設計便於確認粉碎狀態
- 特殊球磨罐設計使樣品粒徑更集中

低溫型冷凍球磨機 CyroMill

- 振動頻率可達30Hz，粉碎效率高
- 最大樣品量：2 x 20ml
- 適用於常溫下不易粉碎的軟性及彈性樣品
- 不銹鋼及氧化鋯球磨罐可選擇
- 可設定自動預冷、研磨時間及循環次數
- 自動充填液態氮設計，操作安全

桌上型行星式球磨機 PM100

- 轉速可達650rpm，公轉半徑大
- 最大樣品量：2 x 220ml
- 可做乾磨及濕磨等應用
- 多種球磨罐材質可選擇
- 可選配特殊安全夾具，避免樣品溢出
- 可選配溫度壓力即時監測配件

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Autolab 多通道恆電位/電流儀系列

多通道 Autolab 系列由模組
化多通道儀器組成
每個儀器最多可容納 12 個獨
立的恆電位儀/恆電流儀模組

M101
M204

單一最高規格儀器

VIONIC
PGSTAT302N

全方位能源產業分析儀器

All-round Energy Industry Analysis Instrument

經濟型恆電位／電流儀

以最小的佔用空間提供強大的性能
這些小巧的儀器被設計為適合
大多數電化學實驗

PGSTAT101 / PGSTAT204

專用配件

參考電極和輔助電極
三極式電池測試槽
鈕扣型電池座
可客製化

含水量測定

鋰離子電池必須完全乾燥無水分
(H_2O 的濃度 < 20 ppm)

卡爾費雪滴定

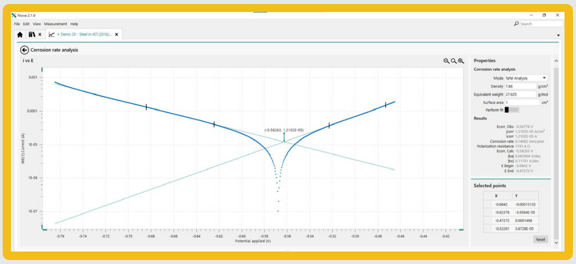
Metrohm
Taiwan

PEOPLE
YOU
CAN
TRUST

Metrohm 成立於1943年，在市場上擁有深厚的化學分析經驗，合作夥伴及客戶遍布全球，因應市場需求並強化 Metrohm 在地服務，Metrohm 決定成立台灣分公司。台灣美創股份有限公司是 Metrohm 的全資子公司，Metrohm 的化學分析及創新產品享譽全球！

Metrohm
Autolab & Dropsens
Corrosion Analysis
電化學腐蝕研究

DC techniques
- Linear sweep voltammetry
- Tafel slope analysis **(塔佛分析)**
- Potentiodynamic polarization



Corrosion rate analysis

Mode: Tafel Analysis
Density: 7.86 g/cm³
Equivalent weight: 27.925 g/mol
Surface area: 1 cm²
Perform fit

Results

Ecorr, Obs -0.56778 V
jcorr 1.2102E-05 A/cm²
icorr 1.2102E-05 A
Corrosion rate 0.14062 mm/year
Polarization resistance 1741.4 Ω
Ecorr, Calc -0.56263 V
|ba| 0.082904 V/dec
|bc| 0.11701 V/dec
E Begin -0.6842 V
E End -0.47272 V

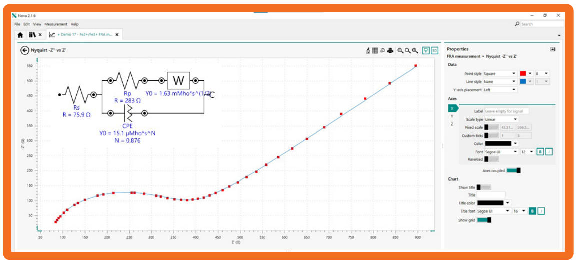
Selected points

X	Y
-0.6842	-0.00013132
-0.62378	-3.9584E-05
-0.47272	0.0001496
-0.52261	3.6728E-05

Chrono and Other Techniques
- Electrochemical Noise (ECN)
- Critical Pitting Temperature (CPT)
- Hydrogen permeation
- Cyclic polarization

ASTM standards
- Hydrogen permeation ASTM G148 **(氫擴散)**

AC techniques
- Electrochemical Impedance Spectroscopy (EIS) **(交流阻抗分析)**
- Electrochemical Frequency Modulation (EFM)



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Custom ticks: 1 5
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Reversed
Axes coupled
Show title
Title
Title color
Title font: Segoe UI 16
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Hyphenated EC-Raman 電化學拉曼
SECM 掃描電化學顯微鏡

Metrohm
Taiwan

Abstract No. 0002 Yu-Jen Shih

Silver nanoparticle intercalated in graphene oxide substrate (Ag/GO_{400} and Ag/rGO_{400}) was synthesized by electroplating and thermal methods for electrochemical oxidation of ammonia in dilute aqueous solutions. Electrochemical characterization, including voltammetry and *in-situ* Raman spectra, identified the redox phases of silver, i.e., $Ag(0) \rightleftharpoons Ag(I) \rightleftharpoons Ag(II)$, which were electron mediators for the conversion of ammonia to other nitrogen compounds, specifically dinitrogen. The electrochemical-chemical processes (EC) controlled the catalytic yields of N_2 and NO_3^- in the applied potential regions of Ag_2O and AgO formation, respectively, in constant potential mode. The incorporation of Ag with reduced graphene oxide (rGO) was critical to enhancing the faradaic efficiency and N_2 selectivity. The intercalation of highly dispersed Ag nanoparticles/nanoclusters in lamellar graphene sheets increased the electrochemical reactivity. GO reduction to rGO decreased surface oxygen content, thereby leading to lower yield of nitrite and nitrate oxyanions on Ag/rGO_{400} than Ag and Ag/GO_{400} electrodes. Ag/rGO_{400} exhibited an ammonia removal efficiency of 97% and N_2 selectivity (S_{N2}) of 80% at +1.0 V (vs. Hg/HgO, pH 11). An asymmetric and undivided electrolyzer, equipped with Ag/rGO_{400} anode and Cu(111)/Ni cathode of different number ratios , was used to treat real wastewater containing around 150 mg-N L^{-1} NH_3. At an optimal anode to cathode number ratio of 2 to 2, the gaseous nitrogen selectivity (S_{N2}) was > 90% in continuous flow mode, which confirmed the electrochemical stability of the electrolyzer.

Abstract No. 0003 Chi-Ping Li

Template-assisted sol gel chemistry provides a versatile approach to introduce order and porosity into nanostructured materials. However conventional evaporation induced self assembly techniques are not easily scaled to produce films with sufficient thickness over large areas at the throughput required by electrochromic windows. Here we demonstrate that the principles of sol gel chemistry may be deployed using ultrasonic spray deposition (USD) for scalable synthesis of nanocrystalline WO_3 films with unrivaled electrochromic performance. Systematic manipulation of sol chemistry enabled the production of mesoporous films with high specific surface area (>100 m^2/g), mean pore sizes of ~5 nm, and narrow pore size distributions. Film thickness is found to be proportional to the sol concentration and number of spray passes, and various combinations are shown to produce films capable of modulating >98% of incident solar radiation in the visible spectrum (450–900 nm). Elimination of haze enables full transmission in the bleached state, while the broadband coloration is attributed to the exceptionally high charge density (>120 mC/cm^2). The materials have good switching speeds which improve with specific surface area, and the long term durability is promising.

Abstract No. 0004 **Jae-Jin Shim**

The demand for fast charge-discharge devices has increased tremendously during the last two decades. Among the sustainable energy storage/conversion devices, batteries and electrochemical capacitors are considered the most important and are being developed to get high energy storage performances, such as high energy density and power density.

Graphene, carbon nanotubes, and carbon fibers have been used for fast charge-discharge supercapacitors. Metal oxides/sulfides-based electrode materials have also been investigated for electrochemical charge storage. Due to the limited capacitances of these materials, many studies have been done to improve the performance of supercapacitors, such as modifying the physical structure of the electrode materials for higher surface area and easy ion accessibility. Other groups have tried modifying the chemical nature by doping or substituting different elements or ions.

This study discusses the effect of doping nearby-family elements, such as nitrogen and sulfur, into carbon and metal oxides/sulfides structure and the substitution of metal ions with other metal elements on their charge storage performance. Vacancy effects caused by doping and substituting metal ions in MXene and perovskites are also discussed.

Abstract No. 0005 **Tso-Fu Mark Chang**

Electrodeposition is commonly applied in fabrication of micro-electromechanical systems (MEMS) components because of the ease in controlling the morphology, crystal structure, composition and deposition rate of the electrodeposited materials. On the other hand, mechanical property characterization of the electrodeposited material is necessary for thorough understanding of the reliability and stability of the electronic component. The mechanical strength of metallic materials is known to be closely related to the average grain size according to the grain boundary strengthening mechanism, the composition by the solid-solution strengthening mechanism, and sizes of the specimen used in the mechanical property characterization by the sample size effect. In this presentation, relationships between the electrodeposition parameters, fundamental properties, and mechanical properties by micro-mechanical testing methods shown as follows are reported.

Abstract No. 0006 Kiho Nishioka

Non-aqueous lithium-oxygen batteries (LOBs) represent next generation batteries due to their high gravimetric energy densities. However, achieving the desired levels requires lowering the charging voltages. In principle, the charging voltage can be lowered by suppressing the generation of insulating byproducts such as Li_2CO_3 and forming highly decomposable Li_2O_2 during discharging. To address the latter problem, various strategies have been proposed, including applying electrocatalysts, and doping Li_2O_2 with different elements. However, little attention has been given to the ability of electrolyte solvents themselves to form highly-degradable Li_2O_2.

LOB cycle tests using the various amide-based electrolyte revealed that *N,N*-dimethylacetamide (DMAc) exhibited the best cycle characteristics. Notably, LOB with an DMAc-based electrolyte exhibited better cyclability than an LOB with the tetraglyme (G4)-based electrolyte, commonly used in fundamental studies. Considering the significance of Li_2O_2 crystallinity in achieving good cyclability, we attempted to evaluate the decomposability of Li_2O_2 formed in DMAc electrolyte using techniques such as on-line differential electrochemical mass spectrometry (DEMS), synchrotron XRD, and Nano-SIMS analysis. Consequently, Li_2O_2 particles formed during discharge in DMA-based electrolyte can be decomposed at a lower cell voltage than those formed in G4-based electrolyte.

Abstract No. 0007 Shang-Hao Chen

WO_3 thin films can present an energy gap below 3 eV, which implies a more comprehensive light absorption range than other wide bandgap oxide materials commonly studied for photoelectrochemical (PEC) device applications with higher energy gaps, such as TiO_2 and ZnO. Additional enhancements can be achieved by proper modifications of WO_3-based materials to extend their light absorption efficiency of the solar spectra and improve their carrier transport properties, for example, by doping or coupling tungsten oxide with other narrow band gap oxide materials. Bi_2O_3 is inexpensive, non-toxic, and has many different polycrystalline forms. Among them, β-Bi_2O_3 has a narrow energy gap, high visible light absorption ability, high dielectric constant, and high conductivity. This makes β-Bi_2O_3 easy to separate the electron-electric hole under light, so it can obtain good PEC performance, making β-Bi_2O_3 a promising photoelectrode material. This study used integrated chemical bath and sputtering technology to prepare a novel visible-light-driven β-Bi_2O_3 sheets/WO_3 thin film composite photocatalyst. In the photoelectrochemical measurements, the photocurrent density of the β-Bi_2O_3/WO_3 composite structure was superior to that of the WO_3 thin film and β-Bi_2O_3 sheets, indicating that the Bi_2O_3/WO_3 composite structure has better electron/hole separation efficiency than the constituent single phase compounds. The unique band alignment between the Bi_2O_3 sheets and WO_3 thin film account for effectively enhancing the photoelectrochemical properties.

Abstract No. 0008 **Yi-Yen Hsieh**

We design a tailored Schottky heterostructure composed of PVP-assisted $Bi_2Sn_2O_7$ (PVPBSO) nanocrystals and moderate work function graphene (mWFG, WF= 4.36 eV), which in turn intensifies the built-in voltage and interface dipole across the space charge region (SCR), leading to the inversion of majority carriers for facilitating K^+ transport/diffusion behaviors. Thorough band-alignment experiments and interface simulations reveal the dynamics between deficient BSO and mWFG, and how charge redistribution within the SCR leads to carrier inversion, demonstrating the impact of different defect engineering degrees on the amplification of Schottky junctions. The ordered transport of bipolar carriers can boost electrons and K ions easily passing through the inner and outer surfaces of the heterostructure. With high activity and low resistance in electrochemical reactions, the PVPBSO/mWFG exhibits an attractive capacity of 430 mA h g^{-1} and a rate capability exceeding 2000 mA g^{-1}, accompanied by minimal polarization and efficient utilization of conversion-alloying reactions. The substantial cell capacity and high-redox plateau of PVPBSO/mWFG//PB contribute to the practical feasibility of high-energy full batteries, offering long-cycle retention and high-voltage output. Our study emphasizes the direct importance of interface and junction engineering in improving the efficiency of diverse electrochemical kinetic and diffusion processes for PIBs.

Abstract No. 0009 **Chih-Chen Kuo**

Since environmental challenges are increasing with the incessant depletion of nonrenewable energy, photoelectrochemicals have attracted great attention technologies due to their potential for green energy. Titanium dioxide (TiO_2) is recognized as a promising semiconductor and is widely studied in photocatalysts, solar cells, sensors, water splitting, and energy storage. In order to enhance the separation rate of photogenerated electrons and holes, two processes are taken to produce the rutile-anatase TiO_2. At first, the rutile TiO_2 tetragonal nanorods are arranged vertically on the F-doped titanium oxide (FTO) substrate via an acid hydrothermal method at 180 ºC. Subsequently, the anatase TiO_2 thin-film spin coating on the rutile TiO_2 nanorods with a post-annealing treatment at 450 °C in ambient air composites the core-shell structure. Through the application of XRD, UV-vis, and UPS investigations to characterize the produced TiO_2 nanorods, it was determined that the type II heterostructure is composed of pure rutile and anatase TiO_2 phases. Photoelectrochemical analysis, which includes photocurrent density-voltage curves, Nyquist, Mott-Schottky, and open circuit potential, can be used to determine the performance of a photoelectrode. The results indicated that the photocurrent density of rutile-anatase TiO_2 has been significantly enhanced. A similar conclusion displayed in the other photoelectrochemical investigation demonstrates that the performance of semiconductors is improved through composite rutile-anatase TiO_2. The aforesaid consequence can be attributed to the synergistic effect and heterojunction between rutile nanorode and anatase thin film. Based on the above, we can conclude that the rutile-anatase TiO_2 composition decreases charge recombination and improves energy conversion efficiency.

Abstract No. 0010 Keng-Wei Liang

Bismuth oxide (Bi_2O_3) has attracted researchers' attention owing to its multi-functions, which possess environmentally friendly properties, wide-ranging energy gap (2 ~ 3.9eV), high dielectric constant, and diverse crystal structures. This makes it manifest considerable potential for development in photoelectrode. However, the photoelectrochemical (PEC) performance of a single component Bi_2O_3 wouldn't catch up with heterojunction due to the swift recombination of photo-induced carriers. Moreover, the heterophase composite would demonstrate high crystallinity and stable reproducibility without foreign elements and join spontaneously to establish a more effective band structure . A facile and low-temperature hydrothermal fabrication and complete energy band system concerning Bi_2O_3 with unique phase transformation are elaborated on in this work. For innovative improvement, ethylene glycol's unique crystalline orientation property is utilized to form a special solvent by mixing with deionized water, and the heterophase composite has self-evolved successfully through the transitional stage between β-Bi_2O_3 and γ-Bi_2O_3. The heterophase compound consists of scattered micro tetrahedra springing up on the abundant scales of triangular nanosheets and strengthens light harvesting ability in the visible region. The Z-scheme junction in the β/γ-Bi_2O_3 composite crystals enhances the photocurrent response, promotes the interfacial charge transfer, and prolongs the photogenerated electron lifetime. Meanwhile, the band curving and internal electric field stemming from fermi level alignment could assist the photogenerated charges to detach effectively.

Abstract No. 0011 Che-Bin Chang

Uniform copper telluride nanotubes were prepared by ion exchange via telluride nanotube template. The copper telluride nanotubes have diameter of 70 nm and the length up to several micrometer. This unique tube structure can not only facilitate the potassium ion transport but also buffer the volume expansion during potassiation/depotassiation process.

Abstract No. 0012 Kai-Wei Lin

Due to global warming and energy concerns, energy storage systems, particularly the vanadium redox flow battery (VRFB), have gained significant popularity. Electrolytes in commercial applications are typically set to a $V^{3.5+}$, with a 1:1 volumetric molar ratio of V^{3+} to VO^{2+}. However, prolonged charge-discharge cycles can lead to changes in the oxidation states, causing an imbalance in the concentrations of V^{3+} and VO^{2+}. Many methods have been presented to measure the electrolyte oxidation states in VRFBs. This study focuses on the ultraviolet-visible (UV-vis) spectroscopic method and potentiometric titration for investigating the imbalance of different electrolytes. From the result of UV-vis spectrum, a correlation between the absorption intensity ratio and the mole percentage of VO^{2+}, Fig.1 (a), indicates the oxidation states are $V^{3.4+}$~ $V^{3.9+}$. By analyze the equivalent volumes (V_{EQ}) of V^{3+} and VO^{2+} form potentiometric titration, the V_{EQ} ratios of V^{3+} and VO^{2+} further illustrate an electrolyte imbalance as shown in Fig.1(b). The results of UV-vis spectroscopy and potentiometric titration are compared with each other and discussed.

Abstract No. 0013 Xuan-Mao Huang

Molybdenum, known for its stable thermal properties and low electrical resistivity, has received considerable attention as a diffusion barrier layer in the semiconductor copper process. In the wet processes of semiconductor manufacturing, such as etching, cleaning, and chemical mechanical polishing (CMP), galvanic corrosion issues often arise. Corrosion inhibitors are often used during CMP to control the difference in reactivity between different materials and adjust galvanic corrosion. Among various inhibitors, 1,2,4-triazole (TAZ) is being explored for its easier cleaning properties compared to benzotriazole. On the other hand, the inhibition effect of glycine on Mo corrosion was also found. This study, examines the difference in corrosion behaviors between Mo and Cu using TAZ and glycine. Figure 1 shows the effects of TAZ concentrations on Tafel plots of Mo and Cu. It indicates that the addition of TAZ shows a greater increase in corrosion potentials but a smaller decrease in corrosion current densities than that of Mo.

Abstract No. 0014 Heyun Du

Excessive use of fossil energy by human activities leads to global warming and climate change. To overcome this, it is necessary to develop a new concept of renewable energy technologies using earth-abundant and low-cost resources. In this context, we will focus on two-dimensional (2D) materials, which are single atoms or molecules thick and have an ideal planar structure, such as graphene and transition metal dichalcogenides (TMDCs) . TMDCs are considered ideal photocatalyst materials due to their suitable band structure. For example, graphene and molybdenum disulfide is widely used in hydrogen reduction reactions (HER) and water splitting . To meet the energy needs while maintaining a sustainable environment, we developed the world-leading active site mapping techniques (AFM-SECM and SECCM). Those techniques investigate the electrochemical and photo-electrochemical current feedback on single crystal 2D van der Waals samples. We aim to investigate various in-situ or ex-situ scanning probe microscopy (SPM) techniques on these 2D heterostructures to further establish the mechanism of photocatalytic carbon dioxide/hydrogen reduction reaction catalysis and electronic structures.

Abstract No. 0015 Tzu-Sen Su

Perovskite solar cells have emerged as promising candidates for next-generation photovoltaic technologies due to their exceptional optoelectronic properties and low-cost fabrication. However, ensuring stability and performance across diverse compositions of perovskite materials remains a significant challenge. In this study, we explore the utilization of crown ethers as versatile host-guest complexes to enhance the stability and efficiency of perovskite solar cells with different compositions. The crown ethers act as efficient vehicles that facilitate the controlled delivery of cations, such as Cs^+, Rb^+, or K^+, into the perovskite material's interior. By establishing local gradients of doping at the nanoscale, this approach enhances photoinduced charge separation, passivates surface and bulk defects, and stabilizes the perovskite phase through a synergistic effect of the host, guest, and host-guest complex. Our findings reveal that the crown ether-based host-guest strategy can be tailored to different perovskite compositions, resulting in remarkable power conversion efficiencies across various material formulations. The resulting solar cells demonstrate superior performance and prolonged operational stability, surpassing 24% efficiency and maintaining over 95% of their initial performance without encapsulation for extended periods.

Furthermore, the crown ether's capability to bind with specific metal cations, such as lead ions, showcases its potential to mitigate the environmental impact of these advanced perovskite solar cells. Overall, our research highlights the versatility and efficacy of crown ethers as host-guest complexes, offering a viable pathway to address the stability and efficiency challenges in diverse compositions of perovskite solar cells. This supramolecular approach opens up exciting opportunities for advancing the field of photovoltaics and promoting the practical deployment of perovskite solar cells in sustainable energy applications.

Abstract No. 0016 Pooi See LEE

Integrated hybrid electrochromic-energy storage device is found to be interesting for their high color contrast, fast response time, and good endurance. Designing materials with appropriate crystal and electronic structures to enhance ionic and electronic transport simultaneously, such as tungsten-bronze-based bimetallic oxide nanomaterial, has proved to achieve high energy storage capacity, excellent rate capability, and long-term electrochemical stability. 2D porous metallo-supramolecular polymers (MSP) are found to promote the rapid transfer of ion and electron simultaneously. High-quality 2D porous MSP with 1,3,5-tris(4-(2,2′:6′,2″-terpyridyl)phenyl)benzene coordinated to Fe(II) ions has been prepared in uniform layers using facile electrostatic spray deposition (ESD) technology. A high specific capacity and ultrahigh coloration efficiency can be achieved simultaneously. On the other hand, Iron terpyridyl coordination polymer (CP) grown with electropolymerization in a 1D manner is found to display predominant capacitive behavior with rapid charge-transfer kinetics for electrochromic-energy storage device.

Abstract No. 0017 Chun-Yi Chen

Poor kinetics of hole transportation at the electrode/electrolyte interface is regarded as a primary cause for the mediocre performance of n-type TiO_2 photoelectrodes. By adopting nanotubes as the electrode backbone, light absorption and carrier collection can be spatially decoupled, allowing n-type TiO_2, with its short hole diffusion length, to maximize the use of the available photoexcited charge carriers during operation in photoelectrochemical (PEC) water splitting. Here, we presented a delicate electrochemical anodization process for the preparation of quaternary Ti−Nb−Ta−Zr−O mixed-oxide (denoted as TNTZO) nanotube arrays and demonstrated their utility in PEC water splitting. The charge-transfer dynamics for the electrodes was investigated using time-resolved photoluminescence, electrochemical impedance spectroscopy, and the decay of open-circuit voltage analysis. Data reveal that the superior photoactivity of TNTZO over pristine TiO_2 originated from the introduction of Nd, Ta, and Zr elements, which enhanced the amount of accessible charge carriers, modified the electronic structure, and improved the hole injection kinetics for expediting water splitting. By modulating the water content of the electrolyte employed in the anodization process, the wall thickness of the grown TNTZO nanotubes can be reduced to a size smaller than that of the depletion layer thickness, realizing a fully depleted state for charge carriers to further advance the PEC performance. Hydrogen evolution tests demonstrate the practical efficacy of TNTZO for realizing solar hydrogen production. Furthermore, with the composition complexity and fully depleted band structure, the present TNTZO nanotube arrays may offer a feasible and universal platform for the loading of other semiconductors to construct a sophisticated heterostructure photoelectrode paradigm, in which the photoexcited charge carriers can be entirely utilized for efficient solar-to-fuel conversion.

Abstract No. 0018 Daniel H.C. Chua

Carbon materials have always attracted a lot of attention in electrochemical energy generators and devices due to their unique material properties, which includes low dimensional effects, good structural integrity, high electrical and thermal conductivity, and chemical stability. In addition, different forms of carbon allotrope have expanded the applications, which have progressed from thick to thin films to the nanoscale multi-dimensioned carbon nanotubes and graphene.

In this talk, we will show the extent of design and engineering, which includes coupling of various 0D, 1D, 2D and 3D carbon-based materials to make it suitable for direct applications into devices such as supercapacitors, fuel cells and batteries. We will further show these supports are highly versatile, such that additional surface engineering of these nano-structures, through incorporation of catalyst and/or core-shell catalyst-support, it opens up a wide range of applications into other electrochemical-based conversion and energy generators. Several examples will be given with a series of in-situ tests to validate the effectiveness and robustness of these materials. We will also briefly mention other applications for these multifunctional carbon-based materials.

Abstract No. 0019 Mohamed M. Abdelaal

Combining the merits of high-capacity batteries and high-power supercapacitors, Lithium-ion capacitors (LICs) are anticipated to meet the demands for efficient electrochemical energy storage applications . As the battery-type anode, it is reported that molybdenum disulfide/carbon (MoS_2/C)-based nanocomposites possess the potential application in LICs. In the present study, a nitrogen-doped MoS_2/hierarchical porous activated carbon (N-MoS_2/HPAC) is successfully synthesized by combining a microwave-assisted approach and calcination in the N_2 atmosphere. Compared to the reported MoS_2/C, it is surprising that our N-MoS_2/HPAC exhibits 85 % of the 1T phase as analyzed through the XPS result. When measuring in the potential range between 0.8 V and 3.0 V *vs.* Li/Li^+, N-MoS_2/HPAC delivers not only high reversible capacity (338 mAh/g at 0.1 A/g) but also superior rate performance (214 mAh/g at 2 A/g). The reversible capacities obtained from all current densities are more than the theoretical value, *i.e.*, 167 mAh/g based on intercalation reaction. It can be attributed to the 1T phase giving a higher Li^+-adsorption affinity than the 2H phase, leading to the synergistic mechanism in the surface and diffusion contributions. The results found in this study would support our N-MoS_2/HPAC to be utilized as a promising anode in LICs.

Abstract No. 0020 Mozaffar Abdollahifar

In order to increase the energy density of lithium-ion batteries (LIBs), research studies have focused on not only various anode and cathode active materials, suitable binders and electrolytes, but also on the development of electrode and cell manufacturing. Currently, the manufacturing of LIB electrodes involves slurry mixing, coating, drying, and calendering processes (Figure 1a). Calendering (Figure 1b) is a standard and low-cost process in electrode manufacturing, which can increase the cell volumetric energy density and enhance the bonding strength between the active materials/conductive carbons/binders and the current collector by reducing the porosity from 50-70% down to 20-40%. Moreover, this process affects the porosity, adhesion, and thickness of the electrodes, as well as the homogeneity of the coatings. Herein, the fundamental processes for electrode production and calendering are discussed.

Abstract No. 0021 Hyunjae Heo

Rare earth elements have been used widely in high-tech industries, and considered as one of the most important raw material resources. Currently a supply of rare earth elements is limited due to their biased burial place and a harmful effect on environment during mining and refining although a demand for high-purity rare earth elements keeps increasing. Nd-Fe-B permanent magnet has been used in IT and automotive industries, however Nd, which is one of most frequently used rare earth elements, has not been recovered easily from magnet waste because of the difficulty of separation. In this study, Nd-Fe-B permanent magnet waste powder, in which Nd was selectively oxidized to Nd_2O_3 in advance, was sintered into a cylindrical shape, and used as an anode. Electrolytic refining of Fe was conducted with three-electrode cells. Electrolytes basically composed of ferrous sulfate and potassium sulfate were used to find an optimal chemistry of Fe separation from Nd_2O_3 by electrorefining.

Abstract No. 0022 Yunhwa Jung

As Si-based microelectronic devices have been integrated further, the line width of Cu interconnect structure has been reduced below 100 nm along with the progress of fine-patterning technology. Voids or imperfections remaining within Cu interconnect structure have become a serious problem after the Cu filling of trench or via by electrodeposition method. Thus, more advanced Cu electrodeposition technology has been necessary to fabricate flawless Cu interconnect structure. In this study, we attempted to manipulate the seedless electrodeposition behavior of Cu thin film directly on Mo diffusion barrier layer in SiO_2/Si substrate by managing the concentration of EDTA (ethylenediaminetetraacetic acid) complexing agent in a $CuSO_4$-based electrolyte. Analyzing the microstructural development of as-deposited Cu and the electrochemical characteristic curves of direct Cu electrodeposition, optimal electrodeposition conditions were explored to form thin, uniform Cu films. Additionally, the time-dependent growth behavior of Cu nuclei or clusters was investigated using electrochemical impedance spectroscopy (EIS).

Abstract No. 0023 Hyeonsan Jo

The economic value of neodymium (Nd) as one of most frequently used rare earth elements has increased because Nd has been used in various fields such as electric motors of electric vehicles, MRI requiring strong magnetic fields, and computer hard disks. Korea has imported most of rare earth elements including Nd from abroad since the mining and refining of rare earth elements is not appropriate due to a lack of reserves. There have been many efforts to recycle rare earth elements from discarded industrial product wastes in Korea over years. In this study, Nd-Fe-B waste powder, in which Nd was selectively oxidized to Nd_2O_3 in advance, was fabricated into a cylindrical-shape anode by sintering in order to construct a three-electrode cell, and Ti plate was used as a cathode. Potentiostatic electrochemical reduction was conducted to increase the purity of Nd_2O_3 by extracting iron from the sintered anode through electrorefining process. The concentration of organic acids such as malonic acid and succinic acid was varied as experimental variables along with applied reduction potential.

Abstract No. 0024 Tzu−Ho Wu

Rechargeable aqueous zinc–ion batteries (RAZIBs) hold tremendous promise for large–scale energy storage applications due to high materials abundance, cost–effectiveness, and intrinsic safety. Until now, vanadium–based oxides have been extensively investigated as promising candidates for RAZIBs. The crystal structure of vanadium oxide plays a decisive role in determining Zn^{2+} storage behavior. In the present work, we reveal that vanadium oxides with various crystal structures can be synthesized from different V^{5+} solute species by controlling the pH value of the precursor solution (pH =1, 4, 6, and 10). The reaction chemistries of different vanadium oxides are discussed, and more importantly, the structure–performance relationships on Zn storage behaviors are also revealed. Among the obtained samples, layered $Zn_{0.15}V_2O_5 \cdot 0.76H_2O$ (pH = 1) exhibits the best electrochemical performance in RAZIBs (320 mAh g^{-1} at 1 A g^{-1}) due to its large open structure. In regard to pH = 4 and 6 samples, the presence of inactive components (ZnV_2O_6 and water−deficient $(NH_4)_2V_6O_{16}$) results in inferior electrochemical performance. For the pH = 10 sample, the obtained $Zn_2(OH)_3VO_3$ is unfit for Zn^{2+} storage with negligible capacity. The current work paves the way forward for understanding structure–performance relationships of vanadium–based oxides on Zn storage.

Abstract No. 0025 Pin-Syuan Haung

Two-dimensional materials, intricately bonded by the comparatively feeble Van der Waals forces that operate between their layers, encompass a diverse spectrum of substances, spanning the gamut from conductors and semiconductors to insulators. Eminent exemplars in this realm include graphene, transition metal dichalcogenides (TMDCs), black phosphorus, and hexagonal boron nitride.

We applied the emerging technique within the realm of electrochemical analysis is the microdroplet electrochemical system. This innovative method capitalizes on working electrodes that span a remarkable range, from the diminutive nanoscale to the modest micrometer scale. Serving as a precision tool, this methodology empowers researchers to unravel the intricate intricacies of material behavior at a microscopic level, shedding light on fundamental processes.

Abstract No. 0027 Fery Prasetyo

Harvesting osmotic energy from organic waste solutions using an ion-selective membrane not only helps to alleviate environmental problems but also provides a clean and sustainable energy source. However, the development of highly selective and high-performance ion-selective membranes for these applications remains largely unexplored. Inspired by the electrocytes in electric eels which contain many angstrom-scale ion channels that allow preferential transport of ions in one direction, we have developed a metal-organic framework (MOF)-based heterogeneous membrane, which consists of HKUST-1 as the sub-nanoscale ion-selective layer and branched alumina nanochannel (BANM) as the supporting layer (known as HKUST-1@BANM), for efficient osmotic energy conversion from organic solutions. Due to the broken symmetries of charges and pore geometry, the HKUST-1@BANM shows strong ionic diode effect, that is, an amplified and directional ion transport, with a rectification ratio of up to 6.4 times in LiCl-methanol solution. Surprisingly, when tested under a 2 M feed solution mixed with pure methanol, the membrane generated electrical energy and achieved a power density of ~30.2 W/m^2, which surpasses commercial benchmark (5 W/m^2). The increased power density can be attributed to the abundant and highly ordered channels that filter dehydrated cations and the membrane diode effect, which strengthens the ionic current that attracts cation transport through the membrane channels, leading to the generation of osmotic energy.

Abstract No. 0028 Rene Mary Amirtha

Zinc (Zn)-based electrochemical devices are recognized as promising alternatives for energy storage due to the inherent advantages of Zn, such as cost-effectiveness, environmental friendliness, intrinsic safety, low redox potential (-0.76 V *vs.* standard hydrogen electrode), and substantial theoretical capacity (820 mAh/g gravimetric capacity and 5,855 mAh/cm^3 volumetric capacity). However, unfavorable side reactions have occurred in the zinc sulfate ($ZnSO_4$)-based aqueous electrolyte, including Zn corrosion, zincate formation, and hydrogen evolution. Recently, it is demonstrated that adopting a protective layer over the Zn is one of the effective strategies for addressing the aforementioned issues. Herein, the multifunctional composite layer comprised of polyhedral ZIF-8 nanoparticles and sodium alginate (SA) was coated onto Zn foil (Z8- SA@Zn) through a doctor-blade method. Following the repeated plating/stripping at a current density of 2 mA/cm^2, it is found that the Z8-SA@Zn not only exhibited lower nucleation potential (32 mV *vs.* Zn/Zn^{2+}) but also possessed stable Coulombic efficiency of 99 % over 600 cycles under the asymmetric configuration. Those positive results can be attributed to (i) rapid Zn^{2+} transportation pathway from the SA, (ii) uniform Zn^{2+} flux regulated by the ZIF-8, and (iii) minimal contact between the electrolyte and Zn electrode. Consequently, the results presented in this study suggest that the Z8-SA@Zn can be a promising anode to prolong the cyclability of Zn-based electrochemical energy storage devices.

Abstract No. 0029 **Yu-Ching Weng**

The utilization of visible light in solar energy to generate hydrogen through photocatalyst decomposition of water is a clean and environmentally friendly non-polluting method. The $In_{0.2}Cd_{0.8}S$ photocatalyst has been proven to exhibit a good photocatalytic effect under visible light in previous studies. However, its interface resistance is relatively large and its electron-hole recombination rate should be further improved. Carbon nanohorns (CNHs) have the advantages of high conductivity, large specific surface area, etc. Therefore, CNHs were used to modify the $In_{0.2}Cd_{0.8}S$ photocatalyst to improve the photocatalytic activity, reaction stability, and electron-hole recombination rate. The photocurrent of the 0.38 wt% CNH modified $In_{0.2}Cd_{0.8}S$ photoelectrode could be achieved at 0.8 mA, which was higher than that of the bare $In_{0.2}Cd_{0.8}S$ photoelectrode. The 0.38 wt% CNH modified $In_{0.2}Cd_{0.8}S$ photoelectrode possesses high charge carrier concentration, small interface resistance, and low electron-hole recombination rate, thus improving the photocatalytic efficiency. The hydrogen production rate could be reached at 3.73 $\mu mol/hr \cdot cm^2$.

Abstract No. 0030 **Shen-Ming Chen**

Electrochemistry is a fundamental branch of science that explores the interactions between electricity and chemical processes. It involves the study of how electric currents can induce chemical reactions and vice versa, shedding light on the principles underlying various electrochemical phenomena. The principles of electron transfer at the atomic and molecular levels are discussed, along with applications in batteries, corrosion prevention, electroplating, and sensors. Understanding basic electrochemistry is essential for advancements in electrocatalysis, energy storage, materials science, and environmental protection, contributing to innovations that shape modern technological landscapes. Electrocatalysis and photo electrochemistry are explored as key components in sustainable energy production and environmental remediation. Furthermore, emerging areas like Bioelectrochemistry and electrochemical synthesis demonstrate the expanding frontiers of this discipline, influencing fields like medicine and materials science. A comprehensive understanding of electrochemistry applications is essential for driving innovations that address pressing global challenges and facilitate advancements in technology and science.

Abstract No. 0031 Po-Wen Chien

We investigate the influence of configurational entropy on the cycling performance of 2D metal phosphorus trichalcogenides (MPS_3) when utilized as anodes in potassium-ion devices. High yield, two-dimensional high-entropy $CoVMnFeZnPS_3$ ($HEPS_3$) with thickness ranging from 6 to 10 nm was synthesized via a vacuum solid-state method. $HEPS_3$ enables efficient potassium-ion transport and intercalation at the interface of electrodes, thanks to the high-entropy effects arising from the interaction of various metal ions on the K^+ binding energy. $HEPS_3$ potassium-ion anodes outperform their medium-entropy ($CoMnFePS_3$ (ME_3PS_3) and $CoMnFeZnPS_3$ (ME_4PS_3)), $CoFePS_3$ (LE_2PS_3), and $FePS_3$ ($LEPS_3$) counterparts, exhibiting a high reversible capacity of 524 mAh g^{-1}, impressive high-rate capability up to 10 A g^{-1}, and exceptional cycling stability over 1000 cycles. Our findings indicate that the electrochemical reconstruction of $HEPS_3$ during cycling is crucial for achieving high-performance potassium-ion batteries. In situ-formed metal alloy layers act as catalysts, offering not only suitable adsorption energy to prevent the shuttle effect but also promoting the complete conversion of polysulfides. Furthermore, cations uniformly dispersed across the 2D plane create a "lattice distortion effect," imparting the structure with high mechanical stability and allowing for even distribution of internal stress generated in the electrode during the K^+ insertion/extraction process, which in turn suppresses electrode pulverization and prevents the aggregation of $MPCh_3$ layers. This work proposes a novel strategy for significantly enhancing potassium-ion storage performance through the electrochemical activation of high-entropy layered metal phosphides, thus opening a new horizon of 2D material design principle in energy storage devices.

Abstract No. 0032 Min-Hsin Yeh

Understanding the levels change in biomarkers over time, especially glucose, is crucial for diabetics to inform early therapy. Recently, wearable sweat biosensors which operate in a non-invasive way have raised attention, providing continuous monitoring of the severity level. Nevertheless, the key challenges are that multiplexed motions may result in undesirable metal cracking by the rigid electrocatalytic layer, leading to decreased sensitivity and stability. In this work, we designed an N-GQDs anchored PANI matrix to realize flexible wearable biosensors with high detection accuracy. Upon the enhanced electron transfer by N-GQDs, N-GQDs/PANI nanocomposite offers greater sensitivity in H2O2 detection compared to pristine PANI, resulting in a sensitivity of 68.1 ± 1.11 and 44.06 ± 2.1 μA mM$_{-1}$ cm$_{-2}$, respectively. Precise glucose detection was also maintained after integrating into a flexible electrode, the sensitivity of the GOx/N-GQDs/PANI-based biosensor had retained 93.2 % with no apparent cracks in the morphology of the nanocomposite layer, compared to GOx/Pt-based one (71.3 %) toward glucose detection after a continuous bending test. Thus, the N-GQDs/PANI nanocomposite layer can provide reliable long-term monitoring with robust electrodes for non-invasive human sweat glucose monitoring on a wearable biosensor. Furthermore, A novel non-invasive wearable self-powered triboelectric sensor (TES) for simultaneous physiological monitoring had shed the light on its extraordinary performance, which become a promising choice for detecting glucose concentration from human sweat via non-invasive strategy. To boost up the reliability and sensitivity of conducting polymer-based TES, in this study, a nanocomposite of N- doped graphene quantum dots decorated polyaniline (NGQDs/PANI) is designed as a triboelectric layer for non-invasive glucose detection. The surface electronegativity of PANI was changed by decorating the NGQDs with electron-rich functional groups for increasing the surface charge, which further facilitating the charge transfer between the PANI and intermedia and then enhancing triboelectric outputs.

Abstract No. 0033 Masashi Kotobuki

Solid electrolytes have attracted increasing attention as they can solve the safety issues related to flammable liquid electrolytes. However, achieving high ionic conductivity of solid-state electrolytes and creating low interface impedance between solid electrolytes and solid electrodes at room temperature are still challenging. Herein, the development of high-performance ceramic-polymer composite electrolytes (CEs) for all-solid-state Na batteries. The novel CEs composed of ceramic porous frameworks filled with polymer electrolyte exhibits high ionic conductivity of 1.4×10^{-4} S cm^{-1} at room temperature due to the synergic effect of polymer and ceramic electrolytes, The novel CE possessed good mechanical strength and flexibility, facilitating the fabrication of all-solid-state Na battery. The all-solid-state Na battery with the novel CE demonstrates stable charge and discharge behaviors at least 100 cycles.

Abstract No. 0034 Ching-Chou Wu

Cells take in nutrients and oxygen to create adenosine triphosphate (ATP), which is cellular energy, and release acidic waste and carbon dioxide at the same time. Cell activity can be estimated by measuring cellular metabolism-related molecules like oxygen, lactate, and carbon dioxide. The oxidative phosphorylation (OXPHOS) rate can be used as a probe to evaluate mitochondrial activity and carcinomatosis degree. Normal cells produce most ATP molecules via OXPHOS, but cancer cells mainly have ATP via cytosol glycolysis, which consumes less oxygen and releases more protons. Therefore, measuring the consuming rate of oxygen and the change in extracellular pH values is meaningful for estimating cell activity and carcinomatosis degree. In our previous studies, different microfluidic sensing chips were fabricated to estimate the acidification rate and respiratory activity of mammalian cells. The time-lapse monitoring shows that the respiratory activity of cells increases with the cultivation time. Moreover, a dissolved oxygen (DO) ultramicroelectrode (UME) array integrated with a microfluidic channel and microstructures can be constructed to measure the oxygen consumption rate (OCR) of the single bovine embryo for the estimation of embryo development. It is worth noting that the microfluidic chip may induce a shear or viscous force to move the attached cell away from the detecting electrodes during medium replacement. Therefore, a novel cell-based chip consisting of a position-raised microchannel and an open chamber slab was constructed for cell operations, such as cell seeding, attachment, and medium replacement. The position-raised microchannel can reduce the effect of shear force on the cell attachment force during performing medium replacement after a 2-h short-term culture. Moreover, the chip-type three-electrode electrochemical DO UMEs can reduce the effect of charging current and self-consumption of oxygen molecules on the estimation of respiratory activity. Four kinds of mitochondrial inhibitors are used to quantify the bioenergetic health index. This presentation reports the applications of microfluidic DO sensing chips in the mitochondrial activity and OCR of mammalian cells or a single embryo.

Abstract No. 0035 Hung-Yi Huang

Electrochemical deionization (ECDI) systems present an enticing avenue for desalination, offering substantial salt adsorption capacity (SAC) while maintaining reasonable energy consumption. These systems hold the potential to either replace or complement existing desalination techniques. Despite these advantages, most ECDI systems are limited to brackish water desalination, and their energy efficiency deteriorates as the salt concentration in brine water rises, often coupled with shortened cycle lifespans. Here, we introduce a novel concept wherein an ECDI cell is designed using electrodes composed entirely of the same conducting polymer, specifically polypyrrole (PPy). This innovative approach showcases the elevated SAC achievable through Faradaic desalination across a wide range of brackish water concentrations. Furthermore, the adoption of ion-capturing/ion-releasing processes within this cell design results in minimized cell voltages, translating to decreased energy consumption and extended cycle longevity. From our results, diverse anionic dopants of varying sizes are employed to modulate the ion exchange capabilities of PPy films. The inclusion of sizable dopants, such as 4-methylbenzene-sulfonic acid (p-TS), imparts cation-capturing traits to the PPy-p-TS electrode. Conversely, smaller dopants, like perchlorate (ClO_4), promote anion exchange functionality in the PPy-ClO_4 electrode. Moreover, optimization of operational parameters, encompassing charging/discharging time ratios, PPy-p-TS/PPy-ClO_4 mass loading ratios, and overall mass loading on both electrodes, yields outstanding desalination performance and extended cycle life. This approach also achieves the dual role of salt removal and concentration. Consequently, this work not only establishes design principles for constructing ECDI systems with superior desalination capacity, rapid deionization rates, minimal energy consumption, and prolonged cycle life but also provides valuable insight for advancing the application of conducting polymer in the ECDI field.

Abstract No. 0036 Jian-Xue Huang

Rechargeable aqueous zinc-ion batteries show great potential for large-scale energy storage applications because of their cost-effectiveness and high safety. In particular, manganese-based oxides are considered promising candidates for cathode materials due to the merits of rich redox transitions, high operating voltage, and low-cost . In this study, layered MnO_2 (K-MO) containing potassium ions was firstly synthesized by hydrothermal method , and ammonium ions were introduced into MnO_2 framework by ion exchange method (NH_4-MO). The results show that NH_4-MO exhibits larger interlayer distance, higher specific surface area, and richer oxygen defects. Accordingly, NH_4-MO demonstrates higher specific capacity (215 vs 184 mAh g^{-1} at 1A g^{-1}) and better capacity retention (74.3% vs 66.6% after 2000 cycles at 4A g^{-1}) in comparison with K-MO (Figure 1). The outcome of this work indicates that ammonium ion migration is an exploitable strategy to enhanced energy storage capability of MnO_2 cathode in RAZIBs.

Abstract No. 0037 Yi-Ying Lee

Urea oxidation reaction (UOR) has gained increasing attention recently, because it can not only remediate urea-containing wastewater avoiding direct emission to the environment but also provide hydrogen for the use in fuel cells. However, UOR suffers from slow reaction kinetics due to six electron transfer in the catalytic mechanism. As such, developing efficient UOR catalysts to facilitate reaction rate is the major focus. For the current research, the electrocatalytic performances of various Ni-based electrocatalysts have been extensively studied. Among them, $Ni(OH)_2$ serves as the most representative catalyst for UOR . In this work, we demonstrate that incorporating yttrium ions can effectively enhance the catalytic performance of α-$Ni(OH)_2$. The optimal sample ($Ni(OH)_2$-10Y) exhibits higher current density (294 vs 214 mA cm^{-2} at 1.7 V vs RHE) and lower Tafel slope (48 vs 75 mV dec^{-1}) in comparison with Y-free $Ni(OH)_2$. $Ni(OH)_2$-10Y is confirmed to render faster reaction kinetics toward UOR, as characterized by various electrochemical analyses. More importantly, $Ni(OH)_2$-10Y exhibits reliable catalytic performance in UOR application (over 22 hours).

Abstract No. 0038 Meng-Dian Tsai

Polyaniline (PANI) is a conducting polymer with great potential for supercapacitor applications. Unfortunately, polyaniline usually shows lower specific capacitance than its theoretical value owing to the aggregation and low porosity. To solve the problems, in literatures, materials containing sulfonate groups, such as polystyrene sulfonate (PSS) and Nafion, are commonly utilized to disperse the polymeric chains of PANI with the electrostatic interaction between the anilinium and the negatively charged sulfonate. In the literature, the PANI composite with sulfonate functional group shows higher conductivity and capacitance than pristine PANI. However, the low porosity of Nafion and PSS may hinder the diffusion of counter ions, so it is reasonable to improve the performance by utilizing porous materials.

Metal–organic frameworks (MOF) are a type of porous materials constructed from metal-based nodes and organic linkers. MOFs are widely investigated in numerous applications due to their regular porosity, high surface area, and tunable functionality. Herein, a two-dimensional (2D) zirconium-based MOF with an exceptional chemical stability during the polymerization of aniline and enriched sulfonate-based ligands post-synthetically coordinated onto its nodes, ZrBTB-SO_3 (BTB = 1,3,5-tri(4-carboxyphenyl)benzene), is utilized as the “dispersant” during the *in-situ* polymerization of aniline; composites with various ratios between PANI and ZrBTB-SO_3 are thus synthesized. Compared to the other control materials, PANI present in the PANI@ZrBTB-SO_3 shows a much higher specific capacitance (515 F/g) due to the assistance of the negatively charged sulfonate-functionalized 2D MOF as the dispersant.

Abstract No. 0039 Ai-Ling Huang

The utilization of lithium metal, whether in an anode or anode-free configuration, represents a highly promising avenue for enhancing the energy density of the existing lithium-ion battery framework. Nonetheless, the uncontrolled growth of lithium dendrites poses challenges to the practical use of lithium metal as an anode due to safety concerns and suboptimal Coulombic efficiency.

In this study, we demonstrate that employing a suitable fiber morphology as a coating on a current collector can effectively facilitate uniform lithium deposition by governing the flux of lithium ions and suppressing the formation of lithium protrusions. Using the electrospinning technique, we showcase the capability to modulate the mechanisms of lithium deposition through variations in the fiber morphology of polyacrylonitrile (PAN).

Furthermore, the intersecting fibers at the base of the structure enables the nucleation of larger lithium clusters at the bottom, which is then complemented by the addition of aligned fibers to assist in the homogeneous upward deposition of lithium. This approach aims to achieve the goal of dendrite-free lithium deposition. Such modifications result in PAN@Cu anodes exhibiting Coulombic efficiency of over 95% sustained for more than 160 cycles.

The simplicity and scalability of the electrospinning method, which can be employed to fabricate efficient and high-energy-density lithium batteries, offer valuable insights for strengthening anode-free lithium battery systems through the creation of artificial solid-electrolyte interphase (SEI) films.

As a result, this study not only presents a rapid and scalable approach for lithium battery production, but also significantly enhances both battery performance and lifespan. Additionally, it provides invaluable insights that have the potential to advance the incorporation of artificial solid-electrolyte interphase (SEI) materials in the realm of lithium-ion batteries.

Abstract No. 0040 Meng-Dian Tsai

Compared to lithium-ion batteries (LIBs), aqueous zinc-ion batteries (AZIBs) have the advantages of high safety, low cost, and ease of manufacturing. VO_2(B) and VO_2(D) have been used as the cathode materials for AZIBs, however, they suffer from low electrical conductivity. Among the VO_2 polymorph, paramontroseite-type VO_2 (or known as VO_2(P)) has been characterized to have the highest electrical conductivity (1.02 S cm^{-2}) . Nevertheless, VO_2(P) has never been employed as the cathode material for AZIBs thus far. In our study, we firstly incorporate VO_2(P) with multiwall carbon nanotubes (MWCNTs) to make the VO_2(P)/MWCNTs composite with uniform morphology. Secondly, we demonstrate that K^+ doping can effectively boost the electrochemical performance in AZIBs. The obtained K-VO_2(P)/MWCNTs exhibits high capacity of 320 mAh g^{-1} even at the current density of 4 A g^{-1}, outperforming pure VO_2(P) counterpart (265 mAh g^{-1}).

Abstract No. 0041 Chung-Sheng Lin

$Ni(OH)_2$ is the most representative electrocatalyst for urea oxidation reaction (UOR), which can be applied to concurrently remedy urea-rich wastewater and produce high-purity hydrogen. To date, heteroatom doping has been demonstrated as an appealing method to regulate the electronic structure of $Ni(OH)_2$ and hence promote the reaction kinetics toward UOR. On the other hand, W-doped $Ni(OH)_2$ has been reported to enhance electrocatalytic water oxidation, however, W-doping strategy has been rarely discussed in UOR. In our work, we employed a one-step electrochemical deposition method to prepare W-$Ni(OH)_2$, which shows high current response of 100 mA at 1.38 V (vs. reversible hydrogen electrode, RHE). From Tafel analysis, W-$Ni(OH)_2$ exhibits promoted reaction kinetics (58 vs 94 mV dec^{-1}) in comparison with unmodified $Ni(OH)_2$. More experimental data reveal that the prepared W-$Ni(OH)_2$ has improved UOR performance, including lower resistance and better catalytic stability.

Abstract No. 0042 Yan-Jie Liao

We report two-dimensional $AgInP_2Se_6$ bimetallic phosphorus trichalcogenides nanosheets as anodes for advanced alkali metal ion batteries. The intrinsic layered architecture of this compound not only facilitates rapid charge propagation but also accentuates ion storage due to its expansive surface area. The integration of the bimetallic motif results in a synergistic enhancement in electronic/ionic conductivity and optimizes the redox dynamics of multi-electronic materials, eventually attaining superior electrochemical characteristics. Moreover, the accompanying deposition of metallic silver during electrochemical processes reduces battery polarization, while the presence of metallic indium acts as an efficacious structural stabilizer, effectively inhibit dendrite proliferation. Therefore, as an anode electrode in lithium-ion (LIB) and potassium-ion batteries (PIB), $AgInP_2Se_6$ for LIB achieves 707.8 mA h g^{-1} at 0.1 A g^{-1}, retains over 900 cycles at 2.0 A g^{-1}, and demonstrates 318.5 mA h g^{-1} at 3.0 A g^{-1} rate capability. For PIB, it reaches 480.3 mA h g^{-1} at 25.0 mA g^{-1}, sustains for 550 cycles at 250 mAg^{-1}, and offers 214.2 mA h g^{-1} at 3.0 A g^{-1} rate performance. Comprehensive full cell tests further endure 100 cycles in both lithium-ion batteries and potassium-ion batteries under diverse current regimes. Our study pioneers a new direction for MIB anode materials, emphasizing the advantages of integrating bimetallic components into two-dimensional frameworks to boost electrode dynamics and achieve consistent conversion reactions.

Abstract No. 0043 Chi-Yu Lai

Aqueous zinc-based energy storage devices offer high safety, low cost, and high energy density, but their widespread adoption has been impeded by dendrite formation and side reactions. Herein, a 3D-polyimide (PI) nanofabric was reported to solve the above issues. The existence of carbonyl oxygen atoms within the PI chain enhances the desolvation process from $Zn(H_2O)_6^{2+}$ to $Zn(H_2O)_4^{2+}$ with a significantly decreased activation energy. The presence of $Zn(H_2O)_4^{2+}$ exhibits a more favorable reduction to metallic zinc on the zinc electrode than $Zn(H_2O)_6^{2+}$, contributing to substantially improved uniformity of zinc plating. Moreover, the PI layer effectively shields zinc from corrosion by suppressing the interaction between water molecules and the zinc surface. As a result, the PI-Zn symmetric cell exhibits remarkable cycling stability (1200 h) and high zinc utilization. Moreover, the unique porous structure of PI allows the symmetric cell to maintain stability with low polarization even at high current densities (20 mA cm^{-2}, 10 mAh cm^{-2}). The PI-Zn||AC hybrid zinc-ion capacitor and PI-Zn||MnVOH achieves a long lifespan (10000 and 800 cycles) with a Coulombic efficiency near 100%. This PI nanofabric protection strategy offers new insights into the enhanced desolvation mechanism and paves a novel avenue for high-performance zinc metal electrodes.

Abstract No. 0044 Liang-Chieh Tseng

A closed-pore-rich hard carbon (HC) structure has been synthesized from phenolic-formaldehyde resin (PFR) precursor via microwave-induced polymerization and the following carbonization, which provides tunable microstructure and less environmental hazard than biomass HC. The presence of closed porosity in hard carbon, confirmed by multiple gas adsorption/desorption isotherms, facilitates the storage of lithium, sodium, and potassium ion with superior reversible capacity than commercial graphite materials as negative electrode. Moreover, the assembled dual-ion battery (DIB) composed by HC as negative electrode and graphite as positive electrode with novel Li-based nonflammable electrolyte inherits remarkable fire-resistant properties, durability in fast charging scenarios and a high operating voltage up to 5.2 V, which results in outstanding energy density and power density. In summary, hard carbon with abundant closed pores is an ideal material as negative electrodes and demonstrates the potential to be applied in the electric vehicles, driving the advancement of eco-friendly storage technologies.

Abstract No. 0045 **Ruben Foeng**

Li(Ni0.8Mn0.1Co0.1)O2 (NMC811) cathode materials have been successfully commercialized to enhance lithium-ion batteries' specific capacity and specific energy, particularly for electric vehicle applications. However, conventional stabilization techniques such as surface coating and elemental doping may lead to undesirable consequences such as increased internal resistance and decreased cathode capacity. To address this, we propose a novel approach to stabilizing the NMC811 cathode using a Polysiloxane-based polymer electrolyte binder. Our polymer electrolyte demonstrates exceptional ionic conductivity (1.34×10^{-4} S cm^{-1} at 30°C) and low activation energy (19.09 kJ), crucial for efficient lithium-ion transport within the cathode. When combined with PVDF binder, the modified cathode shows significantly improved performance, with a higher discharge capacity of 167.46 mAh.g^{-1} at 1C and a stable capacity retention of 91.9%, compared to the pristine cathode discharge capacity of 161.15 mAh.g^{-1} at 1C with 87.6% retention. Overall, this innovative binder modification approach presents a promising strategy for achieving stable, high-performance lithium-ion batteries.

Abstract No. 0046 **Chusnul Khotimah**

$LiNi_{0.5}Mn_{1.5}O_4$ (LNMO) is one of excellent candidate for high voltage application on lithium-ion battery, it has been more than decade many researchers investigated this cathode material. As well known that the spinel LNMO has two types of phases, there are disordered phase (Fd_3m) and ordered phase ($P4_332$). The term of "order" refers to the site of transition metal on the octahedral site of spinel LNMO. Besides, the configuration of transition metal on the octahedral site depends on the heating temperature that used for synthesis and the cooling rate after calcination will affect the rock-salt secondary phase of spinel LNMO. On the other hand, the spinel LNMO has serious issues on cycle life in lithium-ion batteries with liquid due to the decomposition of carbonate solvent at high voltage operation. In this work, the salt additive with fluorine on the benzimidazole as main structure was added to the base electrolyte (1M $LiPF_6$ in EC: EMC). The effect of salt additive was investigated on two types of spinel LNMO disordered phase (re: F-LNMO) and ordered phase (re: P-LNMO). The result shows that the salt additive is able to improve both spinel LNMO by forming stable CEI and scavenged the HF formation on the electrolyte. Thus, it can prevent the further decomposition of the electrolyte with carbonate solvent based and improve the cycle performance.

Abstract No. 0047 Bin-Chuang Chao

Lithium-ion batteries (LIBs) are widely-used in our daily life, including energy storage systems, portable electronics devices, and electric vehicles because of their high energy density and long cycle life. For seeking a reliable high energy density batteries system, various modification methods were treated on lithium cobalt oxide (LCO) presenting their commercial value.

In this research, magnesium-doped LCO (Mg-LCO) thin films were deposited on aluminum foils by radio frequency magnetron co-sputtering technology with the target of LCO and MgO, followed by post-annealed at 600 °C under an air ambience.The suface morphology and film thickness were characterized by scanning electron microscopy (SEM). The Mg dopant was quantified by X-ray photoelectron spectroscopy (XPS). The crystal structure and orientation change of Mg-LCO thin films was figured out by X-ray diffractometer (XRD) and selected area electron diffract pattern (SAED). From the aforementioned material characteristic results, all the Mg-LCOs well maintain layered structure after doping. Evident element exchange between Li and Mg along the increment of MgO sputtering power indicates Mg dopants occupying the Li sites. From the perspective of cycle performance, the 45W Mg-LCO thin film cathode exhibits the best capacity retention at the cut-off voltage of both 4.2V and 4.5V. Moreover, the rate capability of 45W Mg-LCO thin-film demonstrates excellent fast-charging potential. The study contributes to the ongoing efforts in developing next-generation LIBs with improved performances and provides insights into the design of LIBs with enhanced energy storage capabilities.

Abstract No. 0048 Yan-Xiong Liao

Silicon-based materials are regarded as one of the main choices for the anode of next-generation lithium-ion batteries due to their high specific capacity characteristics. However, alloy anode materials have difficulties in terms of power density, initial coulombic efficiency (ICE), and cycle life due to low electrical conductivity, unstable SEI film formation, and drastic volume change, leading to limited applications. The theoretical capacity of silicon oxide (SiOx) is 5-6 times that of graphite. However, lower ICE may lead to battery energy density depletion. Moreover, the ~200% volume expansion during lithiation is still not negligible. The drastic volume change will lead to disintegration of the electrode, which in turn leads to poor cycle life. In addition, the low conductivity of SiOx also limits its application as a lithium-ion battery anode. Common improvements include particle size reduction, porosity increase, metal doping, and carbon coating.

In this study, we used the carbon coating technology and carbon source (CPC-G, CPC-S) developed by CPC Corporation, Taiwan to modify the surface of SiOx. After the carbon source is mixed with SiOx and treated at a temperature greater than 700°C, a core-shell structure is formed, which greatly increases the ICE of SiOx by 10%. Especially in terms of capacity performance, SiOx@CPC-G can increase the capacity to 1600mAh/g, which is 15% higher than that of pristine SiOx as shown in Figure 1. In addition, the rate performance at 0.5C, 1C, 2C, and 3C and the cycle life at 0.5C are also significantly improved.

Abstract No. 0049 Hirotomo Nishihara

For the development of supercapacitors that can operate at high voltage and achieve high energy density, the rational design and development of new electrode carbon materials are crucial. In this presentation, a new carbon material, graphene mesosponge (GMS), is introduced as a promising candidate of an electrode material in supercapacitors. GMS is synthesized by a hard-templating method with either Al_2O_3 or MgO nanoparticles, employing precisely controlled chemical vapor deposition in which the average stacking number of graphene sheets is adjusted to approximately 1. Following template removal, the resulting mesoporous carbon is annealed at 1800 °C to create GMS. Through this high-temperature treatment, most of the carbon edge sites that can lead to supercapacitor corrosion merge through zipping reactions. Consequently, GMS demonstrates ultra-high stability against both chemical and electrochemical oxidation. In spite of its durability, GMS offers a high surface area (approximately 2000 m^2/g) and a large pore volume (greater than 3 cm^3/g). In addition, GMS possesses electrical conductivity superior to carbon blacks and exhibits sponge-like flexibility and mechanical toughness. These unique properties make GMS suitable as a next-generation, durable, and high-performance carbon material for various electrode applications, including supercapacitors. When used as an electrode material for electric double-layer capacitors, a self-standing sheet made from GMS exhibits ultra-high voltage stability up to 4.4 V, even in a conventional organic electrolyte (Et_3MeN/BF_4), surpassing single-walled carbon nanotubes. GMS is also useful for other battery applications, such as Pt support for fuel cells, a cathode S support of all-solid Li-ion batteries, and a cathode of lithium-oxygen batteries.

Abstract No. 0050 Ying-Chen Wu

Rechargeable magnesium (Mg) battery systems are promising candidates to compete with current lithium (Li)-ion batteries owing to their high theoretical volumetric capacity, environmental-friendliness, and low cost. Moreover, Mg negative electrodes are less prone to dendritic growth during charging, improving the safety of the battery system. Most studies of Mg batteries focus on developing novel electrolytes and their feasibility for Mg batteries, but the discharge/charge behavior and evolution of the Mg metal negative electrode microstructure are usually overlooked. Therefore, this study focuses on the relationship between the discharge/charge behavior and the resulting microstructure of the Mg metal negative electrode. Discharge/charges cycles at current densities of 2.25, 0.75, and 0.25 mA/cm^2 were performed on Mg metal electrodes in an all phenyl complex (APC) electrolyte with an Mg||Mg||Mg symmetric cell. The surface microstructure of the Mg metal electrode at different stages of the discharge/charge cycles was analyzed by SEM and EDS. According to the SEM observations, the discharge morphology of the Mg electrode is relatively uniform at 2.25 mA/cm^2. In contrast, the discharge morphology is non-uniform with localized discharge holes at 0.75 mA/cm^2. After charging, the electrodeposited Mg distributes uniformly on the electrode surface at 2.25 mA/cm^2 but preferentially deposits around the discharge holes at 0.75 mA/cm^2.

Abstract No. 0051 **Zhi-Ting Liu**

Electrochemical energy storage devices, such as batteries, play a crucial role in reducing greenhouse gas emissions and providing a reliable alternative to fossil fuel-based electrical energy storage systems. Consequently, hard carbon emerges as a highly promising and cost-effective sustainable material for the energy storage industry. This study explored the potential of hard carbon, derived from phenolic resin, as an anode material for sodium-ion batteries. From 700-1000 °C, the temperature effects was investigated to study the changes of surface morpholgy as well as the correspoding electrochecmial performance on both Li ion batteries and Na ion batteries. The reulsts confiemed that both pore size distribution and percenage of C=O in hard carbon affect Li ions and Na ions storage mechasnims. The electrochecial testing results indicated that PR800 (Precursor sintered at 800 °C) demonstrated the highest reversible capacity of 185 mAh/g after 200 cycles at 1.0 A/g in half-cell testing. The simplicity of the preparation process and the promising electrochemical properties make the synthesized hard carbon a potential candidate for anode materials in sodium-ion batteries.

Abstract No. 0052 **Byungchan Han**

These Design of highly functional core materials for efficient electrochemical reactions regarding with energy conversion systems have attracted tremendous interests due to its industrial impact. Since the last several decades the system efficiency has not reached to the level of our target due to several unsolved issues, such as low activity, high material cost and undesirable instability over long-term operation.

In atomic-level computational electrochemistry a new research paradigm for the target materials has been emerged through the combination of IT-based artificial intelligence (AI) technology and machine learning algorithm based on database calculated from supercomputers. This presentation demonstrates the computational methods applied to searching for active, selective, and durable nanoscale electrocatalysts involving with hydrogen and oxygen as the key chemical species.

Using the first-principles density functional theory calculations we acquire reliable and accurate materials property data as input to machine learning model. To elevate the accuracy even to higher level we incorporate active-learning and multi-fidelity methods. It is shown that an AI-based neural-network model is very useful for identifying multi-component electrocatalysts toward three electrochemical reactions (HER, OER, ORR). A computational platform making the pipeline automatic is demonstrated.

Abstract No. 0053 **Tzu-Ching Chan**

Electrospinning is a convenient method to fabricate nanofiber membrane. The electrospun membrane exhibits several advantages, such as great structural designability, flexibility, and so on. For lithium–sulfur batteries, the structural design of the cell component is important to achieve high electrochemical utilization and stability. In this research, we designed a triple-layered sandwiched-structural gel electrolyte composed of single-layered polyacrylonitrile (PAN) between double-layered poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP). PAN acting as the bone framework of the membrane could inhibit the diffusion of polysulfides and PVDF-HFP could offer stable pathways for lithium transfer. The cells using the PAN, PVDF-HFP, and PVDF-HFP/PAN/PVDF-HFP (FP/N/FP) membranes attained initial discharge capacities of 980.1, 1190.1, and 1370.9 mA·h g^{-1} at C/10 rate, respectively (Figure 1a). After 50 cycles, the discharge capacity of the FP/N/FP cell remained at 954.7 mA·h g^{-1}, which was 72% of the initial capacity, and had the high discharge/charge efficiency of about 95%. The sandwiched-structural FP/N/FP membrane improved the electrochemical utilization of the cell to 82% and the high rate performance to C/3 rates. Therefore, we demonstrated that our sandwiched-structural membrane maintain the characteristic of the suppression for the diffusion of polysulfides of PAN and the stable cyclability of PVDF-HFP.

Abstract No. 0054 **Yu-Hsuan Chiu**

Copper sulfide with ease fabrication, low cost and high electrocapacitive behavior has been widely applied as electrocapacitive material of battery supercapacitor hybrids (BSH). Several morphologies are designed to achieve excellent surface properties and high energy storage ability. Large specific surface area and vigorous pore structure are easier to attain by constructing three-dimensional morphologies especially with hollow features. In this study, novel cobalt sulfide plate-assembled hollow cages are synthesized using solution and hydrothermal processes. The cage structure is formed for cobalt sulfide prepared using different hydrothermal temperatures, but pure cobalt sulfide composition is obtained only by using hydrothermal temperature higher than 130°C. With the preferable morphology and composition, the cobalt sulfide electrode synthesized using 130°C (Cu-O-S130) shows the highest specific capacitance (C_F) of 204.5 F/g at 20 mV/s and excellent high-rate reversibility. The BSH comprising the Cu-O-S130 positive electrode and the activated carbon negative electrode reaches the maximum energy density of 15.68 Wh/kg at the power density of 350 W/kg. Excellent long-term stability with C_F retention of 80% and Coulombic efficiency higher than 95% after 7000 charge/discharge cycles is also achieved for this BSH. This work provides blueprints for designing efficient morphology of copper sulfide to achieve excellent energy storage ability.

Abstract No. 0055 Yi-Xiang Zeng

Due to its high capacity, low cost, and environmental protection properties, zinc metal has attracted extensive attention as an anode material for aqueous batteries. However, the application of Zn anode in rechargeable Zn-ion batteries faces challenges such as corrosion and dendrite formation. The main purpose of this study was to mix commercially available P25 nanoscale TiO_2 and self-synthesized cerium-doped TiO_2 with PVDF to create an artificial solid electrolyte interface (SEI) layer, inhibit dendrite growth, and evaluate its effect on battery cycle life. This TiO_2/PVDF coating forms a barrier on the zinc anode to effectively preventing the penetration of H2O and O_2 while promoting the uniform deposition of zinc ions. Overall, the addition of this artificial SEI layer enhances the battery's stability and reliability. Modified Zn half-cells showed excellent voltage hysteresis at 0.5 mA/cm_2. In contrast, full cells utilizing TiO_2/PVDF-MnO_2 composites demonstrated significant improvement after 200 cycles when compared to unmodified cells. These research showed the enhanced cycle stability of the full battery, providing a compelling direction for the future development of rechargeable Zn-ion batteries.

Abstract No. 0056 Minjun Choi

Use of the electrochemical method for the reduction of carbon dioxide (CO_2) convert into valuable organic compounds is a great solution to solve the problem of CO_2 accumulation. However, issues regarding high purity and high concentration of liquid fuels are significant challenges. Due to uses of electrolytes, the as-obtained liquid products are inhibited from direct use. Therefore, other processes to separate the liquid fuels from the ions would require a further increase of the overall cost of CO_2RR electrolysis.

In this study, we focused on scale-up science and the autonomous nonfaradaic reaction of C-C coupling using CuP_2 electrode. In our previous study, the generation of 1-butanol from carbon dioxide on a phosphorus-rich copper cathode was first reported based on a combination of faradaic and autonomous nonfaradaic reactions. For an approach of economic feasibility and large-scale application, catholyte-free CO_2 electrolysis configuration was used to increase the purity of multi-carbon fuels. From this study, we propose potential future research directions for improvement of product selectivity and purity for the generation of multi-carbon fuels via CO_2RR closer to large-scale application

Abstract No. 0057 **Mokyeon Cho**

Ammonia is one of the important chemicals in the industrial area for its various application which includes perspective hydrogen carrier and fertilizer production. Recently, Electrochemical N_2 reduction reaction(NRR) is drawing attention since it can combine with renewable energy in reaction process to reduce fossil fuel usage and maintain sustainable development. However, there are several problems to apply it industrial field. One of the main problem is that proper catalysts for NRR were not founded yet and many groups try to do find them. Recently, despite copper being considered unsuitable as a catalyst for NRR due to the relatively easy occurrence of HER (Hydrogen Evolution Reaction), several catalysts based on copper have been developed, and promising performances have been reported. Herein, we newly synthesized Cu-P-S type catalyst and proceeded with basic characterization. In addition, we tested NRR activity of that catalyst and analyzed its results by using various analysis.

Abstract No. 0058 **Chia-Min,Lai**

Lithium-ion capacitors (LICs) can provide 4~5 times higher energy density than electric double layer capacitors (EDLCs) at the same power density. Therefore, it is considered as a potential energy storage or power device in the future, which can be applied to wind power generation systems, voltage sag compensation, regenerative braking, etc. Among numerous material systems, carbon materials are considered to be the most promising candidates due to their low cost, good physicochemical stability, and excellent electrolyte permeability. In this study, we used CPC-produced soft carbon (SC) and graphite (GR) as anodes, and CPC-produced activated carbons with two different mesopore ratios (Power AC and General AC) as cathodes. Then, we determined the optimal degree of pre-lithiation (DOP) and the capacity ratio of positive to negative electrode (P/N ratio) to be 80% and 30%, respectively. Next, we tested the Cyclic Voltammetry(CV), Galvanostatic charge and discharge test(GCD), Electrochemical Impedance Spectroscopy(EIS), and cycling performance of these four LICs. The results show that SC||Power AC has the best energy density (111Wh/kg) and power density (9kW/kg), and the capacitance retention is 84% after 5000 cycles at 0.5A/g. Finally, according to the failure analysis, the amorphous structure of soft carbon will be beneficial to the improvement of cycle and rate performance, and appropriately increasing the proportion of mesopores in activated carbon can reduce the probability of blocking pores from by-products, thereby slowing down the decline in cycle life. The above results indicated that soft carbon and activated carbon produced by CPC could be successfully applied in LICs with outstanding performances.

Abstract No. 0059 Bo-Yang Chuang

Titanium dioxide with suitable band edges is one of promising photocatalysts for water splitting. Nanotubes with one-dimensional structure can induce efficient charge transfers and hollow centers can provide large surface area for surface reactions. Modifying Ti foils for anodization can enhance light utilization of TiO_2 nanotube photoelectrodes. In this work, it is firstly to fabricate TiO_2 nanotube photoelectrodes on acid-etched Ti foils by anodization (MNT) for photoelectrochemical catalyzing water splitting. Different acid-etching durations are applied on Ti foils to induce various rugged surfaces. The resulting photoelectrodes present largely enhanced light utilization than that fabricated by the pristine Ti foil. The anodization duration is also optimized to find suitable lengths of MNT. The smallest overpotential of 524.7 mV at 10 mA/cm^2 and Tafel slope of 167 mV/dec are obtained for the optimal MNT photoelectrode. The TiO_2 nanotubes grown on the pristine Ti foil shows the overpotential of 679.3 mV at 10 mA/cm^2 and Tafel slope of 285 mV/dec. This result opens a blueprint for raising the photocatalytic ability by simply modifying the surface property of the conductive substrate .

Abstract No. 0060 Yung-Hsun Chu

Lithium-sulfur batteries possess an extraordinarily high theoretical capacity and are considered as promising energy storage systems due to their environmental friendliness and cost-effectiveness. However, lithium-sulfur batteries tend to generate soluble polysulfides within the electrolyte. These polysulfides react with lithium ions, resulting in a decrease in both the lifespan and capacity of these batteries. In this study, waste coffee grounds (WCG) were used as the raw material, subjected to carbonization and activation processes to create WCG-derived carbon. Both WCG and sulfur were mixed and introduced into a single-neck flask, evacuated, and then subjected to a composite formation process by maintaining the temperature at 155°C for 12 hours in an oven. This approach leveraged the carbon material as a carrier for sulfur, utilizing its porous structure to effectively encapsulate sulfur, thereby mitigating the occurrence of the shuttle effect. By varying the ratios of sulfur to carbon within the single-neck flask and exploring different activation temperatures, a comparative study was conducted against commercially available activated carbon (AC) and biomass-derived carbon (BC) from wood. The evaluation used techniques such as thermogravimetric analysis (TGA), Raman spectroscopy, X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), and electrochemical analysis. The objective was to identify the most suitable parameter combinations for optimizing the electrochemical performance of the lithium-sulfur battery system.

Abstract No. 0061 Chaehyeong Lee

This research is for seeking the effect of amino acid, glutamine, as cathode binder and electrolyte additives on enhancing the performance of lithium-sulfur batteries. Lithium-sulfur batteries are expected to be the next generation of lithium-ion batteries due to many advantages such as outstanding theoretical energy densities and environmental-friendly characteristics. But, many challenges still remained such as severe technical issues and primarily poor long-term performance stability. One of the promising approaches is to develop high-functioning electrode and electrolyte additives. Additives can add optimization of interfaces and electrodes. However, most additives rely on expensive materials or complex and hazardous synthetic processes. Therefore, we suggested new additives, glutamine, for lithium-sulfur batteries. Glutamine, one of the amino acids, is an environmentally safe and cost-effective material. In addition, the molecular structure of glutamine is a polar surface charge containing both two amine and carboxyl groups. Considering properties of glutamine, we observed the reduced overvoltage for Li plating/stripping and the improved long-term performance stability using the electrolyte additives. It indicates that Li dendrite formation was effectively suppressed resulting from the uniform Li-ion flux by the glutamine-containing electrolyte. Also, we confirmed that the electrochemical kinetics of polysulfides at the cathode side was enhanced through several surface and electrochemical analyses. Meanwhile, when applying the binder additives, mechanical adhesion of cathode was enhances by cross-linking phenomena between amine group and carboxyl group of PAA binder. And glutamine binder ensures the intimate contacts between active sulfur and conductive carbon. As a result, glutamine additives applying the electrolytes and electrode helped improve the capacity and mitigate the cell degradation rate for long-term cycles

Abstract No. 0062 Yi Lin Hsu

A vital aspect of energy storage devices is the development of novel materials with excellent electrical conductivity and rational structures. In combination with alkaline electrolytes, the manganese-cobalt layered double hydroxide (MnCo-LDH) cathode material has long been recognized as a highly desirable cathode material. Nevertheless, the synthesis of MnCo-LDH is time-consuming and required high temperatures. Therefore, it is important to find simple routes for the synthesis of MnCo-LDH. Herein, we propose a synthesis of metal organic framework (MOF)-derived MnCo-LDH nanosheets on conductive nickel foam (NF) for the supercapacitor (SC) application. The CoMOF decorated NF was fabricated by simple precipitation method, and then it was converted to MnCo-LDH by etching process at 80ºC for 5 min (MnCo-LDH/80ºC). The MOF-derived MnCo-LDH/80ºC electrode provides large accessible regions for electrolytes, low charge transfer resistance, and rich electroactive sites. Therefore, the MnCo-LDH/80ºC electrode demonstrates preferable energy storage property with a high areal capacitance of 2.62 F/cm^2 at 20 mV/s. In this study, an asymmetric supercapacitor (ASC) is constructed using MnCo-LDH/80ºC and activated carbon (AC) on NF as the positive and negative electrodes, respectively. The optimized MnCo-LDH//AC device provides the maximum energy of 0.116 mWh/cm^2 at the maximum power density of 2.49 mW/cm^2. Added to that, the ASC has excellent cyclic stability with 78% as the capacitance retention and Coulombic efficiency of 94.3% after 5000 charge-discharge cycles.

Abstract No. 0063 Xiang-Yu You

Metallic compounds are widely applied as the active materials of the supercapacitor (SC) due to abundant redox states and high electrical conductivity as clean renewable energy. Solvents play an indispensable role in synthesis, allowing for the modulation of morphology, and the ligand is an essential component in the synthesis of metal-organic frameworks. In this study, cobalt tetrafluoroborate hexahydrate (CTBF) is firstly synthesized using the 2-methylimidazole in one-step solution process as electroactive material of energy storage devices. The amount of ligand was varied based on the solvent of ethanol (CTBF-E) to find the optimal condition. Figure 1(a) shows that the optimal CTBF-E electrode is prepared using the ligand amount of 3 mmol (CTBF-E-3). The optimal electrode achieves a specific capacity (C_F) of 605.5 F/g at 20 mV/s. And the CTBF-E with the ligand amount of 6 mmol (CTBF-E-6) shows a smaller C_F value of 81.80 F/g. Last, another solvents of deionized water (CTBF-D-3) and methanol (CTBF-M-3) were used to find the optimal condition. Ethanol with the largest molecules among these solvents would cause serious stereoscopic disorder. Therefore, metal and ligand ions could experience faster ostward repening, resulting in the formation of smaller crystals. It can provide more active sites and large surface area. As a result, the CTBF-E-3 electrode shows the highest C_F value as shown in Figure 1(b). CTBF-E-3 positive electrode and graphene negative electrode are used to assemble a asymmetric SC which presents a maximum energy density of 44.23 Wh/kg at 428.6 W/kg. This work provides significant information about functions of solvents and ligand on energy storage. It is expected to synthesize more efficient materials based on adjust them for the energy storage devices.

Abstract No. 0064 Lu-Yin Lin

Morphology of electroactive material is highly related to energy storage ability. Structure-directing agent (SDA) can design electroactive materials with favorable surface properties. Zeolitic imidazolate framework 67 (ZIF67) is one of potential electroactive materials for energy storage devices. The SDA concept is less applied on designing ZIF67 derivatives in previous studies. An in-situ technique with ammonium fluoride (NH_4F) as SDA is proposed to produce a ZIF67 derivative with highly improved energy storage ability previously. Attracted by the effective in-situ technique, the NH_4F, ammonium bifluoride (NH_4HF_2) and ammonium tetrafluoroborate (NH_4BF_4) are firstly used as SDA to synthesize ZIF67 derivatives in one-step solution process as electroactive material of energy storage devices. The mechanisms of forming ZIF67 derivatives synthesized with different SDA are discussed to explain the SDA effects on physical and electrochemical properties. The largest specific capacitance (C_F) of 1527.0 F/g and the capacity of 296.9 mAh/g are obtained for the ZIF67 derivative prepared using NH_4BF_4 as SDA. The energy storage device composed of the optimal ZIF67 derivative and carbon electrodes presents a maximum energy density of 15.1 Wh/kg at the power density of 857 W/kg. The C_F retention of 90% and Coulombic efficiency larger than 98% are also obtained after 5000 cycles.

Abstract No. 0065 Pin-Chun Lee

Battery supercapacitor hybrids (BSH) comprising battery and supercapacitor-type electrodes can attain high energy/power densities and long cycle life. Copper oxide is regarded as a promising battery-type active material, due to low-cost, high chemical stability and good electrochemical properties. However, poor electrical conductivity and insufficient active sites should be improved to attain high energy storage ability. In this work, a novel battery-type material composed of $Ni(OH)_2$ nanosheets decorated on Cu_2O cages is synthesized via a facile solution process for the first time. Less deposition of $Ni(OH)_2$ leads to sparse distribution on Cu_2O cages, and full coverage of $Ni(OH)_2$ is achieved via depositing four $Ni(OH)_2$ layers on Cu_2O cages. The largest C_F of 389.1 F/g is achieved at 20 mV/s for the optimized $Ni(OH)_2$ and Cu_2O ($Ni(OH)_2$@Cu_2O) composite, while the Cu_2O electrode shows a smaller C_F value of 79.7 F/g. Coating $Ni(OH)_2$ on Cu_2O can induce active site formation and enhance electrical conductivity. The $Ni(OH)_2$@Cu_2O positive electrode and the active carbon negative electrode are used to assemble a BSH, which presents a maximum energy density of 4.09 Wh/kg at 500 W/kg and excellent cycling ability with C_F retention of 70% and Coulombic efficiency higher than 97% after 10,000 charge/discharge cycles.

Abstract No. 0066 Rio Akbar Yuwono

Improving the energy density is necessary to meet the projected demand for high-performance Li-ion batteries (LIBs). The mainstream is increasing nickel content to more than 60% in the layered structure cathode material, the so-called Ni-rich cathode material. This not only improves the energy density but also lowers the LIBs price. However, increasing the nickel content in layered structure cathode material reduces the cycle life as well as increases the safety issue. One of the reasons is due to the severe surface reconstruction layer (SRL) formation in the particle scale during de-/lithiation processes. Moreover, due to the instability of the unpaired electron in the e_g band, Ni^{3+} will naturally reduce to Ni^{2+} which then induces the Li^+/Ni^{2+} cation mixing as well as surface impurities formation upon contact with the moisture. This then reduced the electrochemical performance of the LIBs and increased the handling difficulty of the Ni-rich cathode material. In this work, the novel oligomer was employed as an artificial cathode electrolyte interphase (ACEI) on the $LiNiO_2$ (LNO) particle surface during the slurry-making process. Thanks to the presence of an electron-withdrawing functional group in the oligomer, the amount of Ni^{2+} on the LNO surface is slightly reduced. Thus, it is likely to promote the polymerization process of the oligomer to form the ACEI. The ACEI prevents the direct contact of the electrode and the electrolyte which then reduces the SRL formation. Therefore, the cycle stability as well as the safety of the LNO cathode material is improved after the addition of the diacrylate-based oligomer.

Abstract No. 0067 Shen-Fa Dung

Incorporating structure directing agents (SDA) in synthesis is expected to confine growth of ZIF67 derivatives and create efficient active materials. Ammonium fluoride (NH_4F) has been widely applied as effective SDA for synthesizing active materials in electrochemical systems. Inspired by the confiner of NH_4^+ and the conductive agent of F^-, two novel SDA of ammonium hydrogen fluoride (NH_4HF_2) and ammonia borane fluoride (NH_4BF_4) are introduced to synthesize ZIF67 derivatives (ZIF-HB) via a facile one-step solution process at room temperature. Substituting 2-methylimidazole with $HF_2^-$and BF_4^- improves conductivity of ZIF67. Effects of NH_4HF_2 to NH_4BF_4 ratio for synthesizing ZIF-HB are investigated. ZIF-HB shows layered structures with different widths **(Figure 1)**. Cobalt and nickel hydroxides are main compositions of ZIF-HB, which also presents metal borides and fluorides formations. The largest specific capacitance (C_F) of 1353.3 F/g is attained for the optimized ZIF-HB at 20 mV/s **(Figure 2)**. An asymmetric supercapacitor with ZIF-HB and activated carbon electrodes shows maximum energy density of 13.3 Wh/kg at 800 W/kg, and C_F retention of 84% and Coulombic efficiency of 97% after 6000 cycles.

Abstract No. 0068 Zong-Yu Yang

Recently, research on ion permeable channels in cancer have been studied owing to the reducing of proliferation and further inducing apoptosis of the cells. Such as voltage-gated calcium channel blockers as well as ligand-gated ion/calcium channels are also discussed. By keeping cytoplasmic calcium concentration low at rest and by mobilizing calcium in response to stimulus, calcium ions act as a second messenger that regulates various stimulus-response reactions of the cells through the diversity of its target molecules. Disruption of intracellular calcium homeostasis can alter cell proliferation or cause programmed cell death.

In this work, several electrochemical methods are adopted to affect ion channels by voltage-dependent influence in ovarian cancer. Within a possible consideration, the activation of voltage-dependent calcium channels during depolarization following a stimulation causes calcium influx, and each low-potential stimulation increases permeability of voltage-dependent anion channels to calcium ions between cytosol and mitochondria. This reaction ultimately affects mitochondrial calcium homeostasis and causes cell death. This study of electrical stimulation may have highly possibility for clinical value on therapy method.

Abstract No. 0069 Ren-Jei Chung

Prostate cancer is a malignant tumor that forms in the prostate cells of males and ranks as the second most common cancer among male populations. The prostate secretes a prostate-specific antigen (PSA), which is an antigenic protease. The function of PSA is to aid in semen liquefaction and the breakdown of cervical mucus. When a patient develops prostate cancer, the PSA concentration in the blood rapidly increases. In general, the normal PSA concentration in the blood of males is below 4 ng/mL. If the PSA concentration rises above 10 ng/mL, there is more than a 50% chance of prostate cancer. Therefore, PSA is considered an important biomarker for prostate cancer. In this study, AuNSs/Zn@N-C/MXene (Gold nanostars/ZIF-8 derived N-doped porous carbon/Ti_3C_2 MXene) was used to modify a screen-printed carbon electrode (SPCE). Cysteamine (Cys) and glutaraldehyde (Glu) were then used to connect the PSA antibody (Anti-PSA, Ab), forming an Ab/Glu/Cys/AuNSs/Zn@N-C/MXene/SPCE direct-type immunosensor. The Ab on the sensor can capture PSA for concentration measurement. Material characterization was confirmed using X-ray diffraction (XRD), Raman spectroscopy, scanning electron microscopy (SEM), and X-ray photoelectron spectroscopy (XPS). Electrochemical analysis was performed using cyclic voltammetry (CV) and differential pulse voltammetry (DPV). DPV demonstrated a linearity between the current response of the sensor and the concentration of PSA, with a linear range of 1.0 × 10−4 – 1000.0 ng/mL, an R^2 value of 0.993 (n=5, (Relative standard deviation, RSD) < 2%), and a detection limit (LOD) of 8.48 fg/mL. This immunosensor exhibits high selectivity, stability, and reproducibility. It also shows good recovery when measuring PSA in real serum samples, making it a promising tool for early detection and diagnosis of prostate cancer.

Breast cancer is the most frequently diagnosed cancer in women and ranks second among causes for cancer related death in women. Clinically, Human Epidermal growth Receptor 2 (HER2) is one of the most diagnostic biomarkers to facilitate breast cancer cell proliferation and malignant growth. The extracellular domain (ECD) of HER2 can be shed into the bloodstream. It can be quantified to provide an essential contribution to diagnostics and patient follow-up. In this study, a sensitive sandwich-type electrochemical immunosensor was developed for the quantitative detection of HER2-ECD. Herein, a disposable gold electrode (DGE) modified by gold nanoparticles decorated $Ti_3C_2T_x$ (Au/MXene) was utilized as a sensing platform to immobilize the primary antibody (Ab_1/Au/MXene). Subsequently, nitrogen doped graphene with the copper-cobalt-manganese organic framework being calcinated (NG/CuCoMn MOF derived material) was tagged as NG/CuCoMn MOFd, which was used for labeling the secondary antibody (Ab_2) to form a probe. Then, HER2-ECD antigen (Ag) was conjugated with Ab_1/Au/MXene and NGO/MOF/Ab_2. Lastly, the sandwich-type immunosensor (NG/CuCoMn MOFd/Ab_2/Ag/Ab_1/Au/MXene/DGE) was manufactured to detect HER2-ECD. The chemical structure, crystalline properties, and morphology of the materials were characterized by XRD, FTIR, Raman, XPS, FESEM, and TEM. Under optimized conditions, the prepared immunosensor displayed an excellent linear range of 1.0×10^{-4} to 50.0 ng mL^{-1}, and the detection limit was 8.0×10^{-4} ng mL^{-1} . This immunosensor had high selectivity, good reproducibility, stability, and acceptable repeatability. Moreover, the proposed immunosensor showed good applicability for determining HER2-ECD in human and BALB/c Nude mice serum samples, indicating its ability to clinical monitor the tumor marker.

Abstract No. 0070 Zi-Fan He

For remote areas being devoid of clean drinking water and conventional electricity, traditional desalination methods cannot give a hand to them. Herein, an eco-friendly, portable, and self-powered integrated desalination system capable of removing salt ions without external electricity is unprecedentedly presented. This system integrates a perovskite solar cell, an anode-free zinc-air battery, and an electrochemical desalination device. The anode-free zinc-air battery serves as a DC-DC converter and current regulator, promising the optimal system operation. Additionally, the battery acts as a power supply to sustain desalination during periods of limited sunlight. Furthermore, the system addresses the issue of lead waste by enabling self-recycling through the residual electrochemical desalination unit. By eliminating the need for extra electricity units and providing a viable disposal solution, this stand-alone system shows promise for the usage in remote or isolated resident areas.

Abstract No. 0071 Po-Chun Tai

Lithium-ion batteries have become one of the most promising energy storage devices due to their high energy density. However, lithium-ion resources are limited, causing a sharp rise in price. On the contrary, sodium resources are abundant, and the price can be much lower than lithium. Therefore, sodium-ion batteries have become a cost-effective alternative solution to lithium-ion batteries. In the common materials, tin disulfide (SnS_2) with high theoretical capacity, is considered a promising anode material of sodium-ion batteries. However, the poor electrical conductivity and significant volume change during charging and discharging limit its application. In this study, we explored the influence of different solvents of deionized water and ethanol to synthesize SnS_2 (SnS_2-D and SnS_2-E). A structure-directing agent cetyltrimethylammonium bromide (CTAB) was used to synthesize SnS_2-E (s-SnS_2-E), to increase the specific surface area and stability. In addition, we also combined UltrapheneTM with s-SnS_2-E (U/s-SnS_2-E) using a ultrasonication technique for the first time, to increase the specific capacity. Different mass ratios of UltrapheneTM and s-SnS_2-E were used for optimization. The results showed that the composite with an optimized mass ratio of 4:1 (U/s-SnS_2-E 4:1) exhibited a specific capacity of 326.3 mAh/g at a current density of 1.6 A/g. The high capacity of 438.9 mAh/g and 308.7 mAh/g after 100 cycles at 0.1 A/g and 1.0 A/g was retained, respectively. The capacity retention was 80.1% and 74.5%. In summary, U/s-SnS_2-E 4:1 electrode demonstrated higher rate performance and much better stability compared with those of the pristine SnS_2 electrode.

Abstract No. 0072 Laurien Merinda

Lithium ternary cathode ($LiNi_{1-x-y}Co_xMn_yO_2$) becomes a widely alternating cathode material, replacing the conventional Lithium Cobalt Oxide, which suffers from sustainability issues. Though higher nickel content successfully delivered higher specific capacity by >200 $mAhg^{-1}$, Ni-rich NCM gradually suffers deterioration performance issues due to the presence of residual lithium compounds, formation of cathode electrolyte interface, and irreversible phase change on the surface caused by cation mixing issue between Ni^{2+} and Li^+ followed by the loss of oxygen at delithiated state. Surface modifications using various organic coating materials become a proposed solution to mitigate the rapid degradation, but the surface homogeneity and complex preparation hinder this method. Maleimide-based additives are introduced as a novel organic coating material with the unique feature of undergoing a thermally self-oligomerization process to form the stable cathode electrolyte interface. The surface chemical behavior on the formation of CEI is observed in real-time by in-operando FTIR. The initial electrochemical cycle reveals less formation of carboxylic species from electrolyte solvent products during the first electrochemical cycle. These results provide the stable subsequent formation of CEI after the prolonged cycle by excellent capacity retention of 85% and maintain performance at various rates.

Abstract No. 0073 Zheng-Ying Huang

Layered-structure $LiNi_xMn_yCo_zO_2$ (NMC) oxides are the promising cathode materials for lithium batteries because of their high energy density and cost-effectiveness. Compositional homogeneity in NMC can be well-controlled through the co-precipitation synthesis. There are several key processing parameters in the co-precipitation synthesis that determine the degree of compositional homogeneity in NMC cathode particles. However, achieving the desired homogeneity in NMC has been the “trial-and-error” process. In this study, a thermodynamic equilibrium constant method is applied to understand the degree of compositional homogeneity as a function of the processing variables such as pH value, chelating agent ammonia concentration, and temperature. As a result, the optimal co-precipitation conditions of $Ni_xMn_yCo_z(OH)_2$ can be predicted. Co-precipitation experiments and materials characterization techniques are conducted to demonstrate the predictive capability of the equilibrium constant methodology, including XRD, ICP, SEM, FIB, EDX and electrochemical cell testing.

Abstract No. 0074 Bo-Xian Y

In order to meet the increasing global demand for energy, high-energy-density batteries have become one promising solution. Despite the advantages such as high discharge capacity, low cost, and environmental friendliness, lithium-sulfur batteries with a high sulfur loading still face poor electrochemical utilization of active material due to the low electrical and ionic conductivity of sulfur. This limits their ability to realize a high energy density. Herein, we propose the incoperation of carbon powder and $Li_{0.34}La_{0.56}TiO_3$ (LLTO) powder, which are electronically and ionically conductive materials, respectively, into hot-pressed sulfur (HPS) cathodes (Figure 1), the total resistance can be reduced as evidenced by the electrochemcial impedance spectroscopy analysis. After long-term cycling tests, the initial discharge capacities of the cell containing carbon powder and LLTO (HPS+C and HPS+LLTO) are improved as compared to that of the reference HPS cathde. Furthermore, through the cyclic voltammogram, it’s confirmed that the ion-conductive LLTO can enhance the lithium ion diffusivity, allowing the active material to react at stable charging and discharging potential. While HPS and HPS+C have difficulty in the reduction of liquid-state polysulfides to lithium sulfide at highe scan rates. In conclusion, HPS+LLTO not only possesses a total resistance close to that of the HPS+C, but also exhibits a high discharge capacity of more than 800 mA h g^{-1} and a lithium-ion diffusion coefficient of approximately 10^{-7} cm^2 s^{-1} even at a high sulfur loading of 6 mg cm^{-2}.

Abstract No. 0075 **Tripti Agnihotri**

We developed a composite gel polymer electrolyte (GPE) with a porous three-dimensional crosslinked structure to address the safety concerns linked to liquid electrolytes in Li-metal batteries. This was achieved through the integration of Poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP) and Fluorinated polyimide (F-PI) polymers using thermal processing. Having the advantages of both liquid and solid polymer electrolytes, the Composite-HT-GPE possesses distinctive anion-trapping by H-bonding between O (FSI- anion) and the N-H moiety in the F-PI. Overall, the heat-treated composite GPE improves the Li-ion kinetics and consistency during the plating/stripping in an anode-free lithium metal battery against Ni-rich, high-voltage cathode materials.

Abstract No. 0076 **Jong-Sung Yu**

Achieving stable and active oxygen reduction electrocatalysts with low cost is a key objective for fuel cells at present. Herein, we introduce a novel class of nitrogen-doped ordered $L1_0$-PtCo intermetallic core-shell catalysts with a strained thin Pt shell via a straightforward two-step heat treatment for nitriding and atomic ordering. The membrane electrode assembly fabricated with such carbon-supported low Pt-loading catalyst delivers an initial mass activity of 0.64 A mg_{Pt}^{-1} at 0.9 V with 72% retention after 30,000 potential cycles, and loses only 9% of its electrochemical surface area, far exceeding the US Department of Energy 2025 targets. The PdCo-based intermetallic core-shell catalyst displays a high specific rated power of 4.45 W mg_{Pt}^{-1} at 0.67 V under practical H_2–air conditions with unprecedented stability of only a minute voltage loss at low and high current densities. We discover that regulating the atomic ordering in the cores of the catalysts results in optimal lattice configuration to speed up oxygen reduction kinetics through the strain effects. Furthermore, the interaction of Co metal with doped N in the ordered core guarantees a larger barrier to Co dissolution during harsh fuel cell degradation tests, resulting in such excellent endurance of the electrocatalysts.

Abstract No. 0077 Wei-Cheng Lai

The manufacture of cement represents the most substantial single cement industry source of CO_2 emissions, responsible for approximately 8% of global CO_2 emissions. Decarbonizing the cement industry presents a formidable challenge, as most CO_2 emissions result from the decomposition of limestone ($CaCO_3$) to CaO and combustion of fossil fuels in calcination and sintering. The CaO product reacts with SiO_2 to form alite, the primary cementitious compound in Portland cement. In this research endeavor, we present an electrochemical process that uses neutral water electrolysis to establish a pH gradient, facilitating the dissolution of $CaCO_3$ at the lower pH region and precipitation of $Ca(OH)_2$ at the higher pH region. The precipitated $Ca(OH)_2$ is decomposed to CaO by heat more readily than $CaCO_3$. Simultaneously, the electrochemical process generates a high-purity gas mixture containing O_2 and CO_2 (1:2 molar ratio at stoichiometric operation) at the anode and H_2 at the cathode. The gas streams H_2 or O_2 can be utilized for electric power generation through fuel cells or combustion systems, and CO_2 can be captured and stored to accomplish net-zero.

Abstract No. 0078 Pei-Yun Kao

Ovarian cancer (OC) currently has no obvious early indications and is effortlessly confused with other gynecological cancers. A basic biomarker, CA125 is usually used to determine a possibility of inflammation. Normally, the value of CA125 is higher than 35U/mL in blood, the hospital will arrange high precise detection for further confirmations. Electrochemical biosensor is being studied and used for earlier detecting since 1962, but no reliable product has commercialized. The possible reasons for not successfully produce as a product are probably cost, reproducibility, and selectivity, respectively. Because human serum contains different species and proteins and easily disturbed signal to noise for low precision.

In this work, Au nanoparticles (AuNP) chemically bond on functionalized carbon nanotube (CNT) has been used for CA125 detection. Compare with a random dispersion of AuNP in CNT slurry, a chemical bond AuNP-CNT provides high reproducibility and reliable quantitative reaction sites for capturing CA125. This synthesis process is fast and easy under general conditions, and has a single electron transmission path, which improves the accuracy and stability of the signal. Under the concentration changes of CA125, this chemical bond AuNP-CNT material indeed detect a high regression rate (84.1%) compares with a random dispersion material. This chemical bond AuNP-CNT material is currently studied with combination of suitable electrochemical protocol for continually improve regression rate and further serum detection.

Abstract No. 0079 Peng-Wei Chu

Magnesium (Mg) and its alloys are important lightweight alloys owing to their low density and high specific strength and are widely used in various applications, including consumer electronics, transportation, and medical equipment. However, because of the high reactivity and poor protectiveness of the surface film, Mg alloys are not only susceptible to corrosion but also galvanic corrosion when in contact with other metallic components, limiting their field applications. Nevertheless, the chemical reactivity of Mg also opens up new ideas, such as the development of Mg-based biodegradable implants and battery systems with Mg metal anodes.

Unlike common metallic materials, Mg possesses unique corrosion and electrochemical behavior, especially under anodic polarization. Specifically, the rate of water reduction and hydrogen gas evolution, which is the dominant cathodic reaction on Mg in aqueous solutions, opposingly accelerates with anodic polarization. This phenomenon is called the "negative difference effect (NDE)" or "anomalous hydrogen evolution" of Mg. Even after decades of research and debate, the underlying mechanism of this peculiar electrochemical response of Mg is yet to be elucidated. But undoubtedly, this unique phenomenon is closely related to the occurrence of localized corrosion on the Mg alloy surface.

This talk will discuss localized corrosion behavior and the underlying mechanism of various Mg alloys based on electrochemical measurements, in situ monitoring, and multiscale microstructure characterizations. Regardless of alloy systems and test conditions, localized corrosion always propagates laterally inside the alloys and underneath the surface corrosion film. Furthermore, rising streams of hydrogen gas bubbles predominantly evolve from the actively propagating localized corrosion fronts. The unique hydrogen evolution response on Mg alloys is related to the presence of the surface corrosion film and the local anodic dissolution of Mg. Understanding the localized corrosion behavior and its interaction with the microscopic features in different Mg alloy systems can guide the development of Mg alloys with better corrosion resistances or controllable reactivities for specific applications.

Abstract No. 0080 Zih-Jhong Huang

In this research, we utilized highly conductive reduced graphene oxide (rGO) as a carrier for cobalt tin oxide ($CoSnO_3$) nanoboxes, aiming to enhance their catalytic capability towards vanadium ions. The nanoboxes-rGO composites were synthesized through a precipitation method, resulting in a square morphology and hollow structure as confirmed by TEM analysis. XPS analysis showed an increase in oxygen vacancies after composite formation, and EPR analysis demonstrated the strongest electron capture signal in the composite material.

Subsequently, we conducted single-cell tests by modifying the catalyst onto the positive graphite felt electrode. At a current density of 160 mA/cm², the composite exhibited a voltage efficiency of 74.22%, which was 2.69% higher than the thermally treated graphite felt. Significant improvements in capacitance were also observed at this current density. Moreover, stability testing over 50 cycles showed no significant degradation, indicating that the $CoSnO_3$-rGO modified graphite felt exhibited enhanced performance and excellent durability during charge and discharge cycling.

These results demonstrate the potential of $CoSnO_3$-rGO composites as effective catalysts for vanadium redox flow batteries, offering enhanced electrochemical performance and long-term stability.

Abstract No. 0081 Cheng-Che Wu

Lithium–sulfur battery technology is a promising energy storage system which can generate high energy density. However, the rapid capacity-fade during long storage time caused by severe self-discharge will significantly shorten the battery shelf life and damage the long-term performance. Unfortunately, the self-discharge effect of long shelf time in lithium–sulfur battery is rarely discussed by literature. To resolve this problem and hinder the self-discharge effect, in this study, we present a low self-discharge polysulfide cathode with a carbonized electrospun substrate. This cathode design can achieve a high areal sulfur loading of 4.03 mg cm^{-2} and a high sulfur content of 66.8 wt%, while maintaining a lowest capacity-fade rate of 0.26% per day over long storage time over 90 days. The cathode can also achieve long cycle life (200 cycles) with stable electrochemistry and high lithium-ion diffusion coefficients after long-term storage. To further evaluate the long-term self-discharge performance of the lithium–sulfur battery, we therefore present a series of quantitative and performance analyses to study the self-discharge behavior of high-loading polysulfide cathode, which will provide further understanding about the electrochemistry during the long-term storage of lithium–sulfur cells.

Abstract No. 0082 Peng-Xuan Yu

In response to the impact of global warming and climate change, and the rise of the green economy, lithium-ion batteries have advantages in electric vehicle applications due to their high energy density, low self-discharge rate, and wide operating temperature range. A liter of gasoline is far from enough. In order to increase energy density, scientists have proposed an innovative battery model—Anode free battery (AFB), which can provide more than twice the volume energy of lithium-ion batteries used today. Density, where the current collector plays a key role in determining the initial nucleation of lithium ions and the morphology and subsequent growth of lithium deposition. Unfortunately, the deposition of lithium ions on copper has a very large nucleation overpotential, and the uneven Electric current also causes uneven growth of lithium dendrites.

This study uses a simple method: Atmospheric pressure plasmas jet (APPJ) to prepare a layer of copper nitride foil film on the surface of copper foil and 3D copper foam. characteristics, make it easier for lithium ions to enter the lattice of lithium nitride, and can nucleate uniformly and smoothly on the surface. In addition to not easily forming lithium dendrites during the cycle, a stable SEI layer will also be formed to protect the AFB. Collector surface to increase cycle life.

The experimental results show that in NMC811 AFB, the initial coulombic efficiency of untreated copper foam Mesh is 58.57, while After APPJ modification treatment, it reaches 66.1, which means that APPJ surface treatment can indeed improve the initial coulombic efficiency and cycle life of anode-free lithium-ion batteries The National Synchrotron Radiation Research Center (NSRRC) Taiwan Photon Source Beamlines (TPS) 31A beamline nano-X-ray microscopy experimental facility cooperates with Amira3D and 4D data visualization software analysis to know the structural characteristics of the sample. The results show that APPJ processing can Make the surface of foamed copper more smooth.

Abstract No. 0083 Lester Tiong Pei Wan

The high nickel content layered material is currently the most commonly used positive electrode in lithium-ion battery commercial products. The reason is its high electrical capacity. This research uses batteries produced by Panasonic Co., Ltd. as the object conducting aging/deterioration analysis, also analyzes battery performance, material structure, battery internal resistance, particle type, and electrochemistry. In addition to improper use of the battery, the most exact reason is the decrease in the amount of lithium ions within the material caused by the irreversible electrochemical reaction. In addition, the layered structure is also due to irreversible reaction, suffering structural damage causing battery performance rapidly decline. In our research, we had first proven the failure of the full-cell by deep discharge under long cycles is due to the Li-ion depletion and therefore further cause's structure collapse. The reason behind running such parameters is to stimulate high energy density Li-ion batteries are used in stressful conditions. After the implementation of this phase of the research, the research team uses the hydrothermal synthesis repair method to re-lithiate the lithium ions, and at the same time repair the layered structure to the nearest possible original state, so that the circular economy of lithium-ion batteries can be realized. According to the research results, the recycled waste cathode materials originally have an electric capacity >200 mAh/g and the waste cathode material recovery rate is> 80%, and the cycle life of the battery after recovering has have an electric capacity >140 mAh/g with a retention of 100 cycles> 60%.

Abstract No. 0084 Siew Hoong-Zheng

The primary challenge in achieving the commercialization of "High-power Li-metal Solid-state Batteries" is the development of solid-state electrolytes (SSEs) that possess sufficient ionic conductivity to rival organic-based electrolytes while retaining their inherent advantages. The garnet-type $Li_7La_3Zr_2O_{12}$ (LLZO) SSE stands out due to its superior ionic conductivity ($\sim 10^{-3}$ S/cm based on cubic phase) and robust chemical/electrochemical stability against Li metal, making it an outstanding candidate. However, conventional sintering methods involving high temperatures in an air atmosphere (> 1000°C) often lead to lithium loss and contamination with Li_2CO_3. Recently, the introduction of cation doping elements (e.g., Al, Ga, Ta) has achieved to stabilize the low-temperature cubic phase LLZO. On the other hand, anion substitution within the "oxygen skeleton" can induce effective lattice structure modifications, thereby enhancing Li-ion transport, which has not been fully studied yet.

In this study, we present a strategy creating a layer-by-layer structure of LiF-LLZO using magnetron RF sputtering, where LiF plays a dual function, supplying supplementary Li sources and an F dopants. Not only the crystallinity of LLZO but also the Li-ion conductivity were benefited from the F-doping. To comprehensively investigate the interfacial challenges related to Li metal, microstructural examinations were conducted on LLZO-exposed and LiF-exposed samples. This enabled us to evaluate the stability of the Li metal half-cell and assess the interfacial compatibility with Li.

Abstract No. 0085 Yi-Xiu Chen

Over the past two decades, silicon (Si) has garnered significant attention as an anode material for lithium-ion batteries due to its highest capacity. However, the structural evolution that occurs during the lithiation/delithiation process, leading to pulverization and delamination, has impeded its widespread industrial adoption. The effective stress relaxation strategy introduced to Li-Si alloy reactions has been highlighted, not only academically significant but also practically useful. Recently, multiscale patterning technologies have been demonstrated on active materials and current collectors to achieve improved battery performance, particularly in terms of longevity.

We have developed an advanced patterning technique based on Lithiated Polyacrylic Acid (LiPAA), where buffer walls envelop individual Si islands to suppress stress accumulation. This aims to accommodate better mechanical stress, particularly at high charge/discharge rates. Ultimately, we present remarkable battery performance with nearly "zero-loss" capacity decay over 200 cycles at 1 C, along with an excellent rate retention of 26.7% at 20 C. We systematically analyze Li-ion diffusivity in various patterned Si anodes to elucidate the mechanisms behind the fast-charging capability and long-term cycling stability. This distinctive patterned structure promotes the rational design of thin-film materials grappling with volume change challenges during battery operation.

Abstract No. 0086 Devendra Rai

Tannery wastewater is treated using Electro Fenton (EF) process in batch and continuous reactors. An undivided magnetically stirred closed reactor containing 300 ml of solution and supported with 25 cm^2 Ti/TiO$_2$-NT/SnO$_2$-Sb/PbO$_2$ anode and CoFe$_3$O$_4$ supported graphite felt (M-CF) cathode was used. as a batch reactor, while a self-assembled flow-through reactor assembly containing similar electrodes and same effective surface area were used in continuous mode. The M-CF cathode was found suitable under both operations, generating H$_2$O$_2$ in higher amount (4.03 mg h^{-1}cm^{-2}) with low energy consumption (EC) of 0.25 kWh m^{-3}, as compared to the unmodified CF. The cathode was characterized using FE-SEM, EDX, contact angle, and nitrogen adsorption-desorption study. The flow-through system was compared to batch reactor, and confirmed best COD, TOC, color, and Cr (VI) removal. The operational parameters such as pH, current density, and Fe^{2+} concentration were optimized for both systems, while the factor for inter electrode distance and flow rate was considered in batch and continuous reactor, respectively. For batch and continuous systems 96% and 99% COD removal, 50% and 58% TOC degradation, 100% and 100% color removal, and 87% and 89% Cr (VI) removal were observed respectively at their optimum conditions. The process followed pseudo first order degradation kinetics for color removal in all cases. Repeatability analysis in the flow-through EF process was also studied and the modified cathode was found very stable and appropriate for practical application.

Abstract No. 0087 **Leyela Hassen Adem**

This study examines the evolution of the surface species over Li_6PS_5Cl (LPSC) solid state electrolyte during moisture exposure and the influence of subsequent heat treatment using in situ DRIFTS analysis. The observed surface impurities of asis LPSC include water, hydroxyl, intermediate SH, and SOX species. A moisture exposure at 0.125 kPa results in evolving surface species like H_2S, hydroxyl, and phosphate. A subsequent heat treatment can lead to the removal of H_2O, H_2S, Li_2CO_3, and LiOH species. Raman spectroscopy indicates the presence of $PS_{4-x}O_x$ and LiCl in the H_2O–exposed LPSC, while the relative intensity of $PS_{4-x}O_x$ can be decreased by heat treatment, indicating a partial recovery of the surface state of the LPSC.

Abstract No. 0088 **John Lai**

A novel approach to utilize machine learning (ML) algorithms on the battery electrical data to explore battery use history is proposed. In this study, the key factors of battery use history covers some general application scenarios such as different ambient temperatures, working SOC ranges, discharging rates, over-charge voltage, and over-discharge voltage. The test samples, lithium-ion batteries, are to be aged through charge-discharge cycling via diverse test conditions, and some feature tests to obtain feature data would also be conducted periodically. The feature data is then processed through both supervised and unsupervised algorithms for classification. The accuracy of the classification is assessed by comparison of the classification results and the real cycling conditions. The key outcome of the study suggests that batteries cycled under various conditions can be accurately identified using this ML approach. When 85% of test data was set as training test baseline, the remaining 15% test data set can display an identification accuracy up to 100% for temperature, 87% for working SOC range, 92% for high-rate discharge, 99% for over-charge, and 93% for over-discharge groups. To sum up, the method proposed in this research can provide an easy-to-use and high accurate way to identify the battery’s past usage. Which is especially useful for battery classification and screening for repurpose application(s).

Abstract No. 0089 Varad Modak

The process of electrocatalytically reducing carbon dioxide (CO_2) into valuable fuels and chemicals has gained significant focus as an environmentally-friendly strategy to address greenhouse gas emissions and generate renewable energy sources. In this study, we present a novel electrocatalytic system comprising nickel single atom catalyst (Ni-SAC) sites uniformly dispersed within hierarchically porous carbon nanofibers (HPCNFs) for the selective electroreduction of CO_2. The synthesized Ni-HPCNFs exhibit a remarkable electrocatalytic performance, manifesting a current density of 250 mA/cm^2 (at 1V vs.RHE). The incorporation of Ni-SAC sites within the porous matrix of the carbon nanofibers contributes to enhanced catalytic activity and stability. These sites provide highly active centers for CO_2 adsorption and conversion, leading to a wide working potential range of 0.8 to 1.2 volts vs. RHE. This extended potential window demonstrates the catalyst's versatility and effectiveness under varying operating conditions. Furthermore, this system demonstrates an impressive Faradaic Efficiency for CO production exceeding 95%, affirming the exceptional selectivity of the Ni-SACs. The atomically dispersed nickel species facilitate the suppression of the competing hydrogen evolution reaction (HER) , yielding a highly specific electrocatalytic process. The hierarchically porous structure of the carbon nanofibers additionally plays a pivotal role in promoting mass transport and facilitating efficient electrolyte access to the catalytic sites, further augmenting the overall performance of the system. The synergistic combination of atomically precise catalyst sites and hierarchical porosity underscores the potential of tailored hierarchically porous carbon nanofibers hosting Ni-SACs as a viable platform for efficient CO_2 electroreduction.

Abstract No. 0090 Yu-Hsuan Chen

Covalent organic frameworks (COFs), a novel porous materials, have drew much attention due to their high specific surface area and high thermal stability.In this study, metal nanoparticles are grafted on COF powders through hydrolysis, replacement, and reduction reactions. The COF powders decorated with metal nanoparticles are infused into the TiO_2 mesoporous films to fabricate the photoelectrodes for dye-sensitized solar cells (DSSCs). The influences of modified TiO_2 thickness and different weight percentages of metal nanoparticle modified COFs on the photovoltaic characteristics of DSSC are investigated. The results show that under simulated one sun illumination, the highest power conversion efficiency of DSSC based on pristine TiO_2 is 6.60%, and that based on TiO_2 added with COFs is 7.11%. After COFs are modified with metal nanoparticles, the efficiency is further increased to 7.32%. The improvement in efficiency can be attributed to an improvement in the short-circuit current density (J_{SC}) and open-circuit voltage (V_{OC}). The increase of J_{SC} comes from the surface plasmon resonance effect of metal nanoparticles, and V_{OC} increase comes from the upshift of Fermi level of photoelectrode induced by the plasmonic metal nanoparticle. Incident photon-electron conversion efficiency (IPCE) is also used to verify the short-circuit current trend and electrochemical impedance spectroscopy (EIS) is used to analyze the electron transfer behavior at the heterojunctions inside the DSSC.

Abstract No. 0091 Po-Wen Chien

We study $CuInP_2S_6$ (CIPS) nanosheet as an anode material for versatile K^+ storage devices. $CuInP_2S_6$ (CIPS) has a distinct room-temperature ferroelectric field effect due to the unique ordering of Cu and In ions in the CIPS lattice, which disrupts its centrosymmetry and causes significant spontaneous polarizations, allowing for efficient charge and K^+ transport at the electrode interface. Its natural dipole moment creates a persistent polarizing electric field, facilitating fast carrier transfer from the material's bulk to its surface, boosting ionic conductivity under high electric fields. Utilizing the synergistic effects, layered CIPS coupled with graphene (CIPS@G) exhibits a high capacity, superior long-term cycling stability and outstanding rate capability. The CIPS@G composite in PIB offers a reversible capacity of 567 mA h g^{-1} at 50 mA g^{-1}, robust stability over 1000 cycles, and high rate performance up to 10 A g^{-1}, and a high reversible capacity of 250 mAh g^{-1} and a cycle life of more than 400 cycles were also provided while assembled in a full battery. In hybrid capacitors, CIPS@G stands out with superior rate performance up to 2.0 A g^{-1} and high energy density of 40 W h kg^{-1} at 2.0 A g^{-1}, surpassing other PIB phosphide and sulfide anodes reported to date. These results show that high-rate nanochannels between 2D CIPS nanosheets and graphene, paired with CIPS's ferroelectric polarization, improve electronic conductivity, support K^+ diffusion, relieve CIPS aggregation, and buffer volume changes. The study on enhancing K^+ performance in 2D materials through the integration of ferroelectric field principles holds promise for pioneering advancements in electrochemical systems.

Abstract No. 0092 Shadab Ali Ahmed

The primary obstacle to the industrial viability of the high nickel-rich single-crystal cathode is the pronounced dissolution of transition metal ions and the subsequent increase in impedance. Modifying high Ni-rich cathodes with the synergistic effect of doping and coating layers is essential to prevent bulk and surface degradation, ensuring the stable operation of high-voltage Li-ion batteries. Here, we propose a novel Ti-alloy ($TiNb_2O_7$) coating on single crystal nickel-rich $LiNi_{0.83}Mn_{0.06}Co_{0.11}O_2$ (SCNMC) cathode via a simple wet chemical method followed by annealing. The simultaneously achieved surface doping results in a stable surface structure for SCNMC and enhances interfacial stability between the electrode and electrolyte. Electrochemical tests prove high interfacial stability and capacity retention at 1C (1C = 200 mAh/g) rate due to improved Li diffusion on the cathode surface.

Abstract No. 0093 Daniel Chang

With the rapid development of portable electronics, electric vehicles and smart grids, the demand for energy storage devices with high energy density has surged. Lithium-ion batteries have emerged as a promising solution. However, the organic liquid electrolytes used inside these batteries have introduced several safety concerns, including liquid leakage, performance instability, and flammability. Therefore, composite solid electrolytes (CSEs) have emerged as an ideal alternative to replace the traditional organic liquid electrolytes. Although CSEs have better safety capabilities, their ionic conductivity still needs to be improved. Among various inorganic solid electrolytes, garnet-type $Li_7La_3Zr_2O_{12}$ (LLZO) stands out due to its high ionic conductivity (10-4-10-3 S/cm) at room temperature and great chemical stability against lithium metal anodes. In this work, we choose LLZO as the ceramic material and poly(ethylene oxide) (PEO) as the polymer matrix to form CSE. We present the fabrication of oriented LLZO with low tortuosity, which is achieved through freeze drying with graphene oxide (GO) as a template. Prior research has shown that the route for lithium-ions transport shifts from the polymer matrix to ceramic fillers as the ceramic materials form connected pathways within CSEs. This study establishes a flexible approach to designing ceramic electrolytes with interconnected pathways, which hold promises to enhance energy density, safety, and stability of the batteries, thereby contributing to the advancement of energy storage technology.

Abstract No. 0094 Yi-Jie Wang

In response to the rapid evolution of energy technologies, such as portable devices, smart grids and electric vehicles, the energy density and lifespan have become significant aspects of modern energy storage devices. Lithium-sulfur batteries (LSBs) have great commercial value and are recognized as one of the promising high energy density secondary batteries. However, the sulfur loading in laboratory-scale research has mostly remained below 2 mg cm−2, far below the requirements for practical applications. Therefore, high sulfur loading is a key bridge between laboratory-scale research and industrialization. Meanwhile, enhancing the sulfur loading will inevitably aggravate the shuttle effect and slow down the polysulfide conversion kinetics. To obtain desirable electrochemical performance, many groups choose to add adsorption–catalysis dual promotion hosts like cobalt, MXene, etc. In this study, our aim is to select cost-effective materials like manganese and iron as the host elements. These materials are then assembled onto a reduced graphene oxide (rGO) aerogel with low tortuosity. The rGO aerogel, created through directional freeze drying, possesses several advantageous properties. It offers flexibility to accommodate volume expansion, high porosity to house sulfur, and it creates direct pathways for fast charging of ions. Manganese iron nitride is synthesized by deriving the manganese-iron bimetallic metal-organic framework (MOF), which possesses high surface area and abundant active sites to adsorb the polysulfide and catalyze the conversion reactions. Previous research has demonstrated that N-doped carbon materials and transition metal nitrides can lead to improved cycle performance in LSBs. Therefore, our approach involves creating and deriving the Mn-Fe MOF/rGO aerogel, resulting in the simultaneous formation of Mn-Fe nitrides/N-doped rGO aerogel. This composite has the potential to enhance the areal capacity and significantly extend the cycle life of LSBs.

Abstract No. 0095 Chao-Hsiang Hsu

All-solid-state batteries (ASSBs) are considered the next generation of energy storage devices due to their higher safety provided by the use of solid-state electrolytes (SSEs), which replace volatile and flammable liquid electrolytes. Argyrodite sulfide-based Li_6PS_5Cl (LPSC) material with superior Li-ion conductivity comparable with commercial liquid electrolytes (~10-3 S/cm) is a promising solid-state electrolyte (SSE). However, ASSBs suffer from the serious degradation, some causes of which may be ascribed to low interfacial chemical and electrochemical stability between LPSC electrolyte and conventional cathodes. Ab-initio density functional theory is a very useful calculation technique for predicting intrinsic materials properties. The chemical and electrochemical stability at cathode-electrolyte interfaces in ASSBs can be predicted. In this study, ab-initio calculations were utilized to predict the interfacial chemical and electrochemical stability between the LPSC and high-energy $LiCoO_2$ (LCO) cathode as a function of charge potentials. The ab-initio understanding of electrolyte/cathode interfacial stability enables the development and design of a variety of stable solid-to-solid interfaces.

Abstract No. 0096 Han-Yi Chen

Li-ion batteries (LIBs) have found widespread use in portable electronic devices and electric vehicles due to their high energy density. However, the challenges of limited lithium resources and high production costs have prompted the exploration of alternatives. Na-ion batteries (NIBs) have emerged as attractive candidates for energy storage due to their cost-effectiveness. This study introduces advanced electrode materials for NIBs, specifically high-entropy oxides (HEOs) and bimetallic chalcogenides. HEOs are unique metal oxides characterized by their crystal structures containing five or more cations, resulting in high system entropy. The synthesized HEOs demonstrated excellent electrochemical performance within NIBs, offering high capacity and cycling stability. To comprehend the charge storage mechanism within these advanced metal oxides, multiple operando synchrotron X-ray techniques, such as X-ray diffraction, X-ray absorption spectroscopy, and transmission X-ray microscopy, were employed. Transition metal sulfides/selenides have displayed potential as materials for alkali-ion batteries due to their considerable pseudocapacitive effects and capacity. However, their tendency to undergo substantial volume expansion during cycling has hindered their cycling retention. To address this, an amorphous bimetallic chalcogenide named $MoSnSe_{1.5}S_{1.5}$ was synthesized. This compound effectively mitigated volume expansion and contributed to enhanced cycling stability. Similar in-situ synchrotron X-ray methods were utilized to delve into the charge storage mechanism of these bimetallic chalcogenide electrodes. Collectively, the outcomes of this research highlight the promising nature of these materials as electrode components for both LIBs and NIBs.

Abstract No. 0097 Ru-Shi Liu

To reach carbon neutrality before 2050, 80% of fossil fuels will be replaced by renewable energy to decrease CO_2 emissions. In energy substitution, energy storage devices, such as Li-ion batteries, are widely used in the smart grid and electric cars. After 30 years of development, the energy density of Li-ion batteries reaches 300 mAh kg-1. Solid-state Li-ion batteries are studied intensively for a high energy density of 500 mAh kg-1 before 2030. In a solid-state battery, solid-state electrolyte is essential in improving electrochemical performance. In this report, a development on solid-state electrolytes will be introduced. Different rechargeable metal-air batteries have caught much attention as one of the most intriguing methods that could simultaneously address carbon dioxide-related environmental concerns and ever-increasing sustainable energy storage demands. We will also introduce these types of batteries and give prospects compared to solid-state Li-ion batteries.

Abstract No. 0098 David Chao

For lithium-ion batteries with multiple cells configurations, some use scenarios can cause uneven aging effects to each cell within the battery. Hence the focus of the study is to explore the aging effect(s) on batteries with different construction designs. In order to systematically study the influence of various factors in some key battery configurations, a detailed analysis on three key battery construction factors is conducted. And those key factors are cells alignment matrix; interconnect resistance between cells; and terminal position.

In this study, the 2S2P circuitry has been set as a multi-cell battery model to set up different battery samples, and the aging behavior is studied by a cycling test to analyze the current distribution, voltage difference, and recoverable capacity. According to the outcome of aging tests, some key findings are: (I) the connection resistance and terminal position have been found to contribute to uneven cell aging within cells, that can cause an accelerated battery aging; (II) different cells alignment matrices can have an impact on the current distribution of the battery; and (III) the self-balancing mechanism within the parallel-connected cells is found.

In summary, the key findings from the study can help to identify the key aging factor of multi-cell batteries, and it can be useful for battery capacity predictions.

Abstract No. 0099 Akichika Kumatani

The recent advancements in the field of electrochemical-based energy conversion and energy storage electrode materials have been quite noteworthy. The precise control of the size of these materials at the nano/atomic scale is imperative to amplify their electrochemical activities. Generally, the evaluation of their electrochemical properties involves the utilization of conventional analytical techniques applied to bulk states. This implies that a challenge persists in comprehending their localized electrochemical properties, including phenomena such as ion transport in lithium-ion batteries and electrocatalytic reactions. In comparison with analytical techniques involving electronic conduction, such as scanning tunneling microscopy, there remains a necessity for the development of spatially resolved electrochemical analyses that possess high sensitivity in terms of ionic conduction. To address this, our efforts have been directed towards a range of electrochemical microscopy techniques. Within the scope of this discussion, we introduce our self-assembled scanning electrochemical cell microscopy utilizing a single-barrel nanopipette (SECCM), designed for the visualization of electrochemical reactions at the nanoscale. The nanopipette, with a controllable size (down to 30 nm), is filled with an electrolyte and a reference electrode (metal wire), engineered to detect ionic currents across the meniscus formed between the pipette and the sample surface. The SECCM exhibits versatility in probing diverse electrochemical activities. In the context of battery analysis, it offers the potential to investigate localized lithium-ion activities on electrodes. Moreover, it enables the visualization of processes such as the hydrogen evolution reaction on two-dimensional materials like graphene and transition metal dichalcogenides.

Abstract No. 0100 Adane Gebresilassie Hailemariam

Layered lithium-rich cathode materials with low-cost, safe, and high-energy density, have been regarded as one of the most attractive candidates for next-generation lithium-ion batteries.1 However, they suffer from voltage decay, capacity loss, and sluggish reaction kinetics which hindered their further utilization for advanced transportation applications. To overcome those challenges, Intensive investigations have been devoted to developing high-performance lithium-rich cathode materials. In this particular study, our focus is to investigate the effect of anion doping on the properties of Li_2FeS_2 cathode through the solid-state method. Our approach involves using both in-situ and ex-situ observations to establish a correlation between the Redox behavior and structural properties of the prepared cathode materials. We have designed and characterized the material using various techniques, such as in-situ X-ray absorption spectroscopy (XAS), and synchrotron-based X-ray diffraction (XRD). To analyze surface morphology and microstructure of the material, SEM and HRTEM were employed. We analyzed the charge transfer behavior of the oxygen-doped Li_2FeS_2 during electrochemical cycling using XAS. DFT calculation has been done to support our experimental data of the Li^+ diffusivity behavior and material property. Our study has revealed that oxygen doping improved air stability and enhanced the intrinsic conductivity of the material, enabling fast Li^+ transportation during the charge-discharge process. As a result, the oxygen-doped Li_2FeS_2 cathode delivers a high capacity of 305 mAh g^{-1} and outstanding cycling stability at C/5 current rate after 100 cycles as well as nearly 100% capacity recovery after rate capability tests of 75 cycles. In summary, our detailed characterization and experimental results demonstrate the potential of oxygen-doped Li_2FeS_2 as a promising cathode material for advanced lithium-ion battery applications. The study's detailed characterization and experimental results will be presented, along with future perspectives.

Abstract No. 0101 Cheng-En Yu

In this study, we prepare LATP solid electrolytes by using a facile microwave-assisted hydrothermal method. The hydrothermal temperature plays an important role on surface morphology and uniformity of particle size distribution of LATP. The as-prepared LATP synthesized at different hydrothermal temperature are characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and impedance analyzer (AC). The XRD pattern of LATP powder prepared by microwave-assisted hydrothermal reaction is shown in Figure 1. The condition-optimized LATP synthesized at a hydrothermal temperature of 180 ^{o}C exhibit a higher ionic conductivity of 1.4×10^{-4} S/cm with lower activation energy of 0.253 eV, which might be due the uniform particle size distribution, highly crystallinity and a relatively density of as high as 97%. Finally, we assemble a NCM 523/ LATP/Graphite pouch cell, which exhibits a stable capacity retention of 92.5% for more than 407 cycles. The results indicate that our LATP synthesized by a microwave-assisted hydrothermal reaction is a potential candidate as a solid electrolyte for all solid-state battery application.

Abstract No. 0102 Yu-Chun Huang

Metal–organic frameworks (MOFs) are a series of nanoporous materials investigated for various applications over the past twenty years. Recently, some water-stable MOFs were utilized in supercapacitors because of their high surface areas and good stability. Cerium(IV)-based MOFs (Ce-MOFs) belong to group 4 metal-based MOFs, and their hexa-cerium nodes could partially undergo the reversible redox reaction between Ce^{3+} and Ce^{4+}, rendering the electronic transport in these MOFs by redox hopping. However, such electron-transport behaviors within these frameworks are usually not efficient enough during the electrochemical processes. Poly(3,4-ethylenedioxythiophene) (PEDOT), a thiophene-based conducting polymer, was widely served as the active materials for supercapacitors owing to its desirable characteristics including excellent chemical stability, relatively high electrical conductivity, and the ease of thin-film fabrication. Therefore, we consider that we could take advantage of PEDOT to solve the problem of poor electron-transport behaviors of Ce-MOFs and improve their capacitive performances.

Nanocomposites consisting of PEDOT and a Ce-MOF, Ce-MOF-808, are synthesized by performing the pulse electrodeposition of PEDOT within the Ce-MOF-808 thin films. Ratios between MOF and PEDOT in the composites are tunable by simply adjusting the charge density used for electropolymerization. The reversible electrochemical reactivity of the highly porous Ce-MOF-808 provides a pseudocapacitance, and the electronically conducting PEDOT can not only offer a remarkable double-layer capacitance but also facilitate the electronic conduction between the redox-active cerium sites present in the MOF. As a result, the composite can outperform both the pristine MOF and pristine electrodeposited PEDOT as the active materials for supercapacitors in the neutral sodium sulfate aqueous electrolytes.

Abstract No. 0103 Shang-Cheng Yang

Ammonia is one of the carbon-free energy carriers with a high energy density. Nowadays, the industrial ammonia synthesis relies on the Haber-Bosch process. However, the reaction condition with high temperature and high pressure is energy intensive. With a mild reaction condition, electrochemical nitrate reduction to ammonia (NRA) is an attractive candidate to replace the Haber-Bosch process. For NRA, Cu has been explored to be a great electrocatalyst. To improve NRA performance, bimetallic materials have also been developed. Recently, some literatures have confirmed that Cu and Ce in bimetallic catalysts with synergistic effect can change the reaction coordinate and enhance the electrochemical performance of NRA.

Metal–organic frameworks (MOFs), which are emerging nanoporous materials with high specific surface area, have been applied in various electrochemical fields. However, the intrinsic insulating nature for electrons and the poor water stability of most MOFs strongly limit the use of them in practical electrochemical applications. By contrast, MOF-derived materials, which consist of carbon, ceramics, or the mixture of them converted from MOFs, not only provide the water stability but also have a high electrical conductivity, which are well qualified for electrocatalytic purposes.

In this study, Cu ions were decorated on the nodes of a Ce-based MOF, Ce-MOF-808, by the solvothermal deposition in the MOFs (SIM) process. After SIM, the MOF-derived material, $CuCeO_x/C$, was obtained by carbonizing the Cu decorated Ce-based MOF through heat treatments. With a high electrical conductivity and water stability, $CuCeO_x/C$ is suitable for electrochemical applications. With the CeO_x and C as the support of Cu, $CuCeO_x/C$ has better faradaic efficiencies of NRA than CuO_x/C at low overpotentials.

Abstract No. 0104 SuryaPrakash

Redox flow battery (RFB) as a cost-effective stationary energy storage device that can balance the mismatch of supply and demand. It has significant characteristics as reservoir and electrode are separated, which make it safer and easily scalable by increasing the electrolyte volume and electrode area. So far the Cell voltage, energy density and capacity of RFB is limited by using traditional inorganic material like vanadium. Recently the organic materials are focused instead of traditional vanadium, because of their outstanding properties like structural tunability, low cost, safety and abundant in nature. Further, the aqueous electrolyte also plays an important role on the safety and cost effectiveness as compared to non-aqueous, which is expensive, flammable and moisture sensitive. In aqueous organic redox flow battery (AORFB), quinoxaline anolyte recently created a fascinating attention due to their high solubility and low negative potential. However, the stability of quinoxaline is affected by a slower kinetics and hydroxy derivative formation in alkaline AORFB. Here we report a structurally modified quinoxaline (MQ) to extend the stability by mitigating the side reaction of quinoxaline. Here we reported a solubility of near-zero parent material to significant solubility of carboxylic derivatives. Carboxylic substituted modified quinoxaline (C-MQ) involves a 5 times faster redox kinetics ($\Delta Ep \sim 59$ mV) compared to quinoxaline ($\Delta Ep \sim 318$ mV). Moreover, in aqueous medium (pH-14) the redox potential of C-MQ exhibits -0.96 V vs Ag/Agcl, which creates a total cell voltage of 1.23 V with $K_4Fe(CN)_6$ in the AORFB.

Abstract No. 0105 Yosef Nikodimos

It is widely accepted that high electrolyte consumption due to decomposition leads to rapid capacity fading in anode-free Li metal batteries (AFLMBs). Here, we prepare an electrospun PVDF-HFP-based gel polymer electrolyte (GPE) membrane, unpeeled-off and integrated with its Cu foil collector (Cu@GPE), prepared using a novel method. A pure crystalline β-phase of PVDF-HFP adhesion layer has been observed sticked with Cu collector as confirmed from the analysis of Fourier transform infrared and Raman spectroscopy measurements. The adhesion layer is further investigated using X-ray absorption spectroscopy (XAS), grazing angle X-ray diffraction (GAXRD) and X-ray photoelectron spectroscopy (XPS) techniques. The GAXRD analysis reveals Cu collector undergoes slight surface reconstruction in the presence of the adhesion layer. Moreover, depth XPS analysis confirmed that the alignment of F atoms in the adhesion layer is toward the Cu collector which can play an important role for homogeneous Li deposition. Based on these findings, a novel approach is developed to prepare GPE, without peeling off the electrospun membrane from Cu collector to take advantage of the adhesion layer. The GPE prepared using the novel method provides strong electrostatic interaction between the adhesion layer, which acts as artificial solid-electrolyte interphase (ASEI), and its collector foil, which prevents electrolyte decomposition as a consequences.4 The Cu@GPE|Li cell achieved outstanding performance even at a high current density of up to 5 mA cm^{-2} (CE, 97.14%) after 200 cycles relative to the GPE prepared by the conventional method (cGPE) (90.08%) after 100 cycles. Coupling with $LiNi_{0.33}Mn_{0.33}Co_{0.33}O_2$ (NMC), the Cu@GPE|NMC AFLMB delivered superior performance than Cu|cGPE|NMC.

Abstract No. 0106 Tarek Fawzi

Titanium nanotubes (TNTs) attracted researchers for decades due to their simple synthesis method, thermal and chemical stability, unique electrical properties, and favorable energy level to CO_2 conversion. However, the wide bandgap of TiO_2 limits available photons in a range of short wavelengths, which allows only 5% of the total energy from the solar spectrum to be used. Here, to tackle this problem, TNTs are decorated with nickel oxide nanoparticles (NiO NPs) forming pn junction followed by another decoration process with carbon quantum dots (CQDs) for a multifunctional component. The resulting structure demonstrates an improved performance of photocatalytic CO_2 conversion.

In this study the design and the fabrication of NiO/TNT are discussed explaining the effect of the NiO decoration, which in turn plays a fundamental role in adjusting charge transport at TNT/NiO interface together with the possible quantum confinement effect induced by the NiO nanoparticles. To further enhance the photocatalytic activity, CQD/NiO/TNT composites are also prepared. The decorated CQDs further facilitate utilization of the photogenerated e/h pairs and extend the light absorption range.

The samples are characterized by several techniques including X-ray diffraction (XRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), Energy-dispersive X-ray spectroscopy (EDX), UV-Vis spectroscopy, photoluminescence, electrochemical impedance spectroscopy and photocurrent spectroscopy. The photocatalytic performance is evaluated by studying CO_2 conversion under AM 1.5 illumination.

This study demonstrates valuable insights regarding the design of ameliorated photocatalysts that could harness CO_2 and solar spectrum to produce sustainable energy.

Abstract No. 0107 Ichiro Yamanaka

We have been investigating new electrochemical synthesis methods applying Solid-Polymer-Electrolyte (SPE) electrolysis cell and new electrocatalysts for production of industrial essential chemicals. The electrolysis unit consisted of two sheets of gas diffusion electrodes sandwiched a SPE membrane such as Nafion-H. The SPE electrolysis has various advantages to compare with a conventional electrolysis system using a supporting electrolyte, solvent, solid electrodes. We can conduct direct electrolysis of gaseous reactants and liquid reactants without solvents by using the SPE electrolysis cell. In addition, automatic separation of reaction mixture from the electrolyte. The structure of SPE electrolysis unit is similar to the Membrane and Electrode Assembly (MEA) in the fuel cell. My research group applied the SPE electrolysis for reduction of O_2 to H_2O_2, reduction of CO_2 to CO, reduction of toluene, oxidation of hydrocarbons, oxidative carbonylation of alcohol, etc. As one of studies, direct synthesis of pure H_2O_2 aqueous solutions by using the SPE cell was introduced, as below.

H_2O_2 is an essential chemical for green sustainable process. Industrial manufacture of H_2O_2 is limited the anthraquinone method but production cost and transport limitation of H_2O_2 are problem. We have developed direct synthesis method of H_2O_2 from O_2 and H_2 by using the SPE electrolysis cell (fuel cell). O_2 (1 atm) and H_2 (1 atm) introduce to the cathode and anode, respectively. When the cathode and anode are shorted at 278 K, fuel cell reactions occur and current flows. If Pt/C anode and cathode were used, no formation of H_2O_2 and simple water formation occurred. Performance of H_2O_2 formation depends on electrocatalysis of cathode. We have found that a partially pyrolyzed Co-TPP/KB at 1023 K showed excellent catalytic activity for the H_2O_2 formation (TPP: tetra-phenyl-porphyrin, KB: ketjenblack). A pure H_2O_2 solutions of 5.5 M (19 wt%) with 55% current efficiency (H_2 selectivity) and 130 mA cm^{-2} dropped from the cathode and accumulated at the bottom of cathode compartment. Attractive electrochemical reactions, new electrocatalysts and unique electrocatalysis will be introduced in the presentation.

Abstract No. 0108 Tsu-Chin Chou

The electrocatalytic CO_2 reduction reaction is gaining significant attention, yet its industrialization requires achieving higher current densities. Gas diffusion electrodes (GDEs) offer a promising solution by vastly improving gaseous CO_2 diffusion compared to conventional reactors. However, the lack of systematic studies on GDE properties has hindered electrochemical CO_2 reduction development. In this work, we explore the impact of GDE gas permeability on electrochemical CO_2 reduction selectivity, revealing a direct correlation between increased gas permeability and enhanced product selectivity. Utilizing computational fluid dynamics simulations, we elucidate the relationship between GDE gas permeability, surface-localized CO_2 concentration, and OH- concentration. These findings provide valuable guidance for GDE selection in electrochemical CO_2 reduction applications.

Abstract No. 0109 Chun-Hong Kuo

By utilizing tungstate immobilized UiO-66 as precursors and employing a dual-solvent impregnation method followed by appropriate temperature calcination, we prepared tungstate zirconia (WZ) as surface electroactive sites at a moderate tungsten content of 22%, the synthesized WZ-22-650 catalyst exhibited a high density of surface electroactive sites, achieved by effectively binding oligomeric tungsten clusters to stable tetragonal ZrO_2 through controlled heat treatment. The results demonstrated that, compared to other tested samples, WZ indeed displayed superior catalytic performance in the VO^{2+}/VO^{2+} redox reactions. Notably, the large specific surface area, mesoporous structure, and the formation of W–O–Zr bonds confirmed the secure anchoring of WO_x onto ZrO_2, thus providing more surface electroactive sites to enhance the electrochemical performance of VRFBs. Charge-discharge tests further validated that VRFBs utilizing the WZ-22-650 catalyst achieved remarkable voltage efficiency (VE) and energy efficiency (EE) at a current density of 80 mA cm^{-2}. This improvement translated to a 13.42% higher VE and a 10.88% higher EE compared to heat-treated graphite felt (HGF), which served as a benchmark. This straightforward method endowed the WZ catalyst with superior catalytic activity and excellent cycling stability, thereby paving a new pathway for the development of metal oxide-based catalysts.

Abstract No. 0110 Madhuri Birare

Electrochemically generating hydrogen from urea-containing wastewater by oxidizing it with small overpotential is much required for cost-effective H_2 production. Constructing a cost-effective catalyst with an open nanostructure and multiple active sites has the potential to enhance catalytic activity significantly. In this study, we investigate the performance of CuO needles supported with Ru nanoparticle with heterostructure of NiMn-layer double hydroxide (LDH), for urea oxidation reaction (UOR). The crystallinity and morphology of prepared sample investigated through X-ray diffraction (XRD) and scanning electron microscopy (SEM) which clearly confirm heterostructure formation. Additionally, X-ray photoelectron spectroscopy (XPS) was performed to analyze chemical composition of prepared samples. Among prepared samples Ru-CuO/NiMn-LDH catalyst exhibits the least overpotential of 290 mV in an alkaline electrolyte solution containing 0.33 M of urea to achieve current density of 100 mA cm^{-2}. The improved electrocatalytic activity was found to synergistic interaction between Ru metal and NiMn hydroxids which is presented in Figure.1. forming Ni^{2+}/Ni^{3+} and Mn^{3+}/Mn^{4+} redox species effectivley allows for *OH adsorbtion over the catalyst surface with lower energy input. Overall, this study presents a new direction for building efficient catalysts through the introduction of a new phase for multiple-electron reactions.

Abstract No. 0111 Hiroki Habazaki

For power electronics applications, there is an increased demand for capacitors with high capacitance, high ripple current, high thermal stability, high durability, and high withstand voltage. Solid aluminum electrolytic capacitors using conductive polymers, such as poly(3,4-ethylenedioxythiophene) poly(styrene sulfonate) (PEDOT:PSS) are promising because this type of capacitors possesses characteristics of high capacitance, high ripple current, high thermal stability and high durability. Such superior performance is owing to the high electrical conductivity of conductive polymer compared with the liquid electrolyte of the aluminum electrolytic capacitors. However, the withstand voltage of the solid aluminum electrolytic capacitors is currently limited to ~100 V. This study introduces our attempt to increase the breakdown voltage of the solid aluminum electrolytic capacitors using PEDOT:PSS by modifying the interphase between the dielectric alumina layer and PEDOT:PSS layer.

The dielectric crystalline alumina layer was formed by anodizing electropolished high-purity aluminum substrate at 700 V in a boric acid electrolyte at 85 °C after hot water treatment at 95 °C. Porous hydrated alumina layer formed during hot water treatment remained on the dielectric alumina layer after anodizing. After PEDOT:PSS coating, the I-V curve measurements revealed a breakdown voltage of ~500 V, which is ~200 V lower than the anodizing voltage. When a thin layer of ~200 nm thickness containing a high density of nanovoids was introduced, the breakdown voltage was highly increased to >700 V. The STEM/EDS analysis revealed the incorporation of a small amount of PEDOT:PSS in the nanovoids-containing layer. The capacitance measurements disclosed that this layer had electronic conductivity, although the conductivity may be low due to the limited incorporation of PEDOT:PSS.

We also tried to modify the porous hydrated alumina layer by an atomic layer deposition (ALD) method and confirmed that the breakdown voltage increased by this approach. The study demonstrates that introducing a thin, highly resistive layer on the dielectric alumina layer effectively increases the breakdown voltage of the solid aluminum electrolytic capacitors.

Abstract No. 0112 Yu-Jun Wang

Lithium-sulfur batteries hold an important position in the future development of energy storage technologies due to their low cost, high theoretical capacity of 1675 mA·h g^{-1}, and high theoretical energy density of 2500 W·h kg^{-1}. However, the liquid polysulfides, acting as active substances, easily dissolve in the electrolyte and then penetrate the separator to react with the lithium anode. This results in the deposition of insulating substances on the electrodes and the irreversible loss of active materials. Therefore, this study employs cement, which is widely used in the construction industry, along with the polysulfide cathode to create a novel cement/polysulfide cathode. This cathode enhances the adsorption capacity of polysulfides and consequently reduces the occurrence of polysulfide diffusion. Simultaneously, the cost-effectiveness of cement maintains the advantage of low-cost lithium-sulfur batteries. To enhance the practical applicability of the battery, this study designs a cathode with a high sulfur loading of 9.0 mg cm^{-2}, a high weight content of 60 wt%, and low electrolyte-to-sulfur ratios of 7.0 and even 3.0 μL mg^{-1}. Through this research, it was discovered that the cement cell exhibited a high initial discharge peak capacity of 1115 mA·h g^{-1} at a lean electrolyte-to-sulfur ratio of 3.0 μL mg-1, which provided the cell with a high areal capacity of 9.63 mA·h cm^{-2} and a high energy density of 20.23 mW·h cm^{-2}. Moreover, the cell maintained a high reversible capacity of 895 mA·h g^{-1} and a high capacity retention of 80% after 150 cycles.

Abstract No. 0113 Yu-Cheng Cao

Tailoring morphology and composition of metal organic frameworks (MOF) can improve energy storage by establishing high surface area, large porosity and multiple redox states. Structure directing agents (SDA) is functional of designing surface properties of electroactive materials. Ammonium fluoride has functional abilities for designing MOF derivatives with excellent energy storage abilities. Systematic design of MOF derivatives using ammonia fluoride-based complex as SDA can essentially create efficient electroactive materials. Metal species can also play significant roles on redox reactions, which are the main energy storage mechanism for battery-type electrodes. In this work, 2-methylimidazole, two novel SDAs of NH_4BF_4 and NH_4HF_2, and six metal species of Al, Mn, Co, Ni, Cu and Zn are coupled to synthesize MOF derivatives for energy storage. Metal species-dependent compositions including hydroxides, oxides, and hydroxide nitrates are observed. The nickel-based derivative (Ni-HBF) shows the highest specific capacitance (CF) of 698.0 F/g at 20 mV/s, due to multiple redox states and advanced flower-like surface properties. The diffusion and capacitive-control contributions of MOF derivatives are also analyzed. The battery supercapacitor hybrid with Ni-HBF electrode shows a maximum energy density of 27.9 Wh/kg at 325 W/kg. The CF retention of 170.9% and Coulombic efficiency of 93.2% are achieved after 10,000 cycles.

Abstract No. 0114 Zong-Xiao Jiang

Lithium-ion battery is currently the mainstream energy storage method, which has the advantages of long cycle life, high reversible capacity and low self-discharge. In it, lithium-rich manganese-based cathode material, $xLi_2MnO_3 \cdot (1-x) LiTMO_2$ (TM=Ni, Co, Mn), is layered to achieve high energy density, high discharge capacity (over 250 mAh g^{-1}) and low cost, for it is also one of the core cathode materials at present. However, due to the redox reaction of Li_2MnO_3, where oxygen is released, which leads to the deterioration of its structure, the process will inevitably result in irreversible drop in performance and capacity over a long-term cycle. In order to effectively prevent the above degradation and to improve the stability of the material, surface coating is generally applied to improve the electrochemical performance.

In this study, $Li_{1.4}Mn_{0.6}Ni_{0.2}Co_{0.2}O_{2.4}$ cathode was synthesized by coprecipitation method with 900 °C sintered for 12 h, and it would be then coated with $LiNbO_3$ and $LiNi_{0.5}Mn_{1.5}O_4$ to form a protective layer on the surface. $LiNbO_3$ can form stronger Nb-O bond, which enhances the lattice structure for better electrochemical performance, while it also effectively inhibits the structure rearrangement during charge/discharge cycles. $LiNi_{0.5}Mn_{1.5}O_4$ in spinel structure provides a three-dimensional pathway for diffusion of lithium ions, as well as creating a rather open interface, where lithium ions can transfer rapidly at the electrode/electrolyte surface. In terms of electrochemical parameters, the first coulomb efficiency and high rate 2C discharge capacity of LRM@Nb were 86.9% and 149 mAh g^{-1}, respectively; and were 90.2% and 146 mAh g^{-1} for LRM@1NM; and 86.6% and 131 mAh g^{-1} for LRM@2.5NM. Compared with LRM-Bare under the same conditions, the properties of modified material were significantly improved.

Abstract No. 0115 Yi-Chun Lai

Bimetallic compounds with multiple redox states are favorable for generating redox reactions. Possible conversions to oxides or sulfides can also induce additional active sites and enhance conductivity. In this study, cobalt and manganese bimetallic MOF (CoMn-MOF) tubular structures are firstly synthesized using polypyrrole nanotubes as the template. Effects of metal ratio on energy storage is investigated to understand contributions from Co and Mn. The CoMn-MOF derived oxide and sulfide are further synthesized to enhance energy storage ability. A larger specific capacitance (CF) of 670.1 F/g is attained for CoMn-MOF derived sulfide (S-CoMn-MOF) electrode, respectively compared to those of 247.0 and 426.7 F/g for the CoMn-MOF and oxidized CoMn-MOF electrodes, because of surface connected tubular structure and balanced components of MOF and sulfides for S-CoMn-MOF. An energy storage device with S-CoMn-MOF and graphene electrodes shows a maximum energy density of 17.9 Wh/kg at 785.7 W/kg. The CF retention of 78% and Coulombic efficiency of 97% after 10,000 charge/discharge cycles are also obtained.

Abstract No. 0116 Heng-Li Wang

Propylene carbonate (PC) used for solvents of liquid electrolytes in lithium-ion batteries could largely enhance the ion conductivity; however, PC would also penetrate into the graphite particles leading to exfoliation and structural damages of natural graphites (NG). To mitigate this issue, we develop an artificial solid electrolyte interphase (A-SEI) based on sulfonated chitosan via as a simple solution coating process on NG particles. When a liquid electrolyte containing 40 vol% PC is employed, the Li//LE//unmodified NG cell shows an initial capacity much higher than the theoretical capacity of NG and a low CE upon formation cycles, indicating harmful effect of PC. In contrast, the Li//LE//A-SEI modified NG cell exhibit the capacity close to the theoretical capacity of NG. Moreover, under the same setup and operating at 0.5C/0.5C charging/discharging, the former one rollover after 160 cycles with noticeable capacity fluctuation, while the later one performs steadily more than 200 cycles. This custom developed A-SEI is demonstrated to effectively prevent PC penetration and thus to improve cycling stability and life time of the resulting cells using PC containing electrolytes.

Abstract No. 0117 Nattharika Runprapan

Devolving label-free immunosensors for detecting ovarian cancer (OC) through cancer antigen (CA125) biomarkers is crucial to enhancing diagnostic capabilities and protecting women from potentially life-threatening illnesses. There have been notable developments in electrochemical sensing and biosensing applications involving single-atom materials (SAMs). For this research, we utilized a metal-organic framework (MOF) that used a zeolitic imidazolate framework (ZIF-8) as a template to produce nanoporous carbon (NC) with Fe-N-C via high-temperature pyrolysis. The Fe^{2+} was chemically doped into ZIF-8 during the synthesis. We proposed an innovative technique to synthesize gold nanoparticles (AuNPs) in Fe-N-C at room temperature. This not only simplifies the process but also reduces production costs. Leveraging these innovations, an immunosensor with exceptional sensitivity (LOD: 0.1 pg/mL) for CA125 detection, an essential ovarian cancer biomarker, is developed. This research highlights SAMs' catalytic and biosensing potential and offers a novel perspective on designing advanced nanocomposites for early ovarian cancer detection.

Abstract No. 0118 Mengstu Etay

The excessive emission of carbon dioxide has reached an unprecedented level, resulting in significant environmental and health impacts. Electrochemical CO_2 reduction reactions (EC CO_2RR) have emerged as a promising strategy to convert CO_2 into storable fuels and valuable feedstock. We successfully synthesized nickel sites dual-coordinated with nitrogen and phosphorus using graphitic carbon nitride as a low-cost and scalable supportive material for EC CO_2RR. This approach modulates the electronic structure of the Ni single atom catalyst to enhance CO_2RR activity, converting CO_2 into storable fuels and valuable feedstock. Furthermore, STEM and XAS confirmed the uniform distribution of nickel atoms on the carbon matrix, without forming clusters. The EC CO_2RR activities of catalysts were examined in a gas-fed flow cell electrolyzer in acidic electrolytes to minimize carbon loss and improve CO_2 utilization for long-term applications. Remarkably, Ni-N3P demonstrates excellent selectivity towards CO FECO >90% in a wide range of potential (-1.0 to -1.8 V) and achieved 340 $mAcm^{-2}$ partial current density CO, this demonstrates its suitability for industrial applications. Moreover, JCO ECSA normalized shows a higher partial current density of CO, suggesting the activity of the catalyst originated from the intrinsic activity of phosphorus coordinated with Ni-N4. Thus, this work will offer promising catalytic performance for the potential application of electrochemical CO_2 reduction reactions.

Abstract No. 0119 Peng-Chih Yu

Biomass has the advantages of good electrochemical properties, low cost, and environmental friendliness. Therefore, there has been extensive research on energy devices with biochar. Lithium–sulfur battery, one of the most promising batteries due to its high energy density compared to commercial electrodes, is limited by poor conductivity and fast capacity fade. In our research, the porous seaweed biomass carbon (PSC) synthesized by pyrolysis and activation is used as an environmentally friendly cathode material in lithium–sulfur cells to ameliorate the polysulfide diffusion. The PSC has a large specific surface area and excellent electron conductivity, making it suitable for the design and development of a high-loading sulfur cathode (6 mg cm^{-2}, in most research:2~4 mg cm^{-2}). The cell demonstrates a high initial capacity of 698.77 mAh g^{-1} and stable cyclability (0.26% decay rate) at C/10. These outstanding electrochemical performances suggest that the PSC has the potential to develop green electrochemical energy-storage devices with a high energy density.

Abstract No. 0120 Chen-Hao Tu

The Ni-rich $LiNi_{0.8}Mn_{0.1}Co_{0.1}O_2$ (NMC811) is a next-generation cathode material for commercial lithium-ion batteries because of its high specific energy density and low cost, but the NMC811 cathodes experience severe capacity degradation during cycling. The primary cause of degradation has been identified as intergranular cracks within the polycrystalline (PC) particles. Single-crystalline (SC) particles can effectively reduce intergranular cracks and preserve the structural integrity of the particles. Figure a shows that SC particles exhibit superior capacity retention than PC particles. Surprisingly, the larger ~10 μm PC particles have clearly higher C-rate capability than the smaller ~3 μm SC particles (Figure b). However, numerous research reports have raised controversy about the rate-performance of PC and SC cathode particles. For the first time, the electrochemical kinetic parameters of PC and SC cathode particles are measured as a function of state-of-charge by using the three conventional techniques of electrochemical impedance spectroscopy (EIS), potentiostatic intermittent titration (PITT) and galvanostatic intermittent titration (GITT). To aid in the interpretation of the electrochemical kinetic behaviors, we utilized concurrent focused ion beam and scanning electron microscopy (FIB+SEM) to observe the evolving particle microstructures.

Abstract No. 0122 Chun-Yen Yang

Metal-organic frameworks (MOFs) are a class of porous materials consisting of inorganic metal nodes and organic ligands. It has been recently found that the electrochemical behavior, storage capacity, and stability of MOF electrodes are significantly relevant to the structure and nature of bonding of MOFs, whereas the mechanistic understanding behind it remains unclear.

In our research, we chose barium and bis(2-Hydroxyethyl) terephthalate (BHET) to synthesize Ba-BHET as model material to investigate the structural and chemical variation upon lithium insertion and extraction. For the electrochemical performances, we found that Ba-BHET shows a good rate capability and long-term cyclability. Interestingly, the corresponding capacity keeps growing with cycling and the capacity retention is over 500 percent after 300 cycles. From SEM images, we could find the surface porosity substantially changed. Additionally, the surface becomes porous from pristine state to fully discharged state, because the lithium ions and electrons would insert into the material when discharging. While being intercalated in the MOF structure, lithium ions would replace metal sites and form a bond with oxygen (from O-M to O-Li), and the lattice structure plays an important role in characterizing MOFs. We found two new peaks form in XRD pattern after twenty cycles, showing that the structural transformation would be induced by lithium intercalation.

The goal of this study is to realize the mechanism behind the increasing capacity, as such an anomalous behavior is distinct from the behavior of conventional battery materials. This study is expected to shed light on developing a fundamental understanding of the nature of mixed conductive MOFs in energy storage applications.

Abstract No. 0123 Yu-Pei Chiang

The electric machine market has driven the demand for rechargeable batteries with a high energy density. The limitations of lithium-ion batteries have led to the development of lithium–sulfur batteries, which offer higher energy density and lower environmental impact. However, lithium-sulfur batteries face challenges such as low utilization of active materials and deposition of insulating lithium sulfide during discharge. To overcome these challenges, this study proposes a nickel/sulfur composite energy storage material, which enhances conductivity and provides chemical adsorption properties. Using the tape-casting technique, a high-loading electrode was fabricated, resulting in a lithium–sulfur cell with a high specific capacity of 1355 mA·h g^{-1} that is an outstanding active material utilization approaching 80%. The lithium–sulfur cell made with nickel/sulfur composite material can maintain excellent long-term cyclability for over 1000 cycles and therefore enhance the probability of commercialization.

Abstract No. 0124 Hyeonggyu Jo

In recent years, as the electric vehicles (EVs) and energy storage system (ESS) have drawn attention, many researches have focused on enhancing energy and power density of lithium ion batteries (LIBs). Among the strategies, concept of binder-free electrodes are promising strategies for improving capacities. The inactive polymeric binder can lead capacity reduction, ion transport limitation and even environmental issues during disposal. However, conventional process of manufacturing electrodes uses polymeric binder for slurry coating. In this study, we fabricated a binder-free cathode electrode for lithium ion batteries through electrophoretic deposition (EPD) technique. Suspension was prepared by adding lithium iron phosphate (LFP) and multi-walled carbon nanotube (MWCNT) into dimethylformamide (DMF) solvent. Suspension was prepared with subsequent stirring and ultrasonication for homogeneous dispersion. Electrochemically etched aluminum with enlarged surface area was employed as the substrate for LFP deposition, and Ti metal was served as a counter electrode. To deposit LFP and CNT onto aluminum substrate, a DC voltage of 100 V was applied. Porous structure of etched aluminum was investigated with scanning electron microscopy (SEM) before and after electrophoretic deposition. Electrochemical impedance spectroscopy (EIS) and galvanostatic charging/discharging were employed to analyze its electrochemical behavior at the binder-free LFP cathode.

Abstract No. 0125 Suseong Hyun

Solid-state electrolytes (SSE) are promising materials for use in lithium-ion batteries (LIB) due to their high energy density, wide temperature range, and reduced risk of leakage or explosion. Although high ionic conductivity is one of the most significant factors for electrolytes, it still remains a challenge for SSE. Intuitively, cation and anion doping are regarded as the most efficient way to boost Li-ion diffusion. Another way is to analyze the dynamics of cations and anions through the properties of the structure itself, such as anion rotation in plastic crystals. Here, we explore the mechanism of the anion rotation-assisted Li ion diffusion in various anion frameworks in solid-state electrolytes. The sulfide framework shows the dynamic motion than the halide one, thereby incrementing the Li-ion diffusion. Also, polyanion frameworks such as $[PS4]^{3-}$, play a key role in Li-ion mobility. We also investigate the collective motion between the anion and the Li-ion and construct a way to maintain its motion even at room temperature. This work suggests that the anion rotation may be a critical factor for enhancing ionic mobility and can be used as a useful guideline for designing a next-generation SSE.

Abstract No. 0127 Takeshi Fukuda

In Proton-exchange-membrane-fuel-cell (PEMFC), platinum carbon (Pt/C) is commonly used as a cathode catalyst. However, its performance is known to deteriorate due to degradation of carbon after repeated operation. Therefore, the development of carbon-free catalysts that do not use carbon as a support is underway. As an alternative to carbon, tin oxide (SnO_2) is expected to be a useful candidate and there have been reports on the use of SnO_2 doped with antimony (Sb) and niobium (Nb) as a catalyst support.

Regarding to SnO_2 synthesizing, a new method used ozone treatment has been developed2). This method enables the synthesis of nanoparticles with excellent dispersibility without the use of amphiphilic molecules. In this study, we developed a new synthesis method for SnO_2 that combines this synthesis method with hydrothermal treatment. Pt was loaded on antimony-doped tin oxide (Sb-doped SnO_2) prepared by this synthesis method, and its catalytic performance was evaluated.

The SnO_2 prepared by ozone-assisted hydrothermal synthesis showed the best electrical conductivity compared to the other three synthesis methods (ozone-assisted, hydrothermal, and chemical co-precipitation). This sample was also used as a support for a catalyst and showed the best values for catalytic performance as well. The highest oxygen reduction activity was obtained for the catalyst doped with 5 at.% Sb, which was higher than that of commercially available Pt/C. The durability of the catalyst was also evaluated. Moreover, the durability of the catalyst was much higher than that of the commercial Pt/C catalyst.

Abstract No. 0128 Jian-Yeh Chen

In the complex field of contemporary materials science, the exploration of multifunctional materials has arisen as a pivotal catalyst for significant progress. These exceptional materials exhibit the remarkable capacity to smoothly incorporate a range of functions, revolutionizing traditional paradigms and opening doors to a new era of innovation. Among these, zinc oxide (ZnO) materials have emerged as a prominent exemplar, captivating the attention of researchers and industry alike. Zinc oxide, renowned for its attributes including exceptional transparency and a heightened refractive index, coupled with distinctive characteristics in piezoelectricity, acousto-optics, electro-optics, and nonlinear optical phenomena, alongside its commendable performance in dielectric and piezoelectric realms, establishes itself as an outstanding multifunctional substance. Its versatility finds application across an array of fields encompassing solar cells, gas sensors, UV light sensors, photonic crystals, LEDs, and more. Its significance resonates across the domains of optics, chemistry, and electronics, underlining its inherent value. In the context of advancing ZnO materials, their growth and development are typically achieved through various techniques, including radio frequency magnetron sputtering, chemical vapor deposition, and molecular beam epitaxy. An additional method, electrochemical deposition, offers an economical and environmentally conscious approach for ZnO fabrication. However, it's noteworthy that, as of yet, there is no reported instance of electrochemically deposited ZnO thin films that are specifically oriented along the c-axis (0002), which holds significance for piezoelectric applications along with the optical applications. In this study, we have successfully synthesized ZnO thin films on indium tin oxide (ITO) coated conductive glass substrates employing a two-step electrochemical deposition process. Our methodology involved the sequential application of constant current mode followed by constant potential mode within aqueous solutions of Zinc Chloride ($ZnCl_2$) and Potassium Chloride (KCl). The initial phase, employing the constant current approach, promoted the uniform nucleation of ZnO onto the substrate, effectively lowering the activation energy required for subsequent zinc oxide growth during the following constant potential stage. By carefully adjusting the factors in the electrodeposition process, we thoroughly examine how certain key aspects, like the temperature during deposition and the time taken for nucleation layer formation, interact. This systematic investigation aims to reveal the significant effects of these factors upon the surface morphology and optical properties of the Zinc Oxide thin film. Furthermore, the influence of these factors on the growth pattern, structure, and properties of the zinc oxide thin film is explored.

Abstract No. 0129 **Yu-Hsuan Li**

In this study, we introduce hard carbon as the core and nano-silicon/pitch coating as the shell to develop a potential anode material with higher reversible capacity and good cycle life for Li ion batteries. Silicon/hard carbon (Si/HC) composite anode materials are synthesized by a pitch coating process1. Although silicon could provide a high capacity of more than 3578 mAh/g compared to commercial graphite. However, huge volume expansion of silicon anode during charge/discharge process and poor electronic conductivity inhibit its commercialization. We demonstrate a new strategy to design exceptionally high electrical conductivity and structure stability of Si/C composite anode via introducing hard carbon, nano silicon and pitch coating process to synthesize highly stable Si/C composite anode with higher reversible capacity for lithium-ion batteries. The composition-optimized 20% pitch coated-Si/HC composite delivers superior cycling stability up to 200 cycles2 at 1 A/g, showing only 0.16% capacity decay per-cycle.

Abstract No. 0130 **Sung-Fu Hung**

As a negative emission technology, carbon dioxide reduction reaction (CO_2RR) has aroused considerable attention due to the Herculean goal of "Net Zero emissions by 2050". To make it develop sustainably, the required current densities of CO_2RR to C1 and C^{2+} products are 100 and 300 mA/cm^2, respectively. Unfortunately, the conventional H-type electrolyzer fails to reach the required current density due to the poor solubility of CO_2 in aqueous electrolytes. Recently, we enhanced current density and selectivity using flow systems to reach the criteria. For the carbon monoxide product, we designed an acid-wash-free nickel-single-atom on the carbon nanofiber to achieve 98% Faradaic efficiency and 588 mA/cm^2 for CO at 600 mA/cm2. It maintained a CO Faradaic efficiency of over 90% at a stable voltage for more than 80 hours. Resonant inelastic X-ray scattering spectroscopy (RIXS) reveals that the d-orbital regulation of Ni was highly related to the catalytic performance. In-situ X-ray absorption spectroscopy showed that the catalyst maintained a stable oxidation state and coordination environment during the electrocatalytic reaction, highlighting its chemical and structural stability. For C2 products (ethylene and ethanol), we design a tubular metal-organic-framework (MOF)-derived copper catalyst generating copper nanoclusters in the structure to create spatial confinement effect to enhance the activity and multi-carbon selectivity of CO_2RR, achieving 71% Faradaic efficiency and 710 mA/cm^2 for C2 products at 1000 mA/cm2. From the in-situ Raman spectrum, we found the crucial intermediates generated during CO_2RR, improving the overall catalytic activity. We hope our designs of electrocatalysts for efficient CO_2RR can facilitate the development of negative emission technology and accomplish Net Zero emissions soon.

Abstract No. 0131 Mei-Jywan Syu

Albumin is the most abundant protein in blood. Human serum albumin (HSA), with a molecular weight of 66.5 kD, is produced in liver. Serum albumin has essential physiological functions such as to maintain the osmotic pressure between blood and tissues and to transport those species such as hormones, fatty acid, etc. Therefore, albumin is a very important biomarker indicating the physiological condition of ones body. Additionally, iron oxide magnetic nanomaterials have been widely investigated because of their superparamagnetic property upon subjected to an external magnetic field. Consequently, we propose an Au electrode modified by iron oxide magnetic nanoclusters (MNCs) for the electrochemical detection of serum albumin.

Thermal decomposition was applied to prepare uniformly distributed iron oxide nanoparticles. Afterwards, iron oxide magnetic nanoclusters (MNCs) were successfully prepared. The hydrophobic surfaces of the nanoclusters were turned into hydrophilic by appropriately chosen ligand. The hydrophilic nanoclusters were further conjugated with sulfo-SMCC (sulfo-N-succinimidyl 4-(N-maleimidomethyl) cyclohexane-1-carboxylate). Vi which, the electrode coated with SMCC conjugated MNCs (MNC@ SMCC) were able to capture albumin. Impedance analysis on the electrodes at different stages was carried out. Thus, the calibration curve of impedance change against albumin concentration spiked in serum was established with excellent linearity.

Detection of albumin concentration in the range of 1~10 g/dL is feasible by the as-prepared MNC@SMCC coated Au electrode. For stability test, the as-prepared sensor can maintain reproducibility for at least 30 days. To the 60 serum specimens received from NCKU hospital, the average recovery of 82% is achieved by the measurements from the as-prepared sensor.

Abstract No. 0132 Shih-kang Lin

Oxide-based all-solid-state Li battery (ASSLiB) with sufficient ionic conductivity and good chemical and electrochemical stability is a promising system for ASSLiB development. Problems in oxide-based composite cathodes are often caused by cathode thermal stability, contact between particles, and unwanted interfacial reactions. Most of the cathode materials cannot withstand the conventional sintering temperature of oxide electrolytes (>1000 °C). Lack of contact between particles and formation of low Li-ion conductivity interphases lead to high interfacial impedance in composite cathodes. To solve the problems, a low-temperature sintering technique and a design of in situ forming protective layer were proposed in this work. Low-temperature sintering was carried out through field-assisted sintering technology/spark plasma sintering (FAST/SPS). Interfacial reactions which provide driving force for chemical bond formation was induced through doping in cathode. By selecting suitable dopant, the interfacial reaction product acts as a protective layer preventing further interfacial reactions between cathode and electrolyte during sintering and cycling. The concept and the method provide an efficient way of solving interfacial problems in ASSLiB composite cathode, and the material design procedure could be promoted to other composite cathode systems.

Abstract No. 0133 Yu-Zhe Wu

Semiconductor heterostructures have emerged as pivotal components in the landscape of optoelectronic applications. Within this context, our study introduces a meticulous approach involving a water-bath method to fabricate a uniform array of ZnO nanorods. The array, characterized by a vertically oriented {002} growth direction and a notable aspect ratio, is grown on a silicon wafer using polyethyleneimine (PEI). To gauge the effects of PEI, we employ X-ray diffraction analysis, focusing on the ratio of the integrated peak intensity corresponding to the {002} diffraction peak against the total integrated peak intensity. Our findings reveal a positive correlation between this ratio and the quantity of PEI incorporated. This correlation is further substantiated by scanning electron microscopy images capturing cross-sectional views of the ZnO nanorods array. This study then sulfides the ZnO nanorod array using thiourea acetamide (TAA) in a water medium and adjusting the sulfidation temperature to attain varying degrees of sulfidation. This approach successfully yields a ZnO@ZnS core-shell nanorod array on the silicon wafer, marked by diverse levels of sulfidation. Introducing different sulfidation degrees into the ZnO@ZnS nanorod array anticipates manifold enhancements. These enhancements encompass augmented efficiency in photocurrent generation, elevated carrier mobility, and the refinement of photocatalytic properties. As such, our study brings forward a versatile and impactful avenue for optimizing the performance of semiconductor heterostructures in various applications.

Abstract No. 0134 Da-Ren Hang

In response to the growing energy demands of our society, the development of high-power density and high-energy storage and conversion devices has become paramount for researchers. Electrochemical capacitors, due to their ultra-long cycle life and high energy and power density characteristics, have emerged as a promising technology. Among the various electrochemical energy storage devices, supercapacitors have garnered significant attention.

Vanadium disulfide (VS_2), a two-dimensional transition metal dichalcogenide (TMD) with a large interlayer spacing, exhibits desirable properties such as weak interlayer interactions, adjustable vanadium valence synthesis characteristics, and high surface activity. These properties endow VS_2 with a large specific surface area, low diffusion barrier, high theoretical load capacity, and remarkable catalytic activity. Notably, several research groups have reported on the simple and environmentally friendly synthesis of various nanostructured VS_2 materials and their applications in electrochemical charge storage.

To enhance the electrochemical performance, the combination of conductive polymers or carbon materials with VS_2 has been explored. Among these carbon materials, graphitic carbon nitride (g-C_3N_4) has shown great promise in energy storage applications due to its charge storage mechanism based on the Faraday reaction, high electrochemical activity, and high porosity. Consequently, g-C_3N_4 can serve as a nanochannel on the electrode, facilitating the transport of electrons and ions. Recent studies have employed one-dimensional g-C_3N_4 as a substrate for the growth of other nanoscale structures, making it an excellent material for energy storage electrodes.

In this study, we present a simple and cost-effective sintering method to synthesize one-dimensional tubular g-C_3N_4 nanotubes (TCN). Subsequently, a one-step hydrothermal method is employed to grow flower-like VS_2 nanoflowers on the surface of g-C_3N_4 TCN, resulting in a VS_2/TCN heterostructure with a distinctive thorn roller morphology. The structure and morphology of VS_2/TCN are comprehensively characterized using various experimental techniques. Our findings demonstrate that VS_2/TCN exhibits an optimized pore size, high specific surface area, and excellent conductivity. Particularly, the VS_2/TCN-10 sample, with a mass ratio of 1:10 (VS_2 to TCN), showcases outstanding electrochemical performance, including a high specific capacitance of 462.9 F/g at 5 A/g and excellent cycling stability (a mere 9.1% capacitance loss after 5500 cycles of charge/discharge at 5 A/g).

Abstract No. 0135 Da-Ren Hang

Electrochemistry plays a pivotal role across various scientific and technological domains, intricately linked to the pursuit of a sustainable future for humanity. Electrochemical sensors hold paramount significance, particularly in the realm of human health and well-being. The simultaneous detection of ascorbic acid (AA), uric acid (UA), and dopamine (DA) assumes critical importance in this context. While ascorbic acid (Vitamin C) acts as a potent antioxidant, safeguarding cells against oxidative stress, elevated uric acid levels can serve as indicative markers for conditions such as Gout. Concurrently, dopamine, a neurotransmitter, is closely associated with various neurological disorders. The concurrent detection of these biomolecules promises profound insights into an individual's physiological state, offering a means to monitor and manage associated health conditions.

The amalgamation of nanomaterials as electroactive matrices has significantly enhanced the efficacy of biosensors, particularly through the synergistic combination of distinct materials. Metal-organic frameworks (MOFs), owing to their high surface area, excellent electrical conductivity, chemical stability, and design versatility, emerge as promising candidates for deployment in electrochemical biosensors. The strategic integration of MOFs with metallic nanoparticles introduces a plethora of advantages, encompassing heightened sensitivity, refined selectivity, enhanced stability, and cost reduction. These attributes collectively position MOFs as promising agents for the detection of diverse biomolecules across various environments, heralding the advent of next-generation biosensors.

This study unveils the synthesis of the NH2-MIL-53(Al)/Au@Ag composite material through a hydrothermal route. This innovative material lays the foundation for voltammetric detection of redox-active analytes within complex multi-analyte solutions. The employment of cyclic voltammetry and differential pulse voltammetry in conjunction with a glassy carbon electrode facilitates the selective electrochemical detection of the target analytes. Notably, this work demonstrates the attainment of nanomolar detection limits, obviating interference from uric acid and dopamine, which often pose challenges in biomolecule analysis. The incorporation of bimetallic/MOF hybrids holds promising potential for the continued advancement of sensitive and selective electroanalytical devices. The proposed methodology bears considerable implications for clinical diagnostics, enabling the simultaneous analysis of minute biomolecules. Through these strides, we envision enhanced capabilities in healthcare diagnostics and biomolecular analysis.

Abstract No. 0136 Da-Wei Lin

This study employs a two-step synthesis approach, combining hydrothermal processing with thermal ammonolysis, for the preparation of nickel-iron nitride (Ni_3FeN) with an anti-perovskite structure. The initial hydrothermal step yields layered double hydroxides, i.e., NiFe LDHs, which transform to Ni_3FeN during the thermal ammonolysis. The structural and morphological attributes of the resulting Ni_3FeN are examined through X-ray diffraction and scanning electron microscopy. In-depth exploration of the optical and photoelectrochemical properties is pursued utilizing various methodologies. These include ultraviolet-visible spectroscopy, photoluminescence spectroscopy, and an array of electrochemical measurements such as photocurrent analysis, cyclic voltammetry, Mott-Schottky analysis, and electrochemical impedance spectroscopy. Through these investigations, our primary objective is to offer nuanced insights into critical aspects of Ni_3FeN, encompassing absorption edge phenomena, electron-hole recombination kinetics, band gap structure, and photoelectrochemical properties. The implications of our study extend notably to the realm of photoelectric applications, where understanding these attributes of Ni_3FeN is paramount.

Abstract No. 0137 **Bo-Lin Chen**

In this study, a thin film of titanium dioxide (TiO_2) nanorod array was successfully fabricated on electrically conductive glass using a microwave method. The resulting nanorods, measuring approximately 4 μm, exhibited a remarkable increase in growth rate compared to conventional hydrothermal methods. X-ray diffraction analysis confirmed the rutile structure of the TiO_2 nanorod array. Under UV and visible light illumination at a bias voltage of 1.5 V, a noteworthy photocurrent response of 33 $\mu A/cm^2$ was observed. Mott-Schottky analysis further substantiated the n-type semiconductor characteristics of the nanorod array, revealing a flat band potential resting at -1.15 V. Moreover, the capacitive performance of the TiO_2 nanorods was evaluated, employing cyclic voltammetry and electrochemical impedance spectroscopy. Applying a metal-organic framework coating into the TiO_2 nanorod array is envisaged to heighten these photoelectric effects further. This study proficiently outlines the fabrication of a TiO_2 nanorods array and examines its crystal structure, photoelectrochemical property, semiconductor characteristics, and capacitive behavior. Enhancing its properties through a MOF coating marks a promising avenue for future research.

Abstract No. 0138 **Jia-En Li**

This study employed a combination of hydrothermal and thermal ammonia treatments to synthesize Co_3CuN, characterized by its distinctive antiperovskite structure. Notably, the photoelectric efficiency of Co_3CuN underwent further enhancement through the strategic application of a metal-organic framework (MOF) coating. Scanning electron microscopy unveiled an irregular morphology, accompanied by distinct diffraction peaks at 2θ of 42°, 47.5°, 72.5°, and 87.5° within the XRD pattern. This affirmed the presence of the Co3CuN crystalline phase. Within the electrochemical analysis, a three-electrode system was employed to evaluate its capacitance performance, where cyclic voltammetry was conducted across a range of scan rates. Electrochemical impedance spectroscopy unveiled a linear response within the low-frequency domain, while further insight was gained through fitting in the high-frequency region. This analysis facilitated the assessment of equivalent series and charge transfer resistance parameters, thereby shedding light on charge transfer capabilities. Under the influence of a bias voltage, exposure to both ultraviolet and visible light led to the generation of photoelectric current, indicative of electron excitation. The application of a MOF coating into the Co_3CuN matrix is envisaged to heighten these photoelectric effects further. This study offers a comprehensive exploration of Co_3CuN synthesis and performance, demonstrating an adept manipulation of materials and techniques to enhance photoelectric properties.

Abstract No. 0139 Le-Yen Lin

Mixed ion-electron transport in electrodes is the backbone for electrochemical energy storage. In solid-state battery, the typical electrode architecture involves multi-phase composites consisting of electroactive material, solid electrolyte, and electronically conductive carbon. The ion and electron transport in such a heterogeneous system is complex owing to sophisticated electrode microstructure and heterointerfaces between each constituent, which can not be elucidated through conventional theory developed for homogeneous electrodes. To this end, we established a charge transport model that enables to characterize the transport kinetics of composite electrodes. By employing simulations of electrochemical impedance, we identify the electrical and chemical transport phenomena in the composites, interpreted via the generalized transmission line model. The critical roles of heterointerfaces' selectivity and effect of particle size on transport process are also highlighted. Furthermore, through the visualization of concentration propagation during battery discharging, the influences of ionic and electronic network as well as the contact between each constituent in composite electrode are revealed, offering guidelines for rationally designing the electrode architectures in solid-state batteries. This work paves the way for understanding and even predicting the behavior of mixed ion-electron transport in complex electrochemical systems.

Abstract No. 0140 An-Rong Huang

Metal-organic frameworks (MOFs) possess excellent tunability, high surface area, and porosity, which make them applicable in numerous fields such as catalysis, adsorption, and separation. The majority of MOFs are electronically insulating, which restricts their application in the energy storage field. As a result, the question of how to impart MOF conductivity has taken center stage. To improve conductivity, several works use extrinsic methods to introduce polymers. However, in this study, modifying the surrounding humidity helps to improve the intrinsic electron conductivity of MOFs. Thus, MOFs are not entirely devoid of conductivity. The model material for this paper is UiO-66, a typical MOF. UiO-66 exhibits exceptional stability and well-known material characteristics, making its structure less likely to collapse during measurements. In the measurement experiments, blocking electrodes were utilized, and the environment was altered to conduct AC impedance experiments, resulting in the determination of proton conductivity. Simultaneously, DC polarization experiments were also carried out to obtain electron conductivity. We discovered that temperature and humidity are crucial factors for proton and electron conduction in UiO-66. From low humidity to high humidity, both proton and electron conductivities rise. The proton conductivity increases by two orders of magnitude, whereas the electronic conductivity increases by four orders of magnitude, even achieving a conductivity as high as 10-7 S/cm. Furthermore, we conducted titration experiments to quantitatively determine the number of defects in the material. Through this approach, we further observed that defects in the material's ligands can generate mobile protons. When coupled with high humidity conditions, a sufficient quantity of water molecules assists in conduction, resulting in three orders of magnitude increase in conductivity. The experimental results reveal the substantial influence of temperature, humidity, and defects on the mixed conduction of UiO-66, allowing UiO-66 to shed its title as an absolute electronic insulator. This work provides a new direction to promote mixed conduction and investigate metal-organic framework.

Abstract No. 0141 Min-Chieh Chuang

This presentation addresses imperative theme of catalyst sustainability, with a specific focus on amorphous iridium oxide (IrO_x), a benchmark catalyst for oxygen evolution reaction (OER). We emphasize the need to find a balance between how well the catalyst works and how long it can be used, so it enables practical applications. A groundbreaking approach utilizing dual-potential pulsed amperometric technique in intermittent electro-flocculation for water oxidation and oxygen reduction reactions will be discussed. This method yields distinct physical morphology and chemical composition of $IrO_x{\cdot}nH_2O$, which lead to altered kinetic mechanisms and improved stability. Expanding the horizon, the integration of the biological molecule chloroprotoporphyrin IX iron (III) (Hemin) as a catalyst to deplete the oxygen produced in such the electro-flocculation emerges. The electropolymerized hemin serves as underlay to mitigate detrimental oxygen accumulation, thereby enhancing IrO_x catalytic stability. Furthermore, an inventive technique for regenerating catalysts in real-time will be presented. This method involves changing the pH to convert between hexahydroxyiridate (IV) ($[Ir(OH)_6]^{2-}$) and IrO_x, which effectively prolongs the lifespan of IrO_x electrodes. We also show how IrO_x can be regenerated while the OER is happening. In addition, to tackle the longstanding challenge of ionic liquid (IL) decomposition during metal electrodeposition, we explore the approach, employing protic amide-type IL and metal oxides, replaces IL decomposition with OER, demonstrating an 'immortal' system for sustainable metal electrodeposition. In summary, this presentation reveals a less noticed aspect of making catalysts last longer. The endeavor not only changes how we think about catalysts, but also shapes a future that is more sustainable and useful.

Abstract No. 0142 Shu-Han Chen

Space charge effect significantly impacts the charge storage and transport across the interfaces between the materials of ionic conductors, semiconductors, or mixed ionic-electronic conductors for the applications of batteries, photovoltaics, and sensors. However, it is difficult to exactly probe the space charge by experiments because the interface regions are usually only a few nanometers. Therefore, a theoretical technique is required to evaluate the space charge situations at different types of junctions.

Traditional simulations consider special cases such as the semiconductor pn junction (electronic conductor/electronic conductor interface) and metal/ionic compound for supercapacitive storage (electronic conductor/ionic conductor interface). However, there are more and more mixed conductor/mixed conductor junctions for device applications, but the corresponding space charge situations have not been clearly discussed. Hence, we propose the model of mixed conductor/mixed conductor interface to calculate the potential and carrier concentration profiles, and the generalized model can also be used to describe other ionic or electronic conductor systems. Furthermore, the influences of the component activity and dopant concentration on the Debye length and interfacial capacitance are also studied. Finally, we execute the simulation on real systems, such as an electrode-electrolyte interface in a lithium battery, where the distributions of interstitial lithium, lithium vacancy, and hole are investigated.

This research is expected to elucidate a general view of the charge storage of various heterogeneous interfaces with different species in equilibrium and build a connection between electrostatic theory and experimental phenomena to provide a guideline for interfacial engineering in electrochemical systems.

Abstract No. 0143 Wen-Ya Lee

In this study, we fabricate a micro-patterned non-enzymatic glucose sensor device by pulse electrochemical deposition at room temperature, which for applicate detect human sweat glucose levels. The sensor can design by personal computer, and flexible can be used on human skin. The prepared sensor device showed a fast response time (~5 s), high sensitivity (0.65 mAmM-1cm-2) and detection limit of 3.74 μM. When potential in 0.6 V the sensor device provides linear dependence (R2=0.99) to glucose oxidation in a concentration range from 3.74 μM to 2.28 mM. The detection limit for micro glucose sensor was calculated as 14 mM (S/N=3). The micro glucose sensor device provides a simple and low-cost method, integrated flexible substrate, variability and convenient for non-enzymatic glucose sensing applications.

Abstract No. 0144 Yi-Pin Chan

Zinc air batteries (ZABs) are regarded as one of the promising candidates for the next-generation energy storage due to their cost-effectiveness, high energy density, and eco-friendly characteristics. Precious materials such as Pt and RuO_2 are commonly used as catalysts in ZABs which lower the energy barrier and enhance the performance of oxygen reduction reaction (ORR) and oxygen evolution reaction (OER) respectively. However, the cost associated with these precious metals poses practical constraints on ZAB implementation. Therefore, the search for alternative materials with exceptional stability, low cost, and strong catalytic activity is imperative.

Metal organic frameworks (MOFs) emerge as promising catalysts, offering controllable morphologies, high surface areas, and abundant active sites that promote the catalytic performance. Prior research has shown that NiFe bimetallic MOF exhibits excellent OER performance, and its morphology further affects the OER performance. Dhaksinnamoorthy's work demonstrates that 2D NiFe MOF has better accessibility of active sites than 3D NiFe MOF does. However, MOFs generally exhibit poor conductivity, limiting their application in ZABs. Consequently, MOFs are commonly grown on conductive substrates such as Ni foam, reduced graphene oxide (rGO), and carbon nanotubes (CNTs). Among these candidates, rGO offers abundant functional groups that facilitate MOF attachment. Furthermore, research by Zhou's group reveals that N-doped rGO not only increases the defect concentration but also enhances the conductivity, leading to further improvement in electrochemical performance.

This work combines 2D NiFe MOF and N-doped rGO using a hydrothermal method, creating a bifunctional material with improved OER and ORR performance. We adjust the ratio of Ni and Fe sources, precursor concentrations, reaction temperatures, and reaction durations to achieve the optimal morphology and electrochemical performance of 2D NiFe MOF/N-doped rGO. Anticipating that the outcome of this study will contribute to the progress in the application and evolution of ZAB technology.

Abstract No. 0145 Tzu-Yang Lan

In recent years, alternative energy storage technologies besides lithium ion batteries have drawn increasing attentions as additional solutions for energy-related issues. Among these technologies, redox flow battery (RFB) is among the most notable ones for advantages including low self-discharge rates, high energy capacity, extended energy storage duration, and prolonged cycle lifespan. However, commercial available vanadium redox flow batteries (VFRB) need to operate under strong acidic conditions to ensure good solubility of vanadium ions, which severely challenging the stability of the electrodes and the membranes. Additional treatment on the electrodes and very limited availability of suitable membrane (such as Nafion) to ensure the acidic stability of these components would rise the installation and infrastructure cost of VFRB, in addition to the expensiveness of vanadium and the unstable material supply to limit their large-scale applications. The strong acidic electrolytes would also bring another environmental issue in maintenance and in waste treatment. To construct a low cost and environmental friendly flow battery, iron-titanium redox flow batteries (Fe-Ti RFBs) are adopted in this work as Ti and Fe are cheap and abundant. With suitable chelating ligands, the electrolytes could form homogeneous solution under natural conditions, allowing a more stable and environmental friendly flow battery system.

In this Fe-Ti RFBs, Fe(CN)64- complexes are employed for the oxidation side while Ti(cat)32-, catechol chelated with Ti^{4+}, are used for the reduction side upon discharge. In this work, a novel one step method is developed to prepare Ti(cat)32-, which is stable ranging from pH = 5 to 11. After adding supporting electrolytes, the resulting solution is steadily homogeneous for more than 1 month at pH = 7~8, allowing the battery to operate at neutral state. The electrochemical properties as well as the cell performance and the cycling stability at various current density are also studied.

Abstract No. 0146 Jarrn-Horng Lin

Although the weight ratio of electron conductive additives and the binder to porous carbons in the electrode component of electric double-layer capacitors (EDLC) is small, well-dispersed electron conductive additives on porous carbon would improve EDLC electrochemical performances. In this study, we develop a one-step method for producing highly-connecting hollow carbon nanospheres (HCNs) on a kilogram scale per hour from a conventional carbon black-CB (PC20) in air at 550 °C for 2 hours. The air-treated PC20-based HCNs exhibit higher graphitic structures as well as hollow and mesopore domains. The PC20HT displays the highest specific surface area of 657 m^2 g^{-1} (PC20 is 112 m^2 g^{-1}) with a volume of 0.73 cm^3 g^{-1} pore compared with those of other CB-based HCNs at 550 °C. Moreover, according to X-ray photoelectron spectroscopy, all air-treated CBs have a high oxygen content of 10-13 wt%. A commercial porous carbon-ACS20 (1858 m^2 g^{-1}, micropore domain with a total volume of 0.86 cm^3 g^{-1}) used as an active component for EDLC and water-soluble polyacrylic acid as the green binder with an organic electrolyte of 1.0 M TEABF4/PC. Interestingly, the PC20HT-based electrodes display the highest cycle-life retention rate of 87.95% after 10,000 charge-discharge cycles when compared to the other two commercial conductive CBs-BP2000 (80.62%) and Super P (80.23%). Thermal removal of carboxylic groups of PC20HT at 900 °C in argon (denoted as TPC20HT), the life cycles of the TPC20HT-based electrode will increase to 88.89% after 10,000 cycles. TPC20HT-assisted EDLC electrode has a high energy density of 34.76 Wh kg^{-1}, which is higher than CB-BP2000 and Super P-assisted EDLC electrodes. The transforming of structural morphologies as well as the oxygenated functional groups and graphitic structures of the as-prepared HCS, PC20HT, and TPC20HT were also described before and after long-term cycling. In this study, we present a simple route and propose a novel concept for the mass production of electronic conductive additives in the preparation of green available EDLC carbon electrodes.

Abstract No. 0147 Yao-Yang Chang

Because of their high energy density, non-memory effect, and wide operating temperature range, lithium-ion batteries (LIB) are the most widely used energy storage devices in portable electronic devices and electric vehicles. However, the charge-rate and charge-discharge safety issues of LIB continue to be a challenge that must be addressed as soon as possible. $LiFePO_4$ has recently been used as the primary cathode material for commercial LIB to address the charge-discharge safety issue. The lower electronic conductivity, like that of other cathode materials, usually Li-based metal oxides, should be improved by using conductive additives, such as carbon black. In this work, we systematically discuss the surface physical and chemical properties of various conductive carbons, including carbon black-Super P, XC-72, N550, S204 and FW200, carbon nanofiber-VGCF, and graphite-KS6, as conductive fillers in LiFePO4-based electrodes. Clearly examined the electrochemical performances, CV, GVD, C-rate, charge-discharge life cycles, of the above-mentioned electrodes, we composite a structural index formula of the conductive carbons. The structural index, which is composed of specific surface area, particle size, aggregate structure, and surface oxygenated groups, has a linear relationship with the specific capacity of $LiFePO_4$-based cathodes. This suggests that the structural index can be used to accurately predict conductive carbon behaviors in future $LiFePO_4$-based electrodes. Our findings may help in the selection of a suitable conductive in cathode for LIB.

Abstract No. 0148 Wen-Han Su

Lithium ion batteries utilizing organic solvent based liquid electrolytes are the mostly adopted setup for commercialization; nevertheless, the risk of electrolyte leakage and high flammability as well as unsatisfactory cell performance at sub-zero temperatures owing to large drop of conductivity of LE at low temperatures are challenges to overcome. In recent years, gel polymer electrolytes (GPEs) and quasi-solid polymer electrolytes (QSPEs) have been considered as effective approaches to resolve the above mentioned issues since organic solvents could be caged within the GPE/QSPE without obvious phase transitions to limit the ion transport. In-situ polymerization of LE to form GPE/QSPE have been proposed to an appraisable methodology to concurrently attain low solvent content and good interfacial contact between electrolytes and electrodes.

1, 3-dioxolane (DOL) is the mostly used solvents of liquid electrolytes for in-situ polymerization. With the help of Lewis acid initiators, DOL can undergo cationic ring-opening polymerization to form gel-like polyDOL; however, polyDOL would undergo crystallization gradually even at room temperature, leading to a decrease in conductivity after long term and poor contact between electrolytes and electrodes. These issues should severely hamper their applications at sub-zero temperatures. In this work, nitrile-based 3-methoxypropionitrlie (MPN) is employed as a co-solvent in DOL based LE due to its high dielectric constant to effectively dissociate lithium salts as well as low viscosity and low melting temperature (-63°C) to suppress crystallization of DOL. By optimizing the composition of the LE, including initiators, lithium salts and the ratio of DOL/MPN, GPEs/QSPEs could be successfully obtained with long term stability and high conductivity, reaching 6×10^{-4} S cm-1 at room temperature. The cell performance at sub-zero temperatures are also investigated.

Abstract No. 0149 Wen-Li Chen

Dimethoxymethane(DMM) with 16 electron is studied for a possible application as fuels in PEMFC, which to be attractive candidates as alternative to methanol，it has the similar energy density to methanol and has a larger molecular weight of the fuel can slow down the migration of the fuel from anode to the cathode and cause poor cell performance. For the environment, DMM is less destructive to the environment than methanol。This study discusses the reaction of Pt/C to DMM and MeOH oxidation in acidic electrolyte and the effect of gold-modified Pt/C on the oxidation of DMM and MeOH. The performance of DMM was evaluated through a single-cell test，with a fixed cathode oxygen feed of 200cc/min, the influence of anode concentration changes and temperature effects on DMMFC was discussed. MEA was manufactured by CCM process to compare gold-modified Pt/C and Performance of Pt/C in dimethoxymethane single cells。 The results show that the reduction of gold on commercial Pt/C by sodium borohydride reduction method or the co-reduction of gold-platinum precursors on XC-72 with a particle size of about 2-5 nm, in which $Au_3@Pt_7/C$ and $Au_4@Pt_6/$ C has a better ability to oxidize DMM than commercial Pt/C, and the onset potential of the gold-modified Pt/C catalyst is more negative than that of Pt/C in 0.1 M DMM. In the test of the DMM single cell, we can see at the 0.2 M DMM show the best discharge current, up to 335 mA/cm^2.

Abstract No. 0150 Szu-Chia Chien

Owing to the excellent corrosion resistance, stainless steels have been widely applied in many fields. The stainless steel is an excellent corrosion resistant alloy (CRA) because of the spontaneous formation of a passive film on the surface. During the fabrication, the inclusion of a small amount of interstitial elements such as carbon (C), nitrogen (N) and oxygen (O) into austenite stainless steels are found to significantly change their corrosion resistance. Understanding of how these minor elements affect the corrosion resistance in detail is apparently necessary for the rational design of stainless steels with improved corrosion resistance for specific applications.
Recently, a simple bond-order bond energy (BOBE) model was developed to decompose the density functional theory (DFT) calculated energy into pairwise bond energies for complex alloys and alloy oxides. This BOBE model allows one to calculate energies of various binary alloys using a simple bond-number count. The model is capable of describing the fcc/bcc phase transition of alloys well using a simple sigmoidal curve and describing the synergistic effect between different cations in alloy oxides. By applying the BOBE model, the understanding of how these minor elements affect the corrosion resistance in atomic level is achieved, which is necessary for the rational design of stainless steels with improved corrosion resistance. The calculated bond energies were further used in machine learning approaches to find the unexpected correlations between experimental parameters and the material properties as well as to identify key features that determine the corrosion resistance, providing a new guidance for rational design of corrosion resistant alloys.

Abstract No. 0151 Yu-Sheng Su

The integration of lithium metal anodes in rechargeable batteries holds immense potential to revolutionize energy storage technology. However, challenges such as limited reversibility, reactivity with electrolytes, dendrite growth, and unstable solid electrolyte interphase (SEI) formation have impeded their widespread adoption. To address these issues, this study proposes a comprehensive solution involving a protective composite coating as an artificial SEI layer. The protective coating, comprising polyvinylidene fluoride, fumed colloidal silica, and paraffin wax, exhibits exceptional electrochemical stability, high ionic conductivity, and mechanical resilience. This coating effectively suppresses dendrite formation and accommodates volume changes during cycling, while the hydrophobic wax component mitigates vulnerability to moisture and air. The cost-effective and scalable coating process is validated through experimental characterizations. Electrochemical measurements confirm the improved performance and stability of coated lithium metal anodes. Furthermore, an artificial SEI layer, constructed using synthesized lithium silicates, is introduced to fortify battery stability. This protective layer minimizes undesired reactions, enhances ion transport kinetics, and safeguards against mechanical deformations during prolonged cycling. In summary, these innovations pave the way for the realization of high-performance rechargeable lithium metal batteries, offering improved energy density and cycling stability, thus propelling the evolution of energy storage technologies towards a sustainable future.

Abstract No. 0152 Ying-Jung Lu

The interface modification engineering based on self-assembling monolayer (SAM) is crucial in perovskite solar cells. Organosilane is considered as an effective surface modifier to regulate the interfacial property of heterojunctions in perovskite solar cells. The organosilane treatment can modify the surface morphology of perovskite layer, increase the crystallinity, reduce the defect density and charge recombination, and tune the work function to align the energy levels between heterostructures. In this poster, a fluorinated organosilane is introduced to prepare the SAM on hole transporting layer in the perovskite solar cell with a p-i-n structure of ITO/MeO-2PACz/perovskite/C60/BCP/Cu. The SAM can fill the potential gaps among large MeO-2PACz molecules, preventing the contact between indium tin oxide (ITO) and perovskite and therefore suppressing the charge recombination at the hole-selective interface. The device power conversion efficiency is improved from 19.8% to 20.4%. Besides, the perovskite solar cells with the silanization treatment exhibit positive light soaking effect. Conductive atomic force microscope (C-AFM) and Kelvin probe force microscope (KPFM) are used for surface characterizations of the hole transporting layer after silanization treatment.

Abstract No. 0153 Po-Cheng Chou

In recent years, there have been numerous studies on the synergistic effects of metal cations and organic compounds in the inhibition of metal corrosion. However, certain nitrogen-containing compounds may lead to the reduction of metal cations during storage or long-term usage, lowering the inhibition efficiency and stability. To understand this phenomenon, a composite inhibitor is added in an alkaline solution to study its stability and inhibition efficiency in copper metal corrosion at 70°C for a week. Four-point probe method is used to measure the corrosion rate and the inhibition efficiency is calculated accordingly. The results show that primary amine compounds exhibit lower thermal stability, and the inhibition efficiency decreases from 95% to 44%. To address this issue, the coordination reactions of different nitrogen-containing compounds with metal cations are investigated to compare their inhibition effects and thermal stability. Additionally, density functional theory, electron microscopy, atomic force microscopy, and electron spectroscopy are used to explore the inhibition mechanism between nitrogen-containing compounds and metal ions.

Abstract No. 0154 Chia-An Lung

Gibbs free energy stored in the form of salinity gradient between seawater and river water can be harvested by using ion-selective membrane. However, the current research of ion-selective membrane, especially one-dimensional channel membranes, suffer from poor osmotic energy performance because of the low ion-selective. In recent years, exploiting A-B stacking structure to regulate ion-selective and enhance osmotic energy performance has attracted increasing attention. Two-dimensional covalent-organic framework (COF) nanosheets with TFPPy monolayer have A-B stacking structure that can provide better ion selective than the traditional COF membrane. Here, we report a mechanically robust and flexible Py-Azo COF/ANF membrane with highly osmotic current and osmotic voltage. Under the salinity gradient of artificial seawater and river water, our membrane can achieve an unprecedented power density of ~6.4 W/m^2 which is higher than commercial benchmark value of 5 W/m^2. This membrane based on a two-dimensional system provides a strategy for the membrane design of high-performance osmotic energy harvesting.

Abstract No. 0155 Yi-Yu Chen

Electrochemical CO_2 reduction reaction (CO_2RR) into value-added chemicals and fuels plays an important role in Net Zero Emissions. The existence of Cu^+ can enhance the selectivity of C^{2+} products such as ethylene and ethanol, but it reduces to a metallic state rapidly, leading to a low C^{2+} selectivity. In this work, to maintain Cu^+ during CO_2RR, we perform pulsed potential electrochemical methods to switch the positive and negative potential on the cuprous oxide nanocubes electrocatalysts. The well-defined (100) plane allows us to study the CO_2RR behavior of the identical Cu active sites. The positive potential facilitates the formation and maintenance of Cu^+, while the negative potential performs highly efficient CO_2RR due to the presence of Cu^+. We quantify the ratio of Cu0 and Cu^+ by performing quick-scan X-ray absorption spectroscopy and find most Cu^+ in the electrocatalyst as the pulsed potential of anodic/cathodic ratio = 1. The cuprous oxide nanocubes exhibit an ethanol selectivity of nearly 45% with an anodic/cathodic ratio = 1, while it only shows 30% of ethanol within constant potential reduction under the current density of 300 mA/cm^2. We believe our strategy to create more Cu^+ active sites, promoting the ethanol selectivity, can offer a promising approach to enhancing the selectivity and activity to realize the industrial CO_2RR.

Abstract No. 0156 Jian-Jie Ma

Over 97 % of water in the earth is seawater; therefore, developing seawater splitting to generate hydrogen is a promising way for the green economy. However, because of chloride evolution reaction (CER), a competitive reaction against OER, seawater splitting is still a big challenge. In this study, we developed a chemical vapor method to prepare zeolitic imidazolate framework (ZIF-67) nanowires and decorated chromium and iron ions into the nanowires to regulate the 3d orbitals of cobalt active sites. We performed X-ray emission spectroscopy and resonant inelastic X-ray scattering to investigate the 3d orbitals modification by foreign ions. The developed electrocatalyst exhibits an overpotential (η10) of 547 mV to reach 10 mA/cm^2 for neutral seawater electrolysis (PBS + NaCl), which is 247 mV lower than the pristine cobalt oxide (η10 = 821 mV) in the same condition. We further put the electrocatalyst into the membrane electrode assembly, boosting the catalytic current density over 1 A/cm^2. The o-tolidine test unveiled that our developed electrocatalyst restrained the CER, making it suitable for selective and efficient seawater splitting. Through in-situ Kβ2,5 X-ray emission spectroscopy, we observed the 3d orbitals of cobalt active sites will interact with the water molecules, confirming the catalytic mechanism of cobalt active sites. This study provides insight into the design of efficient and selective seawater electrocatalysts using non-noble metal with CVD method. We expect to scale up our devices to commercial grades and deploy them worldwide to solve the energy problem.

Abstract No. 0157 Chin-Hao Kuo

Covalent Organic Frameworks (COFs) are a type of organic porous material composed primarily of light elements such as C, H, O, N, and B. They are structured through covalent bonds to form two-dimensional or three-dimensional networks possessing high porosity, large surface area, low density as well as excellent thermal and chemical stability. By varying the chemical structure of the precursors, the functional groups and pore size of COFs can be tailored. In this work, a one-pot chemistry using 4-formylphenylboronic acid and p-phenylenediamine as the precursors is adopted to synthesize the COF to possess both imine and boroxine groups. We systematically investigate the effects of the reaction parameters including solvents, catalysts, and reaction environments on the structure of COFs, such as morphology, particle size, crystallinity, and porosity.

Afterwards, the obtained COFs are serving as additives to the liquid electrolytes to improve the stability of lithium metal surface in a lithium metal battery. These COFs would form an artificial solid electrolyte interphase (A-SEI) with high affinity to lithium ions assisted by imine and boroxine to conduct homogeneous deposition and stripping of lithium, thus to suppress lithium dendrite formation and enhance the battery stability. The long term interfacial resistance of COF containing LE is obviously lower than the pristine LE in a lithium symmetrical cell (LSC), suggesting the inhibition of undesired SEI formation. Galvanostatic cycling studies of the LSC also reveals notable improvement in lithium metal surface stability.

Abstract No. 0158 Jia-Sheng Lin

Practical applications of conversion-type metal selenide electrodes in potassium ion batteries (PIBs) encounter multiple challenges, such as particle aggregation, the shuttle effect, and pulverization during cycling. We design a Janus heterostructure, namely $CoSe_2$-$FeSe_2$/graphite/N-doped carbon (CFS//g@NC), with dual heterojunctions (p-n and Schottky junction), which generates the synergistic effect to enhance interface charge storage and improve electrode structure integrity. When the Janus heterostructure is used as a PIB anode, it demonstrates high-rate performance up to 10 A g^{-1}, offering a capacity of 200 mA h g^{-1} and excellent cycling stability of over 2500 cycles at 0.5 A g^{-1}. According to the density functional theory (DFT) calculations, the diffusion barrier of K ions on CFS//g@NC is two times lower than that on $CoSe_2$ or $FeSe_2$. The distribution of n-type and p-type semiconductors in the Janus particles has been confirmed by quantitative assessment through dark-field electron microscopy. In addition to the p-n junction crossing two semiconductor interfaces, the Schottky junction between the graphite layer derived from Prussian blue analogues (PBA) and the semiconductor also creates a built-in electric field, thus enhancing ion/electron transport and increasing the diffusion of potassium ions. This work provides new insights into the architectural strategy of multi-layer heterointerfaces and offers a promising new pathway for anode design in PIBs.

Abstract No. 0159 Afif Thufail

Silicon suboxide (SiO_x) appears particularly promising strategies for applications due to its good cycle life and lower volume expansion (<200%) but also maintains a high sepsific capacity (~2400 mAh/g) compared to pure silicon. The losses of Li^+ occur during the formation of solid electrolyte interphase (SEI) due to the electron is directly contact to the electrolyte affects the EC decomposed and consumption of active Li^+, which contributes to limits the cycling performance. To compensate for the consumption of the active Li^+, additional active Li^+ into SiO_x anode in advance is one of the reliable methods to overcome this issue, named as prelithiation techniques. In this work, we proposed a novel prelithiation technique by using a simple coating method with different concentration of Li^+ on the surface of SiO electrode, which classified as surface prelithiation design. The use of Compound A and Compound B to understand the different concentration of Li^+, thereby improving the kinetics of SiO anode due to the rich of $-CO_2Li$ functional group on the SiO surface. The results of electrochemical performance, such as the impedance spectroscopy, rate performance, and cyclability tests, demonstrated the modified by using surface prelithiated significantly improved the battery performance. Under the high-surfaces Li^+ concentration by surface prelithiation, which effectively increases capacity gradually, named as activation region providing accelerated kinetics for Li^+ transfer. X-ray photoelectron spectroscopy (XPS) indicated high LiF formation, affect to the lower of diffusion barrier of Li^+ and high shear modulus, which beneficial to improved electrochemical performance. This research confirm that the surface prelithiation affect to the remarkable of SiO anodes, which improvement in the energy density and excellent rate performance.

Abstract No. 0160 Jui-Wen Su

In this study, the primary objective was to enhance the performance of a vanadium redox flow battery (VRFB) by altering the electrode material, specifically the graphite felt electrode. This alteration involved incorporating high-entropy oxides (HEO) into the graphite felt. The purpose of introducing these HEO was to leverage the numerous oxygen vacancies present in them. These oxygen vacancies were identified as potential active sites that could facilitate the oxidation-reduction reactions of vanadium ions within the battery. In the final comprehensive cell testing, initially operating under a current density of 80 mA/cm², using the HEO-modified heat-treated graphite felt as the positive electrode resulted in a voltage efficiency of 89.19% and an energy efficiency of 86.90%. These efficiency values were superior to those observed in the comparison samples. Following 100 cycles of charge and discharge, the efficiency of the system did not experience notable deterioration. The modified HEO-treated graphite felt electrode maintained 65.4% of its discharge capacity, relative to its initial charge and discharge cycle. This outcome implies that employing the HEO-modified graphite felt electrode preserves remarkable stability over extended charge and discharge cycles.

Abstract No. 0161 Mendoza Kassim

Proton Exchange Membrane Fuel Cell (PEMFC) is one of the most promising technologies to fight climate change. This technology is efficient and carbon neutral, having only electric current, water, and heat as output.

Yet, the widespread of this technology is detained due to some challenges, for example, the conventional manufacturing processes do not fit the industry's needs. The screen print deposition technique is fast, easy, and scalable, however, it has a significant drawback, if the paste gets dry during deposition, the mechanical properties of the paste change, dramatically lowering the resulting film quality, and consequently the final cell's performance.

To solve this drawback many solvents have been used to produce a catalyst paste, the most promising is Cyclohexanol due to its high electric constant and low evaporation rate. In recent research, this solvent was added, in a minority percentage compared to water and low molecular weight alcohols, resulting in some improvements that unfortunately still do not fit the industry’s needs.

In this research, a screen print catalyst paste with a majority content of cyclohexanol was produced to avoid paste drying problems. This paste was dispersed by different methods to find which one produced the PEMFC with the best performance. Details of this research will be presented at the conference.

Abstract No. 0162 Yu-Ren Yang

In this study, Poly(3-hexylthiophene-2,5-diyl) (P3HT)/Al-doped ZnO (AZO)/ZnO-based optoelectronic devices were designed and fabricated using electrochemical deposition (ECD) and assembly methods. The schematic plot of the device is shown in Figure 1. A thin nano-ZnO film (seed layer) was first fabricated by spin-coating zinc acetate solution onto ITO substrate and thermally heated at 350 ºC. AZO was then deposited on ZnO using ECD methods. The prepared AZO/ZnO films were assembled with P3HT/ITO through heat treatment. The characteristics of the prepared samples, such as morphology, crystal structure, optical, and electrical properties, were examined using various analytical instruments. The properties of the AZO samples were affected by the amount of Al doped in ZnO. The characteristics of the optoelectronic devices were tested in dark and light measurements. The devices performed semiconductor diodes, based on the I-V data analysis. The optoelectronic performance of the device was evaluated using solar simulation data analysis. This study can be further applied to the development of organic-inorganic photovoltaic devices.

Abstract No. 0163 Kang-Shun Peng

Electrochemically converting carbon dioxide (CO_2) into valuable multicarbon products by electrocatalysis, such as ethylene and ethanol, has drawn attention recently because it can decrease CO_2 in the atmosphere effectively and create economic value. Copper is the only catalyst capable of producing multicarbon products but still shows poor selectivity under a high current density. To resolve this problem, in this study, we developed a copper-aluminum alloy enclosed inside the carbon nanofiber. Carbon nanofibers with a larger diameter provide good carbon dioxide permeability, conductivity, and a well-defined spatial confined environment, concentrating CO* intermediates. Copper-aluminum alloy can regulate the 3d orbitals of the active sites, enhancing the overall catalytic activity. X-ray absorption spectroscopy and resonant inelastic X-ray scattering enable us to observe the alteration in 3d orbitals of copper by aluminum, confirming aluminum changing the electronic structure and improving the copper for carbon dioxide reduction reactions. Our developed electrocatalyst achieves the Faradaic efficiency of 72.13% toward C^{2+} products under the operating current density of 800 mA/cm2 and the partial current density of 577.03 mA/cm^2. It overperforms the pristine copper, whose C^{2+} Faradaic efficiency is 75% under the operating current density of 300 mA/cm^2 and the partial current density of 225 mA/cm^2. We hope our results can provide insightful information for industrial development of carbon dioxide reduction reaction, aiming to reduce carbon dioxide emissions and contribute to the well-being of our planet.

Abstract No. 0164 Chou Chi Wei

Conversion-type transition metal chalcogenide anodes could bring relatively high specific capacity in potassium ion storage due to multiple electron transport reactions, but often accompanying huge volume changes and resulting in low cycle life and rapid capacity fading. While electrode materials are closely packed, the contact at the interface during potassiation/depotassiation is similar to point-to-point contact, generating strong stress to make self-aggregation occur. In this work, we constructed a 3D carbon framework to confine $Co_{0.85}Se$ nanocrystals in three-dimensional space, both fulfilling the requirements of the material's size in the nano-scale and providing the largest contact area for releasing stress. With this optimization, nitrogen-doped carbon confined $Co_{0.85}Se$ nanocrystals ($Co_{0.85}Se$@NC) reach an ultra-stable cycle life over 4000 times with a specific capacity of 190.9 mA h g^{-1} at 500 mA g^{-1} and provide 155.6 mA h g^{-1} at 10 A g^{-1} in the rate capability test. It also renders the areal capacity up to 1.03 mA h cm^{-2} at 500 mA g^{-1} in the high-mass loading test. Furthermore, based on the finite element analysis, the 3D confinement strategy has the lowest interfacial stress, ensuring $Co_{0.85}Se$ nanocrystals with high structural integrity. This strategy can relieve the stress issue in the conversion-type anode and demonstrate superior electrochemical performance even at high-loading mass electrodes.

Abstract No. 0165 Meng-Cheng Chen

Electrochemical reduction of carbon dioxide (CO_2) to carbon monoxide (CO) is high-profile because CO_2, as the primary greenhouse gas, can be lessened effectively, and CO is a high-economic-value chemical and provides wide applications. Single atom catalyst has been recognized as a preeminent electrocatalyst for CO_2 to CO; however, the scarce active sites limit the overall catalytic activity. In this study, we develop a thermal copolymerization of nickel-metal phthalocyanine (NiPc) ions on carbon nanofibers (CNFs) without further acid-wash process, resulting in an ultrathin-conjugated microporous polymer anchored on the carbon nanofibers, providing numerous active sites compared to conventional single atom catalysts. The X-ray diffraction and X-ray absorption spectroscopy confirm the absence of metallic nickel aggregation in the electrocatalysts. Our developed electrocatalyst exhibits a Faraday efficiency of 81.1% under the current density of 150 mA/cm^2 and a partial current density of 121.6 mA/cm^2, reaching the requirement of industrial CO_2RR (a Faraday efficiency over 60% and a partial current density of 100 mA/cm^2). We hope our results provide a promising strategy to design a superior electrocatalyst for CO_2 to CO.

Abstract No. 0166 Xin-Ru Lin

In this study, we set out to explore the intricate relationship between polymer-capped platinum electrodes and the consequent degradation patterns observed in dye-sensitizedsolar cells (DSSCs). Specifically, a chronological study on the degradation of N719-based DSSC devices utilizing iodide/triiodide-based electrolytes was conducted employing cyclic voltammetry (CV), Tafel plot analysis, electrochemical impedance spectroscopy (EIS), and scanning electron microscopy (SEM). The polymers employed include poly(N-vinyl-2-pyrrolidone) and poly(1-vinylpyrrolidone-co-vinyl acetate) abbreviated as PVP and PVP/VA, respectively. Our findings emphasize that the device performances governed by the interfacial charge transfer processes were influenced by the choice of polymer and the ratio of PVP/VA. Remarkably, all the devices exhibited a significant enhancement in open-circuit voltage (VOC), with a maximum increase of approximately 0.2 V, likely attributed to reduced triiodide concentration. Furthermore, the possibility of interaction between triiodide and polymer was also discussed.

Abstract No. 0167 Jae Eun Kim

Li-argyrodite, one of the sulfide solid electrolytes, has gained significant attention owing to its comparable ion conductivity to liquid and electrochemical stability. Despite of their desirable properties, the key challenge of Li-argyrodite is enhancing their poor moisture stability, followed by structural deformation and H2S generation. Experimental studies have shown that aliovalent doping (using Sn, Ge, Si, or Pb) on the P^{5+} site of pristine Li-argyrodite substantially reduces the generation of hydrogen sulfide without compromising Li-ion conductivity. However, detailed mechanisms of how the hydrolysis has decreased due to aliovalent cation doping has not been thoroughly explored. Here we investigate a detailed mechanism of hydrolysis and ion conductivity in aliovalent-doping lithium argyrodites. In addition to considering the S^{2-} in the PS_4 tetrahedron, which is a favorable site for O substitution in hydrolysis, we also examine the role of the free S^{2-} site in understanding the correlation between hydrolysis suppression and lithium diffusion. Using density functional theory (DFT) calculations, we obtain thermodynamically stable structures and static properties. Additionally, we analyze the underlying mechanisms of Li-ion diffusion through ab-initio molecular dynamics (AIMD) simulations. Our findings reveal that the interaction between the dopant and S^{2-} in Li-argyrodite plays a critical role in suppressing hydrolysis while preserving its superior ionic conductivity. This research offers valuable insights for designing promising sulfide solid electrolytes that achieve both moisture stability and rapid Li-ion conduction.

Abstract No. 0168 Haeshik Lee

Hydrogen evolution reaction (HER) with anion exchange membrane (AEM) produces pure hydrogen gas from the abundant water. Platinum (Pt) is one of the most widely used electrocatalyst for HER in alkaline media due to its moderate hydrogen binding energy (HBE). However, the catalytic activity in the alkaline condition compared to the acidic media is a few magnitudes smaller due to the sluggish water dissociability. This can be enhanced by the introduction of Ru where its high oxophilicity leads to strong OH adsorption.

Although Pt-Ru alloy system is studied and used extensively, the understanding on the HER mechanism considering the actual driving environment is poor. In this study, Pt-Ru alloy system is modeled precisely given that Ru segregates towards the surface to vary surface composition, depending on the actual experimental conditions like synthesis temperature and oxidative environment. Different surfaces and crystal structures are considered to give optimal catalyst configuration providing Pt-Ru dual active sites to follow the bifunctional mechanism. With the proposed Pt-Ru nanoparticle model, the activity of alkaline HER and its mechanical understanding is sought through free energy diagrams including the kinetic barriers of rate-determining steps. The effect of Ru on the Pt-Ru system is supported by the strain effect upon alloying and the charge transfer between Ru and Pt atoms.

Abstract No. 0169 Yonghak Park

Zinc-air batteries are promising secondary batteries owing to its high energy density and low cost. In these batteries, the oxygen reduction reaction (ORR) plays a pivotal role at the cathode, making the performance of ORR catalysts crucial. Unfortunately, conventional catalyst materials, mainly composed of Pt, suffer from high production cost. To address this challenge, Cu-S has emerged as a promising low-cost alternative; however, its performance remains insufficient.

In this study, we introduce Cu-S-N as a novel ORR catalyst material, showing significant improvements on catalytic activity compared to Cu-S. From first-principles calculations thermodynamically favorable doping site of N is identified and validated through experimental results, revealing a discernible reduction in the oxidation number of Cu. For the selected model systems, adsorption energies of oxygen intermediates are analyzed to identify the active sites. ORR activity on those active sites is evaluated for various N doping concentrations using free-energy diagram. To gain an atomistic-level understanding of the enhanced catalytic performance, we further investigate the electronic structure of catalyst surface and adsorbates. Our research not only sheds light on the structure-property-performance relationship but also opens new avenues for the development of novel materials with improved ORR catalytic capabilities. The insights gained from this study will lead to a big step forward in improving zinc-air battery technology.

Abstract No. 0170 Rui En Li

Polyetherimide (PEI) is a kind of thermoplastic polymer in which chemical structures consist of repeating aromatic imide and ether units. PEIs possess high strength, rigidity, long-term high heat resistance, highly stable dimensional and electrical properties, and broad chemical resistance, widely applied in aircraft interiors, electrical and lighting systems, and medical devices. However, it also caused a large amount of PEI waste. Because PEIs contain imide groups that could be linked with metal ions to form nitrogen-metal structures. Therefore, the study uses polyetherimide powder mixed with iron and tungsten precursors, loading on Ni foam (PEI-FeWO$_x$ (@NF) as electrocatalysts. The electrocatalytic performances in alkaline electrolytes were measured by linear sweep voltammetry (LSV), Tafel slope, and electrochemical impedance spectroscopy (EIS). The results obtained that PEI-FeWO$_x$ (@NF has the smallest overpotentials of 1.42 V at 10 mA/cm^2 of current density for oxygen evolution reaction (OER) in alkaline water electrolysis.

Abstract No. 0171 **Hsin-Chih Huang**

With the growing emphasis on hydrogen-based energy, there exists a substantial demand for pure hydrogen. Among several methods for hydrogen production, electrochemical water electrolysis stands out as a promising approach for hydrogen generation due to its minimal environmental impact, efficient resource utilization, and energy efficiency. The process of electrochemical water electrolysis involves the oxygen evolution reaction (OER), a challenging oxidation reaction occurring at the anode. This reaction proceeds through intricate multi-step pathways and gives rise to various intermediates in both acidic and alkaline environments, leading to elevated OER overpotential. Consequently, the development of high performance electrocatalysts to mitigate this overpotential is of paramount importance.

In this study, it reveals the distinctive porous barnacle-like structure of NiCuP, which is co-electrodeposited onto nickel foam and rapidly undergoes phosphorization. The catalysts exhibit an overpotential of 250 mV for the OER at a current density of 10 mA cm^{-2}. When employed as the anode in water electrolysis, the optimized catalyst consistently maintains a current density of approximately 180 mA cm^{-2} over a 100-hour operation period at a cell potential of 1.8 V. The surface phosphorization enhances the OER activity, while the catalyst retains its porous structure post-phosphorization, resulting in a substantial electrochemical surface area and minimal electrotransfer resistance.

Beside it, we also try to produce 2D carbon-based catalysts by incorporating a small quantity of Ru precursor and an ample nitrogen source. Subsequently, the samples undergo a heat treatment in an ammonia atmosphere to enhance nitrogen incorporation on the carbon surface, thereby boosting the activity of carbon. Notably, the most optimal sample displays the potential of 1.52 V at 10 mA cm^{-2} and maintains stable performance as the anode of the anion exchange membrane water electrolysis (AEMWE) over a 100-hour duration. These findings hold promise for the commercialization of AEMWE technology.

Abstract No. 0172 **Chung-Wei Kung**

Given several advantages of metal–organic frameworks (MOFs) including regular porosity, ultrahigh specific surface area, and periodic intra-framework functionality, MOFs have been considered as desirable materials for various electrochemical applications including electrocatalysis and energy storage. However, the electrically insulating nature and relatively poor chemical stability of most MOFs strongly limit the use of pristine MOFs as the electroactive materials in these applications. On the other hand, with the electronically insulating nature and high porosity, MOFs could be used as solid-state electrolytes in various electrochemical devices for energy storage and conversion. With the use of the highly robust group(IV) metal-based MOFs, the poor stability issue of MOFs can be further addressed.

In this talk, the design, synthesis and applications of various highly stable group(IV) metal-based MOFs with unique ion-conducting characteristics developed by our research group will be highlighted. It will include the design of a single potassium-ion conducting MOF with a high cationic transference number aiming for potassium-ion batteries, and the use of cerium(IV)-based MOFs for proton conduction . The topics are illustrated in the Figure below.

Abstract No. 0173 Da-Ren Hang

The design of two-dimensional (2D) heterocatalysts featuring active edge sites has garnered significant attention in the pursuit of efficient water splitting reactions and the oxidation of organic dye molecules. In this research, we present a meticulously engineered $WS_2@MoS_2$ nanocomposite, characterized by an abundance of active edges, serving as a robust catalyst. This nanocomposite was synthesized via a straightforward sonication method and was evaluated for its efficacy in the hydrogen evolution reaction (HER) as well as the degradation of methylene blue (MB) solutions. The resulting catalyst comprises MoS_2 nanoparticles, with an average diameter of approximately 40 nm, uniformly coated by ultra-thin WS_2-MoS_2 quantum dots (QDs) measuring an average of about 3 nm. The synthesis process involved the initial formation of MoS_2 QDs interspersed among MoS_2 nanoparticles (NPs), which were subsequently combined with WS_2 QDs to create an extensive network of bifunctional active edges and coupled interfaces. These interfaces demonstrated remarkable HER and photodegradation activities. Electrochemical testing of the $WS_2@MoS_2$ catalyst unveiled a low HER overpotential of 152 mV at a current density of 10 mA cm^{-2} in a 0.5 M H_2SO_4 solution, along with a Tafel slope of 38 mV per decade. Similarly, $WS_2@MoS_2$ displayed remarkable efficiency in the degradation of MB dye under visible light irradiation. These enhanced electrocatalytic HER performance and exceptional photocatalytic dye degradation capabilities can be attributed to the prolific distribution of active edge sites throughout the interfaces. Additionally, the facilitation of photogenerated charge separation at the heterojunctions contributes significantly to these outstanding results.

Abstract No. 0174 Heng-Liang Wu

The solid-liquid interfacial reactions play a crucial role in controlling the performance and stability of electrocatalysts. In situ vibrational spectroscopy techniques such as Raman and surface-enhanced infrared absorption spectroscopy (SEIRAS) are the powerful tools for examining the surface-adsorbed intermediates on the solid-liquid interfaces. In this talk, we report on our use of in situ SEIRAS, Raman, and X-ray absorption spectroscopy to investigate the electrochemical CO_2 reduction mechanism over the Cu-based electrocatalysts. The Cu-based electrodes with different oxidation states result in the formation of various CO intermediates such as COatop and CObridge. The co-existence of COatop and CObridge corresponds to the selectivity of CO_2-to-C_2H_4 reaction. Also, the bimetallic electrocatalysts are developed for efficient CO_2-to-HCOOH and CO_2-to-CO conversion processes. We found that the surface-adsorbed COO species with different binding structures play crucial role in the reduction process. The electronic structures of Cu-based electrocatalysts are associated with the formation of surface-adsorbed intermediates and electrocatalytic properties. The formation of surface-adsorbed intermediates and reaction mechanism associated with CO_2-to-HCOOH and CO_2-to-CO reactions over the bimetallic electrocatalysts will be discussed in detail.

Abstract No. 0175 Shun-Jhih Yang

Poly(ethylene oxide) (PEO)-based solid electrolytes have emerged as propitious candidates in the pursuit of all-solid-state lithium-ion batteries. Although solid polymer electrolytes possess advantages such as good electrochemical stability toward lithium metal, outstanding compatibility with lithium salts, commensurate mechanical properties and convenient fabrication method, they still encounter some critical issues which are necessary to be tackled when it comes to their practical applications; for example, lithium dendrite formation and relatively low ionic conductivity. To efficiently solve these problems, it is essential to elucidate the ionic transport properties in PEO-based solid electrolytes.

Herein, we report the anisotropic ionic transport behavior in PEO-LiTFSI electrolytes and show how through-plane and in-plane configurations for cell assembly dictate their ionic transport properties. A special design of pouch cell device is utilized in this work, and an electrochemical methodology with impedance spectroscopy (EIS) and steady-state polarization is introduced for the analysis of ionic conductivity and cationic transference number within the same PEO-LiTFSI film. The polarized optical microscopic (POM) images are presented as well to delineate the amorphous and crystalline region of PEO-LiTFSI under certain temperatures. We observe that both the ionic conductivity and cationic transference number are higher in the in-plane configuration than in the through-plane one. The results serve as the important information for the choose of preferential direction of cell design, and they are helpful to get a more complete picture of the solution of lithium propagation problems in PEO-based solid electrolytes.

Abstract No. 0176 Chia-Feng Li

Organic-inorganic hybrid perovskite solar cells (PSCs) exhibit photoelectric properties and high transparency, which can be utilized on several photovoltaic applications such as tandem solar cells (TSCs), building integrated photovoltaics (BIPV), and smart windows. To replace the opaque metal electrode, the top and bottom electrodes of semi-transparent PSC (ST-PSC) were prepared using conducting metal oxide. The power conversion efficiency (PCE) of semi-transparent PSCs has reached over 26% with a small active area. However, the performance of large-area ST-PSC was limited by the poor lateral conductivity of metal oxide. In this study, we used DC sputtering to prepare a cerium-doped indium oxide (ICO) film with high transmittance and high conductivity, which was applied to the transparent top electrode of the ST-PSCs. Furthermore, we incorporated a thin silver layer (10 nm) before the ICO transparent electrode. Our results revealed that the average sheet resistance of the electrode reduced from 15.53 Ω/sq to 11.72 Ω/sq with the thin silver, and effectively assisted the charge transport. Finally, we successfully fabricated ST-PSCs with an active area of 1 cm^2 and achieved the highest PCE of 8.90%.

Abstract No. 0177 **Wei Tao**

Sodium (Na) metal is regarded as a “Holy Grail” of anode material for next generation high-energy-density metal batteries due to abundant sodium resources and potentially low cost than lithium metal. This is critically important in large-scale applications such as transportation electric vehicles and grid energy storage. However, severe dendrite growth and large volume change during plating/stripping impede them from being widely applied. Herein, a sodiophilic and conductive 3D framework is designed by in-situ growth of $CuGa_2$ layer on Cu mesh and then accommodating Na metal into them by a facile physical pressing method. The construction of a composite sodium anode has the potential to alter the conventional nucleation and growth mode, resulting in several benefits. On the one hand, it offers a 3D framework that can effectively accommodate the significant volume changes experienced by the sodium anode. On the other hand, the introduction of a sodiophilic $CuGa_2$ layer allows for manipulation of the nucleation process of Na^+ ions, leading to more stable sodium deposition and growth. The regulated behavior of Na stripping and plating has been comprehensively investigated through theoretical simulation and experimental characterization. As anticipated, the symmetric-cell of the composite sodium anode exhibits a lower overpotential of approximately 3 mV and a more prolonged lifespan exceeding 1800 hours at a current density of 1 mA cm^{-2}. Density functional theory calculation combined with SEM characterization was performed to reveal greater sodiophilicity of $CuGa_2$ and uniform growth of sodium on $CuGa_2$.

Abstract No. 0178 **Yen-Lin Chen**

Lithium-ion batteries (LIBs) have been widely applied to mobile devices since their high energy density and good cycling performance. However, the liquid electrolytes in LIBs caused the danger of combustion and explosion. To solve these issues, various solid electrolytes were used in LIBs. High mechanical strength and thermal stability for solid electrolytes can help inhibit the lithium dendrite growth and reduce the chances of catching fire, respectively.

This work successfully synthesized a NASICON-type solid electrolyte for LIBs by a solution-based method. $Li_{1.3}Al_{0.3}Ti_{1.7}(PO_4)_3$ (LATP), one of the most prospective lithium-ion conductors, was chosen for its excellent ionic conductivity and chemical stability in the atmosphere. By optimizing its stoichiometric ratio and heat treatment, the ionic conductivity of LATP is about 5×10^{-4} S/cm at room temperature. Here, we doped different metal ions in the LATP to enhance the ion conductivity. While substituting titanium with other metal ions with proper atomic ratio, the lithium-ion diffusion pathway has been improved due to slight lattice distortion. This can also create more lithium vacancies, increasing the lithium-ion diffusivity. Some cation dopants even lead to densification of the bulk material or favorable second-phase formation. After cation doping, the ionic conductivity of modified LATP is up to 8×10^{-4} S/cm at room temperature.

However, another critical issue is the reduction of titanium, which is caused by the direct contact of LATP with lithium metal. We further introduced Poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP) membrane as a protective layer between the solid electrolyte and lithium metal to avoid this side reaction and obtain better contact. An all-solid-state lithium-ion battery is eventually assembled with PVDF-HFP, modified LATP ceramic pellet, $LiFePO_4$ cathode, and Li anode.

Abstract No. 0179 Chen-Wei Tai

Hard carbon (HC) materials have demonstrated great potential in sodium-ion storage; however, their application for lithium-ion storage continues to pose a challenge due to difficulties in managing carbon porosity. Most HCs exhibit completely capacitive responses when storing lithium ions, significantly hindering the nominal cell voltage of configured lithium-ion batteries. Herein, this study provides feasible solutions by introducing phenolic-formaldehyde resin-derived HCs with tunable microporous structures. The carbon porosity is well manipulated by tailoring chemically cross-linked environments via microwave-induced polymerization. A highly closed microporous HC (closed pore volume: 0.336 cm3 g^{-1}), verified by multiple gas (N_2, O_2, and CO_2) adsorptions, is successfully prepared by reducing cross-linking degree. Combining in situ X-ray diffractions and ion-diffusion kinetic explorations, the linchpin has been clearly identified. Closed ultramicropores < 0.7 nm, which play the same role as graphitic interlayer spacing in graphite, are termed as "active closed pores", because they can facilitate the insertion of lithium ions and mitigate substantial initial irreversible capacity by blocking the penetration of solvents. The transformation from open porosity to closed porosity in HC and their respective galvanostatic charge/discharge (GCD) performances are illustrated in Figure 1. In particular, the HC with abundant active closed pores can deliver a reversible capacity of 550 mAh g^{-1} at 50 mA g^{-1} in 0.001-1.5 V, with an ultrahigh low-voltage plateau capacity of 230 mAh g^{-1} contributed by the lithium-ion insertion in active closed pores. The excellent rate capability (210 mAh g^{-1} at 2 A g^{-1}) and cycling stability (90% capacity retention after 200 cycling at 0.1 A g^{-1}) of this closed pore-rich HC are also confirmed.

Abstract No. 0180 Cheng-Tai Lee

A cost-effective and efficient heterogeneous photocatalyst, namely hierarchical Co_xS_y nanoneedles (Co_xS_y-NDs), are synthesized via hydrothermal method followed by a sulfurization process for the application in photocatalytic CO_2 reduction reaction. The morphological and structural characteristics of the as-prepared Co_xS_y-NDs were confirmed through scanning electron microscopy (SEM), respectively. X-ray diffraction spectroscopy (XRD) and high resolution transmission electron microscopy (HRTEM) further reveal the presence of two distinct phases within the Co_xS_y nanoneedles, i.e., Co_9S_8 and Co_3S_4. Meanwhile, the composition of Co_xS_y-NDs is investigated via X-ray photoemission spectroscopy (XPS), which identified signals corresponding to cobalt 2p and sulfur 2p. Moreover, UV-Vis measurements indicate that Co_xS_y-NDs exhibit main absorption peak around 550 nm. Finally, gas chromatography-flame ionization detection analysis indicate that the primary products after photocatalysis reaction are methane, acetaldehyde, and acetone.

Abstract No. 0181 Cheng-Tai Lee

In this work, we synthesized hierarchical cobalt oxide nanoneedles (Co_3O_4-NDs) as a photocatalyst for CO_2 reduction reaction by using hydrothermal synthesis approach. The as-prepared Co_3O_4-NDs show acicular nanostructure consisted of lots of small particles whose diameters are around 10~25 nm; moreover, they possess specific surface area of 32.4 m^2/g. The one-dimensional structure of Co_3O_4-NDs can serve as a fast charge transport pathway to facilitate electron-hole separation; the small particles can decrease the distance of electron-hole pair migrating to the catalyst surface for the oxidation-reduction reaction, both of which could enhance the efficiency of photocatalytic CO_2 reduction. From the analysis of gas chromatography-flame ionization detector (GC-FID), we found the main product is carbon monoxide. Most importantly, this work demonstrates great potentials since the catalytic efficiency of as-grown Co_3O_4-NDs increases 100% compared with the commercial Co_3O_4 which is obviously a highly potential photocatalyst to date.

Abstract No. 0182 Chun-Ting Chang

Nickel-rich cathode material, $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ (NCM811), shows the advantages of high energy density and low cost, for which it is often used in various electronic products. To create battery with higher electrochemical performance, the most direct way is to increase its operating voltage range. However, under high voltage cycles, NCM811 will have problems such as capacity degradation, structure destruction, excessive metal dissolution or residual compounds on the surface; thus, in this study, we aimed to improve its electrochemical performance by coating the surface of positive electrode.

In this paper, the wet process was used to coat the cathode material surface of $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ with $LiCoMnO_4$ of different concentrations (1% and 2.5%), which is in a spinel structure. It was hoped that the surface of nickel-rich material coated with residual lithium compound could be improved of its electrochemical performance at room temperature and high temperature under high voltage.

The cyclic performance test was carried out at room temperature, and it was found that the unmodified $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ had only 73% of original capacitance after 100 cycles, whereas the cathode material coated with either 1% or 2.5% high-voltage spinel material, $LiCoMnO_4$, by the wet process was able to maintain a retention rate of 82% to 90% . However, when tested at 55°C, the capacitance retention rate of the unmodified NCM811 was only 61% after 100 cycles, while the coating of 1% and 2.5% of test compound helped to increase the cycle retention rate to 70% and 74%, respectively.

Through experiment, it was found that $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ was improved by the coating to operate at both room and high temperatures, as we speculated that the stable phase of spinel structure could prevent volume change under high voltage and even inhibit the formation of particle cracks to maintain the overall structural integrity during the cyclic process. Therefore, the surface coating of high-energy density $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ cathode material with high-voltage spinel compound is one effective way to improve the cycle life of such battery at normal and high temperatures under high voltage.

Abstract No. 0183 Chih-Chieh Cheng

The utilization of electrochemical water splitting for hydrogen production plays a pivotal role in realizing the ambitious goal of achieving net-zero emissions by the year 2050. However, this endeavor faces a significant obstacle in the form of the substantial electricity costs associated with large-scale electrochemical water splitting implementation. Consequently, there exists an urgent need to embark on the development of advanced electrocatalysts that exhibit heightened levels of efficiency, stability, and cost-effectiveness. Such a pursuit is imperative, as it holds the potential to substantially reduce the overall financial outlay associated with the process of water electrolysis.

In this study, we introduce a novel single-atom catalysts (SACs) design strategy that involves anchoring single atoms (SAs) onto catalytically active porous supports. This strategy is demonstrated through the use of NiFe-based metal-organic frameworks (MOFs) to stabilize binary Mo and W SACs. These SACs emerge as highly efficient and stable bifunctional electrocatalysts for electrolytic water splitting. The binary SAC system, where both Mo and W SAs are anchored onto the FN-MOF, is termed MOF-MoSAWSA. For comprehensive comparison, unary SAC systems were fabricated, including FN-MOFs containing only Mo SAs (sample MOF-MoSA) and only W SAs (sample MOF-WSA), as well as a plain FeNi bimetallic MOF (sample FN-MOF). Confirmation of the atomic dispersion of Mo and W SAs was achieved through HAADF-STEM images and FT-EXAFS. Notably, FT-EXAFS and XPS indicated both long-range interactions between Mo and W SAs and interactions between SAs and MOF supports.

For the present work, MOF-MoSAWSA exhibited the best catalytic performances toward both OER and HER among all samples studied, exhibiting overpotentials of 199 and 250 mV for OER, and 57 and 297 mV for HER at 10 (η10) and 500 (η500) mA cm^{-2}, respectively, and Tafel slopes of 30.2 and 82.4 mV dec^{-1} for OER and HER, respectively. When serving as both anode and cathode for overall water splitting, the MOF-MoSAWSA//MOF-MoSAWSA couple required only ultralow cell voltages of 1.501 and 1.780 V to deliver current densities of 10 and 500 mA cm^{-2}, respectively, and showed excellent stability, experiencing only 2% decay in current densities after a 56-hour chronoamperometric operation at an initial current density of 515 mA cm^{-2}. The remarkable performance of MOF-MoSAWSA can be attributed to several key factors. First, the utilization of the porous and catalytically active FN-MOF as the SAC support effectively stabilizes Mo and W SAs while also serving as a co-catalyst during reactions. Second, atomically dispersed Mo and W SAs significantly reduce overpotentials. Third, the robust interactions between Mo and W SAs, coupled with the interactions between SAs and supports, synergistically enhance catalytic efficiency. This innovative catalyst design approach, featuring catalytically active support-hosted SACs, opens new avenues for advanced catalyst development and holds promise across diverse catalytic processes.

Abstract No. 0184 Meng-Hua Lin

Perovskite-structured oxides have been commonly used as electrode materials in pseudocapacitive energy storage. The prevailing charge storage model in perovskite oxides implies a variation of oxygen vacancies and electron in the bulk of oxides. Thus, the conventional wisdom lies in that the energy is stored through an anion intercalation mechanism involving oxygen vacancy transport. However, as the chemical bulk diffusion of oxygen is extremely sluggish at room temperature, altering the oxygen content in oxides is thus kinetically unfavorable. Such a sluggish energy storage mode is thus inconsistent with the fast kinetics that has been generally observed for perovskite oxide electrodes in pseudocapacitors. Herein, we report that the pseudocapacitances of perovskite oxides in alkaline electrolytes can stem from the hydrogen intercalation, realized by the dissociation of protons and electrons in oxides. We combine the electrochemical studies of a series of perovskite oxides in KOH electrolytes with detailed structural and chemical characterizations employing surface-sensitive X-ray spectroscopy and depth profiling X-ray photoelectron spectroscopy. It is found that the origin of the pseudocapacitance arises from the subsurface hydrogen intercalation rather than the classic bulk anion intercalation. The finding of a new charge storage mechanism in perovskite oxides provides a better understanding of redox behaviors of functional oxides in alkaline electrolytes, highlighting the importance of reconsidering surface hydrogen intercalation for the diagnosis and design of electrode materials toward pseudocapacitive applications.

Abstract No. 0185 **Yu-Hsiang Yang**

Doping multi-walled carbon nanotubes (MWCNTs) presents a simple and cost-effective approach for enhancing the electrochemical performance of copper hexacyanoferrate (CuHCF). This study delves into the role of CuHCF@CNT composite materials in electrochemical systems across different doping ratios. Thanks to their superior specific surface area, improved crystallinity, and reduced charge transfer resistance, these composites significantly bolster the deionization performance of CuHCF. In solutions featuring various cations, the doped carbon nanotube active materials elevate the deionization capacity by an astonishing approximate 60%. This discovery provides a straightforward and economical pathway for increasing the storage capacity of Prussian blue analogs. Furthermore, the affinity between CuHCF and different cations closely correlates with the ionic radius of the cations involved. The study also indicates that by fine-tuning the charging voltage, the selectivity of the CuHCF@CNT100 composite for K^+ ions can be remarkably enhanced from a βK/Mg value of 3.09 at 1.2 V to 16.43 at 0.6 V. This opens up new strategic avenues for improving the selectivity of Prussian blue analogs towards K^+ ions.

Abstract No. 0186 **Zi-Jun Lin**

Hydrogen (H_2) energy is the most promising, green, sustainable, and alternative energy source to replace conventional fossil fuel in the next generation. Our work reports a photocatalyst, g-C_3N_4, prepared by a gel-like network containing silver (Ag) and dicyandiamide as a precursor for photocatalytic H_2 generation under light irradiation. Ag can be intercalated within the g-C_3N_4 structure through linking Ag together, forming a gel-like network, which can greatly enhance the charge separation and light absorption property, and photocatalytic H_2 evolution activity. The Ag-incorporated g-C_3N_4 had H_2 generation activity after Pt loading under light irradiation ($\lambda > 400$, 450, 550 nm) in the presence of triethanolamine, and it can be used as an effective and efficient photocatalyst for H_2 production.

Abstract No. 0188 Mingxu Li

Lithium-sulfur (Li-S) batteries are considered promising energy-storage systems because of their high theoretical energy density, low cost, and eco-friendliness. However, serious problems, especially the notorious shuttle effect, can result in the loss of active material, poor cyclability, and rapid capacity fading. The utilization of a structural configuration that enhances the electrochemical performance via adsorption-catalysis dual strategies can overcome the limitations of Li-S batteries. Herein, an integrated interlayer structure, in which hollow carbon fibers (HCFs) were modified with in situ generated nickel (Ni) nanoparticles, was prepared by a scalable one-step carbonization method. Highly conductive and hierarchically porous HCFs as the carbon skeleton provide a continuous three-dimensional (3D) conductive network to enhance the ion/electron diffusion and physically confine polysulfide diffusion. The Ni nanoparticles with superior anchoring ability and a strong catalytic effect can prevent the shuttle effect and increase the conversion rate of polysulfides, promoting excellent electrochemical performance at high rates. This synergistic effect resulted in a high capacity retention of 582 mAh g^{-1} at 1 C after 100 cycles, providing an excellent rate capability of up to a 3 C. The novel structure wherein Ni nanoparticles are embedded in cotton-tissue-derived HCFs provides a new avenue for enhancing the electrochemical performance at high C rates, affording a low-cost, sustainable, high-performance hybrid material for the development of practical Li-S batteries.

Abstract No. 0190 Yu-Chi Wang

Lithium-ion batteries power essential applications like electric vehicles and portable devices. Concerns about the safety of liquid electrolytes have sparked interest in solid-state alternatives. Poly(ethylene oxide) (PEO) has emerged as a cost-effective, chemically stable, and lithium-ion-conductive solid electrolyte. However, PEO faces limitations such as low room-temperature lithium ion conductivity ($\sim10^{-5}$ S/cm) and a low transference number (t^{+} averaged at ~0.1), hindering practical use as a solid electrolyte[1]. To overcome these challenges, researchers have explored methods like addition of plasticizers, polymer blends, crosslinking, and block copolymers. Among these, the addition of fillers stands out as a straightforward and effective solution[2].

Our study aims to enhance PEO-based solid electrolytes' electrochemical properties, particularly lithium ion conductivity and transference number, by incorporating metal-organic framework (MOF) fillers. MOFs offer extremely high specific surface area, and through surface Lewis acid-base interactions with ionic species and PEO, improving electrochemical performance[3]. We employ nano-sized UiO-66 MOF[4], characterized by zirconium-based metallic clusters and terephthalic acid (bdc)-based organic linkers, known as $Zr_6O_4(OH)_4(CO_2)_{12}$, with exceptional stability[5]. By modifying the functional groups on the bdc linker, we can alter the filler's surface properties, including surface pH value and potential, affecting the PEO electrolyte's behavior. Our research demonstrates that the addition of MOF fillers can tune the electrochemical performance of PEO-based solid electrolytes. This work opens up a new avenue in solid-state electrolyte development, offering the potential to address critical issues in lithium-ion battery technology.

Abstract No. 0191 Wen-Yang Jao

Calcium-based batteries are considered a promising candidate for the sustainable energy storage system of the next generation because of the abundance of Ca. However, the development of Ca-based batteries is hindered by the incompatibility between metallic Ca and common electrolytes as well as the absence of calcium-ion-hosted materials with good performance and cycling stability. Herein, we firstly investigate a small molecular organic material, 3,4,9,10-perylenetetracarboxylic diimide (PTCDI), as the calcium-ion host for calcium-ion batteries (CIBs) in the non-aqueous electrolyte. Spectroscopic, structural, and computational studies reveal that PTCDI with an enhanced Ca^{2+}-storage degree can increase the solubility of reduced PTCDI due to the reduced π-π interaction, suppressed by the saturated electrolyte owing to the high redeposition rate to form a PTCDI film with strengthened hydrogen bonds, which facilitates a fast enolization reaction for Ca^{2+} storage. A cell assembled with the PTCDI negative electrode and carbon-based positive electrode exhibits a high-power density >3000 W kg^{-1}, a high energy density of ~150 Wh kg^{-1}, and superior reversible capacity of 80 mAh g^{-1} at 5 A g^{-1}. The assembled CIB even demonstrates the high-rate performance (90 mAh g^{-1} at 1 A g^{-1}) and ultra-stable cyclability over 4000 cycles with negligible decay at -10 ℃, suggesting the promising future as low-temperature batteries.

Abstract No. 0192 Ying Liu

With a high theoretical capacity (1675 mAh g^{-1}) and energy density (2600 Wh kg^{-1}), low prices, and environmental friendliness, lithium-sulfur (Li-S) batteries are considered as a suitable successor in energy storage. However, Li-S batteries also face a series of problems, which are currently hindering the commercialization progress, including the intrinsically insulated elemental sulfur and the final discharged product (Li_2S), the generated intermediates of lithium polysulfides, and sluggish reaction kinetics. Therefore, a unique hierarchical interlayer structure in which *in-situ* generated Fe_3O_4 nanoparticles are encapsulated in hollow graphitic carbon fiber (HGCF) composite has been elaborately designed to address the limitations in Li-S batteries. In particular, the *in-situ* generated Fe_3O_4 nanoparticles not only have the superior anchoring ability for polysulfides, but also possess the strong catalytic effect to enhance the conversion rate, promoting an excellent electrochemical performance at high rates. In addition the HGCF derived from waste cotton tissues constructs a three-dimensionally interlacing carbon network to further enhance the transfer of electrons/ions, accelerating the reaction kinetics. As a result, the Super-P/S cell with the hybrid interlayer shows a high capacity retention of 700 mAh g^{-1} at 1 C after 100 cycles, providing excellent rate capability up to 3 C-rate. The excellent cycling stability and rate performance demonstrate that the hybrid interlayer is effective in improving the electrochemical performance even with a simple sulfur cathode electrode.

Abstract No. 0193 Wei-Chu, Hsu

In this study, we propose an oxygen-induced plasma-assisted surface modification method to improve the electrochemical performance of hard carbon derived from phenolic resin as an anode material for Li ion batteries. The hydrophobic surface of hard carbon is dramatically transferred to hydrophilic via oxygen-plasma engineering. The pristine hard carbon (HC-0) and plasma-modified ones were characterized by XRD, SEM, EDX, Raman as well as contact angle measurements and FTIR analyses. The optimized-condition of 3 mins plasma treated (HC-3) demonstrated the excellent electrochemical performance which shows in Fig 1, the initial specific capacities of HC-3 was 648.2 mAh g^{-1} at 0.1 A g^{-1}, while maintaining 123.7 mAh g^{-1} at 5.0 A g^{-1}, respectively. In addition, contact angle of modified hard carbon dramatically decreased from 114.333° to 3.792° after O_2 plasma treatment for 3 mins, and the diffusivity of Li^+ in hard carbon was enhanced from 4.27×10^{-13} cm^2 /s to 4.78×10^{-12} cm^2 /s. The charge resistance also reduced from 200 Ω to 50 Ω. All these results demonstrated that plasma-treated hard carbon is a potential candidate as an anode material for LIBs.

Abstract No. 0194 Ammaiyappan Anbunathan

The primary issue of the lithium-sulfur battery (LSB) system is the significant shuttle effect of polysulfides. The shuttle effect is effectively eliminated by sulfurized polyacrylonitrile (SPAN), in which the sulfur is covalently bound to the carbon matrix of the PAN polymer matrix. Designing quasi-solid state LSB (QSSLSB) systems appears to be more trustworthy and effective when considering battery safety and energy density into consideration. In this work, we used a solution-casting method to fabricate a freestanding hybrid solid-state electrolyte (HSE) membrane from a suspension of interconnected $LiTa_2PO_8$ (LTPO, as the filler), poly (vinylidene fluoride-co-hexafluoropropylene (PVDF-HFP, as the polymer matrix), lithium bis (trifluoro methane sulfonyl) imide (LiTFSI, as the salt), and succinonitrile (SN, as the plasticizer). The as-prepared LTPO-HSE composite membrane was assembled with a SPAN cathode and a Li anode. Our composite membrane exhibits good compatibility with the cathode and decreased interfacial resistance and delivers better Li^+ transport characteristics (ca. $t_{Li}^+ = 0.78$). According to the GITT test result, the 2032-type coin cells with LTPO-HSE membranes have an average Li^+ diffusion coefficient of about 1.06×10^{-10} cm^2. Furthermore, the symmetrical cells that have Li metal and LTPO-HSE membrane exhibit smoother Li plating/stripping for 100 h at a current density of 1 mA cm^{-2}. A SPAN/LTPO-HSE/Li full cell exhibits a high initial capacity of 1189 mAh g^{-1}, and after 200 cycles, it maintained the specific capacity of 1118 mAh g^{-1} with a steady coulombic efficiency of 99.9%. With a decay rate of 0.02%, the capacity retention was over 96% (from the second cycle). Furthermore, our QSSLSB cell exhibits superior capacity retention of 81% after 350 cycles at a 0.5C rate. Due to its higher flexibility, ionic conductivity, wider electrochemical window, and minimal in-situ heat generation, the as-yielded single-layer LTPO-HSE membrane shows promising to be a solid-state electrolyte for future solid-state lithium-sulfur battery applications.

Abstract No. 0195 Zabrian Dirfan

Lithium-sulfur (Li-S) batteries are considered as one of promising energy storage systems for the next generation due to their high theoretical capacity (1675 mAh/g), high energy density (2600 Wh/kg), low cost, and environmental sustainability. However, the serious problems of Li-S batteries result from low electrochemical activity, poor cyclability, and sluggish reaction kinetics. Therefore, in this study, a honeycomb-like porous carbon (HPC) with micro-, meso-, and 95icroporous structure as sulfur host has been elaborately designed, which was derived from waste coffee grounds. The micropore, as the main reactor, undergoes a "solid–solid" reaction mechanism in carbonate based electrolyte, effectively preventing the generation of polysulfides. The macro- and mesopores can improve the accessibility of the electrolyte, accelerating ion transfer in the cell. As a result, the cell with this novel configurational shows only 0.03% capacity fading per cycle over 1500 cycles at 0.5 C-rate, providing excellent long-term cycle durability up to 10 C-rate. The excellent cycling stability and rate performance demonstrate that the novel structural configuration is effective in improving the electrochemical performance and prolonging the cycle life of Li–S batteries.

Abstract No. 0196 Ching-Tzu Liu

This chip is established to a three-electrode design by screen printing with inks, Ag working/ counter electrodes and Ag/ AgCl reference electrode. This chip is used to incubate ES-2 cell (ovarian cancer cell) directly and proceeds several experiments on it. A 3D-printing circle surrounded with the three-electrode is prepared in order to limit the grow area of ES-2 cell under different testing conditions. Fig. 1 shows the concept of this new Lab-on-a-chip biosensor system for ovarian cell observation.

Compared with the previous method using ITO to be the platform of culturing cells, it is not consuming time to set up the electrodes. This chip can rapidly go into chemical procedures. At the same time, using an optical microscope to observe present phenomenon, which the ovarian cells are electrical stimulated. And it also avoids external variables effecting the cells, such as: variety of the temperature and long set-up time. With this chip design, several instruments are adopted to an operando measurement such as surface plasma resonance, scanning electrochemical microcopy, and electrochemical quartz crystal microbalance for revealing more detail information.

Abstract No. 0197 Sheng-Heng Chung

Lithium-sulfur electrochemical cells with a sulfur cathode of the conversion type having a high theoretical capacity of 1672 mA h g^{-1}, corresponding to a high energy density of 2600 W h kg^{-1}. In addition, lithium-sulfur cells are low cost and environmentally friendly. However, the conversion-reaction electrochemistry of sulfur is sensitive to the amount of sulfur and electrolyte, resulting in poor electrochemical utilization and severe polysulfide diffusion. As a result, low sulfur loading and excess electrolyte amount are often employed, but these conditions limit the energy density of lithium-sulfur cells. Therefore, practical cell design parameters are required for the development of commercial high performance cells. In this presentation, we present a carbon structural material consisting of an entangled carbon nanotube matrix that entraps graphene nonosheets. The material is used as a highly flexible and stable electrode substrate for a high-loading polysulfide cathode with high sulfur loadings of 6-12 mg cm^{-2}. The high-loading cathode demonstrates attained a high rate performance of C/10-C/2 and stable cyclability for 200 cycles at low electrolyte-to-sulfur ratios of 6-4 μL mg^{-1}. In addition, we present a new cathode design with the material and configuration modifications as a core-shell polysulfide/carbon cathode in a lean-electrolyte lithium-sulfur cell. Such an integrated configuration optimization achieves a high sulfur loading and content of 12 mg cm^{-2} and 65 wt%, respectively, and record low electrolyte-to-sulfur ratios of 4 and 3 μL mg^{-1}, while enabling the cell to attain a high areal capacity and energy density of 9-10 mA h cm^{-2} and 20 mW h cm^{-2}, high rate performance of C/10-C/5, and stable cyclability of 200 cycles with high capacity retention.

Abstract No. 0198 Kumlachew Zelalem Walle

Solid-state lithium metal batteries (SSLMBs) that contain polymer and ceramic solid electrolytes have received considerable attention as an alternative to substitute liquid electrolytes in lithium metal batteries (LMBs) for highly safe, excellent energy storage performance, and stability under elevated temperature situations. Here, a novel fast Li-ion conducting material, $LiTa_2PO_8$ (LTPO) was synthesized, and electrochemical performance of as-prepared powder and LTPO-incorporated hybrid solid electrolyte (LTPO-HSE) membrane were investigated. The as-prepared LTPO powder was homogeneously dispersed in polymer matrices and a hybrid solid electrolyte membrane was synthesized *via* a simple solution-casting method. The room temperature total ionic conductivity (σ_t) of the LTPO pellet and LTPO-HSE membrane were approximately 0.17 and 0.54 mS cm^{-1}, respectively. Addition of 10 μL lithium difluoro(oxalato)borate (LiDFOB) and LiDFP salt containing liquid electrolyte (in EC/DME, 1:1 v/v %) to the cathode side improved the interfacial wettability and stable cathode electrolyte interface (CEI) and solid electrolyte interface (SEI) layers formation. A 2032-type coin battery with LFP cathode is cycled under 1C/1C between 2.5 to 4.0 V at room temperature, achieving an average coulombic efficiency of 100% with a capacity retention of 92.1% (the maximum specific capacity is at 19th: 138 mAh g^{-1} and 600th: 127.1 mAh g^{-1}) after 600 cycles. Similarly, a high-Voltage NCM811 cathode coin cell was cycled under 1C between 2.8 to 4.5 V at room temperature, achieving a Coulombic efficiency of 99.3% with capacity retention of 74.1% after 300 cycles. These results demonstrate the feasibility of a high Li-ion conductor LTPO as filler and the developed polymer/ceramic hybrid electrolyte has potential to be applied for the long-term cycling of high-performance electrolyte in high-voltage cathode materials, which may provide a fresh platform for developing more advanced solid-state electrolytes.

Abstract No. 0199 Yu-Chun Huang

Rechargeable aqueous zinc ion batteries (AZIBs) promise alternative rechargeable batteries for large-scale energy storage applications due to their high-safe and low-cost characteristics. However, AZIBs with aqueous electrolytes still suffer many challenges and problems, such as narrow electrochemical stability windows, zinc dendrite growth, and fast electrode deterioration. In this work, we prepare a high-stable hydrated eutectic electrolyte (HEE) of $Zn(ClO_4)_2$/EG with expanded electrochemical stability windows, significantly improving the zinc plating/stripping cycling performance. In the $Zn(ClO_4)_2$/EG electrolyte, the EG molecules also participate in the Zn^{2+} solvation via coordination and hydrogen-bond interactions, and the ClO^{4-} anions promote a stable SEI formation on the zinc anodes. The results show that the $Zn(ClO_4)_2$/EG electrolyte can effectively suppress the dendrite growth on zinc anodes, enabling long-term zinc plating/stripping cycling performance in symmetrical Zn/Zn cells. In the test of full cells, the assembled cell with the $Zn(ClO_4)_2$/EG HEE shows improved cycling stability compared to the cells with conventional aqueous electrolytes. Moreover, the solvent structure and electrochemical properties of $Zn(ClO_4)_2$/EG HEE are characterized by the spectra and electrochemical curves analysis, respectively. The mechanism of dendrite suppression on zinc anodes in $Zn(ClO_4)_2$/EG HEE is revealed via in-situ/in operando optical microscopy.

Abstract No. 0200 Yu-Chun Huang

Aqueous zinc ion batteries (AZIBs) employing zinc metal anodes have been considered an alternative battery system for large-scale energy storage applications due to their unique advantages of high safety, environmental friendliness, and low cost. However, the problems from the dendrite growth of zinc metal anode and the electrochemical instability of aqueous electrolytes result in the poor cycling stability of AZIBs. In this work, we effectively improve aqueous electrolyte stability and expend the electrochemical stability window (ESW) up to > 2.2 V in the high-temperature environment of 60°C by regulating zinc perchlorate/dimethyl sulfoxide ($Zn(ClO_4)_2$/DMSO) hybrid electrolytes. At a high temperature of 60°C, the severely electrochemical HER and corrosion/passivation on zinc metal anodes are suppressed. The Zn/Zn symmetric cell with a $Zn(ClO_4)_2$/DMSO electrolyte can exhibit a high-stable zinc plating/stripping cycling performance of over 800 h. Moreover, the assembled Zn//VO_2 full cells with a $Zn(ClO_4)_2$/DMSO hybrid electrolyte exhibit better high-temperature cycling performance than the aqueous electrolytes, achieving capacity retention of 45% after 500 cycles. These results confirm that the developed $Zn(ClO_4)_2$/DMSO composite electrolytes can effectively enhance the cycling stability and high-temperature adaptability of AZIBs.

Abstract No. 0201 Jeng-Kuei Chang

Supercapacitors (SCs) are compelling energy storage devices that allow ultrafast charging/discharging with a long cycle life and thus can be perfect complements to batteries and fuel cells. However, serious self-discharge has long been a crucial issue for SCs, which results in Coulombic efficiency loss and energy dissipation. These problems restrict the application of SCs. In this study, we find that the self-discharge behavior, which involves charge redistribution and Faradaic side reactions, is closely related to the pore size distribution of SC carbon electrodes. In addition, we propose a facile and cost-effective strategy of using electrode binders to alter the carbon pore size and thus mitigate the self-discharge. Our experimental results have proved a way to suppress self-discharge and improve cell reliability of SCs, which can thus become a more powerful component for future energy storage applications.

Abstract No. 0202 Yuta Inoue

$Ba_{0.5}Sr_{0.5}Co_{0.8}Fe_{0.2}O_{3-\delta}$ (BSCF) has been focused as a promising electrocatalyst for the oxygen evolution reaction (OER) in alkaline media. One of specific properties of BSCF is the structural transformation at its surface triggered by OER operation, which causes the enhancement of its OER activity by the formation of *in-situ* active layer. In general, the OER activities of metal oxides strongly depend on electrochemically active surface area (ECSA) and inherent catalytic activity per surface area (specific activity). However, it is difficult to quantitatively evaluate these time-variant parameters. 3D electrochemical impedance spectroscopy (EIS) is useful to obtain these parameters. In this study, we used 3D EIS to track the variation of ECSA and specific activity of BSCF during OER operation.

The OER activity of BSCF was evaluated using a three-electrode electrochemical cell with a rotating disk electrode in 1.0 mol dm^{-3} KOH solution. A working electrode was prepared by drop-casting an ink suspension with perovskite oxides (0.25 mg cm^{-2}), acetylene black (0.05 mg cm^{-2}), and Nafion (0.05 mg cm^{-2}) on glassy carbon. Pt wire and a reversible hydrogen electrode (RHE) were used as the counter and reference electrodes, respectively. 3D EIS was obtained in the following steps: First, cyclic voltammetry (CV) was performed for a certain number of cycles (1, 5, 10 ,30, and 50 cycles). Second, the electrode was left at open circuit potential for 5 min. Finally, potentiostatic EIS (PEIS) was recorded 5 times, and then instantaneous Nyquist plots at 5 min from the beginning of the first PEIS were compared.

Figure shows instantaneous Nyquist plots of BSCF. The diameter of semi-circle in middle-frequency region, which was assigned to the OER transfer resistance decreased with the increment of the CV cycles. Fitting results using the equivalent circuit indicated that the double-layer capacitance increased and the charge transfer resistance decreased during OER operation. These results demonstrated that while the ECSA significantly increased, the specific activity dropped to less than half of the initial value. Consequently, enhanced OER activity of BSCF was mainly attributed to the increased ECSA rather than specific activity. More detailed evaluation of their ECSA and specific activities during OER and comparison with other perovskite oxides will be discussed at the conference.

Abstract No. 0203 Yu-Hua Lai

Solid-state lithium batteries represent one of the most promising devices of battery technology. The high energy density of solid-sate lithium batteries is attractive. Nevertheless, a notable challenge lies in facilitating the smooth transport of lithium ions through the dense cathode within solid-state batteries. This limitation impacts the electrochemical performance, consequently leading to a decrease in the cell rate capability. To address this issue, this study introduces an innovative approach. The $Li_7La_3Zr_2O_{12}$ (LLZO) particles with a carbon coating layer are incorporated in the composite cathode. The experimental results obtained in this study demonstrate a noticeable enhancement in the electrochemical performance of the composite cathode. This study highlights the importance of employing carbon-coated LLZO as an additive for fabrication of better composite cathodes for solid-state lithium batteries.

Abstract No. 0204 Salva Salshabilla

Nickel-rich cathode materials have gained significant attention in the field of lithium-ion batteries due to their high energy density and potential to enhance the performance and capacity of rechargeable batteries. With a focus on their behavior and performance at high voltages, This report provides a comprehensive analysis of nickel-rich cathode materials, focusing on their behavior and performance at high voltages. It starts by highlighting the increasing demand for high-energy-density batteries in various applications such as electric vehicles. The importance of cathode materials in determining the overall performance of lithium-ion batteries is emphasized, with a specific focus on nickel-rich cathodes. Then we analyze the challenges associated with nickel-rich cathodes, particularly at high voltages. The issues which might limit their application, include voltage fade, capacity fading, and structural failure. At high voltages, occurs additional peaks at 4.5-4.7 V which indicates a sudden capacity fading or capacity roll-over throughout the cycles. In this report, we present an overview of the development of nickel-rich cathode materials and discuss various strategies to enhance the stability, cycle life and capacity retention of nickel-rich cathodes. By summarizing the main results and insights from the research project, we can emphasize how important it is to understand how nickel-rich cathode materials behave and function under high voltages to prevent capacity rollover.

Abstract No. 0205 Yi-Ting Huang

This research project aims to develop a flexible, smart color-changing, and self-powering zinc-ion air battery for creating a visually intelligent multifunctional energy storage device. To achieve multifunctionality while addressing challenges such as flexibility for wearables and electrolyte leakage prevention, we chose flexible conductive plastic (PET-ITO) as the substrate and used electrochemical synthesis to polymerize sulfur-treated sulfonated polyaniline (SPANI) on PET-ITO as the energy storage electrode. The resulting SPANI film possesses a unique quasi-biological nano-rod structure, with gaps between the nano-rods facilitating ion interaction between the electrode and the electrolyte, enhancing the Faradaic redox reaction. In this study, SPANI serves as the positive electrode paired with zinc as the negative electrode, creating a energy storage device resembling a zinc-ion air battery. Additionally, taking inspiration from biomimicry, we modified an ionic liquid-containing zinc-ion gel electrolyte with starch, endowing it with zinc-ion and ionic liquid properties while aiding the SPANI electrode in rapidly returning to a stable state after discharge. Furthermore, the thickening and antioxidant properties of starch contribute to creating an efficient and longer-lasting energy storage device that can self-charge through a chemical equilibrium process. As a result, this device combines multiple functionalities, including electrochromic, efficient energy storage, chemical equilibrium-based self-charging, and extended cycle life.

Abstract No. 0206 Hsing-Yu Tuan

Lithium, despite its numerous applications, particularly in lithium-ion batteries (LIBs), presents a significant challenge in terms of sustainability, given its scant presence, accounting for only 0.0017 wt% of the Earth‘s crust. These LIBs, though integral to evolving technologies like electric vehicles and expansive energy storage, are potentially unsustainable. In light of this, potassium-ion batteries (PIBs) have rapidly emerged at the forefront of battery technology research. Not only are they significantly more abundant, with potassium making up 2.09 wt% of Earth‘s crust, but they also present promising electrochemical attributes that could redefine energy storage. With the world moving towards innovative, high-density energy storage modalities, PIBs have positioned themselves as potential trendsetters. However, like all emerging technologies, PIBs have their challenges. A critical hurdle they face pertains to the dramatic volume changes (~400%) in anode materials during the ion insertion/extraction process. This massive shift often results in material fragmentation, severely truncating the battery‘s operational life. This presentation will show strategies for mitigating this volume expansion by employing nanostructured anodes made from high-capacity materials like Bi, Sb, P, and Se. By utilizing nanostructured anodes crafted from high-capacity substrates such as Bi, Sb, P, and Se, we believe a solution is within reach. An aspect of our exploration includes the optimization and activation of these materials, transforming them into high-performance anodes for PIBs. As a result, we‘ve achieved a benchmark in specific energy density, unlocking new prospects for designing robust, high-density energy storage systems adaptable across diverse electronic platforms.

Abstract No. 0207 Yola Bertilsya Hendri

Among the commercialized cathodes, Ni-rich layered cathode materials (Ni >90%) have been reported as one of the promising materials to pursue a high energy density and low-cost cathodes for Li-ion batteries (LIB) due to high Ni content is favorable to high capacity (>200 mAh g^{-1}), while low Co content is beneficial to minimize battery cost. However, Ni-rich layered cathodes (Ni>90%) suffer from intrinsic issues, such as phase transition, transition metal dissolution, microcrack generation, oxygen evolution, etc, leading to poor cycling performance and capacity degradation. Herein, the full-concentration gradient (denoted as FC-gradient) strategies were introduced on Ni-rich layered $Li[Ni_{0.92}Co_{0.04}Mn_{0.04}]O_2$ cathode materials. Our structural design allows a relatively high Mn concentration of the shell part of the particles to reinforce the structural integrity, and Ni-rich core part could impart a high energy density to the cathode materials. Our FC-gradient Ni-Rich Layered $Li[Ni_{0.92}Co_{0.04}Mn_{0.04}]O_2$ was prepared via a facile co-precipitation approach using a novel scalable Taylor–Couette reactor (TCR), followed by a solid-state reaction under suitable sintering conditions. The successful synthesis of FC-gradient Ni-Rich Layered $Li[Ni_{0.92}Co_{0.04}Mn_{0.04}]O_2$ (FCG-NCM92) was confirmed by cross-sectional energy dispersive spectroscopy line scanning. Importantly, the electrochemical performance of FCG-NCM92 materials was greatly enhanced relative to that of non-gradient NCM92 one. The charge-discharge test showed that the FCG-NCM92 cathode provided a capacity retention of 83.74% at 4.3 V, 62.82% at 4.5V, and 75.51% at 45°C after 100 cycles at 1C/1C. In contrast, the non-gradient NCM92 sample delivers a much inferior capacity retention of only 64.72% at 4.3V, 57.91% at 4.5V, and 67.55% at 45°C after 100 cycles at 1C. Thus, this state of art full-concentration gradient Ni-rich cathode materials offers an interesting strategy for improving electrochemical performance to facilitate the development of high-energy density cathode materials for high-performance Li-ion batteries.

Abstract No. 0208 Gokul Raj Deivendran

Li_2S based Lithium-Sulfur batteries with high energy density has been consider as a prominent energy storage technology and it’s limited by few decades. However, the poor conductivity of Lithium sulfide (Li_2S), the shuttle effect of polysulfide (PS) intermediates leads to a high-potential barrier at initial cycle, fast fading rate, and low-rate capability. The Li_2S active material which is decorated by porous two-dimensional Graphene Oxide Nanoribbon (GONR) and one dimensional multiwalled carbon nanotube (MWCNT) to synthesis Li_2S/GONR/CNT composite can improve the interconnected Li-ion pathway and enhance the electronic conductivity of cathode material. Moreover, we designed a lightweight Super P (SP) and carbonized Polyacrylonitrile (PAN) blends were used to prepare the SP/cPAN composite, which is used as the coating layer of Celgard PP separator (single layer structure). The Li_2S cathode side face the conductive coating layer of modified PP separator can accelerate the reaction kinetics of conversion mechanism and help to smooth delithiating from Li_2S cathode material. Our cell based on PP modified with SP/cPAN layer (double layer structure) shows a low activation barrier of 2.4V, smaller polarization by 0.66V, as compared with the bare one. Moreover, the PS adsorption capability and catalytic conversion of polysulfides are enhanced by SP/cPAN with N doping. Our analysis results indicated that the cell based on modified PP separator with SP/cPAN coating layer could effectively suppress the shuttle effect and improve the electrochemical performance. Significantly, it improves an initial discharge capacity of 1133 $mAhg^{-1}$ at 0.1C and achieved 815.6 $mAhg^{-1}$ at 1C rate. After 500 cycles, it maintains 329.4$mAhg^{-1}$ at 3C rate with capacity retention of 51.14%.

Abstract No. 0209 Pavitra Srivastava

Garnet-type solid-state electrolytes are among the most reassuring candidates for the development of solid-state lithium metal batteries (SSLMB) because of their wide electrochemical stability window and chemical feasibility with lithium. However, issues such as poor physical contact with Li metal tend to limit their practical applications. These problems were addressed using β-SiC as an additive to the Li anode, resulting in improved wettability over $Li_{6.75}La_3Zr_{1.75}Ta_{0.25}O_{12}$ (LLZTO) and establishing an improved interfacial contact. At the Li–SiC|LLZTO interface, intimacy was induced by a lithiophilic Li_4SiO_4 phase, whereas robustness was attained through the hard SiC phase. The optimized Li–SiC|LLZTO|Li–SiC symmetric cell displayed a low interfacial impedance of 10 Ω cm^2 and superior cycling stability at varying current densities up to 5800 h. Moreover, the modified interface could achieve a high critical current density of 4.6 mA cm^{-2} at room temperature and cycling stability of 1000 h at 3.5 mA cm^{-2}. The use of mechanically superior materials such as SiC as additives for the preparation of a composite anode may serve as a new strategy for robust garnet-based SSLMB.

Abstract No. 0210 Yu-Sheng Chiou

In the realm of semiconductor electrochemistry research, it has been observed that when subjected to anodization in hydrofluoric acid at room temperature, the anodized surface of low resistivity, 0.001 ohm-cm, *p*-type silicon usually exhibits a black flannel-like hue. Moreover, such surfaces typically do not manifest photoluminescence (PL) when irradiated with ultraviolet (UV) light. Here we found that the anodization process was conducted at a cryogenic temperature of -20°C, the PL emission from the surface under UV exposure exhibited bright red light as shown in Figure 1. This phenomenon may be due to quantum confinement, i.e., the appearance of nanocrystals. Utilizing Field Emission Scanning Electron Microscopy (FE-SEM) and Transmission Electron Microscopy (TEM), a distinct nanostructure was recognized on anodized surface. Contrary to conventional pothole-like etching patterns, the observed contour resembles a fern-like morphology as shown in Figure 2. This cryogenic electrochemical procedure proves efficacious for crafting luminescent porous silicon on heavily doped (low resistivity) P-type silicon. Consequently, this method holds significant potential for generating nanostructures on silicon substrates with specific electronic attributes.

Abstract No. 0211 Karthic Natarajan

The anode-free lithium metal battery (AFLMB) is a particular type of LMB with zero-excess lithium configuration (i.e., the N/P ratio is almost zero). Lithium metal is plated and stripped directly onto the anode current collector (CC), e.g., copper foil. This design helps to alleviate issues like lower volumetric energy density without increasing the cost of lithium metal. Due to the poor lithiophilic nature of CCs, anode-free Li batteries suffer from low coulombic efficiency (CE), poor cycling stability, and dead or dendritic lithium formation. Modifying the surface of current collectors with hierarchy decreases the local current density thereby providing uniform Li deposition and introducing lithiophilic materials improves lithium wettability. In this work, a nitrogen-rich metal-organic framework (Cu-TCNQ) was grown on the copper foil and simultaneously annealed to get a carbon-coated structured copper foil (Cu@N-C). The structured copper foil when assembled in an anode-free (AF) cell with NCM811 cathode showed a better electrochemical performance with an average CE of 98.12 % for 100 cycles and retained 31.26 % of initial capacity (CR).

Abstract No. 0212 Wei-Chi Huang

For great applications of nanomaterials, the synthesis of graphite nanoparticles and graphene is of paramount importance due to their unique properties and broad range of applications. Here we show an electrochemistry-based silicon carbide (SiC) thinning approach for by-producing graphite nanostructures, including nanoparticles and graphene, using hydrofluoric acid (HF) electrolyte. SiC wafers, when subjected to an HF/alcohol electrolyte for anodization followed by ultraviolet irradiation, exhibited unexpected photoluminescence, as illustrated in Figure 1. Notably, the electrochemical processing also exhibits superior fluorination of graphite nanoparticles (potentially incorporating graphene fragments). As shown in Figure 2, the characterization is further confirmed by XPS photoelectron spectroscopy. Such enhanced fluorination extends their potential applications in energy storage, high-performance supercapacitors, and advanced optics. The electrochemistry-based, rather than chemical-vapor-deposition based, approach is the ability to derive high-quality nanostructures and graphene in alignment with green chemistry principles. It signifies a pivotal leap in nanomaterial synthesis, especially in the energy sector.

Abstract No. 0213 **Jagabandhu Patra**

Transition metal oxides (TMOs) have found extensive application as electrode materials in the realm of next-generation lithium-ion batteries (LIBs). TMOs undergo a conversion reaction that enables multi-electron redox transitions, resulting in a notably high capacity (>1000 m Ahg^{-1}). Nonetheless, the practical utilization of TMOs is hindered by their rapid capacity degradation caused by limited reversibility, rendering them less suitable for practical applications. Recently, a new category of materials, known as high entropy materials (HEMs), has captured considerable research attention as potential candidates for high-performance anode materials. The fundamental premise of HEMs involves leveraging a multitude of constituent elements to maximize configurational entropy ($S_{config} \geq 1.5$ R) and achieve a single-phase solid solution structure. Among these HEMs, high entropy oxides (HEOs) stand out for their remarkable lithium storage performance attributed to the entropy-driven stabilization effects. While much of the investigation concerning HEOs revolves around tailoring their properties by exploring novel elemental combinations, the binder effects on the HEO performance has never been explored. The electrode binder is typically incorporated in a minimal amount, but it significantly affects the key aspects like the first-cycle Coulombic efficiency, cycling stability, rate performance, and solid-electrolyte interphase chemistry. The roles of the binder in the context of HEO anodes have remained unexplored until now. In this study, we investigate into this uncharted territory by introducing several binders and conducting a comprehensive analysis of their impact on the electrochemical characteristics of the HEO anodes. This study not only sheds light on the unexamined influence of binders but also unveils fresh avenues for optimizing HEO electrode performance.

Abstract No. 0214 **Tzu-Yu Kuo**

Solid-state lithium batteries exhibit great potential as next-generation energy storage devices. Nevertheless, certain challenges have constrained their practical utilization. Challenges like the thickness of solid-state electrolytes (SSEs) and the ionic conductivity they can offer at room temperature have hindered practical applications. In this study, modifications are made to the commercial polyethylene separator using SSE slurry to develop a solid composite electrolyte (SCE). Subsequently, the SCE is integrated with a high-capacity cathode to construct a solid-state $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ (NMC811)|SCE|Li cell. The proposed SCE demonstrates an excellent chemical stability and ionic conductivity. Moreover, the solid-state cell shows exceptional electrochemical properties at room temperature.

Abstract No. 0215 **Shih-Hua Chen**

Copper has been widely used in microelectronic devices because of its favorable properties. In recent years, many researchers have reported that introducing nanotwin defects into the microstructure of the copper can further improve mechanical strength, thermal stability, and electromigration resistivity. Additonally, the proportion of Kirkendall voids can be decreased as well. However, the common method to fabricate nanotwinned copper is through pulse electrodeposition by adjusting various parameter, and the synthesis rate of this way is rather slow (usually < 100 mA/cm^2). Therefore, it cannot satisfy the requirements of the industry for large-scale applications. In this study, we tried several combinations of additives to get high-orientated nanotwinned copper and have demonstrated that copper with certain orientations can be prepared at a high deposition rate (400 mA/cm^2). Apart from material analysis (such as XRD, SEM, and TEM) to confirm the twin structure, we also use electrochemical methods to explore the mechanism of copper deposition. It has been observed that the concentration of cuprous ion (Cu^+) is the key factor of nanotwin growth in our electrolyte formulation. Moreover, we hope to further understand the generation mechanism and orientations prediction by quantifying the stress changes in copper foils during electroplating.

Abstract No. 0216 **Shu-Cheng Li**

The inherent challenge of solid-state light emission from silicon, due to its indirect bandgap, may find a solution in the nanostructure of porous silicon. Semiconductor electrochemistry has highlighted that, following electrochemical etching, porous silicon can exhibit photoluminescence or electrically excited luminescence. These phenomena align with the predictions of the quantum confinement. Notably, in silicon crystals, electrons drift approximately three times faster than holes under static electric fields. Although electrons—the major carriers in N-type silicon—have the potential for superior efficiency, anodization remains unfeasible due to their absence of electron holes. Consequently, anodized regions of N-type silicon display no photoluminescence when subjected to UV irradiation, as illustrated in Figure 1. Our novel method involves a temporary hydrophobic bonding of N-type to P-type silicon, creating a detachable P-N junction before the electrochemical etching process. As visualized in Figure 2, this approach, under the influence of an electric field, draws holes from the P-type to the N-type silicon, enhancing its anodization and resulting in luminescent porous silicon. Crucially, this method avoids the contamination pitfalls associated with traditional PN junction formation techniques like ion implantation and epitaxial growth. It sets the stage for innovative nanostructure fabrication on N-type substrates.

Abstract No. 0217 Chun-Huang Wu

Silicon carbide (SiC), prized for its resilience to high temperatures, pressures, and corrosion, holds promise in applications from aerospace to electric vehicles. Yet, its inherent hardness and inertness pose etching challenges, hindering scalable production. While electrochemical etching presents a more straightforward, economical alternative to traditional methods, the mechanisms driving SiC thin film formation during this process remain underexplored. Here, we employ hydrofluoric acid for electrochemical anodization of SiC substrates, delving into the interplay between voltage-current and the resulting film's morphology. Our findings, underscored by increased impedance from film layering and pore density, are visually supported by a dense, sponge-like porous structure identified through SEM (Figure 1). Transmission electron microscopy (TEM) and X-ray diffraction (XRD) analyses further attest to the preservation of the SiC lattice structure (Figure 2). Our insights offer a deeper comprehension of SiC's electrochemical etching dynamics, paving the way for refined thin film production.

Abstract No. 0218 Lu-Yu Chueh

The exorbitant cost of iridium (Ir) poses a significant obstacle to the widespread adoption of polymer electrolyte membrane water electrolysis (PEMWE) on a large scale. To mitigate this challenge, it is imperative to substantially reduce the utilization of Ir on the anode. One straightforward strategy involves downsizing the catalyst particles; however, this necessitates the use of appropriate support materials capable of dispersing and anchoring fine Ir nanoparticles. In this study, we have explored the potential of tungsten oxide-based materials as supports for the oxygen evolution reaction (OER) catalysts, Ir and ruthenium (Ru). Our research delves into the synthesis of nanostructured substoichiometric tungsten oxide and the subsequent loading of ultrafine Ir/Ru-based nanoparticles. This loading process has led to a noteworthy enhancement in the mass activity of the tungsten oxide-supported Ir/Ru-based catalyst when evaluated under rotating disk electrode (RDE) conditions, surpassing the performance of commercially available Ir/Ru-blacks.

Moreover, through non-destructive depth profiling using synchrotron-based X-ray photoelectron spectroscopy (XPS), we have unveiled a robust catalyst-support interaction that curtails the oxidation of the supported Ir/Ru-based catalysts. This interaction has significantly bolstered the durability of the catalysts, even when subjected to accelerated durability testing conditions. To assess its performance under real-world PEM electrolysis conditions, we have directly coated the tungsten oxide-supported OER catalyst onto a polymer electrolyte membrane, forming a catalyst-coated membrane (CCM). These CCMs were then tested under single-cell conditions without a pressure differential. Additionally, we investigated the voltage-dependent chemical state of the supported catalyst in situ using synchrotron-based XPS, revealing a potential-dependent electron transfer between the catalyst and the tungsten oxide support.

Our findings are expected to contribute to the advancement of cost-effective PEM electrolysis anodes, thereby addressing the pressing issue of iridium cost in this technology.

Abstract No. 0219 Yuan-Yao Li

Rechargeable lithium-chlorine batteries, developed recently, have garnered significant attention due to their remarkable attributes, including high energy density, a substantial operating voltage, and an extensive operational temperature range. In this study, we harnessed biomass-derived activated carbon, boasting an ultra-high specific surface area (3672 $m^2 g^{-1}$) and a significant pore volume (2.67 $cm^3 g^{-1}$), derived from rice straw. This biomass-derived activated carbon served as the active material for our lithium-chlorine batteries. Furthermore, we employed carboxymethyl cellulose (CMC) as a binder, while introducing lithium tetrachloroaluminate ($LiAlCl_4$) into the electrolyte as an additive. Our developed battery demonstrated an initial discharge capacity of 3625 mAh g^{-1} at a current density of 150 mA g^{-1}. Impressively, it exhibited stable cycling performance through 240 cycles at a current density of 1000 mA g^{-1}, maintaining a capacity of 1200 mAh g^{-1}. The ultra-high specific surface area of the activated carbon provides ample storage capacity for redox products, significantly enhancing both capacity and cycling stability. CMC, with its excellent adhesion properties, complements these attributes, while the addition of $LiAlCl_4$ enhances the battery's stability during cycling. These achievements collectively contribute to the outstanding performance of the Li-Cl_2 battery.

Abstract No. 0220 Kevin Iputera

In recent years, the production and storage of green energy have arisen to be an important issue, where the most widely used energy storage devices today are batteries. Among them, Li–O_2 batteries process high energy density and are widely studied. Lithium peroxide (Li_2O_2) is deposited on the cathode during discharge and is decomposed while charging. Nevertheless, the discharge products are insulators and occupy the active sites on the cathode, which is responsible for the final death of the batteries. In this study, we utilize the soluble characteristic of Li_2O_2 in water to remove Li_2O_2 and thus regenerate the cathodes of the batteries after discharge. The used cathodes can be regenerated at least five times without capacity fading.

Abstract No. 0221 Jheng-Yi Huang

The high-voltage spinel $LiNi_{0.5}Mn_{1.5}O_4$ (LNMO) cathode material with high energy density, low cost, and excellent rate capability has grabbed the attention of the field. However, a high voltage platform at 4.7 V causes severe oxidative side reactions when in contact with the organic electrolyte, leading to poor electrochemical performance. Furthermore, the contact between the liquid electrolyte and LNMO leads to Mn dissolution during cycles. In this work, we applied the sol-gel method to prepare Li_3InCl_6-coated LNMO (LIC@LNMO) to address the mentioned problems of LNMO. By introducing a protective layer of halide-type solid-state electrolyte on LNMO, we can prevent direct contact between LNMO and electrolyte while maintaining good ionic conductivity. Thus, we could obtain the cycle performance of 5 wt% LIC@LNMO exhibited a Coulombic efficiency of 99% after the 230th cycle and a capacity retention of 80% at the 230th cycle at 1 C at room temperature.

Abstract No. 0222 Chun-Chieh Chou

In this experiment, electrodes primarily composed of transition metal oxide molybdenum trioxide (MoO_3) were fabricated and applied in the field of bioelectrochemical sensing. Silicon substrates were used as the base for electrode fabrication, onto which an array of carbon nanotubes (CNTs) was deposited. Subsequently, MoO_3 was coated onto the CNTs using chemical vapor deposition to create a three-dimensional bioelectrochemical sensing electrode structure, MoO_3/CNTs/Si.

To enhance the detection sensitivity of the fabricated sensor, photolithography was employed during electrode fabrication to define the growth morphology of the CNTs. The honeycomb-shaped CNTs further increased the specific surface area of the original electrode, augmenting the contact area between the electrode and the electrolyte, thus elevating the measurement sensitivity of the fabricated electrode.

Compared to bioelectrochemical enzyme sensors, non-enzyme bioelectrochemical sensors offer several advantages such as high stability, reproducibility, low cost, and reduced susceptibility to environmental influences. Therefore, in this experiment, the developed electrode was applied to non-enzyme glucose electrochemical sensing. During the measurement process, a 0.1 M sodium hydroxide aqueous solution was used as the experimental electrolyte. The hydroxide ions of sodium hydroxide and MoO_3 underwent a chemical reaction upon contact with glucose, resulting in an increase in peak current during measurement.

The experiment was conducted with segmented measurements ranging from 20 mM to 7 mM. Within the concentration range of 20 mM to 100 mM, the highest sensitivity of 17.4 $mA/mM\cdot cm^2$ was observed in this experiment, with a linear response correlation coefficient (R^2) of 0.9929, as shown in Fig. 1, demonstrating that MoO_3/CNTs/Si is an excellent non-enzymatic glucose electrochemical sensor.

Abstract No. 0223 Wan-Tien Huang

Zinc-ion batteries hold tremendous potential in the field of rechargeable batteries. However, as the number of charge-discharge cycles increases, the zinc negative electrode undergoes side reactions, leading to the formation of dendritic zinc byproducts, which results in a decline in the capacity and cycle life of zinc-ion batteries. This study successfully developed a multifunctional and smart color-changing polypyrrole//Zn flexible battery system that can achieve rapid chemical equilibrium through exposure to air, enabling self-charging. Additionally, it utilized a novel zinc-ion gel electrolyte to improve cycle life during testing and facilitate rapid self-powering reactions. The study employed various instruments, such as SEM, ex-situ FTIR, and XPS to identify the characterization and chemical structure of the organic energy storage electrode. This allowed for an investigation of the chemical structural changes of the electrode during charging and discharging processes at different working potentials. The fabricated polypyrrole//Zn flexible energy storage device exhibits excellent energy storage performance, operating at a working voltage of 1.6 V. At a current density of 1 Ag^{-1}, it achieves a high specific capacitance of up to 123.7 $mAhg^{-1}$ and demonstrates outstanding energy and power density. Even after 500 charge-discharge cycles, the device still retains 86.8% of its capacitance value. Notably, it can self-recharge to approximately 89.3% of its original capacity within approximately 10 minutes when discharged to 0.2 V without the need for external energy sources. Furthermore, the polypyrrole//Zn flexible energy storage device can serve as a visual indicator of its charge status through color changes. It effectively maintains its electrochemical energy storage performance even at different bending angles, making it suitable for applications in wearable devices, enabling the normal operation of LED lights and electronic watches. This demonstrates its significant potential for commercialization.

Abstract No. 0224 Ming−Jie Zhang

Nickel sulfides have been extensively studied in electrocatalytic reactions due to their high electrical conductivity. However, there is still room for improving catalytic activity and stability of nickel sulfides in urea oxidation reaction (UOR). Heteroatom doping has been regarded as an attractive approach to improve the electrocatalytic performance of nickel sulfides. In this work, we demonstrate that Co and Sn can be successfully incorporated into Ni_3S_2 host material by hydrothermal method (Figure 1a). The results show that Co and Sn codoped Ni_3S_2 exhibits the better UOR performance in comparison with Co-Ni_3S_2, Sn-Ni_3S_2, and Ni_3S_2 counterparts (Figure 1b). In UOR tests, Co/Sn-Ni_3S_2 exhibits the highest current responses (230mA cm^{-2} at 1.5 V), the lowest Tafel slope (94 mV dec^{-1}), and the highest turnover frequency (0.17 s^{-1}). The results indicate that the binary metal co-doping strategy can be effectively enhance the catalytic activity toward UOR.

Abstract No. 0225 Jung-Jie Huang

The flow-electrode capacitive deionization system has the advantages of high adsorption capacity, low energy consumption, continuous operation, and simultaneous electrosorption and electrode regeneration. This technology has attracted increasing attention for water resource regeneration. However, due to the high hydrophobicity and low electrochemical characteristics of the commonly used activated carbon based materials. The surface must first be modified to improve the wettability between the electrode material and the solution to further improve the desalination efficiency of the system. In addition, the use of activated carbon balls (ACB) as the flow electrode material has a spherical three-dimensional surface and the characteristics of sedimentation and stacking, which increases the difficulty of surface modification or coating process. In order to improve this problem, this study used dynamic liquid phase deposition to prepare TiO_2 films with good hydrophilic properties on ACB to form TiO_2/ACB electrodes, and then used dynamic high-pressure hydrothermal deposition of MoS_2 materials to prepare MoS_2/TiO_2/ACB electrodes. The experimental results showed that when the synthesis ratio of $(NH_4)_6Mo_7O_{24}\cdot 4H_2O:C_2H_5NS$ was 0.01:0.1, the MoS_2/TiO_2/ACB electrodes achieved an optimal desalination efficiency of 48.83 F/g in 5 mM NaCl solution, which was a 78.6% enhancement compared with the 27.33% desalination efficiency of the ACB. After 50 repeated desalination tests, the desalination retention rate was maintained at 93%. The research results verified that the MoS_2/TiO_2/ACB electrode has high desalination efficiency and long-term stability, meriting its great potential in the development of high-performance capacitive deionization technology in the future.

Abstract No. 0226 Yung-Tin Pan

The development of high performance and durable membrane electrodes are key to the success of hydrogen energy and net zero emission. Specifically, the mass deployment of water electrolzers and direct CO_2 electrolyzers is limited by the cost and manufacturing scale of membrane electrodes and related components like electrode catalysts and anode flow field materials. Operating cost is another concern where cheap renewable electricity must be available and utilized with high efficiency. Our group have been devoted in the engineering of membrane electrode and electrode materials for polymer electrolyte membrane water electrolysis (PEMWE) and membrane electrode assembly (MEA) based CO_2 reduction reaction (CO_2RR). In this presentation, we will present our recent research outcomes on 1. Low loaded iridium (Ir) oxygen evolution reaction (OER) catalyst for water electrolysis anodes and 2. $MgO/Mg(OH)_2$ incorporated cathode catalyst layers for MEA-based CO_2RR. Specifically, we will present how strong catalyst-support interaction of the developed Ir-IrO_x/WO_x catalyst can be utilized to boost OER activity and durability. Our further evaluation of this catalyst material on actual membrane electrode will also be revealed. The effects of incorporated $MgO/Mg(OH)_2$ to the performance of Cu cathodes for CO_2RR, including local pH effects, cation effects, and others are systematically studied and will also be discussed in this presentation.

Abstract No. 0227 **Ananya Panda**

Solid-state batteries (SSBs) are anticipated to revolutionize the domain of energy storage by virtue of their exceptional safety and elevated energy density, which result from the use of solid-state electrolyte (SSE) and a lithium metal negative electrode. The properties of SSEs, the key component of SSBs, are quite critical. SSEs have excellent thermal stability, high mechanical strength, a broad electrochemical window, but lack enough ionic conductivity, which is one of the most challenging aspects.[1] Incorporating appropriate active or inert fillers in the solid polymer electrolyte matrix is among the various methods employed to enhance the ionic conductivity of polymer-based SSEs.[2,3] Two-dimensional graphene-based fillers are a promising option as they provide a high surface area for creating an abundant interface with the polymer matrix. This establishes effective pathways for Li^+ transport and simultaneously their robust nature enhances the mechanical strength of the electrolyte. Pristine graphene is electronically conducting in nature owing to the continuous sp^2 carbon linkages, yet this electronic conductivity can be hindered by introduction of heteroatom functionalization on the graphene, which disrupts the sp^2 bonds. This study explores the heteroatom functionalization of graphene to produce diverse graphene-based fillers, including graphene oxide (GO), reduced graphene oxide (rGO), and fluorinated graphene oxide (FGO). These fillers are then separately incorporated into a polymer SSE matrix for application in $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$-based SSBs. Among these, FGO filler outperforms the others in terms of ionic conductivity, thermal stability, electrochemical potential window, and compatibility of the SSE. The optimized content of FGO fillers in the SSE demonstrates excellent electrochemical performance, enabling long-term Li plating/stripping cycling with small overpotential and stable operation of the $Li/LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ full cell. This work highlights the notable potential of FGO fillers in improving the properties of polymer SSEs and promoting the application of polymer SSEs in high-performance SSBs.

Abstract No. 0228 **Hao-Yu Ku**

The self-discharge phenomenon is an unavoidable response of electrical double layer capacitors (EDLCs) when the applied voltage is interrupted. How to alleviate this natural behavior is a challenge in the practical usage of EDLCs, especially since such a self-discharge phenomenon is demonstrated to be induced by the presence of trace water in the organic electrolyte. This research focuses on the alleviation of the water-induced self-discharge process in non-aqueous EDLCs through the utilization of a polyimide (PI) separator coated with the polyurethane-poly(acrylic acid) (PUPAA) copolymer (denoted as PI@PUPAA). The trace water in the non-aqueous electrolytes is effectively absorbed by the copolymer, leading to the obvious suppression of self-discharge in the EDLC cells. The introduction of Al_2O_3 nanoparticles into PI to form a composite separator (PI + Al_2O_3@PUPAA) substantially improves the electrochemical responses of EDLCs though the ionic conductivity of the PI@PUPAA separator is reduced by the PUPAA coating. This PI + Al_2O_3@PUPAA composite has been demonstrated to be a promising separator that significantly decelerates the self-discharge process of an EDLC with a comparable charge/discharge performance compared with the same cell utilizing the commercial TF4030 separator, as shown in Fig. 1.

Abstract No. 0229 Sanjana K.

Silicon have been identified as an alternative new material and is been proven to be an excellent anode material for high-energy LIBs due to their excellent theoretical capacity (4200 $mAhg^{-1}$), attractive discharge potential (0.2 – 0.4 V V/s Li/Li^+) and low toxicity. However, it undergoes volume expansion (~ 400%) during lithiation and delithiation process, which causes pulverization of particles leading to cracks in the internal structure of Si and repeated growth of high and thick solid electrolyte interphase (SEI) which intern leads to low initials columbic efficiency, rapid capacity fade and low rate capability of battery. Therefore, in order to overcome these critical issues and to enhance the Si anode performance some strategies developed are various morphological designs, synthesis of composites with Si and modifying the surface of Si anode and reducing the anode-electrolyte interphase kinetic barriers. In this study, we will do research on the surface modification of Si. In this 3-mercaptopropyl trimethoxysilane (MPTMS), is tailored on the surface of Si. The MPTMS acts as a coupling agent with thiol (-SH) functional group and is functionalized as a modification. And by using organosilane reaction and by forming strong Si-O-Si covalent bonds leads to the formation of artificial SEI on the Si surface, which inhibits the volume expansion. In the further reaction mechanism, the thiol (-SH) group is replaced by gold nanoparticles (AuNPs), which enhances the electrical conductivity and improves the interface kinetics for fast charging. In the latter part of the reaction, in order to increase the life cycle an oxidation reaction is carried out into a sulfonic acid ($-SO_3H$) group which acts as a functional group to be pre-lithiated by replacing -OH group with Li^+ ions. This study provides a new approach for fast charging with low cost for next generation LIBs.

Abstract No. 0230 Jen-Wei Teng

Lithium iron phosphate (LFP) has emerged as a compelling cathode material for lithium-ion batteries due to its pronounced safety, extended cycle life, and cost-effectiveness. However, the inherently poor electronic conductivity and low ion diffusivity of LFP adversely affect its electrochemical performance. To overcome these limitations, introducing a conductive coating layer onto the surface of LFP particles presents a simple and effective approach. The carbon coating layer establishes pathways for electron conduction, facilitating the electron transport across the LFP particles. Additionally, doping nitrogen into the coating layer can create lattice defects within the graphite structure and promote the electronegativity, which consequently enhance the electronic conductivity. In this study, dopamine is employed to provide the nitrogen-doped carbon coating onto LFP. To enhance the quality of coating layer, the mixing process of LFP and dopamine is carried out in supercritical carbon dioxide fluid ($SCCO_2$) due to its low density, negligible surface tension, and high diffusivity. The aim of this study is to optimize the $SCCO_2$-based surface coating process and develop a promising strategy to boost the electrochemical performance of LFP cathode materials.

Abstract No. 0231 Meng-Wen Chiu

Lithium metal has long been recognized as an ideal anode material for lithium batteries due to its high theoretical capacity (3860 mAh g^{-1}) compared to the conventional graphite-based anode (372 mAh g^{-1}). However, one of the major challenges for Li metal batteries is to mitigate the instability of the electrolyte-electrode interface caused by the formation of Li dendrites during cycling. Previous work in our group has demonstrated that the polyethersulfone (PES) membrane with asymmetrically porous structure can effectively suppress the dendrite formation through its nanoporous skin layer. In this study, we further improve the asymmetric PES membrane via surface functionalization with sulfonate groups (s-PES). The electronegative sulfonate group ($-SO_3H$) can enrich the PES chains with Li^+ hopping sites, which are expected to greatly promote the ion transport property of membrane. Therefore, a series of s-PES polymers were prepared by adjusting reaction conditions for sulfonation, and the corresponding s-PES membranes were fabricated using nonsolvent induced phase separation method. The physico-chemical and electrochemical properties of s-PES membranes were also systematically investigated to identify the optimal level of sulfonation and pore structure for promoting battery performance.

Abstract No. 0232 Nideesh Perumbalathodi

Cuprous thiocyanate (CuSCN) is considered one of the emerging candidates as an inorganic hole transporting material (HTM) for perovskite solar cell (PSC) applications due to its robust thermal stability and economic feasibility. However, challenges arise from the use of polar sulfide solvents, such as Diethyl sulfide (DES), during CuSCN film deposition. This solvent adversely affects the perovskite (PVSK) layer, leading to compromised PVSK/CuSCN interface contact, thereby impacting the open circuit voltage (V_{OC}) and long-term stability of CuSCN-based PSCs. In this study, we introduce 3-Mercaptopropyl trimethoxysilane (MPTMS) as a passivating agent at the PVSK/CuSCN interface to mitigate these challenges. Our findings demonstrate that MPTMS acts as a unique bifacial agent, addressing under-coordinated Pb^{2+} centers in the PVSK layer and meanwhile forming Lewis acid-base interactions with Cu^+ in the CuSCN (HTM layer). Serving as a multifunctional interlayer at the PVSK/CuSCN interface, MPTMS enhances the V_{OC}, resulting in a remarkable increase in power conversion efficiency (PCE) from 16.35% to 19.85%. Furthermore, the incorporation of MPTMS protects the PVSK layer from the detrimental effects of sulfide solvents during CuSCN spin-coating.

Importantly, MPTMS-treated PSCs exhibit robust stability, retaining approximately 93% of their initial performance after 1000 hours under ambient conditions, even without the use of additional encapsulation agents. This study offers a novel approach to enhance both the performance and stability of CuSCN-based PSCs, opening new avenues for the development of highly stable and efficient perovskite solar cells for practical applications.

Abstract No. 0233 Minjoon Hong

Neural network has been extensively investigated to parametrize the force field for molecular systems, providing the efficient and accurate multi-scale atomistic simulation. One of the widely investigated method, proposed by J. Behler and M. Parrinello encoding both geometric and chemical information with atom-centered symmetric function (ACSF) to predict the atomic energy with high dimensional neural network, is a powerful tool for fitting the interatomic potential to ab-initio DFT calculations. Still, its capability of extrapolation to unseen structures is a huge obstacle since the computational cost of data acquisition is notoriously high. This limitation prevents the neural force field from accurate simulation of chemical reaction such as decomposition of electrolyte since the molecular structure of such reaction significantly deviates from training dataset.

To resolve the issue, we apply the regularization layer with the analytical bond-order potential (BOP) to conventional neural force field model. Per-specie local BOP parameters set in multi-component systems was predicted through the high dimensional neural network to calculate the atomic energy. We further stabilize and accelerate the training by implementing global BOP parameter fitting. Our model is end-to-end differentiable that the interatomic force can be directly obtained analytically without any modification to the model. The model outperforms the conventional Behler-Parrinello neural network (BPNN) model in extrapolation task for both bulk and molecular systems with significantly less training dataset. We further analyze the capability of predicting atomic decomposition of electrolyte for ethylene carbonate(EC), which is common electrolyte solvent for Li-ion battery. Our model accurately predicts DFT-calculated bond dissociation energy profile of EC only using chemically stable training dataset, while BPNN does not.

Abstract No. 0234 Shao-Chun Liao

Recently, aqueous zinc-manganese secondary batteries have attracted much attention due to their high safety and low cost. However, the shortcomings of manganese dioxide, such as inferior electrical conductivity, slow reaction kinetics, and poor structural stability, hinder its large-scale application. In this study, we demonstrate that an Ag modified layered manganese dioxide can be successfully synthesized by a one-step hydrothermal method. The resulting $K_{0.20}MnO_2 \cdot 0.3H_2O/Ag_{0.08}$ (AgMO) shows better electrical conductivity and facilitated ion diffusion kinetics. Moreover, the Ag particles can be partially oxidized to Ag^+ during the charge/discharge process, and the formed Ag^+ can intercalated into the gallery space of layered MnO_2 creating structural defects, conferring improved ion transport kinetics. The prepared AgMO exhibits 246 and 125 $mAhg^{-1}$ at the current density of 1 and 8 Ag^{-1}, respectively. By contrast, the unmodified $K_{0.26}MnO_2 \cdot 0.39H_2O$ (MO) shows inferior electrochemical performance with only 125 and 55 $mAhg^{-1}$ under the same conditions. More importantly, the discharge capacity of AgMO remains 120 $mAhg^{-1}$ after 2000 cycles at 4 A g^{-1}, outperforming the MO sample (50 mAh g^{-1}). The reaction mechanism was further studied by ex situ XRD, TEM, and XPS analyses. The results signify the importance of Ag modification strategy for obtaining better cathode materials for energy storage.

Abstract No. 0235 Ting-Jun Lai

Current top-selling consumer electronic products often feature characteristics such as lightweight design, flexibility, and wearability. This trend has increased the demand for electrolytes with high strength, stretchability, plasticity, or self-healing properties in product development. Traditional hydrogel electrolytes tend to freeze and lose their ion conductivity properties under sub-zero temperature, limiting their application in various conditions. Therefore, there is a growing focus in recent electrolyte research on conferring anti-freezing properties to hydrogel electrolytes. Here, our objective was to create a foundational hydrogel by combining two distinct polymer segments, PVA (polyvinyl alcohol) and PEG (polyethylene glycol), to achieve effective stretchability and self-repair capabilities. The addition of SA (sodium alginate) was aimed at introducing additional hydrogen bonds to enhance the hydrogel's potential anti-freezing properties. Additionally, we incorporated an ionic liquid, LA (lithium perchlorate + acetamide), known for its high ion conductivity, chemical stability, and safety, to develop cost-effective ion gel electrolytes. We conducted comprehensive investigations to evaluate the stretchability, self-repairing ability, anti-freezing capability, and energy storage performance of these hydrogel electrolytes. In the final phase of the work, we electroplated carbon fiber cloth with manganese oxide and applied three different ratios of ion gel electrolytes to fabricate supercapacitors for testing. Ultimately, our findings revealed that PVA/SA/PEG/LA-0.25 (PSPLA-0.25) exhibited the most promising energy storage performance. It demonstrated a wide potential window of 1.8V, coupled with excellent capacitance (106.4 F/g) and energy density (47.9 Wh/kg). Furthermore, it displayed superior mechanical properties with a tensile elongation of up to 338%.

Abstract No. 0236 Ajayan Mano

The ordered mesoporous carbon (CMK-3) is used for LIBs because it presents a high surface area, controllable morphology, pore size, and chemical stability. However, CMK-3 suffers from a high irreversible specific capacity during the initial and remaining cycles. Alternatively, the addition of liquid metal which poses properties such as self-healing, fluidity, and surface tension improves the cycle life of LIBs. In this study, we successfully prepared Gallium (Ga) infused mesoporous carbon CMK-3/Ga by a simple ball-milling process. The Ga captivity into CMK-3 was confirmed through higher angle low-temperature XRD (reveals liquid to crystalline Ga phase transformation temperature down to 150K and vice versa), BET, SEM, TEM, and EDX. Then the CMK-3/Ga composite electrode materials were used to test EIS spectrometry, cyclic voltammetry, and the Galvanostatic Charge Discharge (GCD) cycling. We noticed that pristine CMK-3 initially in the range of 45% reversible capacity on the other hand Ga-loaded CMK-3 shows a higher initial reversible capacity ranging from 50-70% subject to the amount of Ga percentage less to high respectively but high load shows unstable GCD performance. Furthermore, a low Ga load shows capacity recovery during the long cycling GCD process. Moreover, the Ga phase change during the GCD conversion reaction examined through real-time in situ XRD analyses shows a steady growth of Li_2Ga alloy phase diffraction peaks. After the GCD coin cells were disassembled and then observed by SEM showed less Ga-loaded electrode uniform crackles surface but a highly loaded Ga wrecked island irregular surface was noted. The overall summary of this study is that less amount of Ga delivers favorable electrochemical performances detailed shown in Fig.1.

Abstract No. 0237 Hao-Hsiang Chang

Sodium-ion batteries (SIBs) are a promising technology for large-scale energy storage systems due to the abundance and wide distribution of sodium sources. In the composition of sodium-ion batteries, the energy density and retention rate depend on the performance of the cathode material. Among the studies on cathode materials of SIBs, Prussian blue analogs ($Na_xTM^I[TM^{II}(CN)_6] \cdot y\ H_2O$, TM^I = Mn, Fe, Co, Ni, etc., TM^{II} = Mn, Fe, Co, etc.) have been extensively studied and commercialized because of their cost-effective fabrication which is relatively simple and doesn't require heat treatment. Besides, its inherent open framework structure contributes to the diffusion pathway of sodium ions, and the composition of transition metals can vary widely, further enhancing its performance. However, the most significant issue lies in the water molecules trapped at the metal ion vacancy sites within the structure during the synthesis process, affecting sodium atom storage in the interstitial site. Additionally, the diffusion of sodium ions during the charging and discharging process can lead to structural distortion or even phase transition, further impacting the capacity retention of the battery. Therefore, it is crucial to minimizethe generation of interstitial water and remove it effectively. The composition of transition metal elements is also a key factor influencing the performance characteristics of the cathode materials.

In this study, quaternary Prussian blue analogs, $Na_x[MnFeNiCo]\ [Fe(CN)_6] \cdot z\ H_2O$, were fabricated by co-precipitation method as a cathode material for Na-ion batteries. By using four transition metals as precursors, the characteristics of high capacity and high stability can be combined. The material was confirmed by X-ray diffraction, field-emission scanning electron microscope, energy dispersive spectroscopy, X-ray absorption near-edge structures, and extended X-ray absorption fine structure. The electrochemical properties were investigated by galvanostatic charge-discharge, cyclic voltammetry, and rate performance testing. The results confirmed that the coexistence of these four metals can balance both capacity and stability, providing Prussian blue analogs a way to enhance the electrochemical performance.

Abstract No. 0238 Wuttichai Tanmathusorachai

In response to energy challenges, rechargeable zinc-air batteries (RZABs) are intriguing for their high energy density and environmental friendliness, although the sluggish cathode oxygen reduction reaction (ORR) and oxygen evolution reaction (OER) kinetics restrict RZABs performance. Prussian blue analogues (PBAs), owing to their highly porous structure and tunable morphology, are often utilized as the precursors of the materials. Particularly, high-entropy PBA (HEPBAs), formed by blending five or more metals in a random lattice, have achieved enhanced thermal and chemical stability to that of PBAs *via* a robust structure with multiple transition metal ions, reducing the likelihood of phase changes. Meanwhile, transition metal nitrides (TMNs) are a promising class of OER electrocatalyst due to their superior intrinsic conductivity compared to oxide-based materials. On the other hand, the N-doped carbon nanotubes (N-CNT) have shown remarkable ability in addressing the sluggish ORR. Herein, we introduced N-CNT into HEPBA derived TMNs nanoparticles, followed by *in-situ* nitridation and calcination processes, resulting in the synthesis of high-entropy metal nitride on N-CNT (HE-TMNs/N-CNT) which are effective for the bifunctional OER and ORR performance. HE-TMNs/N-CNT demonstrate superior activity towards the ORR ($E_{1/2}$ = 0.74 V) in a 0.1 mol L^{-1} KOH solution and OER (η = 390 mV @50 mA cm^{-2}) in a 1 M KOH solution. These results provide a facile pathway for the development of efficient bifunctional electrocatalysts for high-performance RZABs.

Abstract No. 0239 Soorathep Kheawhom

Efforts to improve the energy efficiency and longevity of zinc-air batteries (ZABs) have focused on addressing oxygen reaction challenges using sustainable electrocatalysts. Metal-organic frameworks (MOFs) and their derivatives are promising bifunctional electrocatalysts for these reactions, yet they often falter in real-world conditions due to limited conductivity and electrochemical performance. This study introduces a hybrid material, where MOFs-derived FeNiO porous material is embedded with 2D MXene nanosheets. This configuration enhances conductivity and exposes more active sites, leading to improved oxygen evolution (OER) and reduction reactions (ORR). The FeNiO@NC/Ti_3C_2 hybrid showcases impressive bifunctional activities, including a half-wave potential of 0.84 V and an overpotential of 1.55 V, along with commendable long-term durability and alcohol resistance in alkaline solutions. Notably, the 2D conductive Mxene contributes to the peak ORR and OER activities, achieving an ΔE value of 0.71 V. In practical application, a ZAB fitted with a FeNiO@NC/Ti_3C_2 air-cathode displayed an open circuit voltage of 1.48 V, peak power density of 164 mW cm^{-2}, and sustained cycling stability beyond 500 h. Beyond acting as conductive scaffolds, Ti_3C_2 Mxene nanosheets also optimize surface areas for the FeNiO@NC materials. This research paves the way for advancing oxygen reactions in ZABs and provides insights for crafting efficient MOF-based catalysts for energy transformation.

Abstract No. 0240 Atsuo Yamada

Achievement of carbon neutrality requires the development of electrochemical technologies suitable for practical energy storage and conversion. In any electrochemical system, electrode potential E is the central variable that regulates the driving force of redox reactions. However, quantitative understanding of the electrolyte dependence of E has been limited to the classic Debye-Hückel theory that approximates the Coulombic interactions in the electrolyte under the dilute limit conditions. Therefore, accurate expression of E for practical electrochemical systems has been a holy grail of electrochemistry research for over a century. Here we show that the "*liquid Madelung potential*" (E_{LM}) based on the conventional explicit treatment of solid-state Coulombic interactions enables quantitatively accurate expression of the electrode potential, with the E_{LM} shift obtained from molecular dynamics reproducing a hitherto-unexplained huge experimental shift for the lithium metal electrode. Thus, a long-awaited method for description of the electrode potential in any electrochemical system is now available.

Abstract No. 0241 **Sofiannisa Aulia**

The electrochemical reduction of oxygen to generate H_2O_2 is a promising route since it can show high energy efficiency and cost effectiveness compare to the existing anthraquinone process and various metal free carbon materials have been developed. Herein, we fabricate the carbon nitride quantum dots embedded on the graphene as support (CNQDs@G) to create additional edge sites to the graphene. Fig. 1a shows that CNQDs have a 3 nm average size. The structure of bulk g-C_3N_4, CNQDs, and CNQDs@G was confirmed by FTIR spectra (Fig. 1b) which shows the consistent characteristic peaks appear at the 800 cm^{-1} for triazine unit and between 1200-1700 cm^{-1} correspond to aromatic C-N. The electrochemical performance shown in Fig. 1c revealed that the CNQDs@G could provide significant improvement with the selectivity could reach to 99% in 0.65 V and the faradaic efficiency which reach to 99% in 0.65 V. The CNQDs@G shows high production yield of H_2O_2 when applied to the 2e- ORR zinc-air battery as shown in Fig. 1d. It can produce up to 5.39 mg cm^{-2} which could last for 3 hours. Thus, this study may shed a light to the exploration of metal free carbon material design for the electrochemical H_2O_2 production.

Abstract No. 0242 **Nurulhuda Shah**

Green, efficient, and sustainable are the key-features for future energy storage device application. Identifying biomass resources with high carbon content could be the decisive transition factor from petroleum to biomass resources in developing electrode material for electrochemical capacitor applications. This study investigates the extraction of carbon from coconut rachis to a honeycomb-shaped porous activated carbon for lithium-ion capacitor. The honeycomb-shaped carbon was further activated using KOH as the chemical activation agent to improve its surface area. The sample was activated at 600°C in nitrogen atmosphere. The surface area recorded a five-fold enhancement, from ~38 m^2 g^{-1} to ~1200 m^2 g^{-1} and is highly favourable in enhancing the non-faradaic surface charge accumulation mechanism. This study reports honeycomb-shaped porous carbon (HSPC) from a non-edible biomass (coconut rachis) with high surface area (up to ~1200 m^2 g^{-1}) as an electrode for lithium-ion capacitors. The lithium-ion capacitors fabricated in the HSPC//$LiPF_6$//Li configuration has delivered a specific capacitance ~126 F g^{-1} at 100 mA g^{-1}. The cathode material was capable of retaining 89% of its initial capacity after 500 cycles of charge-discharging at 100 mA g^{-1}, with coulombic efficiency of 99.8%. In addition, our research, study the beneficial of higher surface area and honeycomb structure as a way for the development of renewable and low-cost advanced energy storage and conversion devices.

Abstract No. 0243 **Ghufira Ghufira**

Solid polymer electrolyte (SPE) for lithium-ion batteries is considered as the most promising electrolyte due to high safety compared to liquid electrolyte. However, it still has some challenges to increase the ionic conductivity and to inhibit the dendrite formation of Li metal during charge discharge. In this work, we prepared solid polymer electrolyte based on polymerization of polyethylene glycol diacrylate (PEGDA), tetraethylene glycol dimethyl ether (tetraglyme) and lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) with a UV-crosslinked solvent-free method. To increase the mechanical strength of solid polymer electrolyte, the electrospun PVDF-HFP with ZIF67 (1 wt%) was used as substrate. ZIF-67 was incorporated in PVDF-HFP co-polymer to regulate Li flux for prevention of lithium dendrite growth. Solid polymer electrolyte containing 20 wt% of PEGDA exhibits superior ionic conductivity of 4.25×10^{-4} S cm^{-1}, the electrochemical stability window of *ca.* 4.4 V at room temperature, and energy activation of the SPE as 14.61 kJ mol^{-1}. The symmetrical cell with Li/SPE@PVDF-HFP-ZIF67/Li showing stable performance and good compatibility until 600 h at 0.2 mA cm^{-2} with an areal capacity of 1 mAh cm^{-2}. The full cell based on $LiFePO_4$/ SPE@PVDF-HFP-ZIF67/Li can achieve high coulombic efficiency as 99.89 % until 60 cycles with discharge capacity 145.48 mAh g^{-1} at 0.2 C rate at room temperature. These performances make the SPE a promising candidate for all solid-state lithium batteries.

Abstract No. 0244 **Jian-Tong Ke**

LFP is a commercialized cathode material, permitted by its high techno-economic index. However, a fast-charging feature has yet to be realized in this material, reasonably due to its suppressed electronic conductivity of nearly 10^{-9} S cm^{-1}. To alleviate this, we added various carbons in a slurry to improve the electrode's electronic conductivity, such as GONR, VGCF, and *r*-GONR. In this work, all the LFP electrodes were prepared with the same composition (active material: conductive additive: binder = 80:10:10 % wt. *vs*. slurry weight) and (the standard conductive additive used Super P), then the conductor between Super P and other conductive additives were constant 9:1% wt. *vs*. slurry weight). The electrode with 1% *r*-GONR agent showed the best electronic conductivity, which is 3.6×10^{-3} S cm^{-1}. Moreover, it was found that our sample with GONR additive demonstrated its long-term cycling capability, in particular, at high current of 10C (1700 mA g^{-1}). Under this extreme test condition, our LFP sample with 1 wt.% *r*-GONR showed 102.58 mAh g-^{1} discharge capacity after 600 cycles; it showed outstanding capacity retention (CR = 95.23%) and high average discharge capacity of 100.95 mAh g^{-1}. It was found that *r*-GONR is a highly promising additive for high C-rate LIB application.

Abstract No. 0245 **Kainat Darwaish**

Anode-Less Lithium-Metal Batteries (ALMBs) represent the next generation of high-energy-density and safe energy storage devices, offering the advantage of eliminating active anode materials. However, replacing the anode with copper (Cu) as a current collector in ALMBs is challenging due to uncontrolled lithium dendrite growth on the copper surface, causing rapid capacity decay and low Coulombic efficiency (CE). In this study, we present a facile one-step method for thermal-treating commercial Cu foils, leading to the growth of Cu_2O and CuO nanoparticles in an air atmosphere on the copper surface. The CuO/Cu_2O nanoparticles obtained display a spherical morphology, which offers abundant active sites for promoting uniform lithium plating and cyclic stability enhancement, primarily attributable to the development of a Li_2O-rich solid-electrolyte interphase (SEI). When integrated into an anode-less full cell (based on 2032-type) alongside a lithium iron phosphate cathode, the thermal-treated Cu foil electrode demonstrates remarkable performance. After 100 cycles at 0.5C, it exhibits an outstanding capacity retention of 99% with CE of 99.99%, significantly surpassing the performance of a bare Cu foil (its capacity retention of 26% with CE of 98.26%). This work highlights the potential of thermal-treated Cu current collectors to address the challenges associated with dendrite growth, thus offering a promising avenue for the development of stable and high-performance ALMBs.

Abstract No. 0246 **Feng Li Tea**

Vanadium redox flow batteries possess exceptional longevity and adjustable capacity, rendering them suitable for advantageous features such as rapid charge and discharge. Wherein, graphite felt usually serves as an electrode material due to its advantages of good conductivity, high surface area and electrochemical stability. This study employs the well-recognized method of utilizing chemical vapor deposition to coat graphene onto graphite felt, facilitating its surface activity and then enhance electrochemical performance. The as-prepared graphene-coated graphite felt is observed via scanning electron microscopy (Figure 1), which reveals a successful graphene coating on the carbon fibers of graphite felt. Furthermore, Raman spectroscopy testing confirmed that the defect density of graphene-coated graphite felt significantly exceeded that of the pristine graphite felt. This implies a substantial increase in more available active sites for electrochemical reaction. Finally, the enhancement mechanism will be further investigated by cyclic voltammetry and electrochemical impedance spectroscopy, etc.

Abstract No. 0247 Tsan-Yao Chen

Heterogeneous catalyst containing high density of oxygen vacancies (O^V) is proposed by decorating atomic metal oxide clusters and metal clusters with tunable dimension from atomic scale to sub-nanometer regime in the carbon or oxide supported metal / oxide nanoparticle (NPs). These catalysts are applied for electro and thermal catalytic application. With the unique geometric configuration, the collaboration between active atoms or O^Vs to the neighboring atoms on the atomic clusters is triggered. Such a collaboration boosts the reaction kinetics and enables the simultaneous operation of all intermediate steps consequently leading to a quantum leap of the catalytic performance. In addition to noble metal catalyst, atomic scaled Co oxide clusters (CoO_x^a) were demonstrated. Those clusters are decorated in surface defect regions of Co oxide supported Pd nanoparticles (CoO_x-Pd) by chemisorption followed by ultra-high-speed quench reaction of Co oxides by using strong reduction agent. The decorated CoO_x^a localizing electrons from the neighboring atoms and thus boost the activity of CoO_x-Pd by 10-times in ORR. For the optimum scenario, the CoO_x-Pd enhance its mass activity by 340 times as compared to that of commercial Pt catalysts in an alkaline electrolyte of 1.0M KOH.

Abstract No. 0248 Kuan-Wei Lu

In this study, we use the metal electrodeposition method to produced fabrication of flexible amorphous indium-gallium-zinc-oxide thin-film transistors (a-InGaZnO TFTs) on the 25-μm-thick copper substrate. The Cu substrate compatible with high-temperature processes was deposited by electroplating, which led to a smooth surface. The InGaZnO layer was deposited at room temperature processed, and annealing process was conducted at 600K in the air after the fabrication of TFTs. We found that the threshold voltage shift and contact resistance are improved after annealing, whereas the mobility are also increased.

Electrochemical indium-gallium-zinc-oxide thin-film transistors (InGaZnO TFTs) have been widely investigated over the last decade.This study comprehensively investigates the self-heating effect of amorphous InGaZnO thin-film transistors under various oxide insulator fabrication processes. To mitigate the degradation caused by self-heating in a-InGaZnO TFTs, four different insulator structures were employed, each subjected to electrical characterization individually. Initially, a Self-Heating Stress was conducted to observe the deterioration behavior of a-InGaZnO TFTs under high gate-source voltage (VG) and drain-source voltage (VD) conditions. Based on experimental results, it was found that the a-InGaZnO TFT exhibited optimal reliability when the oxide insulator layer (SiO_2) possessed both “loose” and “SiO2 etched on both sides” characteristics (Fig.1). This study introduces a novel electrochemical 121iffusion model to elucidate the impact of these two insulator characteristics on reliability. We propose that silicon dioxide (SiO_2) can capture oxygen elements from the active layer of a-InGaZnO. When oxygen elements are captured, oxygen vacancies are formed in their original positions. An increased number of oxygen vacancies make it easier for hydrogen atoms to diffuse from the source and drain, leading to an increase in channel resistance. The increase in channel resistance reduces both current flow and Joule heating, effectively suppressing the degradation of a-IGZO TFTs. Finally, by calculating the contact resistance and hydrogen diffusion distance using the Transfer Length Method, the validity of the model is confirmed.

Abstract No. 0249 Gayathry Ganesh

Supercapacitors (SCs) contribute significantly to meeting the surging demand for energy storage technologies requiring rapid charge-discharge capabilities and high power. Using aqueous electrolytes in SCs further expands their advantages by providing safety and eco-friendliness compared to organic electrolytes. A strategic approach of increasing the specific capacitance and voltage window of the electrolyte is essential to boost their energy density, a critical factor in availing their broader usage in applications requiring higher specific energy. In this regard, green fluorescent carbon dots (CDs) synthesized from palm kernel shells synthesized via hydrothermal route are introduced as an additive in 1 M KOH aqueous electrolyte. The utilization of these CDs in a symmetric cell yields a notable increase in specific capacitance, raising it from an initial 29 F g^{-1} to a striking 41 F g^{-1} along with an expansion of potential window from 1.6 to 1.8 V. Further, the incorporation of CDs enhances the electrode/electrolyte interaction which lowers various resistances appearing in the system. The addition of the as-prepared CDs outperformed the specific energy of 10 Wh kg^{-1} of the bare electrolyte by increasing to ~18 Wh kg^{-1}. Simultaneously, the maximum specific power presented a commendable improvement, by incrementing from 2.2 to 2.4 kW kg^{-1}. This study not only highlights the potential of sustainable additives but also underscores the pivotal role they play in advancing the performance and eco-friendliness of energy storage solutions.

Abstract No. 0250 Chih-Ping Chen

The passivation of interfacial defects in perovskite solar cells (PSCs) through the use of a transport layer (TL) has emerged as an intriguing and efficient strategy to enhance their performance. [1] In this study, we explore the potential of A–D–A molecules, specifically DTPTCY, DTPTID2CN, and DTPTID2CN2F, which consist of electron-donating coplanar heteroacenes as the core (DTPT) and are capped with various electron-accepting groups, as effective modifiers for the electron TL (ETL) in indoor PSCs. [2] By carefully managing the compatibility and energy level alignment at the interface between the perovskite and the ETL, we have successfully implemented an efficient approach to mitigate trap-induced nonradiative carrier recombination within the perovskite and address interfacial trap state defects in PSCs. Our investigations reveal that employing DTPTCY:PCBM as the ETL effectively passivates perovskite defects, resulting in improved electron extraction capabilities and reduced recombination losses in indoor PSCs. When compared to control devices, this approach leads to a substantial increase in indoor power conversion efficiency, raising it from 30 % to 34.1 % under TL84 (4100 K, European shop fluorescent) lighting conditions (337.3 μWcm^{-2}). Additionally, this enhancement is accompanied by higher open-circuit voltage and fill factor. Remarkably, the unencapsulated devices exhibit excellent long-term stability, maintaining performance at 40% relative humidity, 25°C in the absence of light for 1500 hours.

Abstract No. 0251 Han-Wei Chang

Supercapacitors are currently one of the energy storage devices that have attracted much attention. In the present study, we synthesize carbon nanomaterials as supercapacitor electrode materials made from organic compounds (using glucose as carbon source) by using pre-carbonization and combined annealing processes. Field emission scanning electron microscopy (FESEM), synchrotron radiation X-ray spectroscopic techniques, and electrochemistry were employed to investigate the morphological, local electronic/atomic structure, and electrochemical properties. The unique properties allow glucose-derived carbon nanomaterials to serve as electrodes in supercapacitor application, and further deliver excellent capacitive performance (high specific capacitance of 967.40 mF cm^{-2} at current density of 2 mA cm^{-2} and outstanding cyclic stability (96.15% capacity retention after 1000 cycles) at current density of 32 mA cm^{-2} in three-electrode system). In order to characterize the practical application of glucose-derived carbon nanomaterials, they were assembled into symmetric supercapacitor devices. These symmetric supercapacitor devices could connected in series were able to light up light emitting diodes (LEDs), showing a potential of the glucose-derived carbon nanomaterials for practical applications.

Abstract No. 0252 An Hsueh

A photoelectrochromic device (PECD) is a combination of a dye-sensitized solar cell (DSSC) and an electrochromic device (ECD), which can directly achieve transmittance contrast by the solar energy without any external power supply. As for the application, PECD has been recently used as a self-powered smart window for green buildings. The primary focuses of most PECDs revolve around achieving either rapid response time or high optical contrast. In this study, we have designed a counter electrode characterized by both high optical contrast and electrocatalytic properties. PANI, engineered for its exceptional electrocatalytic performance, has been incorporated as the catalytic layer in the counter electrode to improve response time. Tungsten oxide and Prussian Blue synergistically serve as complementary components within the device. In Figure (a), the PB/PANI hybrid film exhibits a high optical contrast (DT=57.4% at 700 nm). Figure (b) illustrates the mechanism of PECD. When the smart window is in an open circuit and exposed to light, lithium ions will undergo intercalation within the WO_3 film, causing the film to change to a blue color. When the smart window is in short circuit and light off, lithium ions will intercalate the PB film leading to the change from PB to PW. These results demonstrate that the application of PB/PANI as a composite film for the bifunctional electrode in PECD has good performance.

Abstract No. 0253 Wen-Chang Wu

Solid oxide fuel cells (SOFCs) are considered to have excellent prospects due to their high power density, diverse fuel choices, and high conversion efficiency. One method for developing solid oxide fuel cells operating at low temperatures (LT-SOFCs) with high ionic conductivity in the electrolyte is through the formation of heterostructures by compositing with semiconductor materials. In this study, a commonly used semiconductor material, LNCA ($LiNi_{0.8}Co_{0.15}Al_{0.05}O_{2-d}$), was combined with the pure ionic conductor SDC ($Ce_{0.8}Sm_{0.2}O_{2-d}$) to investigate the impact of LNCA at different sintering temperatures (550, 600, 650, 700, 750, 800°C).The composite materials were prepared following the literature's weight ratio of 6LNCA-4SDC, and they were named $6LNCA_{CX\ (X=550,\ 600,\ 650,\ 700,\ 750,\ \mathrm{and}\ 800)}$-4SDC. The physical and chemical characteristics of the composite materials were analyzed using X-ray diffraction (XRD), thermogravimetric analysis (TGA), and Fourier-transform infrared spectroscopy (FTIR). The electrochemical characteristics of electrochemical impedance spectra (EIS) analysis.
Electrochemical impedance analysis was conducted using Pt/LNCA-SDC/Pt, revealing that as the sintering temperature of LNCA increased, the impedance decreased significantly. The $6LNCA_{C800}$-4SDC of optimal sample, achieved the highest conductivity of 0.02 S/cm at operating temperature of 600°C, with a corresponding low activation energy of 0.45 eV, while the conductivity reached 0.007 S/cm at 550°C. These results are superior to the conductivity and activation energy of traditional ionic electrolytes in similar device setups.
Interestingly, the coexistence of ionic and electronic conduction in LNCA-SDC did not result in any short-circuit phenomena but rather improved the electrochemical performance. The formation of heterostructures at the interfaces played a crucial role in enhancing ionic conduction, providing a unique and insightful strategy for advanced LT-SOFCs.

Abstract No. 0254 Ming-hung Lin

Talk about the Surface finishing trend evolution for PCB industry. PCB & IC substrates illustration & several types of surface finish are discussed in this speech. For high or low end of surface finish, different surface finish owns different market & packaging requirement. We just talk about the evolution trend.

Abstract No. 0255 **Mia Rinawati**

Ammonia, has traditionally been produced using the Harber-Bosch process, which involves harsh conditions. However, due to the high energy input required, researchers have been exploring electrochemical NH_3 synthesis through nitrogen (N_2)–water reactions under ambient conditions. Despite this approach's potential, it currently faces challenges such as low yield rates and poor selectivity, mainly due to the inertness of the N≡N bond. To address these limitations, the developed environmentally benign electroreduction of nitrate to ammonia conversion have been studied. Enlightened by the selective nitrate reduction (NO_3^-RR) of molecular Fe catalyst, herein we reported the Fe-N_x sites of the immobilized molecular Fe on NGQDs. The conjugation between the molecular Fe and NGQDs had exposed the molecular Fe-N_x coordination that played critical role in the NO_3^-RR as shown by the XAS result (Fig. 1a). Moreover, the *operando* Raman spectroscopy, we unveiled the dynamic nature of the Fe-N_x active sites during the NO_3^-RR, demonstrating its significance in the nitrate reduction reaction (Fig. 1b). The Fe-N_x molecular catalyst enables maximum Faradaic efficiency of 93% at -0.8 V (Fig. 1c) with a high yield rate 5.41 mmol h^{-1} cm^{-2}, leading to the high selectivity for the NO_3^-RR.

Abstract No. 0256 **Rasu Muruganantham**

Identification of novel materials is important for diversity applications. Storage performance through efficient electrodes is particularly desirable in battery applications. In this study, we prepared the novel $Fe_3V_3O_8$ (FVO) as an anode material for Na-ion storage by hydrothermal technology for the first time. The prepared material exposed a cubic phase structure with space group Fd-3m (Figure 1a). The synthesize FVO chemical compound with the oxidation states is detected through X-ray absorption spectroscopy (XAS) and X-ray photoelectron spectroscopy (XPS) analyses. The initial sodiation capacity is 805 mAh/g at 100 mA/g, and a reversible sodiation capacity of 540 mAh/g is maintained over 200 cycles at 500 mA/g (Figure 1b), which is higher than that of the carbon anode. In addition, the rate capacity is more stable with different current densities. The possibility of electrochemical reaction mechanism is predicted by ex-situ/in-situ X-Ray diffraction (XRD) analysis. Overall, the FVO material and its results demonstrated significantly higher electrochemical performance and promising suitability for sodium-ion storage. Besides, it can be used for other types of storage applications.

Abstract No. 0257 Geuna Kim

Imidazolium-based ionic liquid electrolytes (ILs) are promising candidates as alternatives to conventional aqueous electrolytes in zinc-air batteries due to their high electrochemical stability and wide operating temperature range. To maximize performance, a stable solvation shell of zinc ions and the electrochemical stability of ILs are crucial. While a number of theoretical and experimental studies have been reported on the performance of ILs for Li-based batteries, fewer studies have been conducted for zinc-air batteries. In this study, we screened several Imidazolium-based ILs for zinc-air batteries with respect to the solubility of zinc ions and redox potential using first-principles calculations.

Instead of directly calculating the solubility of zinc ions, we calculated the formation energy of the zinc ion solvation shell by anions to assess the stability of the zinc ion solvation shell. Additionally, the redox potential of the electrolytes was calculated for each cation-anion pair. The analysis was performed considering the HOMO/LUMO of the cations and anions of ILs. Our study provides theoretical insight into designing high-performance and stable ILs for zinc-air batteries.

Abstract No. 0258 Ding-Huei, Tsai

Carbon neutrality is an urgent issue in the sustainable energy development. The global have the target of net-zero carbon emission before 2050. Electrochemically derived reduction reaction of CO_2 (CO_2RR) to value added products provides a promising way to reach the goal. Although electrochemical CO_2RR is a technology of high potential, insufficient energy efficiency needs to be solve before large scale deployment. In this work, the activation of CO_2 molecules for the CO_2RR is tackled by incorporating magnesium oxide/hydroxide as a sacrificial boosting material for copper catalyst, i.e., Cu-MgO/$Mg(OH)_2$. Compared with the commercial copper, a significant improvement of electrochemical performance was observed. Most significantly, the onset potential for practical partial current density and Faradaic efficiency (FE) towards ethylene was achieved under zero-gap membrane electrode assembly (MEA) reactor conditions. In this work, we discuss these boosting phenomena from a local pH and cation effect perspective.

Abstract No. 0259 Ajith K

All Solid-state Lithium Metal Batteries (ASSLMBs) are highly rated to be the future of safe and sustainable energy storage. The key element of an ASSLMB is a solid electrolyte, which is greatly promising in terms of its mechanical, thermal and electrochemical properties. However, out of sorts ionic conductivity value and the poor interfacial compatibility with electrodes hinder their application in practical ASSLMBs. Herein, we demonstrate the synthesis and characterizations of a cubic phase silicon (0.15 mol%) doped $Li_7La_3Zr_2O_{12}$ (Si-LLZO) garnet-type ceramic filler by a ball-milling induced phase transition and solid-state reaction route. Further, the fabrication and electrochemical characterizations of a composite solid electrolyte (CSE) membrane using the home-made Si-LLZO garnet-type filler, poly(vinylidene fluoride-co-hexaflouropropylene) (PVDF-HFP) host polymer, lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) salt, and succilonitrile (SN) plastic crystal as the plasticizer has also been discussed. The CSE membrane was fabricated according to the weight ratio PVDF-HFP **:** LiTFSI **:** SN **:** Si-LLZO = 1 **:** 1 **:** 0.1 **:** 0.1. Our CSE membrane with 10 wt% filler content (with respect to PVDF-HFP) showed a very good Li^+ conductivity of approximately 1.35×10^{-3} S cm^{-1} at room temperature, a promising electrochemical window (*ca*. 4.38 V), and a lithium ion transference number of 0.34. The Li|CSE|LFP 2032-type coin cell cycled at 0.2C delivered a discharge capacity of 119.96 mAh g^{-1} with a capacity retention of 92.79 % after 50 cycles at room temperature. This work paves a way towards the reliable and scalable approach for the production of ASSLMBs based on CSE membranes incorporated with a Si-LLZO garnet-type filler.

Abstract No. 0260 Ya-Syuan Wu

The zinc-iodine battery is frequently employed in large-scale emerging energy storage systems due to the favorable reversibility of iodine in the positive electrode. Nonetheless, during cycling process, polyiodide (I_3^-) tends to gradually dissolve into the electrolyte, resulting in an irreversible loss of active substances, a reduced cycle life, and a decline in capacity, which is called shuttle effect. As a consequence, mitigating the shuttle effect represents a principal challenge for zinc-iodine batteries.

This investigation leverages conductive polymers, which carry positive charge in their oxidized state to attract negatively charged polyiodide (I_3^-). Specifically, polypyrrole (PPy) doped with perchlorate ions (ClO_4^-) is employed as the positive electrode material for iodine adsorption. Due to the smaller dimensions of doped perchlorate ions (ClO_4^-), they exhibit anion exchange characteristics, enabling PPy to capture polyiodide (I_3^-) during its oxidized state. This strategy aims to effectively suppress the shuttle effect.

A comparative analysis is conducted between two positive electrode materials: activated carbon (AC) and polypyrrole (PPy). Within the same potential range, AC/I_2 electrode starts with an initial iodine content plateau of only 75 mAh/g, which subsequently decreases to 50 mAh/g after 150 cycles. In contrast, PPy/I_2 electrode exhibits a considerably higher initial iodine content plateau, reaching 110 mAh/g. Even after 150 cycles, it maintains its capacity at 80 mAh/g. Therefore, these findings confirm the effectiveness of PPy in mitigating the shuttle effect.

Abstract No. 0261 Zhi-Ting Huang

In recent years, secondary aqueous zinc-manganese batteries have attracted lots of attention due to their high safety, low cost, and low environmental pollution. In this study, we first proposed synthesize δ-MnO_2 manganese oxide using one-pot hydrothermal method in the presence of cyclodextrin, a supramolecular host molecule, and then the resultant δ-MnO_2 was further employed as a cathode material for secondary aqueous zinc-manganese batteries. The effect of β-cyclodextrin concentration on the electrochemical properties of the MnO_2 electrodes was investigated. According to the experimental results, the optimized concentration of β-cyclodextrin in this study was 1.0%. The optimized 1.0% β-CDM electrode exhibited the discharge capacity of 205.2 $mAhg^{-1}$ and 177.2 $mAhg^{-1}$ when operated at current densities of 0.5 Ag^{-1} and 1 Ag^{-1}, respectively. In comparison, the discharge capacities of the δ-MnO_2 electrode obtained in the absence of cyclodextrin was 117.0 $mAhg^{-1}$ and 53.6 $mAhg^{-1}$ at current densities of 0.5 Ag^{-1} and 1 Ag^{-1}, respectively. Furthermore, after 1000 cycles, the 1.0% β-CDM sample maintained an impressive capacity of 129.2 $mAhg^{-1}$ even after 1000 cycles, which outperformed the pristine δ-MnO_2 electrode 14.8 $mAhg^{-1}$.

Abstract No. 0262 Chih-Han Wang

The performance of lithium-ion batteries, such as working voltage and power density, is mainly determined by the properties of the cathode materials. Therefore, developing high voltage cathode materials is one important research direction for lithium-ion batteries with high energy density. High-voltage cathodes cannot only offer more options for anode materials but also increase the output voltage of batteries. To develop high-voltage cathode materials for Li-ion batteries, in this study, high ionic conductivity Li_3PO_4 was adopted to coat on the surface of $Li_{1.2}Ni_{0.13}Mn_{0.54}Co_{0.13}O_2$ (LNMCO) cathode materials via a facile. Among all Li_3PO_4 coated LNMCO materials, the 4 wt% Li_3PO_4 coated LNMCO cathode exhibited the best rate capability and cycling performance due to its improved Li^+ diffusion and the suppression of cathode material dissolution in electrolyte. The 4 wt% Li_3PO_4 coated LNMCO cathode still exhibited an impressive capacity retention of 78.8% after 100 cycles at 0.3C, which is superior to that of the pristine LNMCO electrode (ca. 66.8%). Thus, the 4 wt% Li_3PO_4 coated LNMCO cathode can be regarded as one of promising high-voltage cathode materials for high-performance Li-ion batteries.

Abstract No. 0263 Yi-His Chu

MOF catalysts have porous properties and typically exhibit extremely high specific surface areas, which help to improve catalytic performance. These catalysts could increase the reaction areas for Li^+ and O_2 reactions. In this study, we combined the perovskite-structured materials $LaCoO_3$ (LCO) and $La_{0.5}Sr_{0.5}CoO_{3-d}$ (L5SC) with MOF-74 in the hope of improving the performance of lithium-air batteries. The molar ratios of organic ligands to cobalt in LCO/MOF-74 were 0.5, 1, 1.5, and 2.5, while they were 0.5 and 1 in L5SC/MOF-74.

In testing the performance of LCO/MOF-74-based batteries, the results showed that LCO + Super P had a discharge capacity of 12664 mAh g^{-1}, LCO/MOF-74-0.5 + Super P reached 16792 mAh g^{-1}, and LCO/MOF-74-1.5 + Super P had the highest discharge capacity of 19200 mAh g^{-1}. However, LCO/MOF-74-2.5 + Super P decreased to 15133 mAh g-1. In charge-discharge cycling tests, LCO + Super P began to lose performance after 60 cycles, LCO/MOF-74-0.5 + Super P maintained performance up to 45 cycles, LCO/MOF-74-1.5 + Super P remained stable for 90 cycles and LCO/MOF-74-2.5 + Super P for 100 cycles.

In the case of L5SC/MOF-74 cell testing, the results showed that L5SC + Super P had a discharge capacity of 9081 mAh g^{-1}, L5SC/MOF-74-0.5 + Super P had the highest discharge capacity at 24602 mAh g^{-1}, and L5SC/MOF-74-1.0 + Super P saw a decrease to 19183 mAh g^{-1}. In charge-discharge cycling tests, L5SC + Super P maintained its performance to cycle 45, L5SC/MOF-74-0.5 + Super P could only maintain its performance to cycle 25, while L5SC/MOF-74-1.0 + Super P lasted to cycle 80.

From the experimental results with LCO and L5SC, it can be observed that the growth of MOF-74 contributes to the capacity enhancement in lithium-air batteries. The capacity tends to increase and then decrease as the ratio of organic ligands to cobalt increases, L5SC/MOF-74-0.5 + Super P exhibits the highest discharge capacity with lower discharge current density. In cycling tests, the presence of organic ligands could improve the cycling stability.

Abstract No. 0264 Han-Lin Wang

To increase the energy density of supercapacitors (SCs), developing high-voltage electrolytes to extend cell voltage has been recognized as an effective strategy since energy density is theoretically proportional to the square of the cell voltage. Recently, deep eutectic solvents (DES), analogs of ionic liquids, have been regarded as green liquid media and novel alternatives for non-aqueous type electrolytes for SCs. This is primarily due to their unique characteristics, including non-flammability, cost-effectiveness, wide potential window, low vapor pressure, reproducibility, and tunable composition. However, DES possesses high viscosity and low ionic conductivity due to their strong interactions between molecules, which ultimately limit capacitance performance, especially at high current densities. In this study, we developed dimethyl sulfoxide-based DES electrolytes and introduced water (W)/acetonitrile (AN) as a co-solvent for symmetric SCs. The optimized hybrid electrolyte enabled the as-fabricated SCs operated at 2.2 V with excellent physical properties, such as high ionic conductivity, low viscosity and improved flame retardancy. The SCs with the optimized DES hybrid electrolyte displayed an -impressive specific capacitance of 46.6 F g^{-1} at a current density of 1 A g^{-1}, and with a high energy density of 28.55 Wh kg^{-1} at a power density of 1020 W kg^{-1}. Moreover, its capacity retention up to 84.5% was reached even after 20000 cycle.

Abstract No. 0265 Tzu-Ting Chen

Nanostructured iron disulfide (FeS_2) was uniformly deposited on regenerated cellulose (RC) and oxidized carbon nanotube (CNT)-based composite films using a simple chemical bath deposition method to form RC/CNT/FeS_2 composite films. Although metal sulfides such as FeS_2 have high redox activity, their use in supercapacitors (SCs) is limited due to their poor cycling stability and inferior conductivity. Therefore, polypyrrole (PPy), a conductive polymer, was coated on the RC/CNT/FeS_2 composite to improve its conductivity and cycling stability. The RC/CNT composite film served as an ideal substrate for the homogeneous deposition of FeS_2 microspheres due to its unique porous architecture, large specific surface area and high conductivity. Due to the synergistic effect of FeS_2 with high redox activity and PPy with high stability and conductivity, the RC/CNT/FeS_2/PPy composite electrode exhibited excellent electrochemical performance. The RC/CNT/0.3FeS_2/PPy-60 composite electrode tested with Na_2SO_4 aqueous electrolyte could achieve an excellent areal capacitance of 6543.8 mF cm^{-2} at a current density of 1 mA cm^{-2}. The electrode retained 91.1% of its original capacitance after 10000 charge/discharge cycles. SEM images showed that the ion transfer channels with a pore diameter of 5-30 μm were formed in the RC/CNT/0.3FeS_2 /PPy-60 film after a 10,000 cycle test. A symmetrical supercapacitor device composed of two identical pieces of RC/CNT/0.3FeS_2/PPy-60 composite electrodes provided a high areal capacitance of 1280 mF cm^{-2}, a maximum energy density of 329μWh cm^{-2}, a maximum power density of 24.9 mW cm^{-2}, and 86.2% of capacitance retention after 10,000 cycles at 40 mA cm^{-2} when tested at a wide voltage window of 1.4 V. These results demonstrate the greatest potential of RC/CNT/FeS_2/PPy composite electrodes for the fabrication of high performance symmetric supercapacitors with high operating voltages.

Abstract No. 0266 Wei-Lin Lee

Nitrogen-doped activated carbon (NAC) is prepared by a combination of acid pre-treatment and thermal nitrogen doping for the positive electrode of asymmetric capacitive deionization (a-CDI) cells. The oxygen content in AC controlled by the acid pre-treatment significantly affects the doping amount of N atoms from melamine, which enhances the surface negative charge in NACs to promote the salt adsorption capacity (SAC). Here NAC with 30% HNO_3 pre-treatment (NAC30) possesses a highly negatively charged surface to exhibit a fast ion desorption rate during discharging. The asymmetrical NAC30//AC cell shows the maximum reversible SAC of 24.7 ± 1.6 mg g^{-1}. In addition, the negative surface charge of NAC30 is further promoted and the reversible SAC of NAC30//AC are greatly enhanced to ca. 55 mg g^{-1} when pH of the 8 mM NaCl solution is adjusted from 5.4 to 7.5. In the long-term stability test, NAC30//AC remains 40% of its maximum reversible SAC after 100 charging-discharging cycles, indicating that our nitrogen doping is able to effectively reduce the oxidation of activated carbon, confirmed by the electrochemical impedance analysis.

Abstract No. 0267 Y.H. Hsiao

Zinc oxide (ZnO) is an attractive wide bandgap semiconductor for optoelectronic applications in the near ultraviolet (UV) spectral range. The feasibility of depositing ZnO epilayers using an electrochemical method has been demonstrated recently. ZnO epilayers are deposited on not only (111) but also (103) oriented Cu substrates. The full width at half maximum of $(0002)_{ZnO}$ rock curve distributes in a range of 1.0-1.8^{o}, mainly due to the rotation of crystals upon relaxation of lattice mismatches. The results stimulate us to find the strategies to improve the crystallinity of the ZnO epilayers. In this study, the rotating electrode method is employed to study the effect of rotating speed on the crystallinity of the ZnO epilayer. A combinatorial substrate approach is used to deposit ZnO on polycrystalline substrates. The electrolytes contain KNO_3 and $Zn(NO_3)_2{\cdot}6H_2O$ with a pH value of 6 and the temperature is maintained at 70 °C during deposition. The rotating speed varied from 0 to 500 rpm and the working distance is changed from 1 to 5 cm. With the assistance of electron backscatter diffraction (EBSD) technique, the orientations of substrate grains and the overlaid films are characterized. In addition, the crystallinity of the ZnO film are evaluated by a kernel average misorientation method and a pattern-refinement method according to the EBSD results. The results indicate that both the rotation speed and working distance have significant effects on the nucleation and growth behaviors of ZnO. Epitaxial growth is inhibited at a long working distance. In addition, less epitaxial orientation relationships are exhibited at a high rotating speed. More details will be discussed in presentation.

Abstract No. 0268 Chia-Liang Sun

We have been studying graphene oxide nanoribbons (GONRs) since 2011. In this work, we reported the electrochemical and photoelectrochemical based detection of serotonin (5-HT) with GONR following our early papers. Besides the material analyses of GONR reported in our early papers, the absorption intensity of the catalyst under different light wavelengths was studied by ultraviolet/visible light spectroscopy. The comparative catalytic activity was measured by cyclic voltammetry (CV), under dark and illumination conditions. It was found that the GONR/screen-printed carbon electrode (SPCE) exhibited a change in current response in the presence of 5-HT. Under the detection condition of 10 μM 5-HT, the Faradaic current increased by 110.9 % after irradiation with solar light (400 – 800 nm, 80 mW/cm^2) compared with that of unexposed CV. More details about this study will be presented in this conference.

Abstract No. 0269 Yu-Han Shiu

Formaldehyde (HCHO) is a volatile organic compound (VOC) that is harmful to the human body and has become one of the main pollutants of indoor air due to its widespread use in daily life. It was regulated that the HCHO concentration should be beyond 0.08 ppm. Due to indoor air's highly humid and complicated composition, it is a challenge to develop a highly selective and humid resistive ppb-level HCHO sensor. The carbon nanotube (CNT)-based electrochemical HCHO sensors were chosen to overcome the humid effect, and electrocatalysts were introduced to enhance the sensitivity and selectivity to ultralow concentration HCHO sensing. Three kinds of bimetallic electrocatalysts, ie. PtPd, PtCu and PdCu were decorated onto CNT surface utilizing the supercritical water technique. Compared with CNT, the metallic electrocatalyst decorated CNT catalyzed the redox reaction of formaldehyde and the oxidation potential was reduced from 0.4 V to less than 0.1 V vs. Ag/AgCl. Electrochemical analysis results show that PtCu/CNT and PdCu/CNT electrodes have excellent electrocatalytic activity for HCHO. Among these electrodes, the PdCu/CNT electrode exhibits the highest sensitivity over a wide sensing range of 0–100 ppm and has a low sensing limit of 1 ppb. The sensing mechanism of these electrodes was investigated by FTIR spectroscopy. The sensing response of potential interfering substances on PdCu/CNT electrodes was also evaluated. The PdCu/CNT electrode exhibits high sensitivity and selectivity to low concentrations of HCHO and has unlimited application prospects in indoor air quality monitoring.

Abstract No. 0270 Zong-Hong Lin

Designing devices with self-powered sensing function has become a popular research field since its emergence in recent decades. Triboelectrification occurs when two materials come into contact with each other, causing charge transfer that leads to oppositely charged surfaces; the amount of charge transfer varies depending on material composition. By combining triboelectrification with electrostatic induction, relevant devices can be designed. If used for energy collection purposes, scientists generally refer to them as Triboelectric Nanogenerators (TENGs); but if used for self-powered sensing purposes, scientists call them Triboelectric Nanosensors (TENSs). In our previous research on TENSs, we demonstrated the concept of selective detection of some targets by specific materials or their surface-modified probes. When the targets are adsorbing or binding to the surface, different electrical output signals will be generated compared to before, and these changes can be used for qualitative and quantitative analysis of the targets. In the past few years, we have further developed solid-liquid TENSs for measuring targets such as metal ions, small molecules, proteins and microorganisms. Compared with our previously developed solid-solid TENSs, we have not only improved several shortcomings but also established sensing mechanism and working principle which are very important research achievements in this field. We also look forward to expanding the applications of the solid-liquid TENSs in the near future.

Abstract No. 0271 Tsung-I Yeh

To develop the process for the electrolyte layer in a sulfide-based all-solid-state lithium-ion battery, including process improvements and the establishment of an electrochemical analysis system. Owing to Sulfides have excellent lithium-ion conductivity, which helps facilitate the transfer of lithium ions in the electrolyte. Diversified processing techniques are employed to coat the solid particles and form thin electrolyte sheets, of which the sulfide material $Li_{5.4}PS_{4.4}Cl_{1.6}$ is the main component. Composite electrolyte sheets add polymer materials enhancing the stress and strain properties, reducing the interface impedance between solid particles, and mitigating the occurrence of lithium dendrite penetration and short circuits. This increases the cycle life of the battery and allows for a composite electrolyte membrane with high lithium-ion conductivity and mechanical strength.

Hence, the core focus of this research is the property analysis of the Diversified processing thin sheet and the establishment of the measurement benchmark of the thin sheet system. Utilizing structural studies such as XRD, PXM CT, EIS, and other instruments to observe surface morphology and confirm no side reaction between the sulfide and the polymer material. Fabricating uniform and stable thin sheet-type electrolytes, and allows us to effectively study and evaluate the properties of sheet-type electrolytes.

Abstract No. 0272 Shin-Yu Hung

In order to reduce fossil fuel usage and carbon dioxide emissions, it’s crucial for modern society to acquire a clean, low-cost energy source. Hydrogen energy is considered the ultimate energy storage method, and water electrolysis offers a sustainable approach to producing an endless supply of green hydrogen. Currently, three major techniques dominate this field: alkaline electrolysis, alkaline anion exchange membrane electrolysis, and acidic proton exchange membrane electrolysis. While alkaline and AEM electrolysis allows for the use of non-noble metal catalysts like nickel, it requires the use of corrosive alkaline electrolytes. On the other hand, PEM electrolysis can utilize pure water as a reactant, but traditionally, it has been limited by the need for precious metal catalysts such as Iridium and Ruthenium, which are known for their superior activity and stability under acidic oxidizing conditions.

Cobalt oxide, which is an earth-abundant element has reported high OER activity in acidic environments but suffered from stability issue. Thus, in this study, we explored the different acidic stable elements (Sn, W, Mn, Mo, Sb) doped into the crystal structure of Cobalt oxide, and evaluated the OER activity and stability in 0.5 M H_2SO_4. It has been discovered that Sn and Mn have the highest potential to exhibit excellent stability and activity among the designed elements, which could be explained by their diverse valence states and lattice structures. This work provides insight into screening doping elements to improve the catalytic performance of cobalt oxide, offering guidance towards synthesizing a robust PGM-free water electrolysis catalyst under acid conditions.

Abstract No. 0273 Zhi-Qing Lim

The performance of quasi-solid-state dye-sensitized solar cell (DSSC) with Cu^{+2}/Cu^{+1} redox couple under sun light and room light conditions were studied in this work. PEO, PMMA, PVDF and PVDF-HFP were utilized as gelators to prepare the gel electrolytes. The results shew that, by using the PVDF-HFP, the gel-state DSSC can obtain the highest conversion efficiency (9.51%) under sun light condition. Although this efficiency is slightly lower than that of the liquid cell (9.69%), the stability of the gel-state cell reveals a much better stability than the liquid one. For the performance of the cell under indoor light conditions, the electrolyte composition is different from that utilized for the cells under sun light environment. It is found that a lower concentration of Cu^{+2}/Cu^{+1} is advantageous since it can decrease the light loss due to the absorption of the electrolyte, increasing the light harvest of the photoelectrodes. By tuning the electrolyte composition, the liquid-state cell can achieve an efficiency of 26.95% under indoor light condition of 2000 lux. For preparing the quasi-solid-state cells, a printable process was applied by using gel electrolytes containing PEO. The conversion efficiency obtained is 22.5% for electrolyte with PEO only. However, by addition of PMMA and PVDF, the efficiency can increase to 23.97% and 24.19%, respectively.

Abstract No. 0274 Hyeonseok Lee

Severe environmental issues relating to atmospheric CO_2 gases such as global warming and erratic weather patterns are imperative to be solved for human beings on the Earth together with skyrocketing energy demands. As one of the solutions to the problems, photocatalytic CO_2 conversion through semiconductor materials has aroused lots of attention from the science and engineering field. This is because the semiconductor photocatalysts for CO_2 conversion can contribute to the removal of CO_2 and energy fuel production from CO_2 simultaneously. However, since the pioneering works done by Halmann and Inoue et al. in 1978 and 1979, respectively, the related research has remained challenging for nearly four decades for the fabrication of highly active, precisely selective, and long-term stable photocatalysts.

Here, in our work, we demonstrate the fabrication of nanostructured SnS-based photocatalysts for efficient, selective, and long-term stable photocatalysts. Nanostructures are constructed in the sculptured thin film method by using a thermal evaporator. The SnS nanostructures are coupled with other n-type materials, g-C_3N_4 and SnO_2 for the formation of heterojunction. In addition, we deliver our impressive findings from the nanostructured photocatalyst in various aspects such as material, optical, and electrochemical findings.

Abstract No. 0275 Cheng-Liang Liu

Photovoltaics composed of organic-inorganic lead halide perovskite materials have a tremendous potential as solar power collectors. Solution-processing enables the cost reduction for perovskite solar cell production due to its high throughput vacuum-free manufacturing process. However, challenges for commercialization of perovskite solar cells remain and are critically dependent on cost-effective scalable fabrication of large and high-quality crystalline perovskite films. In my presentation, we present the basic principles governing the morphologies of spray-coated perovskite films and fabricate up-scaling perovskite solar celles device. This demonstrates the reliability and uniformity of the perovskite films and the corresponding device parameters. These findings highlight the relevance of high-throughput screening of perovskite compositions and the versatility of a scalable solution process, in which active layers are deposited by spray-coating.

Abstract No. 0276 Hsisheng Teng

Solid-state lithium batteries are promising candidates for next-generation high energy and safety batteries. Solid polymer electrolytes (SPEs) provide an intimate contact with electrodes and accommodate volume changes in the Li-anode, making them ideal for solid-state batteries; however, confined chain swing, poor ion-complex dissociation, and barricaded Li^+-transport pathways limit the ionic conductivity of SPEs. In the present study, we developed an interpenetrating polymer network electrolyte (IPNE) comprising O- and F-containing networked SPEs (O-NSPE and F-NSPE, respectively) and lithium bis(fluorosulfonyl) imide (LiFSI) with the following functions to achieve high performance of the resulting lithium batteries: (a) connect FSI^--aggregate domains for facile Li^+ diffusion; (b) dissociate complexed ions and expedite the Li^+ transport; and (c) prevent space-charge zone formation on the Li-anode surface for uniform Li deposition. The synergy between the polymer network and connected FSI^--aggregate domains enable the Li^+ to transport via the decoupling ion-transport mechanism. In experiments, a Li|IPNE|$LiFePO_4$ battery outperformed liquid electrolyte-based batteries in terms of charge-discharge performance.

Abstract No. 0277 Wei-Li Shih

Water-based Synthesis of MOFs and Their Derived Materials for Chemical Engineering Applications,
Smart Taste Profiling and Recognition Using Micro-Sensor Array Chips based on Functional MOF Materials

Poly(3,4-ethylenedioxythiophene) (PEDOT) and its composite materials has been applied in electrochemical researches about electrochemical sensors, electrochromic devices, photovoltaic cells, and super capacitors. Thus, electrodeposition of PEDOT films plays an important role in the researches using PEDOT. In this work, we find that the electrodeposition solvent can change the electrocatalytical behavior of chlorogenic acid on PEDOT:ClO_4 film. For example, if the PEDOT:ClO_4 film is electrodeposited in acetonitrile, the 136oltametric scans in chlorogenic acid solution shows a linear relationship between the scan rate and the peak current, implying a adsorption control or a surface reaction control behavior. On the other hand, if the PEDOT:ClO_4 film is electrodeposited in water, the 136oltametric scans shows a linear relationship between the square root of the scan rate and the peak current, implying a diffusion control behavior. What's more, the SEM photos also show a significant morphological difference of the PEDOT:ClO_4 films electrodeposited in different solvents. The PEDOT:ClO_4 films deposited in acetonitrile has a silk-like structure and those deposited in water has a cauliflower-like structure. Thus, we suggest that the electrodeposition solvent makes the structural difference of PEDOT films and then contribute to the different electroctatalytical behavior of chlorogenic acid on PEDOT films.

Abstract No. 0278 Muhammad Faizan

We synthesized nano-scale magnetic metal-organic frameworks (MMOFs) which is used as an ultrasensitive electrochemiluminescense (ECL) genosensor for simultaneous detection of dual micro-RNAs by using the luminol and screen printed electrode system. A functional bi-metallic MMOF was electrochemically synthesized by citrate-modified MNP as a core and copper/ zinc MOF as a shell with two electrodes of iron and 20 mA current for 30 minute. This nanocarrier was sequentially immobilized with luminol and capture sequences to endore the resonance energy transfer (RET) and capture functions. A sandwich detection was composed by horseradish peroxidase and dual detection probes conjugated with distinct fluorophores (Alexa-flour and Pacific blue). The ECL signals emitted from two wavelengths (450 and 530 nm) were observed from FET from luminol (420 nm). This ECL genosensor provided a linear range of 1 fM to 1000 fM with a detection limit of 0.001 fM for miRNA-21 and 0.003 fM for miRNA-183, respectively. We successfully developed a highly sensitive ECL platform for rapid dual-target analysis in point-of-care diagnosis.

Abstract No. 0279 Ching-Hsun Wu

Composite polymer electrolytes (CPEs), which combine the strengths of both polymer-based and ceramic-based electrolytes, are being considered as a complementary approach to enhance the performance of solid-state electrolytes. In this study, an interpenetrating composite polymer electrolyte (ICPE) is developed, consisting of poly(ethylene oxide)-based and poly(vinylidene fluoride) (PVDF)-based polymer networks, along with a lithium lanthanum zirconium oxide ($Li_7La_3Zr_2O_{12}$, LLZO) powder. The La atom of LLZO can complex with the N, N-Dimethylacetamide solvent, resulting in electron enrichment at the N atom. This behavior can be likened to that of a Lewis base, leading to the chemical dehydrofluorination of the PVDF skeleton. This leads to the formation of a crosslinked PVDF network and C=C bonds within the PVDF segment, which can enhance the acid–base interactions between PVDF, LLZO, and salt lithium bis(fluorosulfonyl)imide (LiFSI). Li^+ ions are dissociated and transported through ether groups and the LLZO-polymer interphase, whereas the FSI^- anions are anchored by the PVDF domain. The aggregated FSI^- create another pathway for Li^+ hopping, leading to the achievement of an enhanced Li^+ transference number. Moreover, incorporating LLZO enhances both the mechanical property and electrochemical stability of the ICPE, ensuring stable performance throughout charge and discharge cycles. This ICPE exhibits high ionic conductivity (1.72 mS cm^{-1}) and high t_{Li+} (≈0.7) at 30 ºC. It also shows excellent compatibility with Li anode; the Li||Li symmetric cell delivers high critical current density (3.4 mA cm^{-2}) and long-term stability. The as-prepared Li||$LiFePO_4$ cell maintains an impressive capacity retention of 80% after 350 charge-discharge cycles at 1C. The synergetic effect of the polymer network and ceramic powder presents a novel approach to designing prospective composite solid electrolytes.

Abstract No. 0280 Minh Le Nguyen

Solid polymer electrolytes (SPEs), which are favorable to form intimate interfacial contacts with electrodes, are promising electrolytes of choice for long-cycling lithium metal batteries (LMBs). However, the challenge of SPEs is the limited ionic conductivity due to a constricted chain swing, inefficient ion-complex separation, and obstructed pathways for Li^+ ion transport. Therefore, we designed networked SPE (NSPE) configurations combined with polymer-in-salt (PiS) to enhance ionic conductivity. The presence of ether linkages in poly(ethylene oxide) (PEO) is highly effective in dissociating salts, and the salt LiFSI demonstrates exceptional conductive properties. The PiS-NSPE exhibited high ionic conductivity of 2.3 mS cm^{-1}, superior lithium-transference number of 0.69 at 30 ºC, and excellent interfacial compatibility with lithium metal electrode at applied current density toward 1 mA cm^{-2}. The PiS-NSPE prevented the Li-anode volume change and the formation of a space-charge zone for a uniform Li deposition owing to the FSI^--aggregation. The Li|PiS-NSPE|$LiFePO_4$ cell presented a superior long-term lifespan (capacity retention of 94.9 % after 200 cycles at a current density of 0.3 mA cm^{-2}). Utilizing the cooperative interaction between networked polymer and polymer-in-salt to create efficient pathways for rapid Li^+ ion transport holds significant promise for advancing the development of solid polymer electrolytes (SPEs).

Abstract No. 0281 Martin Ihrig

Oxide-type solid electrolytes are promising as they have beneficial intrinsic properties such as high thermal and oxidation stability, and good ion selectivity. However, the integration into cells and batteries and the processing cost have to be optimized. These limitations are due to the requirement of high-temperature treatment of the oxide ceramic electrolyte to obtain acceptable mechanical strength, and high Li-ion conductivity, and prepare electrodes that support high energy density.

Based on the progress achieved by several groups, the preparation of garnet, NaSICON-, and perovskite-based all-solid-state cathodes with a high CAM loading, high initial capacity, and high-capacity utilization can be fabricated. However, the problem of fast capacity fading during electrochemical cycling which is observed in nearly all published oxide-type solid electrolyte-based batteries, still limits their application. This is caused by processing-induced degradation, mechanical fracturing of the electrode/electrolyte interface, or electrochemical degradation of the materials.

Here, we evaluate various oxide ceramic electrolytes with garnet-, NaSICON-, and perovskite structures and analyze their electrochemical properties and performance, and the mechanisms occurring during cycling that cause their degradation. Based on this analysis, we develop a possible explanation for the observed degradation and provide guidelines to prevent the degradation and achieve stable and well-performing oxide-ceramic-based Li batteries.

Abstract No. 0282 Wei-Hsiang Tsai

Among the alternatives to current Lithium (Li)-ion battery systems, rechargeable Magnesium (Mg) batteries are promising candidates owing to their high theoretical volumetric energy density, environmental-friendliness, and improved safety. Among the explored conversion-type cathodes for rechargeable Mg batteries, sulfur (S) attracts lots of interest because of its high theoretical capacity (1673 mAh/g) and earth abundance. Despite the excellent characteristics of sulfur, its electrophilic nature makes it chemically incompatible with nucleophilic magnesium organohaloaluminate electrolytes. In this study, the carefully designed microstructure of the sulfur cathode results in improved sulfur utilization and cycle stability in a nucleophilic electrolyte for Mg-S battery. The electrochemical characteristics of the prepared sulfur cathode and the electrode microstructure evolution along cycling were investigated. The sulfur cathode was synthesized by the melt diffusion method of sulfur into different carbon structures, then coated on a nickel (Ni) current collector with a sulfur loading of 2 mg/cm^2. SEM and EDS mapping of the sulfur cathode reveal a homogeneous distribution of sulfur on the surface of the carbon structure, and XRD identified the diffraction peaks of sulfur S_8 and graphite. Cyclic voltammetry of the sulfur cathode shows multiple reduction and oxidation peaks corresponding to the transitions between elemental sulfur, high-order magnesium polysulfides, and low-order magnesium polysulfides. The discharge curve of the battery shows two voltage plateaus, which agrees with the results from cyclic voltammetry.

Abstract No. 0283 Yu-Qi Wang

In the redox flow battery (RFB) system, the electrodes are the sites for the positive/negative electrolytes to carry out oxidation-reduction reactions, so that its need with a good electrical conductivity, chemical and mechanical stabilities. In our study, the graphite felt (GF) electrode was modified by the sol-gel process and electroless plating method to form various composite electrodes, such as GF-TiO_2, GF-TiO_2-CoP and GF-TiO_2-MnO_2. The structure and electrochemical activity analyses of these electrodes were carried out by SEM/EDS, XRD, and cyclic voltammetry (CV) method. The electrochemical properties, such as anodic current (I_a), cathodic current (I_c), double-layer electric capacitance (C_d) and porosity (φ) were obtained from the cyclic voltammograms (CVs). A cerium/iron redox flow battery (Ce/Fe RFB) was designed with iron salt as the negative electrolyte and positive cerium salt to form an active electrolyte couple (AEC) and assembled various type electrodes. The results show that the GF-TiO_2-CoP composite electrode has the best electrochemical activity than that of others. In $(NH_4)_2Fe(SO_4)_2$/ H_2SO_4 active electrolyte, this composite electrode exhibited a symmetric oxidation/reduction current ratio (1.09) and the oxidation peak current density (I_a) was more than 5 times than that of the GF electrode. In addition, the porosity of composite electrode contrasting with GF electrode increased from 0.295 to 0.933 in H_2SO_4 solution; implys that has a excellent active area, and the Cd value was promoted from 0.129 F/cm^2 to 0.253 F/cm^2. And the porosity increases from 0.325 to 0.909, the Cd value was promoted from 0.151 F/cm^2 to 0.186 F/cm^2 in $Ce(NO_3)_3$/methanesulfonic acid (MSA) solution,. means that the composite electrode has a good electrocatalytic effect in the Ce/Fe AEC solution. In Ce/Fe RFB single cell, the use of GF-TiO_2-CoP composite electrode and Nafion$^{®}$212 membrane can effectively suppress ion cross-contamination and improve the electrocatalytic area, thereby increasing the working voltage of the battery from 0.91 V to 1.04 V. The charge/discharge efficiency was greatly improved compared with the GF electrode, and the energy efficiency (EE%) of the energy storage was increased by 37%; the electric capacity was increased by 62.4%.

Abstract No. 0284 H.-P. Chen

Copper and silver coatings containing a high density of nanotwins parallel to substrate surface showed superior properties such as high strength and thermal stability. It is therefore interested to develop technique to deposit nickel coating having similar microstructure and properties, due to the fact that a great portion of nickel produced is used as electrodeposited coatings. There are two potential difficulties. First of all, nickel has a higher stacking fault energy than both copper and silver. Second, electrodeposited Ni seldom shows a fiber texture of <111>//ND. In this study, effects of additive content, electrode rotating speed and current density will be explored on the deposition of nickel coatings from a Watts bath not only having a strong <111>//ND texture but also containing a high density of nanotwins parallel to the substrate surface. The deposited coatings were analyzed by X-ray diffraction, scanning electron microscopy and electron backscatter diffraction. Results indicated that the deposited coating exhibited a strong <100>//ND texture at low current densities, but a <110>//ND one at high current densities, regardless the rotation speed of the electrode. By adding 2-Butyne-1,4-diol in electrolyte, the texture of deposits changed from <110>//ND to <111>//ND with increasing the rotating speed at high current densities. High density of twins of approximately 50 nm thick were observed in the <111>//ND coatings. An increase in current density leads to a reduction in the twin spacing.

Abstract No. 0285 Y.C. Tung

Zinc ion battery (ZIB) attracts great attention on applications for storing electric energy generated by wind or solar radiation1. A key issue hinders the widespread use of ZIB is the rampant grwoth of dendrites on charging which penetrate the separator and cause short circuit. An effective countermeasure for the dendrite problem is to deposit zinc epitaxially. In this study, the electroepitaxial growth of zinc was investigated using a combinatorial substrate approach in an acidic electrolyte. The combinatorial substrate approach employes polycrystalline substrates for deposition. The orientations of the substrate grains were analyzed prior to deposition by electron backscatter diffraction (EBSD) and those of the deposits in the same area were characterized after deposition. Accordingly, a one-to-one correspondcnce of the orientation relationship (OR) between a substrate grain and the overlaid zinc can be established. Considering that Zn has a six-fold symmetric structure while the structure of Cu contains four three-fold axes, it is naturely assume that the most suitable orientation relationship between Cu and Zn is (111)Cu//(0001)Zn, [1-10]Cu//[11-20]Zn with a lattice mismatch of 4.1%. In this study, two more ORs were identified as (110)Cu~//(-330-7)Zn, [1-10]Cu//[11-20]Zn and (001)Cu//(1-101)Zn, [1-10]Cu//[11-20]Zn. In other words, substrate grains with orientations far away from <111>//ND, can still find a suitable OR for epitaxial growth. An example is given in Fig. 1 in which the micrographs of Zn deposited on three substrate grains of different orientations are shown. The (111) pole figure of Cu and (0001) pole figure of Zn obtained from EBSD analyses are also shown in the inset to reveal their orientations. Clearly, Zn epilayers are deposited on each Cu grain, shedding light on solving the dendrite problem of the ZIB. Moreover, the micrographs indicate that the growth of Zn was in a layer-by-layer manner on the (0001) plane along three <10-10> directions, regardless the ORs.

Abstract No. 0286 Xin-Xian Yang

Barium titanate ($BaTiO_3$; BTO) is a versatile material widely applied in dielectric, piezoelectric, and ferroelectric applications. The synthesis of preferred-oriented BTO films was achieved through the hydrothermal-galvanic couple (HT-GC) approach, employing conductive titanium nitride (TiN) thin film electrodes with (111) and (200) preferred orientations. TiN seed layers were deposited using an air-based sputtering technique, and their preferred orientations were controlled by adjusting the air/Ar flow ratio. The HT-GC process was conducted at 80°C for 1 h in an alkaline solution comprising 0.5 M $Ba(CH_3COOH)_2$ and 2 M NaOH. X-ray diffraction patterns confirmed that the resulting BTO films possessed a cubic structure, with (111) and (200) textures aligned with the TiN seed layers. Regarding piezoelectric and dielectric properties, the (111)-preferred BTO films exhibited a higher D33 value of 27 ± 4 pm·V-1 and a dielectric constant of 7.7 ± 0.1, compared to 15 ± 2 pm·V-1and 3.9 ± 0.2 for (200)-preferred BTO. This may be attributed to a higher internal strain energy. On the other hand, the (200)-preferred BTO films revealed a more robust photocurrent response of $10.6 \pm 0.2\ \mu A \cdot cm^{-2}$, higher than $4.6 \pm 0.1\ \mu A \cdot cm^{-2}$ for (111)-preferred BTO. This may be attributable to the most closed plane (200) in BTO.

Abstract No. 0287 Wei-Sheng Liao

Many metallic single-atom catalysts suffer from the poor conductivity of the molecular support. In this experiment, a highly conductive two-dimensional (2D) material called Ti_3C_2 from the family of transition metal carbides/nitrides (MXene) was used as a support material to prepare metal single-atom catalysts through a simple method. During the etching process, surface Ti vacancies were created, which are seen as the adsorption sites for enhanced loading of catalytic metal ions, thus allowing the formation of single-atom catalysts (SACs). The platinum (Pt) atom was chosen as the adsorbed species for the hydrogen evolution reaction. Scanning electron microscopy (SEM) observations revealed an accordion-like morphology, and X-ray diffraction (XRD) analysis confirmed a decrease in the diffraction angle of the (002) crystal plane from 9.5° to 8.6°, indicating an increase in interlayer spacing from 9.24 Å to 10.2 Å.

Further ultrasonic treatment increased the interlayer spacing to 14.4 Å, demonstrating the successful synthesis of MXene flakes. The ultrasonic treatment helped the flakes exfoliate and expose more interlayer Ti surfaces. X-ray absorption spectroscopy (XAS) revealed no observation of Pt-Pt metal bonding, confirming the formation of dispersed metal Pt as single atoms within the MXene structure. Additionally, it was found that Pt^{4+} was reduced to Ptδ+ and existed within the Ti vacancies. The abundant Ti vacancies formed at different etching times were further investigated and correlated with the adsorption of more Pt atoms as active sites, reducing the electrochemical potential required for water splitting. Currently, pure MXene exhibits an overpotential of 0.62 V for the hydrogen evolution reaction. However, it can be lowered to 0.2 V after loading Pt single atoms. The best performance was achieved by etching MXene for 48 hours and loading 2 wt% of Pt single atoms. The overpotential and Tafel slope at 10 mA/cm^2 were 77 mV and 57 mV/dec, respectively. It was observed that after 24 hours of stability testing in a 0.1 M HClO4 environment, the degradation was only 0.5%.

We have developed a simple method to synthesize MXene-PtSAC with a loading amount of 2.2 wt% of Pt single atoms. This method allows for the mass production of Pt single-atom catalysts with high conductivity without additional conductive carbon materials.

Abstract No. 0288 Shu-Hao Chang

Lithium-sulfur batteries, with a high theoretical capacity and abundant sulfur reserves, emerge as promising candidates for next-generation energy storage. However, the commercialization of these batteries is impeded by the polysulfide (Li_2Sx) shuttle effect, which degrades both cycling durability and battery lifespan. By utilizing the breath figure mechanism, we incorporated porous nanostructured cobalt sulfide into the battery's separator to address this challenge. We synthesized cobalt sulfide nanoparticles using a straightforward hydrothermal process and subsequently crafted a porous thin film. Factors such as substrate type, temperature, and relative humidity were adjusted to refine the nanostructures. This fine-tuning effectively mitigated the shuttle effect by capturing the migrating polysulfides, thereby enhancing battery stability.

Abstract No. 0289 Yu-Yao Huang

Commercial lithium-ion batteries with organic liquid electrolytes are notorious for their issues related to leakage, flammability, and performance degradation. Hence, polymer based solid state electrolytes have been proposed to be a promising alternative to address these concerns. However, the low ionic conductivity of polymer electrolytes remains a significant challenge, which has garnered significant research attention. One of the commonly employed strategies to enhance the ionic conductivity of a polymer electrolyte is to form composite polymer electrolytes (CPEs) by introducing inorganic ceramic fillers, which act as plasticizers, to decrease the crystallinity of the polymer matrix, improving ionic conductivity.1 Ferroelectric ceramic fillers, which are highly polarized under external electric field, have been demonstrated to facilitate the diffusion of lithium ions within the electrolyte.2 Prior research has shown that, barium titanate ($BaTiO_3$), a specific ferroelectric ceramic, can help with lithium salt dissociation due to its high dielectric constant.3 Moreover, BaTiO¬¬3 nanowires have been found to be more effective in improving the dielectric constant of composite materials then their nanoparticle counterparts.4 In this work, various proportions of pure $BaTiO_3$ and Bi-doped $BaTiO_3$ nanowires are introduced into the polyethylene oxide (PEO) matrix. The aim is to systematically investigate the correlation between the dielectric constant and the ionic conductivity and electrochemical properties of these CPEs. This study offers a comprehensive understanding of the potential applications of ferroelectric material fillers within CPEs, presenting innovative approaches for the development of high-performance CPEs suitable for advanced lithium metal batteries.

Abstract No. 0290 Yi-Min Wu

Solid-contact ion-selective electrodes (SCISEs) represent a promising sensor for long-term ion monitoring in IoT systems. Numerous studies enhanced the properties of traditional liquid-junction ISEs through potentiometric or galvanostatic polarizations. However, there is a lack of direct evidence and a clear understanding of the distinct mechanisms underlying the effects of applied potentials and currents on the ion-to-electron transducers (IETs) and ion-selective membranes (ISMs) of SCISEs. We employed in situ optoelectrochemical analysis to concurrently record transmittance and potentiometric responses. A K+ SCISE was fabricated layer by layer, employing ITO glass as the substrate, electrodeposited PEDOT as the IET, and a PVC-based K+ ISM. The transmittance curves of SCISEs revealed that both polarizations could oxidize the PEDOT layer, even when an ISM covered it (Fig. 1). Significantly, the differential EMF curve of ITO/ISM after the galvanostatic polarization exhibited a diffusion-like behavior, distinct from the observed maintenance of EMF at a specific value after potentiometric polarization (Fig.2). These findings highlight that potentiometric polarization affects PEDOT's oxidation-reduction reaction more than ion diffusion in ISMs. Conversely, galvanostatic polarization alters both state of PEDOT and ion fluxes of ISMs simultaneously. Consequently, in situ optoelectrochemical experiments unveil unique behaviors in individual layers of SCISE without electrode disruption, enhancing their feasibility of in situ conditioning.

Abstract No. 0291 **Shu-Ling Huang**

A typical redox flow battery (RFB) consists two electrodes and two circulating electrolyte solutions are separated by an ion-exchange membrane. Electrolytes store in two tanks are pumped and circulated through the stack where an electrochemical reaction occurred; in charging/discharge state, using the RFB exchange the chemical energy and electrical energy. The key materials of RFB system include ion exchange membrane, electrode, electrolyte, and flow channel. In this study, a large size area (26*30 cm^2) cerium/iodine redox flow battery (Ce/I RFB) was designed by an iodide salt as the main negative electrolyte and positive cerium salt to form an active electrolyte couple (AEC). The graphite felt (GF) electrode was modified via the sol-gel and deposition processes to form the GF-TiO_2-MnO_2 composite electrode with nano-porous TiO_2 network structure that enhances the electrochemical activity and the energy storage performance. The electrochemical properties of the composite electrode were analyzed by SEM/EDS, XRD, and cyclic voltammetry (CV) method. The results show that the oxidation peak current density (Ia) of the composite electrode is more than 10 times than that of the GF electrode that is beneficial to the electrocatalytic reaction of RFB. In large-size area (26*30cm^2) Ce/I RFB, compared with GF electrodes, the CE%, VE% and EE% values of GF-TiO_2-MnO_2 composite electrodes are increased by 7%, 42% and 39% respectively. The flow rate of 400mL/min showed the best battery energy efficiency value (EE % =82%) and storage capacity (30.42Wh) at 10 A (amps) of charge/discharge state.

Abstract No. 0292 **Chih-Hung Chen**

With the high theoretical capacity and low electrochemical potential, lithium metal is an attractive choice for the anode material in high-energy-density rechargeable batteries. However, the inherent instability of the lithium plating-stripping process during battery cycling leads to the development of lithium dendrites, resulting in challenges such as capacity reduction, decreased cycling lifespan, and the risk of internal short circuits . The quality of the passivation layer spontaneously formed between the electrolyte and the anode, commonly known as the solid electrolyte interphase (SEI), plays a crucial role in the stability of electrodeposition. The pronounced changes in volume that the lithium anode undergoes during deposition can have detrimental effects on the SEI and alter the behavior of lithium-ion migration. To address this, we propose a curvature-dependent deposition rate to investigate two distinct mechanisms of lithium-ion migration: the slower pathway within the intact SEI and the faster pathway within the fractured SEI. As suggested by our simulation results, the formation of mossy dendrites observed at current densities below the theoretical limiting current density—an unsolved puzzle from the past—can be attributed to the heterogeneity of lithium-ion transport mechanisms.

Abstract No. 0293 Han-Wei Chang

In this work, Ni-Co-O nanosheets grown on 3D porous Ni template (Ni-Co-O@3DNi) were synthesized via a simple hydrothermal process. Hydrogen bubble templates possess can act as pore-forming template strategy to form 3D porous Ni template. Hydrogen bubble templates possess with different applied voltages can make these 3D porous Ni template differences in terms of physicochemical properties, as well as the factors that affect the subsequent growth of Ni–Co–O nanosheets. The architecture and structural traits of the Ni-Co-O@3D-Ni nanocomposites are scrutinized using techniques such as field-emission scanning electron microscopy (FESEM), synchrotron radiation X-ray spectroscopy, and electrochemistry. The as-synthesized Ni-Co-O@3DNi (3D-Ni template performed at an applied voltage of 6V) exhibits the highest areal capacitance (2075.6 mF/cm$_2$) at a current density of 1 mA/cm$_2$. Synchrotron radiation X-ray spectroscopic results reveal that the local atomic and electronic structural characterizations of Ni and Co atoms within the Ni-Co-O@3D-Ni nanocomposites profoundly affect supercapacitor performance. This work clearly demonstrate that the integration of synchrotron radiation X-ray spectroscopy with electrochemical techniques give further insight into the fundamental atomic and electronic structure of novel electrode materials, greating opportunities for advancing the science in the field of electrochemical energy storage technologies.

Abstract No. 0293 Han-Wei Chang

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Abstract No. 0294 Chi-You Liu

Oxygen reduction reaction (ORR) has been studied for decades due to its importance in fuel cells or batteries. Even though the Pt-based electrodes show the lowest overpotential for ORR, some issues such as high cost and the earth abundance problem still limited the daily use. Carbon-based materials decorated with few metal active sites are one of the options to replace and reduce the use of metals. Here, we demonstrate the efficiency of ORR on different Fe/C_3N_4 nanotubes by DFT calculations. The results show that the amounts of adsorbed O_2 molecules on the active site could extremely affect the ORR overpotentials, which may correlate with the demand of higher O_2 extent environment in the experiments. The results of this study provide experimentalists a nanoscale understanding of the different operating conditions of the ORR.

Abstract No. 0295 Pravanjan Malla

We designed a novel electrochemiluminescence (ECL) biosensor for rapid simultaneous detection of dual-target micro-RNA using magnetic nanoparticles (MNP), luminol, and screen-printed electrodes. A functional nanocomposite of CNT-MNP was synthesized and further immobilized with a capture sequence, and a sandwich assay was followed to prepare the biosensor. The detection system contained luminol, horseradish peroxidase, and two detection probes conjugated with fluorophores (Alexa flour-430 and Pacific blue). The ECL emission at two wavelengths, 450 and 530 nm was observed by resonance energy transfer from HRP. In the presence of target mi-RNAs, efficient hybridization took place, and the ECL signals at two wavelengths emitted upon increasing the target concentration. This ECL biosensor provided a linear range of 1 fM to 1000 fM with a detection limit of 0.23 fM for mi-RNA 21 and 0.8 fM for mi-RNA 183, respectively. We developed a highly sensitive ECL biosensor with promising value for rapid dual-target analysis in point-of-care diagnosis.

Abstract No. 0296 Ching Yuan Su

Lithium metal batteries (LMBs) face challenges such as dendrite growth and degradation during cycling. Two effective methods to address this issue are using a nano-structured current collector as a lithium host and creating an artificial solid-electrolyte interphase (ASEI) layer. However, synthesizing an anode modifier with a high cycling stability and efficient Li diffusion/storage using a well-controlled deposition method remains a challenge.In this study, we prepared a dual-functional anode modifier that serves as both a lithium deposition host and an ASEI layer. This modifier was created by co-depositing fluorinated electrochemically exfoliated graphene sheets (FECG) and crumpled micro-balls (FECGB) using the electrophoretic deposition (EPD) method. The introduction of a hollow micro-ball structure into the coating provided extra lithium storage space and enhanced the mechanical strength of the coating, resulting in improved LMB performance stability.An optimized FECG/FECGB composite coating with a sheet/ball ratio significantly improved stability and inhibited dendrite growth in LMBs. This coating exhibited a low nucleation overpotential, high stability of coulombic efficiency (CE) of up to 87.63% after 400 cycles, and remarkable polarization performance for up to 400 hours in a half-cell. Additionally, full-cell LMBs demonstrated a capacity of up to 120 mAh/g after 100 cycles. This study presents a new strategy for enhancing the mechanical strength of LMB anodes by introducing FECG balls as structural support and creating additional lithium storage space, realizing the potential of high-stability LMBs.

Abstract No. 0297 Shih-Chieh Liao

We have investigated into the electrochemical performance of NMC/LMFP composite cells, featuring both blended and dual-layered electrode structures. Our synthesized 4V olivine-structured LMFP exhibits a discharge capacity of 150 mAh/g with excellent rate capability (>15C) and lifetime >5000 cycles. We found that LMFP/NMC cells with dual-layered electrode structures exhibited improved safety, rate performance, and cycle life compared with LMFP/NMC blend and NMC counterparts. The underlying mechanism will be discussed.

Abstract No. 0298 Yu-Fan Chen

Ni-rich layered oxide is considered as a promising cathode material of high energy Li-ion batteries due to the high capacity and low cost. LiNi_0.8 Co_0.1 Mn_0.1 O_2 materials were synthesized by a modified solid-state method. The single-crystal process typical requires calcination temperatures as high as 900°C. Transition metal oxides tend to exhibit low oxidation state at higher temperatures. For example, Co_3 O_4 spinel tends to release oxygen and converts to rock-salt CoO. Thus, oxygen partial pressure (pO2) may play an important role on the crystallization of layered oxide cathode. To investigate the effect of pO_2, $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ samples were first calcined in air and then second calcined under different oxygen partial pressure. With additional treatment of $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ under a high oxygen partial oxygen, a lower cation mixing was observed, leading to better electrochemical performance of high discharge capacity (186.6 mAh/g) and capacity retention (69.89% after 150 cycles at 0.5C). The results demonstrate that higher oxygen partial pressure leads to $LiNi_{0.8}Co_{0.1}Mn_{0.1}O_2$ having a better crystallinity and better electrochemical performance.

Abstract No. 0299 Zun-Wei, Wang

Proton exchange membrane water electrolyzer (PEMWE) has become one of the most promising technologies to create sustainable hydrogen power in recent years due to its high efficiency and high purity of hydrogen. However, the use of costly PGM catalysts like Ir, Ru, or their oxides has led to high capital costs due to their scarcity. Research efforts are focused on reducing catalyst loading and improving utilization efficiency. Parameters such as I/C ratio, ionomer content, ink concentration are varied in the present work. The effect of varying the concentration of the catalyst ink consisting commercial Ir Black, perfluorosulfonic acid ionomer ink, solvents is investigated towards a target loading of 0.5 mg/cm^2 and 2 mg/cm^2. Our results indicate that higher ink concentrations lead to decreased stability under different loadings, with noticeable differences in impedance (HFR values) after electrochemical testing. This study provides insights into the impact on the activity, stability, and sustainability of the MEA with different ink concentrations and catalyst loadings, which can be helpful information for research on scaling up PEMWE in the future.

Abstract No. 0300 Yu-Tone Chien

Heterostructures serve as one of the methods to enhance photoelectrochemical response. In this study, a facile hydrothermal-galvanic couple synthesis in which no external voltage or current was applied to synthesized $SrTiO_3$ thin films over TiN-coated substrates. Spontaneous galvanic currents occurred during the synthesis indicating the presence of galvanic couple effects. The syntheses were conducted at 80°C for 30 min in sodium hydroxide and strontium acetate mixed solutions where sputtered TiN thin films were used as the working electrode. X-ray diffraction and field-emission microscopy results revealed cubic $SrTiO_3$ films with granular morphology were formed over TiN. Subsequently, the films were annealed in a controlled atmosphere with different oxygen/nitrogen partial pressures including air, N_2 and, N_2/H_2. $SrTiO_3/TiO_2/TiN$ heterostructure films were formed after annealing in reducing N2/H2. The obtained photocurrent densities under UV-light illumination were evidently higher than those annealed in air and N2 and those before annealing. The peak value could reach more than 7000 $\mu A/cm_2$. This may be attributed to the $SrTiO_3/TiO_2/TiN$ heterostructure in which dense TiO_2 was formed by the slow oxidation of TiN. Another key factor may be due to oxygen vacancies generated under such reducing annealing conditions. The enhancement of photoelectrochemical response for $SrTiO_3/TiO_2/TiN$ heterostructure could be further elucidated using electrochemical impedance spectroscopy and photoluminescence spectra.

Abstract No. 0301 Gaurav Kumar Silori

Electrochromic materials (ECMs) are able to vary their coloration and transparency in a reversible manner when they are subjected to a small electric field (1–5 V). In this study, an idea is conceived to theoretically predict the optical and electrochemical behavior of inorganic electrochromic materials by choosing MnO_2 and TiO_2. Predicting optical properties (UV-Vis, HOMO/LUMO) can deliver preliminary ideas about (i) whether or not the chosen material has electrochromic features and (ii) the nature of unstable and stable states. Further, predicting electrochemical properties (redox potential) can significantly help in the selection of counter electrode materials in the electrochromic devices. The calculations in this work were executed on the Gaussian platform (assisted with GaussView interface) and mainly comprise Hartree-Fock (HF) approximation and time-dependent density functional theory (TD-DFT) methods. The excited state, optical energy/band gap, and redox potential calculations for chosen electrochromic materials were indexed with reported experimental findings to draw some valuable insights. Initially, electrochromic inorganic metal oxides were opted for simulation studies due to their simplistic structure and less complex computational requirements. The simulation for complex electrochromic chromophores (such as viologens) are also conceived to widen the scope of this study. It was observed that theoretical simulation of electrochromic materials has a near-good consistency with observed experimental data, and thus, the use of such calculations to predict the material's behavior is encouraged.

Abstract No. 0302 Hikari Sakaebe

High energy battery is required for several applications such as vehicle use, and at the same time, all-solid-state batteries (ASSB) are thought to be favorable in safety issues when the energy density increased. Authors have developed a series of new positive electrode materials, nano-composite for ASSB, such as $LiVS_2$-Li_2S. $LiVS_2$ – $2Li_2S$ (Li_5VS_4) has high electric conductivity and high capacity. Electrodes of Li5VS4 works in ASSB without conductive additive and showed 600 mAh/g when 20 wt% of argyrodite-type solid electrolyte was added. In this study, we successfully increased the Li_2S content for capacity enhancement. $LiVS_2$-$3.5Li_2S$ ($Li_8VS_{5.5}$) also worked without or with slight amount of conductive additive (1 wt% is enough) to show more than 700 mAh/g. We constructed the full cell using Si negative electrode and the volumetric energy density of the proto-type cell was estimated more than 800 Wh/L. This cell showed better thermal stability than that using layered-oxide, NMC. Nano-composite materials seems promising for ASSB.

Abstract No. 0303 Wesley Jen-Yang Chang

The electrochemical CO_2 reduction reaction (CO_2RR) can transform CO_2 into valuable multi-carbon molecule products like ethane, ethylene, ethanol, etc. Copper is an effective catalyst for CO_2 reduction reactions. However, the efficiency of the process is limited by the competing hydrogen evolution reaction (HER). Many studies introduced silver into the catalyst layer to improve the selectivity of multi-carbon products. Nevertheless, the structure of the tandem Cu-Ag catalyst layer wasn’t studied well. In this study, different kinds of tandem Cu-Ag catalyst layer structures were fabricated by spray coating and inkjet printing methods. The nano copper and silver particles were dispersed in deionized water/ isopropanol and then printed on the gas diffusion layer individually. The morphology and the distribution of Cu-Ag were characterized by SEM-EDS. The faradaic efficiency and electrochemical performance were tested in a flow cell with CO_2 gas in the cathode and 1M potassium hydroxide solution in the anode. The reaction products from the cathode were continuously measured by online gas chromatography. The tandem Cu-Ag catalyst layer did improve the selectivity of C_2 products, and the layer Ag-Cu-GDL layer structure achieved 2 to 4-fold enhancement of multi-carbon products compared to pure Cu or random mix Cu-Ag catalyst structure.

Abstract No. 0304 Hanh T. T. Nguyen

Solid polymer electrolytes (SPEs) offer several advantages for all-solid-state lithium metal batteries, including intimate electrode contact and the ability to accommodate volume changes in the Li-anode. Additionally, ensuring high stability and uniform deposition of Li is crucial for practical applications of Li-metal batteries (LMBs). One approach to achieving stable operation and preventing dendrite formation involves the design of a scaffold for polymer electrolyte. This scaffold employs a porous membrane, specifically a poly(vinylidene fluoride-co-hexafluoropropylene) (PVdF-HFP) membrane, as a host for a networked poly(ethylene oxide) (PEO)-based solid polymer electrolyte, forming a scaffold-hosted electrolyte. The PVdF-HFP membrane facilitates uniform Li deposition on Li-metal anode with negligible dendrite growth. This scaffold design shows promise for the practical implementation of LMBs. However, the ionic conductivity of SPEs is limited by factors such as restricted chain movement, insufficient dissociation of ion complexes, and hindered pathways for Li+ ion transport. To address these limitations, a second study introduces an interpenetrating polymer network electrolyte. This electrolyte comprises networked SPEs based on PEO and poly(vinylidene fluoride), along with lithium bis(fluorosulfonyl) imide. By leveraging the synergistic effects of the polymer networks, this approach enables the development of a robust solid-state lithium battery with a breakthrough improvement in lithium-ion conductivity (1 mS cm^{-1} at 30 °C). Consequently, this advancement establishes solid-state batteries as superior alternatives to liquid electrolyte batteries in terms of safety and performance.

Abstract No. 0305 Avi Arya

Achieving high reversible capacity with a structurally stable anode is becoming a critical component for next-generation lithium-ion batteries (LIBs). Polyaromatic hydrocarbons (PAHs) are a new class of promising anode materials with a well-defined, low-cost and lightweight structure. Due to their highly reversible lithiation and de-lithiation process, they enable long cycle life and high performance in LIBs. Their π-π conjugate bond resembles sp^2 allotrope forms of carbon, making them a good candidate to replace graphite as an anode material. In this work, two common PAHs, naphthalene (Naph) and biphenyl (Bp), were used as anode active materials for LIBs. These PAH-based electrodes were synthesized by mixing them with carbon black as a conductive agent, carboxymethyl cellulose (CMC) as a thickening agent, and styrene-butadiene rubber (SBR) as a binder (weight ratio in 70:20:10). Electrochemical characterization using half-cell architecture shows that Naph and Bp have a high specific capacity of 189 mA h g^{-1} and 209 mA h g^{-1}, respectively, at a C-rate of 0.5C with negligible capacity degradation after 1000 cycles. Structural analysis shows that they have a stable orientation even after cycling, which can be confirmed by SEM and Raman. The solubility test in electrolytes confirms that they are quite stable and have no change after 24 hours, which makes it a perfect material to be used as an anode material for LIBs. The rate capability analysis showed that they have good capacity retention of 84.5% and 86.3% for Naph and Bp, respectively. Overall, the studies showed that these PAHs-based organic anode materials are the potential anode material candidates for high performance LIBs.

Abstract No. 0306 Ha-Phuong Ngo Thi

Organic-inorganic hybrid perovskite solar cells are the most promising next-generation photovoltaic technology due to their extraordinary optoelectronic characteristics. Spin-coated mesoporous titanium dioxide (TiO_2) is popularly used as the electron-transporting material (ETM) in the regular n-i-p architecture. However, pure TiO_2 exhibits low conductivity and its fixed band position is not optimal for advanced perovskite formula such as $MA_xFA_{1-x}PbBr_yI_{3-y}$. Moreover, spin coating is not suitable for deposition of large area film for photovoltaic module production. Consequently, we prepare a Zn-doped TiO_2 films by a co-electrodeposition method from a single electrodeposition bath at 60^{o}C and apply it as the ETM for perovskite solar cells. The doping amounts, optical property, morphology, electrical conductivity, and the power conversion efficiency are systematically elucidated. The device efficiency of TiO2 based ETM with 3 % Zn dopant achieves 20.69 %, corresponding to J_{SC} of 24.64 mA.cm^{-2}, V_{OC} of 1.08 V, and FF of 0.78. Notably, this efficiency surpasses that using common spin-coated TiO_2 ETM, which is 19.09 % (J_{SC} of 23.44 mA.cm^{-2}, V_{OC} of 1.07 V, and FF of 0.76. This notable enhancement can primarily be attributed to the enhanced electron extraction capabilities due to Zn doping.

Abstract No. 0307 Tung-Han Yang

Multicomponent high-entropy-alloy (HEA) nanocrystals have recently emerged as a versatile family of catalysts due to their immense chemical space and tunability. However, there are no effective strategies for synthesizing libraries of HEA nanocrystals with controlled surface atomic structures for the capability of fine-tuning or optimizing catalytic performance. Here we present a straightforward strategy to craft a library of facet-controlled HEA nanocrystals with up to ten dissimilar metallic elements by solution-phase layer-by-layer epitaxial growth, giving rise to the expanded design space for catalysts. We show that diverse subnanometer-thick HEA atomic layers can be deposited epitaxially on nanocrystals with well-defined facets, thus achieving HEA shells with desired atomic arrangements. Several facet-dependent effects of HEA-based core-shell nanocrystals are discovered toward hydrogen evolution and oxidation reactions in electrocatalysis and photocatalysis, which are elucidated by in situ X-ray absorption spectroscopy and theoretical calculations.

Abstract No. 0308 Mohamad Afiefudin

The use of MnO_2 as a cathode material in rechargeable aqueous zinc-ion batteries shows great promise for development due to its high safety, low cost, and environmental friendliness. However, the manganese dioxide cathode suffers from a dissolution-redeposition reaction mechanism, leading to poor structural stability. To address these issues, this study focuses on modifying the structural properties of layered MnO_2 to overcome its drawbacks, such as low conductivity, capacity, and cycling stability. Synthesizing Ni-MnO_2 with flower-like could improve conductivity and rapid diffusion of Zn^{2+} ions and electron transfer are enabled. This results in a high capacity of 350 mAh/g at 50 mA/g and excellent long-term cycling stability, maintaining capacity over 100 cycles. The distinctive morphology and layered structure of Ni-MnO_2 are believed to facilitate ion transportation, making it a promising cathode material for aqueous zinc-ion battery applications.

Abstract No. 0309 Cian-Ping Lin

The utilization of deep eutectic solvent (DES) as an innovative energy storage electrolyte has garnered notable attention in contemporary times. Relative to conventional ionic liquid electrolytes, DES offers a spectrum of merits, encompassing heightened ion concentration, cost-effectiveness, an expanded electrochemical stability range, and enhanced safety characteristics.

The DES is comprising lithium nitrate ($LiNO_3$) and N-methyl acetamide in a eutectic ratio of 1:4. Various additives are subsequently incorporated into the DES matrix to enhance electrochemical performance. The symmetric Li//Li cells and asymmetric Li//Cu cells are adopted to study the deposition/stripping behaviors. A variety of analytical tools, including Fourier-transform infrared (FT-IR) spectroscopy, Raman spectroscopy, differential scanning calorimetry (DSC), viscosity measurements, and conductivity analyses, are employed to investigate the physical properties of the electrolyte. Additionally, cycling stability evaluations and AC-impedance analyses are executed, employing LMO as the cathode material.

The research results demonstrate that different additives in the deep eutectic solvent (DES) exhibit distinct effects vis various tests. The inclusion of vinylene carbonate (VC) in the electrolyte enhances the Coulombic efficiency of asymmetric cells and prolongs the cycle life of symmetric cells. This effect is also evident in Li//LMO lithium metal battery tests, where a substantial increase in cycle life is observed. In AC-impedance analyses after 50 cycles, it is apparent that cells with VC exhibit lower impedance compared to cells without additives, demonstrating the beneficial impact of additive inclusion. Furthermore, with an increase in the additive content, conductivity is significantly improved and electrolyte viscosity is also decreased. In the investigation of electrolyte properties, the coordination of C=O bonds with lithium ions is confirmed, as indicated by Raman spectroscopy's blue-shift of the C=O peak. Notably, in Li//LMO lithium metal battery tests, the battery demonstrates a cycling life extending to 1000 cycles.

Abstract No. 0310 Shih-Hsuan Chen

Carbon dioxide reduction reaction (CO_2RR) offers potential solutions to energy problems by converting CO_2 from fossil fuel utilization into usable fuels, effectively mitigating atmospheric CO_2 levels. However, CO_2RR faces difficulties including high overpotential, intensifying competing hydrogen evolution reaction (HER), low catalytic activity and selectivity, and the reliance on costly and noble catalysts. In this study, the Ag_x-In_y/C catalysts with different Ag/In atomic ratios of 8/2, 4/6, and 2/8 were prepared by incorporating cost-effective In_2O_3 to modify the surface of Ag/C catalysts. High-resolution transmission electron microscopy (TEM) revealed that In_2O_3 was dispersed on the Ag surface to form a core-shell structure. Linear sweep voltammetry (LSV) demonstrated that the current density of Ag_x-In_y/C catalysts exhibited more larger (negative) values and lower overpotentials compared to Ag/C in the voltage range of -0.6 to -1.0 V vs. RHE (VRHE), as shown in Figure 1(a), indicating that the In_2O_3 addition enhanced the activity and decreased the overpotentials of the catalysts. Particularly, Ag_2-In_8/C demonstrated the lowest overpotential and the largest formate partial current density, indicating its highest activity and most favorable for CO_2RR. During CO_2RR, the Ag_8-In_2/C catalyst achieved a high CO faradaic efficiency (FE_{CO}) of 91.2% at -0.8 VRHE with a partial current density of 1.67 mA/cm^2 , as shown in Figure 1(b). Similarly, the Ag_2-In_8/C catalyst exhibited and high formate faradaic efficiency (FE_{HCOOH}) of 95.5% at -0.9 VRHE with a partial current density of 3.53 mA/cm^2, as shown in Figure 1(c). This study reveals the critical role of In_2O_3 surface in the Ag_x-In_y/C catalysts in modulating the binding energy of intermediates through the comprehensive analysis of their structure and electrocatalytic characteristics, revealing a novel approach for the selectivity regulation in CO_2RR controlled by compositions and potentials.

Abstract No. 0311 Sin-Yi Syu

Due to its low cost, high safety, and easy production characteristics, rechargeable zinc-based aqueous batteries are considered as promising energy storage systems. However, the high reactivity of water molecules can induce passivation and dendritic growth within zinc-based aqueous batteries. In this study, the electrolyte primarily comprises a mixture of 1 mole zinc acetate, 1 mole lithium acetate, and 2 mole urea. The mixture is subjected to heating and stirring at 80°C to create a deep eutectic liquid, to which methanol and ethanol are added as additives. Lithium iron phosphate ($LiFePO_4$, LFP) is utilized as the cathode material to form a Zn//LFP half-cell for conducting electrochemical tests. Initially, different mole of additives (n=6, 8, 10) are introduced to investigate their effects on the Zn//Zn symmetric cell and subsequently the Zn//Cu asymmetric cell, identifying the optimal additive ratio. Following this, a Zn//LFP half-cell is assembled to assess the electrochemical performance using different types of alcohols.

The experimental results demonstrate that the electrolyte maintains a stable overpotential after 2000 hours of operation in the Zn//Zn symmetric cell. Additionally, in the context of the Zn//Cu asymmetric cell, it sustains a remarkable coulombic efficiency of 99.5% over 700 cycles. Following 1000 cycles, the coulombic efficiency of 8 mole ethanol exhibits greater stability compared to that of methanol. Consequently, within the Zn//LFP half-cell configuration, the electrochemical performance is notably enhanced with 8 mole ethanol, exhibiting a specific capacity of 130 mAh/g. Even after undergoing 700 cycles, it retains a specific capacity of 90 mAh/g. Analysis of the electrolyte, as indicated by Raman and FTIR results, highlights that the introduction of urea coordinates with zinc acetate and lithium acetate, culminating in the formation of a deep eutectic electrolyte. This alteration leads to a restructuring of the solvation shell within the electrolyte.

Abstract No. 0312 Saravanakumar Muthusamy

In the drive for sustainability, innovative tech and pathways are vital for green fuel production and curbing carbon emissions. Electrochemical energy conversion, using solar and wind sources, captures and stores intermittent energy as fuels from Earth's resources like H_2O, N_2, CO_2, and O_2. Electrochemical H_2O_2 synthesis from oxygen offers an eco-friendly alternative to the energy-intensive anthraquinone process. Despite the potential, challenges like high overpotential and limited rates hinder it. We mimic metalloenzyme-like active structures in carbon-based single-atom electrocatalysts, enhancing oxygen reduction efficiency. Using a carbonization approach, we tune the metal center's electronic structure through nitrogen and oxygen coordination and epoxy oxygen functionalities. In acidic conditions, CoNOC structures exhibit over 98% H_2O_2 selectivity ($2e^-/2H^+$), surpassing CoNC sites favoring H_2O ($4e^-/4H^+$). Notably, CoNOC stands out among MNOC (M = Fe, Co, Mn, Ni) single-atom catalysts, boasting the highest (> 98%) selectivity with zero overpotential, achieving a TOF of 0.73 s^{-1} for H_2O_2 production. CoNOC-5 produces abundant H_2O_2, suitable for water bleaching and sterilization. Acidic media selectivity is metal-centered with epoxy microenvironments. X-ray spectroscopy confirms unsymmetrical MNOC structures. Comparative DFT analysis highlights epoxy-surrounded CoNOC's optimal structure-activity relationship yielding high selectivity through optimum ΔG_{*OOH} binding energies.

Abstract No. 0313 Liang-Yin Kuo

Doping and surface coating have been widely studied for the modification of Ni-rich cathode active materials (CAMs). Research has shown that various types of dopants enhance the capacity retention and rate capability of Ni-rich CAMs. A comprehensive analysis of the role of dopants and their impact on the structure of Ni-rich CAMs remains necessary. Here, we studied the effects of dopant size and oxidation state on the structure and electrochemical performance of Ni-rich CAM. Boron (B) which has a small ionic radius with an oxidation state of 3+ and ruthenium (Ru) which has a larger ionic radius with a higher oxidation state of 5+ are investigated. It is found that Ni-rich CAM with B-doping leads to the formation of a boron oxide-containing surface coating, primarily on the outer surface of the secondary particles. While the primary particle size and the initial capacity are slightly changed, there is a significant improvement in capacity retention. However, Ni-rich CAM with Ru-doping does not show segregation on the outer surface of the secondary particles. Instead, it preferentially occupies incoherent grain boundary sites, resulting in a smaller primary particle size and initial capacity compared to B-doped and pristine ones. Simulations indicated that a small number of dopants may not significantly affect bulk properties but can profoundly influence the surface and/or grain boundary properties of the microstructure, consequently impacting the overall performance of cathode materials.

Abstract No. 0314 Chih-Ming Chen

Interfacial composite engineering based on silanization can reconstruct the surface properties of target materials for versatile applications in microelectronics. Through surface silanization, chemically inert organic and inorganic materials become active, remarkably enhancing their functionalities and application scopes. Three examples are given to show the significance of interfacial composite engineering. The first example is polyimide which is a flexible film widely used in wearable and portable electronic devices. After oriented grafting of aminosilanes, the surface of polyimide is functionalized with a molecular nanolayer that can strengthen the immobilization of catalytic Pd nanoparticles for efficient atomic deposition of Ni and Cu. The amine functionality of the polyimide surface is maximized through a new co-silanization treatment and thereby enhances the deposition of metal atoms as well as the heterojunction adhesion. The second example is glass, a rigid substrate widely used in human daily life. Through surface silanization treatment, the glass surface becomes chemically active for metallizations. Co-silanization also improves the grafting orientability of aminosilanes, increasing the adhesion strength of the metallic film on glass. Silicon is the third example to take the advantage of surface silanization in advanced semiconductor packaging. The silanization nanolayer shows a high potential to replace traditional Ta/TaN film as the bi-functional interlayer at the silicon/Cu heterojunctions for metal adhesion and diffusion barrier.

Abstract No. 0315 Ching-Kai,Chang

Oxalic Acid ($H_2C_2O_4$) is one of the key solutions to precipitate Nickel, Cobalt, Manganese, and most importantly Lithium which are all in the form of oxalates [$MC_2 O_4 \cdot 2H_2O$ (M=Ni/Co/Mn)] from Nickel based high-energy cathodes ($LiNi_xCo_yMn_{1-x-y} O_2$). In this research conducted, 96.9% of Oxalates are precipitated from the commercial NCA waste batteries. The process is highly sensitive to parameters of temperature per time, and acidity concentration. So, after filtration of the precipitate oxalates (which can further be reduced into a separate compound by other reduction reactions), in order to produce a higher efficient precipitation of Lithium carbonate precipitants from the oxalic acid solutions, and more active oxidant solution (K_2CO_3) is introduced into the oxalic acid solution to subsidize Potassium with Lithium and produce Lithium carbonate ($Li_2 CO_3$). From the reaction chain above, 93.86% of Lithium carbonate is successfully precipitated from g of commercial NCA waste batteries.

Abstract No. 0316 Ze-Ren Jhang

In many applications such as portable electronic devices and electric vehicles, the lithium-ion batteries are the primary energy storage devices. Increasing the capacities of batteries is urgently needed.

However, the development of electrodes with a certain thickness is still hindered by slow electrochemical kinetics caused by tortuous pathways/channels for Li^+/e^- transport in high tortuosity electrodes. To overcome these challenges, it was been proposed to use porous electrodes with desired pore structure. Due to its zero-strain property, lithium titanate oxide (LTO) is a good candidate for the demonstration of thicker porous electrode. Through adequate sintering control, the porous electrode may provide the required electronic and ionic conducting paths through interconnected porous structure. The design of electrode skeleton will affect the penetration of electrolytes and the transfer of electrons and ions. In this study, the arrangement of pore and the porosity can be controlled by adjusting the templating slurry. Thus, LTO skeleton thickness, electronic/conducting, pore sizes, and porosity are factors affecting the battery performance. The fabricated LTO were characterized by X-Ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Electrochemical Impedance Spectroscopy (EIS) and discharge-charge tests of the batteries for crystallization, particles morphology, impedance analyses and electrochemical performance.

Abstract No. 0317 Thai Hoang Nguyen

Sugarcane bagasse is one of the most common agricultural wastes, which possesses a large percentage of cellulose, making it an abundant and environmentally friendly source for the fabrication of cellulose carbon aerogel. Herein, waste sugarcane bagasse was used to synthesize cellulose aerogel with tuneable hierarchical structures using urea, polyvinyl alcohol (PVA), and sodium alginate (SA) as crosslinking agents. The 3D porous network of cellulose aerogels was constructed by intermolecular hydrogen bonding, which was confirmed by Fourier transform infrared, X-ray diffraction, scanning electron microscopy and nitrogen adsorption/desorption. We found that the specific surface area as well as the micropore percentage values of the fabricated electrode composite material from cellulose-based carbon aerogel depended on the crosslinking agents in the order Urea < PVA < SA. The cellulose aerogel fabricated from SA crosslinking agent (denoted as SB-CA-SA) exhibited the lowest density of 0.04 g cm^{-3} and the highest porosity of 97.38%, which gave a high surface area of 497.9 m^2 g^{-1} with 55.67% micropores after carbonization/activation to form carbon aerogel (denoted as SB-ACCA-SA). Interestingly, the salt adsorption capacity of the carbon porous electrode fabricated using SB-ACCA-SA obtained an outstanding value of 31.40 mg g^{-1} with respect to carbonaceous materials. The desalination investigation using the SB-ACCA-SA electrode showed high stability after 50 testing cycles. We note that hierarchical structures in cellulose carbon aerogels from sugarcane bagasse can be tuned by using sodium alginate for maximum salt adsorption capacity. The effect crosslinking agents on microstructure of the cellulose aerogel, and then on the carbon aerogel, has been investigated extensively in this work.

Abstract No. 0318 Ray-Rong Tang

Lithium batteries are commonly used in consumer electronics such as mobile phones, notebooks, and electric vehicles. However, to meet the high safety, energy density, and power density requirements of these applications, it is needed to improve the ratio of active material to non-active materials including binder and conducting agents for accommodating more active materials.

Electrophoretic deposition (EPD) is a special colloidal processing technique that the charged particles suspended in a solution are deposited on a substrate under an electric field. In this study, the nickel-rich layered oxide, $LiNi_{0.8}Co_{0.15}Al_{0.05}O_2$ (NCA) is first processed as charged particles mixing with small amount of binder and conducting agent. With the assistance of applied an electric field of 60V, NCA with a thickness ~ 20mm was nicely deposited on a Al foil. After drying, the EPD-deposited NCA on Al film is ready for testing. Various morphologies/microstructures of NCA films processed under different voltages and time will be examined. The resulted properties will be elucidated and explained based on electron and ion transport, as well as charge-discharge curves.

Abstract No. 0319 Ting-Wei Kuo

As the increasing demand for energy and the rising environmental pollution become global challenges, the electrochemical carbon dioxide reduction reaction (CO_2RR) has emerged as a potential solution for reducing carbon emissions. Scientists have developed many binary catalysts, including copper (Cu) and tin (Sn) bimetallic catalysts. In this study, Cu-SnO_2/C and CuO-SnO_2/C with the same atomic ratio of Cu/Sn = 99/1 were prepared. Under different voltages, Cu-SnO_2/C and CuO-SnO_2/C showed higher CO faradaic efficiency (FE_{CO}) than Cu/C, CuO/C, and SnO_2/C, indicating that the synergistic effect between Cu/CuO and SnO_2 could effectively suppress the hydrogen evolution reaction and enhance CO selectivity, as shown in Figure 1(a). Additionally, CuO-SnO_2/C exhibited the best CO selectivity and stability, with a FE_{CO} of 95% at -0.8 V (vs. RHE) and maintaining 90% after 10 hours, compared to 80% for Cu-SnO_2/C within 5 hours, as shown in Figure 1(b). These results indicate that the CuO-SnO_2 interface demonstrates a superior synergistic effect compared to Cu-SnO_2 interface, leading to the best improvement of CO selectivity and stability. When a small amount of Sn was added, numerous Sn-Cu bonds were formed. As the Sn content increased, Sn tended to aggregate and form Sn-Sn bonds, causing a shift in selectivity from CO to HCOOH. In addition, SnO_2-modified CuO catalysts could prevent SnO_2 from being reduced to Sn and maintain the activity site for CO_2-CO conversion. This study demonstrates the synergistic effect of CuO and SnO_2 on CO_2-CO conversion and investigates the impact of the atomic ratio on selectivity, providing new insights for catalyst design in CO_2RR applications.

Abstract No. 0320 Chun-Yang Kang

Maximizing the batteries' energy densities is an imperative topic with the growing demand for electric vehicles[1]. However, a direct approach to thickening the electrodes is strictly limited by electrolyte penetration, sluggish lithium-ion diffusion, and mechanical instability. Therefore, different types of fabrication methods have been proposed recently to accelerate rate performance, but few of them could be able to strike a balance between a high active material ratio with optimal performance and cost-effectiveness for scaling[2]. In this work, a low-tortuosity $LiFePO_4$ (LFP) electrode with a high areal loading of active material was constructed by stamping process after low-temperature drying. As a result, it achieves superior diffusivity by simultaneously increasing porosity and decreasing tortuosity. Under special experimental design, we have successfully created low-tortuosity micro-channels that effectively conventional LFP electrodes' ion transport issue, while keeping the cathode's adequate mass loading and high levels of porosity. The use of a 3D profiler couping with scanning electron microscopy (SEM), provided us a comprehensive and better understanding of the complicated electrode structure. the electrochemical analysis further confirmed that this novel method greatly enhanced the lithium-ion kinetics, thereby improving the electrodes' charging/discharging performance. Under high loading of active materials, this work still delivers high discharge specific capacity of 92.6 mAh g^{-1} at 4C.

Abstract No. 0321 Jing-Sen Yang

Superionic solid-state electrolyte Li_6PS_5Cl (LPSC) with ionic conductivity on par with those of liquids has gained intense interest in the development of all-solid-state batteries. A comprehensive understanding of ion transport mechanisms in LPSC would help the design of solid-state fast ion conductors; however, the mechanism behind such extraordinarily high ionic conductivity remains unclear. A phenomenon of positional exchange between S and Cl anions was observed in previous works; we referred to this as "S/Cl site-exchange." There is a correlation between anion site-exchange and Li ion mobility. We investigated this correlation by integrating *ab-initio* molecular dynamics (AIMD) and nudged elastic band (NEB) simulations. Li ionic conductivity in LPSC is increased by up to two orders of magnitude when introducing the S/Cl site-exchange. Notably, the diffusion energy barriers over the pathways connecting neighboring cages are lowered when S/Cl site-exchange is in the cages. The atomistic inter-cage pathways varied by S and Cl anions is a key factor in enhancing the ionic conductivity in LPSC.

Abstract No. 0322 Hoang Long Ngo

The global need for clean and safe water has prompted the exploration of advanced, cost-effective, and environmentally friendly methods for water purification. This study presents a low-cost and eco-friendly approach to fabricate a Membrane Capacitive Deionization (MCDI)-utilized ion exchange membrane using poly(vinyl alcohol) (PVA). MCDI is an emerging technology that has shown great potential in removing ions from water, but its wide-scale implementation has been hindered by the cost and environmental concerns associated with the fabrication of ion exchange membranes. In this work, we have successfully developed a novel ion exchange membrane by incorporating a green crosslinking agent into a PVA matrix, followed by a simple casting and drying process. The resulting PVA-based membrane demonstrated excellent ion exchange capacity, mechanical stability, and chemical resistance. Additionally, the membrane showed superior performance in MCDI applications, achieving a high salt removal efficiency and low energy consumption. Life cycle assessment (LCA) revealed that the environmental footprint of the PVA-based membrane is significantly lower than that of conventional ion exchange membranes. This study not only provides a viable and eco-friendly alternative for ion exchange membranes in MCDI applications but also contributes to the sustainable development of water treatment technologies.

Abstract No. 0323 Je-Nam Lee

Lithium metal (Li) has been attracted much attention due to the theoretical specific capacity equal to 3,860 mAh g^{-1} and the lowest redox potential (-3.04 V vs. SHE). This enables increase in the energy density of lithium-ion batteries (LIBs) using Li anode. However, there are several drawbacks associated with the high reactivity with electrolyte and safety issues, which dendrite growth can penetrate the separator and the electrolyte. Recently, lots of strategies have been focused on controlling dendrite growth, including making a passivation layer, selecting functional electrolyte with additives.

Alternatively, unique structures with ability to accommodate Li and control the battery performance have been attracted significantly due to lowering local current density along anode surface and mitigate the volume change during Li plating/stripping. Among the several candidate materials for the scaffold, carbon nanotubes (CNTs) have been studied for LIBs due to the excellent conductivity, large surface area, and mechanical strength of CNTs. In addition, CNTs have been introduced as promising material for Lithium metal batteries (LMBs). There has been some works dealing with CNTs, but still less attention has been paid to examine the effect of scaffold structure on the electrochemical reversibility of Li deposition/stripping.

In this work, we introduced MWCNT fabric structure as an interlayer for the Li accommodation. The effect of MWCNT fabric scaffold on the deposition/stripping behavior of Li metal was investigated.

Abstract No. 0325 Kuan-Zong Fung

Lithium-ion batteries are widely used in energy storage applications, and the cathode material plays a crucial role as it directly impacts the battery's capacity and cost. In recent years, the manufacturing of single-crystal cathodes has been considered as the most effective method for improving battery lifespan. Consequently, many research teams have dedicated their efforts to this area.

However, for NMC layered oxides to grow into larger grains typically requires much processing temperatures at least 900°C. However, to form the layered structure of NMC oxides prefer the trivalent state of transition metal ion in particular at lower temperature. Thus, for large-grain Ni-rich NMC to maintain good crystallinity, it may require some adjustment in processing procedures and heating history. In this synthesis study of single-crystal $LiNi_{0.8}Co_{0.15}Al_{0.05}O_2$ (NCA), the addition sequence of CoO and Al_2O_3 was adjusted accompanied by additional heating. The structural, microstructural and electrical properties of resulted layered oxides will be examined using XRD, SEM, impedance measurements. CV and charge/discharge tests from assembled coin cells will be used to evaluate electrochemical properties of single-crystal Ni-rich layered oxides.

Abstract No. 0326 Yi-Jui Yeh

Surface-enhanced Raman scattering (SERS) is a useful analytical tool that allows ultrasensitive molecular-level detection through an enhanced electromagnetic field generated by plasmonic metal nanoparticles (MNPs), which is helpful for biomedical-based detection, environmental pollution monitoring and chemical industry. Recent study suggests that porous MNP with enhanced SERS active area and hybrid plasmonic nanostructures such as core-shell NPs and metal-semiconductor-based NPs with designed and controlled plasmonic properties can further improve the SERS responses.

Here we report a microplasma nanoengineering of plasmonic nanostrutures including Au-Ag core-shell NPs for ultrasensitive SERS-based applications. Microplasmas are low-temperature plasmas that feature microscale dimensions and a unique high-energy-density and a non-equilibrium reactive environment, which makes them promising for the fabrication of advanced nanomaterials and devices for diverse applications. Detailed characterization indicates the microplasma-enable controllable-designed growth of plasmonic nanomaterial with heterostructure effect, providing enhanced charge transportation, adsorption ability or forster resonance energy transfer during Raman scattering. To understand the plasmonic effect, we use 3D confocal microRaman scattering study that shows that a large SERS volume was formed in the as-fabricated SERS-active substrates, leading to significant SERS properties of low limit of detection and high enhanced factor (EF) with the Rhodamine 6G (R6G) as the Raman probe. Furthermore, we also used the biomoleculars, medicines, and dyes as the target molecule. Our work not only provides environmentally friendly fabrication techniques with strong potential for the design and growth of the nanostructure but also the fundamental insight of plasmonic nanostrutures for emerging applications including nanocataysis, sustainable energy, and biomedical imaging.

Abstract No. 0327 Ahmed Fouad Musa

Perovskite solar cells (PSCs) have garnered substantial attention due to their exceptional power conversion efficiency (PCE) and cost-effective fabrication. Among the semiconductors, the cubic α-phase of formamidinium lead triiodide ($FAPbI_3$) has emerged as the most promising choice for creating highly efficient and stable perovskite solar cells. Maximizing the performance of this material is of paramount importance to the perovskite research community. However, thin $FAPbI_3$ films tend to undergo a phase transition from the photoactive black α-phase to an inactive yellow δ-phase when the temperature drops below 150°C. In this study, we explored the impact of introducing cesium thiocyanate (CsSCN) into the perovskite precursor solution. This addition facilitated the creation of a stable perovskite film with a larger grain size, even at a lower temperature of 100°C. The role of SCN^- anions proved critical in promoting the formation and stabilization of α-$FAPbI_3$ below its thermodynamic phase transition temperature. Notably, the inclusion of the CsSCN additive resulted in a remarkable enhancement of the power conversion efficiency (PCE) of the devices, exceeding 22%. This performance improvement can be attributed to several factors, including the formation of a stable perovskite film with larger grains, a film that is more uniform and compact, reduced defects, and improved charge transport properties. Furthermore, X-ray diffraction analysis verified that the CsSCN additive facilitated the formation of pure α-phase perovskite crystals, eliminating undesirable secondary phases. These findings underscore the effectiveness of CsSCN as an additive in achieving stable and high-performance α-$FAPbI_3$ perovskite solar cells with a pure phase composition.

Abstract No. 0328 Ting-Wei Chen

Charged species, which are contributed by free charge carriers, dopants, vacancies and other types of charged defects, are related to the functions which will affect the application of semiconductor devices. Charged defect, which can establish additional states in the band gap, can significantly affect charge behaviors including conductivity and free charge carrier recombination with different defect concentration and energy level. With the above mentioned, it is quite valuable to have a detailed investigation for providing the defect distribution. However, charged defect cannot be distinguished directly from all the charge species. Therefore, it is hard to directly detect the defect distribution.

Compared to other methods like SIMS, XRP, XPS, alternating current (AC) admittance spectroscopy can detect charge carrier distribution in a nondestructive way. Another advantage is that AC admittance can directly measures the electrons or holes in the system while other methods measure them indirectly from dopant profile. It can detect all free charge carriers that can give us a more accurate charge carrier distribution.

Traditional AC admittance spectroscopy uses a semiconductor-insulator-semiconductor structure to characterize the charge carrier distribution. It will have multiple interface that may cause undesired contribution. Also, insulator layer needs heat process during the synthesis, which may change the defect distribution in the semiconductor layer. In this research, we apply a more facile device which has no insulator layer. Instead, we propose the desired space charge layer by a metal-semiconductor Schottky junction. Also, in order to further obtain the defect distribution profile, we need to compare the charge carrier distribution profile between defect excited condition and nonexcited condition. The difference from the above comparison will be the contribution from corresponding defect, that can finally give us the defect distribution. This work establishes a method to provide defect distribution, offering a great support for further exploration of semiconductor materials and devices.

Abstract No. 0329 Dhayanantha Prabu Jaihindh

The electrochemical reduction of CO_2 process (CO_2RR) is a fascinating approach for reducing CO_2 emissions while generating valuable substances such as chemicals and fuel in a carbon-neutral way. Numerous studies have been performed to mitigate the hydrogen evolution reaction (HER) and boost the CO_2RR by adjusting the catalysts with additives such as anchoring agents, anion, and furthermore. Chlorinated copper catalysts have demonstrated potential for electroreduction of carbon dioxide to complex compounds; however, the challenging control of chlorination has kept chlorine's potential as a selectivity promoter hidden from view. To investigate the effect of chlorine content in CuO, we developed a deep eutectic solvents (DESs) assisted chlorination approach based on varying molar ratios of choline chloride to citric acid. In this case, DESs serves as a green solvent as well as a Cl source in the preparation of catalysts. X-ray photoelectron spectroscopy, X-ray absorption investigations, and other physicochemical characterizations were also performed to demonstrate the presence of chlorine in the CuO lattice. A particular amount of chlorine-doped CuO electrocatalyst exhibiting a high C_{2+} product of ethylene with Faradaic efficiency (FE) of 57% at -1.17 V versus reversible hydrogen electrode (V_{RHE}) with the current density of 220 mA cm^{-2} in flow cell system is shown here. In addition, the catalyst displayed reasonable catalytic stability in 1M KOH over a period of 10 hours. The chlorine-induced stable cationic Cu^0/Cu^+ species, as well as the well-preserved structure with many active sites, are important to the high FE of ethylene in electrochemical CO_2 reduction. These findings may help to synthesize the catalysts in a greener way and improve structure-performance correlations, paving the way for the next generation of catalysts for energy applications.

Abstract No. 0330 Chieh-Hao Wan

It is highly desirable to exploit an anti-corrosion catalyst support to improve the durability of proton exchange membrane fuel cells (PEMFCs)[1-2]. In this study, potassium tantalate with rod-like structure ($K_6Ta_{10.8}O_{30}$) was used as the catalyst support, and its surface was coated with reduced-graphene oxide (rGO) layer to improve the long-term performance durability of catalyst. This sample was denoted as rGO-$K_6Ta_{10.8}O_{30}$ and loaded with 40% platinum (Pt/ rGO- $K_6Ta_{10.8}O_{30}$). The results of the accelerated degradation test (ADT), i.e, the measurement of cyclic voltammogram scanning from -0.20V to 1.00V for 10k cycles, showed that the Pt/rGO-$K_6Ta_{10.8}O_{30}$ catalyst could maintain about 83.4% of its electrochemical active area (ECSA). While the Pt/C catalyst could only retain 28.1% of its ECSA. The membrane electrode assembly (MEA) formed by as-prepared Pt/rGO-$K_6Ta_{10.8}O_{30}$ as cathode catalyst shows the power density of 203.97 mW/mg, which are 10.0% higher than that of the 40% Pt/C (185.40 mW/mg) catalyst, tested at 60°C before the ADT. After the ADT, the power densities of the MEA with Pt/rGO-$K_6Ta_{10.8}O_{30}$ as cathode catalyst show a performance decrease of 5.6% while that with Pt/C catalyst has a performance decrease of 40.8%. These results suggested that $K_6Ta_{10.8}O_{30}$ coated with rGO layer can effectively improve the performance of fuel cells and long-term performance durability. This may attribute to the rGO layer offering high electron conductivity and large specific surface area on $K_6Ta_{10.8}O_{30}$ support, which effectively improves the catalyst utilization and transfers the produced electrons to the external circuit. It thus improved the performance of the catalyst. Due to the directional arrangement of columnar structure of the $K_6Ta_{10.8}O_{30}$ support, it is believed that this structure benefit to the transferring of electrons. This caused the catalyst with $K_6Ta_{10.8}O_{30}$ support offering superior power density than Pt/C.

Abstract No. 0331 Chia-Yu Chang

Single-atom catalysts (SACs) have become one of the most popular research directions for electrocatalysis and fuel cells in recent years. Along with their unique coordinately nonsaturated and electronic structures, SACs exhibit excellent activity in water splitting, photoelectric catalysis, CO_2 reduction reactions, and hydrogenation reactions. Herein, we developed on a novel and unique method for synthesizing high-loading SACs, which involves cationic substitution deposition to create high-loading palladium single atoms on commercial copper(II) phthalocyanine (CuPC). CuPC features alternating carbon and nitrogen coordination and inherent stability, which allows electrochemically treated CuNP@CuPC to remain stable without aggregation under operative conditions and exposure to air for 5 hours, providing an advantageous condition for further cationic substitution. By designing a method of atom adsorption, we were able to create a charge transfer effect between single atoms and defect sites, forming a stable single-atom catalyst. The suggested method is simple, versatile, and electrochemistry-based without any heat treatment. Several techniques have been applied to characterize PdSA@CuPC, including including XANES, EXAFS, HAADF-STEM, XRD, XPS. Our studies provided a unique and easy method of utilizing natural copper phthalocyanine to synthesize high-loading single-atom catalysts. The proposed electrochemically-generated template and cationic substitution have been further testified to prepare other metal single-atom materials. In addition, we also measured the multiple catalytic performances, and the results show a promising future. The synthesis method that we developed provides a way to customize highly efficient single-atom catalysts for the target reaction.

Abstract No. 0332 Yee Jun Quay

Lithium-sulfur batteries are promising candidates for next-generation energy storage devices due to the lithium anode and sulfur cathode provide high theoretical capacity of 3860 mA·h g^{-1} and 1672mA·h g^{-1}, respectively. However, due to conventional lithium-ion batteries use organic electrolytes that are flammable, volatile, and explosive, which pose safety hazards, and the energy density has reached the theoretical upper limit. The use of non-flammable solid electrolytes to replace the flammable liquid electrolyte is now widely considered by researchers due to its high safety, and high energy density. Herein, we propose to use argyrodite sulfide electrolyte system (Li6PS5X, X=Br, Cl) with a liquid state polysulfide as a cathode for lithium-sulfur batteries to inhibit the growth of lithium dendrites and to improve the safety of batteries. Our experimental and analytical results show that the argyrodite sulfide electrolyte provide high ionic conductivity and discharge capacity can reach on above 900mA·h g^{-1}, which enhanced the lithium-sulfur battery performance.

Abstract No. 0333 Yi-Ni Jhang

Self-charging electrochemical capacitor systems have great advantages in modern life because they have the ability to collect, convert and store energy at the same time, and have also attracted a lot of research interest. This study uses commercially available conductive plastic (PET-ITO) as the substrate to not only exert the electrochromic function of the electrode, but also to prepare wearable energy storage electrodes. The prepared V_2O_5 / PET-ITO electrode has a three-dimensional nanoporous network structure. The pores between the three-dimensional network structure will facilitate the transmission of ions and electrons between the active material and the electrolyte. In order to understand whether the electrode was successfully produced, further research was conducted using analytical identification tools such as scanning electron microscopy (SEM) and X-ray photoelectron spectroscopy (XPS). $BaTiO_3$ material with piezoelectric properties is added to the PVA-$LiClO_4$-2-Oxazolidinone-PVA (PLO) ionic gel electrolyte, and chemical energy is converted into electrical energy through simple mechanical energy, so that the device has a piezoelectric voltage of 1.029 V, and performs the symmetrical electrode electrochemical capacitor energy storage test not only improves the electrochemical stability and performance of V_2O_5, but also avoids safety risks such as leakage that are common with ordinary electrolytes. Supercapacitors made from this device can exhibit a wide potential window of 4 V and a capacitance of 11 F/g and an energy density of 24 Wh/kg, as well as a high power density of 9900 W/kg. The electrodes can show different shades of electrochemical under different voltages. When the device is discharging, it will appear yellow; when charging, it will appear green. You can directly determine whether the device is charged through the color change. The electrochemical performance of this device barely changes at various bending angles. The prototype can light up a red LED light at any time and power a wearable storage device. Wearable symmetric supercapacitors show potential for wearable energy storage device applications.

Abstract No. 0334 Tracy Asamoah

Electric vehicles reduce fossil fuel use with eco-friendly technologies, such as batteries. Batteries convert chemical energy to electricity to power electric vehicles. Battery research focuses on finding suitable anodes, cathodes, separators, and electrolytes, and assessing electrode stability through cycling. Lithium-ion batteries (LIBs) have high energy density, long lifespan, and low environmental impact. Research has advanced LIB cathode materials, such as polyanion compounds ($LiFePO_4$, $LiFeSiO_4$, $LiMnPO_4$, $LiCoPO_4$), layered compounds ($LiCoO_2$, $LiNiMnCoO_2$), and spinel compounds (Li_4Ti_5O12, $LiMn_2O_4$). LIBs' environmental impact applies to usage and end-of-life, but the latter has received little attention. this review paper presents a comprehensive analysis of spent LMO batteries. Authors have studied recovering components and compounds of spent LMO batteries, as well as regenerating LMO, for use in cathodes in lithium-ion batteries. Recovery of spent LMO batteries have been explored as alternative cathodes in SIBs, and are potential candidates for cobalt removal and catalysts for acidic OER . Green processes such as sol-gel, chemical lithiation, leaching, co-precipitation, and hydrothermal processes have been used to recycle LMO batteries. This review assesses selective recovery and recycling of spent LMO cathode material, comparing current selective recovery with traditional methods. The study covers LMO structure, eco-friendly recovery routes, separation procedures, and their developments. The challenges and future prospects of recycling LMO cathode materials are also examined, with the ultimate aim of promoting sustainability through the development of new and improved recycling technologies.

Abstract No. 0335 Yi-De Tsai

As we know, the conventional recycle method of spent LIB battery is via a landfill in many countries, which contain with valuable metal elements such as Li, Co, Ni, Mn, Cu. With limited natural resources, recycled and re-synthesis of chemicals become a significant issue. In this work, a $LiNi_{0.5}Mn_{01.5}O_4$ cathode materials was synthesized by using $Ni_{0.25}Mn_{0.75}(OH)_2$ precursor (via a co-precipitation method) and a recycled Li-salt from spent lithium-ion batteries (99.91%, UWin-lib, Taiwan). This study indicated that our as-prepared (recycled) LNMO cathode materials, which use a recycled Li_2CO_3 (named 100%Uwin-lib-LNMO) showed a similar performance to conventional LNMO sample using commercial Li_2CO_3 (named 0%Uwin-lib-LNMO). The XRD pattern shows the typical spinel peak and approximative intensity for all the LNMO samples. Our DLS results showed different LNMO particle sizes between commercial Li_2CO_3 sample (D_{50}=13.22 μm) and UWin-lib Li_2CO_3 sample (D_{50}=7.347 μm), this shows some negatively impact on low and high C-rate. It was found that the LNMO based on 100%Uwin-lib recycled Li_2CO_3 shows an average capacity of 110.80 mAh g^{-1} and 98.76% capacity retention after 200 cycles at 1C/1C, as compared to the bare LNMO based on 0%Uwin-lib Li_2CO_3 (106.88 mAh g^{-1} and 99.35% capacity retention). In this work, the as-prepared LNMO cathode materials based on recycled Li_2CO_3 demonstrates the highly feasibility for using recycled Li_2CO_3 to prepare LNMO material, which shows promising electrochemical performance; as a result, it can be also applied to other cathode material preparation for LIB applications.

Abstract No. 0336 Ho Cheng Chang

In recent years, the rapid development of portable electronic devices and electric vehicles has led to more strict standards for lithium-ion batteries. $LiNi_xCo_yMn_zO_2$ (NCM, x + y + z = 1) has become a popular cathode material for lithium-ion batteries due to its high energy density and long cycle life. Furthermore. single-crystal cathode material has better electrochemical stability and thermostability than polycrystalline type. In this work, $Ni_{0.6}Mn_{0.2}Co_{0.2}(OH)_2$ precursors were prepared via a co-precipitation by Laminar Continuous Taylor Reactors (LCTR). The dried hydroxide precursors were mixed with LiOH using a ball-mill method. NCM622 samples with Li/TM ratios of 1.05, 1.10 and 1.15 were prepared. The powder mixtures were sintered with pure O_2 by tube furnace at different temperatures (850, 900, 950°C) for 15 h. As a conclusion, Li/TM ratio of 1.10 and a sintering degree of 900°C showed their optimal electrochemical performance. The initial discharge capacity of 169.10 mAh g^{-1} at 0.1C and the capacity retentions (86.32% after 100th cycle) at 1C rate at room temperature were achieved. Our as-prepared SC-NCM622 oxide material method shows a promising performance.

Abstract No. 0337 Gilang Baswara Anggara Putra

Since commercial products of lithium-ion batteries (LIBs) launched in the 1990s, most LIBs have used liquid electrolytes as their main component. However, there are a number of safety concerns with liquid electrolytes, including electrolyte leakage and high flammability if the system is subjected to short circuit or thermal runaway. This problem was solved by using a semi-solid electrolyte. This not only changed the physical structure of the electrolyte but also reduced its flammability. The semi-solid electrolyte is typically developed in an ex-situ process and then assembled with the battery. However, under these conditions, the interfacial resistance with the electrode became extremely high. Here, SYNergy ScienTech Corporation uses the properties of electrolytes as polar compounds and mixes them with monomers with polar and nonpolar groups to form microcells containing electrolytes. Then electrolyte is injected into the battery and undergoes some thermal polymerization with the help of an initiator. This colloidal system prevents electrolyte leakage and acts like a flame retardant, but does not affect the performance of the electrolyte within the battery. We offer a simple solution for applying in-situ semi-solid electrolytes for high-volume production without changing the mass-production process. The performance of the semi-solid electrolyte was comparable to that of the liquid electrolyte, achieving approximately 89% capacity retention after more than 500 cycles at room temperature and 65% capacity retention after 300 cycles at 60°C. Even in nail penetration tests, which involve severe short-circuit conditions, it was found that by applying semi-solid electrolyte, explosions, and fires did not occur, and temperature rises were suppressed (down to 80°C). Unlike normal liquid electrolytes, thermal runaway and explosions occur. Therefore, we offer non-flammable, high-performance solutions for LIB electrolyte applications.

Abstract No. 0338 Jue-Jie Xu

Though $Li_{1.2}Ni_{0.2}Mn_{0.6}O_2$ lithium-rich materials are known for superhigh capacities; they still faced severe their capacity fading, poor high-rate performance and cycling performance. Such issues were mainly arisen from their low structural stabilities, which is extremely daunting to solve from the root. To advocate the structural stability of this end material, we used a spray-drying method to form tiny and irregularly shaped particles into porous spherical-like morphology. Our Li-rich $Li_{1.2}Ni_{0.2}Mn_{0.6}O_2$ processed by a spray drying method (denoted as SP-LRNMO) has been confirmed that is well-defined crystalline and has good layer structure by XRD. The SEM image also shows each particle are the micron-sized porous spherical shape. Comparing to the material synthesized by a normal solid-state method (denoted as SS-LRNMO). Our SP-LRNMO presents higher capacities, better cycling performance and excellent high-rate performance without any surface modifications. The performances of SP-LRNMO show high discharge capacity of 266 mAh g^{-1} at 0.1C and its capacity retentions is around 86.94% after 100th cycle at 1C at room temperature. Our LRNMO cathode materials show a promising application for Li ion batteries.

Abstract No. 0339 Yuh-Lang Lee

The power conversion of Dye-sensitized solar cells (DSSCs) are determined by several factors including the photoelectrods, counterelectrodes (CE), electrolytes and device structures. Among them, photoelectrode was made by a mesoporous TiO_2 film with adsorbed dyes to increase the light harvest ability. The electrolytes contain ions of a redox couple, which can perform reduction and oxidation reactions, respectively, on the photoelectrode and CE, transporting charges between the two electrodes. On the CE, a high catalytic film was coated and, by which, the oxidized ions can be reduced effectively into reduced ions, employing to recover the oxidized dye. In addition to the three components mentioned above, the structures of the devices are also critical factors determining the power conversion efficiency (PCE) of DSSCs. In this talk, three device structures including bifacial, tandem and direct contact DSSC were investigated and reported. The results show that, by introducing an additional main layer (ML) behind the traditional photo electrode with ML and scattering layer (SL), creating a sandwich (ML/SL/ML) architecture of the TiO_2 film. The bifacial cells can achieve 25.04% and 23.70%, respectively, under 1000 lux fluorescent lighting, which has a rear-to-front efficiency ratio of 95%. For the tandem cell, due to the effect of additional bottom cell, conversion efficiency as high as 36.27% can be achieved under 2000 lux fluorescent lighting. Finally, a direct contact cell was utilized to decrease the ion transport between photoelectrode and CE, the efficiency can further be increased to 37.5% under 6000 lux.

Abstract No. 0340 Cheng-En Ho

High-speed electrodeposition of Cu pillars over printed circuit boards (PCBs) has received a great deal of attention from microelectronic industry because of its efficient utilization of space in microelectronic packages and acceptable electrical/mechanical characteristics. According to Faraday’s laws, the thickness of electroplated film increased linearly as function of the product of plating current density (j) and plating time (t), the Cu pillar fabrication via a high-j electrodeposition becomes an efficient technology for reducing t. In this talk, we probed into the crystallographic microstructure of the Cu pillars fabricated using different plating current densities through scanning electron microscopy (SEM) combined with electron backscatter diffraction (EBSD) analysis and field-emission transmission electron microscopy (FE-TEM). The distribution of organic impurities within the Cu pillars was investigated by a time-of-flight secondary ion mass spectrometer (TOF-SIMS). The effect of j on the high-speed Cu electrodeposition in a via structure was simulated by the finite element analysis (FEA) method via COMSOL Multiphysics software. Additionally, the adhesion of Cu pillars to an Ajinomoto build-up film (ABF) substrate after various aging times was evaluated via a bond shear test. In summary, the Cu crystallographic microstructure strongly depended on j, which plays a dominant role in the mechanical/electrical reliability of Cu pillars. Methodologies of Cu microstructure modification were also proposed in this reach work. The information advanced our understandings of the electrochemical metal deposition, and would be helpful in development of the high-speed Cu electrodeposition technology.

Abstract No. 0341 Peter Axmann

Lithium ion batteries (LIB) are regarded the most promising energy storage systems for future mobility. Currently, most LIB cathode materials on the market contain high amounts of nickel and significant amounts of cobalt. Both elements are classified critical raw materials in terms of cost, economic importance and supply risk. Thus, reducing nickel and avoiding cobalt are the most prominent strategies to moderate the effects of raw material shortage and to lower cost.

Among the next generation concepts, lithium manganese rich layered oxides LRLO and lithium nickel manganese spinel LMNO are considered the most promising cathode materials on the way towards more sustainable cell chemistries. They come along with certain challenges: LRLO requires a high cut-off voltage, LMNO operates permanently at high potentials, both beyond the stability limit of the electrolyte. For both, side reactions with the electrolyte become critical issues with respect to long-term stability. Further degradation effects can occur depending on the material class.

Beside these limitations, which are given by their thermodynamic properties, there are attributes to a functional material which help stabilising their performance in cells; and these attributes strongly relate to the particle properties. Particle design becomes key; it comprises the design of primary crystallites, particle architecture, particle shape and size distribution, and surface chemistry; particle design is key in optimizing the performance and long term stability of a material in later application. These attributes can be adjusted via selection of the synthesis route, synthesis parameters and post-treatment steps.

This talk will give an overview on the next generation material classes and highlight recent developments from our labs with specific emphasis on particle design and surface modification and scalability.

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Abstract No. 0342 Bing Joe Hwang

Anode free lithium metal battery (AFLMB) is one of the alternate choices and new system for high energy density storage system because it has no active anode material initially. In addition, the fabrication of AFLMB is simple, low-cost, safe since Li metal is not directly used as an anode. The energy density of AFLMB will be significantly larger, by more than ~50% relative to conventional LIBs. Since the Li amount is limited and electrolyte decomposition, consuming Li during the SEI formation, the capacity can fade quickly relative to LMB. However, AFLMB is the best system to understand the interfacial phenomena and the effectiveness of the approaches to improve cell performances of LMBs. In this talk, the recent progress of anode-free lithium metal batteries in Sustainable Electrochemical Energy Development Center (SEED Center) will be reported.

Abstract No. 0343 Ming-Der Ger

In recent years, due to the increasing emphasis on environmental conservation, nickel plating has gradually replaced the highly polluting process of hexavalent chromium plating. However, because the mechanical strength of nickel plating is not superior to that of chromium plating, the Ni-B coating has garnered significant attention in both academic and industrial sectors due to its outstanding hardness, wear resistance, and corrosion resistance. It has been hailed as having the potential to replace chromium in environmentally friendly processes.

This study investigates the impact of nickel salts on nanocrystalline Ni-B alloy coatings produced through electroplating. It analyzes deposition rates, surface morphology, crystallinity, grain sizes, hardness, and corrosion resistance in coatings deposited with nickel sulfate (NS) and nickel sulfamate (NSA) plating baths, varying temperature and current density. NSA consistently demonstrates higher deposition rates and lower boron content due to the formation of Ni-ammonium complexes, except in the case of the NS bath at 60°C. Coating hardness is optimized by reducing grain size and increasing boron content. The study underscores NSA's superiority under conditions of high current density and temperature.

In addition, we also studied and evaluated various boron sources and power supply types. TMAB enhances hardness with increasing boron content, while DMAB, despite having a higher boron content, results in lower hardness due to surface cracking caused by chemical plating. Pulse electrodeposition with TMAB improves both hardness and boron content, with the duty cycle influencing hardness. These findings provide insights into future research opportunities in Ni-B electrodeposition.

Abstract No. 0344 Pei-Hsin Young

The design of functional nanostructured materials derived from metal-organic frameworks (MOFs) has been important for various applications in energy storage and catalysis. Various hybrid materials derived from MOFs are introduced, including carbonaceous materials and heterostructures. These materials find applications in supercapacitors and catalysis for water splitting. The integration of MOF-derived porous carbon materials with other components enhances energy and power density in supercapacitors. Sulfidation and carbonization of MOFs result in hybrid materials with copper sulfide and carbon, exhibiting varying capacitance. MOF templates are used to fabricate nanowire arrays, providing increased surface area for improved capacitive behavior. Controlled sulfurization of cobalt-containing MOFs yields hollow cobalt sulfide structures with high capacitance. The use of MOFs as precursors for bimetallic sulfides shows promising catalytic activity for the hydrogen evolution reaction (HER) and oxygen evolution reaction (OER). Further research is ongoing to optimize these materials for various applications.These instructions are an example of what a properly prepared meeting abstract should look like. Proper column and margin measurements are indicated.

Abstract No. 0345 Chi-Chang Hu

In this talk, the first part will discuss the evaluation methods for the performances of supercapacitor electrode materials. For examining the newly developed materials in laboratories, evaluation mostly relies on cyclic voltammetry (CV), galvanostatic charge-discharge (GCD), electrochemical impedance spectroscopic (EIS), and voltage-stressing (floating test) analyses. The major parameters used to quantitatively evaluate the capacitive performances of electrode materials generally include specific capacitance, specific energy, specific power, internal resistance, and cycling stability. The evaluation methods for the performances of supercapacitor electrode materials are very important because biased performance reports usually come from the difference in the evaluation method. In addition, the information reported in the literature is usually estimated on different bases, such as mass of active materials on a single electrode, total mass of active materials on two electrodes of a supercapacitor, or the whole device mass, which has to be carefully considered when comparisons are made. The second part will provide an example for constructing the high-voltage supercapacitor using the commercially available organic liquid electrolyte. In addition, the interactive influences between carbon crystallinity and electrochemical activation (EA) on the capacitive behavior for a series of soft carbons (SCs) modified with KOH have been systematically examined for the high-voltage (≥4.0 V) supercapacitors in the conventional liquid electrolyte of 1 M $TEABF_4$/PC. The energy storage behavior of SCs without and with the KOH modification as well as before and after the EA treatment in various potential regions are investigated by the GCD and CV tests. The results show that the specific capacitance of SCs can be significantly promoted by the KOH modification through crystallinity reducing and the EA via the irreversible insertion of either BF_4^- or TEA^+. The EA process is found to be more effective for KOH-modified SCs with relatively low crystallinity.

Abstract No. 0346 Kuan-Zong Fung

Ni-rich NMC layered cathode is an oxide containing 4 different cations per formula. The synthesis/fabrication of Ni-rich NMC layered oxides tends to be complicated and difficult. Co-precipitation method based on the simultaneous precipitation of muti-element hydroxides is known to be a standard process for mass production. Followed by calcination and lithiation at ~700°C, Ni-rich NMC layered oxides tend to form primary particles with diameters close to ~200 nm. For preparation of cathode, micronmeter-sized secondary particles, namely polycrystals, are obtained from the aggregation of primary nano-particles through spray drying

In recent years, layered oxides processed by a single-crystal process have received great attention. When the grain size of Ni-rich layered oxides reaches micronmeter range, they tend to show better cycling performance with better structural integrity and less volume change during charge/discharge cycles. For both polycrystals and single crystal processes, reactions such as decomposition, chemical reactions, diffusion, oxidation, sintering, grain-growth are involved in the process of heating/calcination of oxide/carbonates/nitrates powder compacts. Processing parameters such temperatures and atmosphere play important roles on the grain growth of Ni-rich layered oxides. Furthermore, the lithiation/oxidation of Ni-containing oxides during processing also involves charge compensation resulted from defect reactions. For comparison between polycrystals and single-crystal NMC, the resulted electrical, optical, structural, and electrochemical properties of layered oxides will be analyzed and discussed based on defect chemistry consideration. During the different stages of processing, the structural, microstructural and electrical properties of decomposed precursors and resultant layered oxides will be examined using XRD, SEM and DC/AC impedance measurements. CV and charge/discharge tests from assembled coin cells will be used to evaluate electrochemical properties of these Ni-rich layered oxides.

Abstract No. 0347 Seigo Ito

Carbon-based multi-porous-layered-electrodes perovskite solar cells (MPLE-PSCs) have ability to be the commercialized photovoltaic panels. The porous carbon electrodes have special five functions as below,

[1] high stability against halogen in perovskite crystal (Au and Ag can be damaged by the halogen)
[2] high conductivity to be the back contact electrodes (the sheet resistance can be around 5 ohm/square)
[3] strong hole-extraction ability (in place of organic hole-transporting material)
[4] water absorption ability as activated carbon after annealing procedure at 400 °C
[5] water blocking ability after making photovoltaic device with perovskite crystal

Using such porous carbon electrodes, MPLE-PSCs can be very stable. And, the points for the commercialization of MPLE-PSCs can be listed as,

[1] high stability against high temperature and strong radiation against sun illumination
1-1 Thermal stability at 100°C over 4500 h in dark (by Univ. of Hyogo, Japan).
1-2 Damp-heat stability at 85°C-85%RH over 3,000 h in dark (by Univ. of Hyogo and Kishu Giken Kogyo, Japan).
1-3 Light stability at 55°C over 10,000 h (by EPFL, Switzerland).
[2] relatively photoenergy conversion efficiency for the utilization (11.5% as module)
[3] cost-effective fabrication process by fully-printing method under ambient air (without glove box and dry room)
[4] Recyclable device

In the conference, the fabrication technology and the challenging works of high thermal stability over 100°C are presented.

Abstract No. 0348 Atsushi Inoishi

Mg-based compounds such as MgH_2 are used as the anode without a solid electrolyte in its mixture because of the formation of an ionic conduction path during lithiation in the all-solid-state battery. "*In-situ* formed electrolyte" enables the development of a solid-state battery with a higher capacity.

The insertion of Li^+ into $Mg(BH_4)_2$, MgH_2 and $MgCl_2$ occurs via the following electrochemical reactions:

$Mg(BH_4)_2 + 2Li^+ + 2e^- \rightarrow 2LiBH_4 + Mg$ (1)
$MgH_2 + 2Li^+ + 2e- \rightarrow 2LiH + Mg$ (2)
$MgCl_2 + 2Li^+ + 2e^- \rightarrow 2LiCl + Mg$ (3)

In these cases, Li^+ ion conductor such as $LiBH_4$, LiH and LiCl are generated and ionic conduction paths are formed during the electrochemical reactions. For the $Mg(BH_4)_2$ anode mixture without solid electrolyte such as $LiBH_4$, the initial lithiation capacity is 751 mAh/g and the working potential is ~0.9 V (vs Li/Li^+). In this case, high Li^+ conductor, formation of $LiBH_4$ is confirmed from NMR. On the other hand, for the MgH_2 anode mixture without solid electrolyte, the initial capacity is 1818 mAh/g and the working potential is ~0.5 V (vs Li/Li^+). LiH and Mg clearly formed upon lithiation and returned to MgH_2 upon delithiation, as revealed by TEM-EELS analysis. For the $MgCl_2$ anode mixture without solid electrolyte, the initial lithiation capacity is 465 mAh/g and the working potential is ~0.9 V (cs Li/Li^+). The formation of LiCl and Mg were confirmed by XAFS.

Abstract No. 0349 Wei-Hung Chiang

Microplasmas are a special class of electrical discharges formed in geometries where at least one dimension is less than 1 mm. As a result of their unique scaling, microplasmas operate stably at atmospheric pressure and contain large concentrations of energetic electrons (1-10 eV). These properties are attractive for a range of nanomaterials synthesis and nanostructure engineering such as metal nanostructures and semiconductor nanomaterials. Recently, we found that the energetic species including radicals, ions and electrons generated in the microplasmas were capable of initiating electrochemical-assisted reactions for the nucleation and growth of graphene quantum dots (GQDs), silicon quantum dots (SiQDs), and metal nanoclusters (MNCs). Moreover, we discover a simple and controlled synthesis of metal/metal, metal/QD heterostructures using our unique microplasma engineering. In this presentation, I will discuss these topics in detail, highlighting the advantages of microplasma-based system for the synthesis of well-defined nanomaterials for detections of metal ions, SARS-CoV-2 proteins, cancer and neurotransmitter biomarkers. These experiments will aid in the rational design and fabrication of nanomaterials for nanotechnology-enhanced biosensors and may also have significant impact in emerging applications for next generation biomedical applications.

Abstract No. 0350 She-Huang Wu

A simple mechanistic simulation method based on the reaction chemistry of lithium-ion cell was developed for investigating the reasons of capacity fading in two case studies and validated with post-mortem analysis. In the first study, home-made pouch cells containing electrolytes of various $LiPF_6$ concentrations were prepared and cycled at 0.5 C rate until at least one cell show capacity loss higher than 30%. It was found that cells prepared with 1 M $LiPF_6$ shows the highest capacity fade and the capacity fade of the cells decreases with increasing salt concentration used, as shown in Table 1. The losses of lithium inventory and anode active material are the two main reasons of the cells degradation due to the reactions between NMC and carbonate solvents. The suppression of capacity loss by increased salt concentration can be caused by less free solvent. In the second study, commercial 18650 cells with NMC cathode were cycled by charging with various C rates to 4.25 V followed by CV mode till current lower than 1/10 of the CC current and discharged at 0.5C rate until the discharge capacity lower than 80% of their initial discharge capacity or cycle number higher than 800. Contrary to the commonly believe, the cells charged at the slowest rate of 0.5C manifest the highest capacity fade at the end of study. The losses of anode material and lithium inventory are the two main reasons of the capacity fading of the cells cycled at 0.5C rate. It can be caused by the more reaction products precipitate on anode surface and more lithium inventory loss due to the longest duration at the highly charged state for reactions between NMC and electrolyte.

Abstract No. 0351 Phuong Tuyet Nguyen

Electrolyte composition plays a crucial role in Dye-sensitized Solar cells' performance and stability. Ionic liquid electrolytes so-called "robust" ones have been demonstrated to be the most appropriate for long-term stable DSC devices. By understanding the mechanism of the reactions between the dye and electrolyte composition, we have developed novel ionic liquid electrolytes based on deep eutectic solvents/ compounds (DES). The DES synthesized from inexpensive and biodegradable precursors, *e.g.* choline chloride, acetamide, ethyleneglycol, urea, *ect.,* were used as electrolyte solvents or/ and additives, or to synthesize eutectic electrolyte mixtures. The DSC devices with new eco-friendly DES electrolytes achieved equivalent photovoltaic performance with the most popular commercial ionic liquid electrolytes, yet at a significant low-cost. For more details, the influence of DES molecular structures on the DSC devices' performance was discussed by electrochemical impedance analysis. The results allow us to target such potential DES electrolytes for commercialization.

Abstract No. 0352 Wei-Chih Chen

In recent years, there has been a growing demand in high-power cells for fast charging and low-temperature applications. To meet these increasing requirements, CSCC has developed proprietary surface modification techniques and polygonal materials with a small particle size. After surface modification, a low crystalline carbon layer is coated on the graphite surface. This modification increases I_D/I_G ratio from 0.17 to 0.68 according to Raman analysis, and significantly reduces the charge transfer resistance. Consequently, the charge and discharge capabilities of the modified material have been greatly improved.

Particle size plays a critical role in influencing rate performance of anode materials. CSCC has successfully developed the smallest particle size anode product in the market, with a D50 size of approximately 3 μm. Reducing the particle size has led to a significant enhancement in charge and discharge capabilities.

Abstract No. 0353 Celastin Bebina Thairiyarayar

Ambiently synthesized sulfide-based solid-state electrolytes present promising energy storage possibilities, particularly for cost-effective sodium-ion batteries that complement the drive towards affordable electric vehicles. These batteries offer enhanced safety, extended cycles, high energy density, and rapid charging, with room-temperature producible sulfide-based electrolytes standing out among the attractive choices. Using simple mechanochemical methods at 510 rpm for 20 hours, followed by sintering at 250°C for 12 hours, we successfully synthesized t-Na_3SbS_4, exhibiting an ambient temperature ionic conductivity of 3.1×10-4 S/cm. Evaluation of the $Na_{2/3}Fe_{1/2}Mn_{1/2}O_2$|t-NSS |Na system revealed 106 mAh/g discharge capacity at 0.01 A/g current density, validated by a 100-cycle test, showcasing noteworthy 99.3% Columbic efficiency and 38.5% capacity retention, underscoring its enduring energy storage capability. X-Ray Diffraction (XRD), Scanning electron microscopy with energy dispersive X-Ray spectroscopy (SEM/EDX), XPS, and various spectroscopic techniques characterized crystal structure, morphology, conductivity, and activation energy. Furthermore, electrochemical performance was assessed through all-solid-state battery assembly.

Abstract No. 0354 Tsai-Te Wang

In this work, we study the heterogeneous catalytic solar to hydrogen (STH) generation by loading gold nanoparticles and cuprous oxide on hydrogenated (methanol treated) anatase titanium dioxide nanoparticles. Fabricated photocatalysts were characterized by SEM/EDS, XRD, UV-Vis, Raman, and XPS analysis. Photocatalytic hydrogen evolution experiment was carried out in the sealed apparatus under AM1.5G irradiation. With ethylene glycol 20% (v/v) as a sacrificial reagent, the hydrogen production rate of H:TiO_2 was estimated as 0.032 mmol g^{-1} hr^{-1}, whereas Cu_2O/H:TiO_2 reached 2.06 mmol g^{-1} hr^{-1}, which is 64 times as efficient as H:TiO_2. The hydrogen yield of Au-Cu_2O/H:TiO_2 further reached 2.27 mmol g^{-1} hr^{-1} , a promising 71-time enhancement was achieved. These results confirmed the synergetic enhancing effect on STH with Au and Cu_2O co-loading and the hydrogenation of TiO_2.

Abstract No. 0355 Chieh-Ting Lin

The challenge of ensuring stability for organic photovoltaics (OPVs) in underwater environments presents a significant barrier to their wider commercialization and application. Water infiltration not only compromises the OPVs' efficiency but also raises concerns about their longevity. To tackle this issue, a novel strategy was developed to enhance water resistance in these systems. A pivotal aspect of this method involves the incorporation of nanoparticle titanium dioxide (np-TiO2) as an electron transport layer (ETL) alongside an all-polymer bulk heterojunction (BHJ). This innovative mix has demonstrated superiority over traditional zinc oxide (ZnO) ETL and polymer-small molecule BHJ blends. Initial evaluations reveal a marked improvement in water resistance for polymer-based BHJ when contrasted with small molecule variants. Additionally, modifying the TiO2 ETL from a planar structure to a nanoparticle form improved its adhesion with the BHJ, reducing delamination risks. When exposed to water, the combined np-TiO2 and all-polymer design showcased remarkable resilience, heralding a new era for OPVs in high humidity and underwater settings.These improvements mark significant progress in solving the underwater challenges of OPVs and suggest a new direction for their use in solar-powered water splitting

Abstract No. 0356 Yi-Shiun CHEN

This presentation focuses on the latest trends for the Li-ion battery (LIB) industry. Several key aspects would be addressed here.

The latest developments and the roadmaps of LIBs used for a) IT product, b) Pure/Plug-in EV and c) Energy storage system (ESS) fields would be introduced first. Methods to increase the energy density or the change of material trends would be shown here.

Besides that, the emerging technologies for the post-LIB in the coming years would be also discussed briefly, including a) 4.55+ V cathode and the electrolyte, b) LMFP cathode material, c) Sodium-ion battery and d) All solid-state battery with Lit-metal anode. Those new technologies may change the current LIB market after a few years.

After talking over those new technologies or trends, their challenges, especially from the industrial viewpoint, would be also studied. This presentation provides a concise overview of the latest trends of LIB industry, the emerging technologies for the coming years and the associated challenges.

Abstract No. 0357 **Masashi Ishikawa**

Lithium-sulfur (Li-S) batteries theoretically have the highest gravimetric energy density of all sealed rechargeable batteries. In addition to this, the fact that valuable transition metals are not used in the cathode makes this battery promising for a variety of applications, including aircraft and power storage applications. However, S has not been put to practical use because it has almost no electronic conductivity and its reaction intermediates dissolve easily in electrolyte . In order to solve these problems, we have succeeded in confining S in a microporous carbon (C) material to ensure a sufficient cycle life. By using a special nitrogen-containing C precursor as a microporous C material, we succeeded in loading 75wt% of S into the cathode, Efforts were also made to improve the microporous C surface; surface oxidation treatment and polymer modification treatment were found to be effective in increasing capacity and cycle stability. Furthermore, we developed electrolytes suitable for such a S-C composite cathode. Among these, we developed an electrolyte that does not leach S reaction intermediates even when the cathode pore size is mesoporous . In addition, we succeeded in developing excellent electrolytes that are compatible with both the cathode and the Li anode, since the use of microporous C allows more freedom in electrolyte design.

Abstract No. 0358 **Elise Y. Li**

Lithium-based batteries are among the most promising energy storage techniques with the highest stability and energy density. In this talk, we will share our previous studies using first-principles approach to investigate and propose novel design strategies for Li-based battery materials, ranging from the electrode, electrolyte and separators. In particular, we focused on resolving the shuttle effect of lithium-sulfur battery and proposed new electrode systems for the lithium-ion battery. For example, we investigated the redox mechanisms of the polysulfides in different organic electrolyte, and designed carbon-based separators to effectively reduce the shuttle effect. We also evaluated the prospect of the 1D nano-structured transition metal sulfide electrodes for lithium-ion batteries via detailed first-principles analyses on the open-circuit voltage, diffusion barrier and charging/discharging mechanisms. Overall, we attempt to provide mechanistic explanations to experimental observations through extensive first-principles calculations and explore effective and universal strategies for realization of high-energy and low-cost energy storage applications.

Abstract No. 0359 Li-Hsien Yeh

The chemical energy stored between seawater and river water, the so-called osmotic energy (or blue energy), can be harvested by an ion-selective membrane. However, previously reported membranes suffer from insufficient ion selectivity and inferior transmembrane ionic flux (low conductance), thus impeding practical application. For example, the output osmotic power density reported by most of existing ion selective membranes is typically below the commercial benchmark of 5 W/m^2. Taking the inspiration from electrocytes in electric eel, which consist of a large number of sub-nanoscale rectified ion channels that allow unidirectional ion transport with amplified flux, we engineered two types of ultrathin sub-2 nm-scale metal-organic framework (MOF) and covalent-organic framework (COF)-based ionic diode membranes for osmotic energy harvesting. We show that the two MOF and COF-based heterogeneous membranes can rectify and amplify ionic current even in high salt concentration. We then probe application of the membranes in harvesting energy from salinity gradients. Notably, in addition to ultrahigh ion selectivity, these sub-2 nm-scale ionic diode membranes can achieve an unprecedented power density, higher than the commercial benchmark bandgap and outperforms all the state-of-the-art ion selective membranes. Our works would open up new avenues of using defect-free MOF and COF membranes towards next-generation highly selective and high-performance sustainable energy harvesting.

Abstract No. 0360 Panitat Hasin

Various transition metal compounds such as transition metal oxides, sulfides, and phosphides are widely studied as the electrode materials for energy storage applications, particularly in supercapacitors (SCs). In the class of transition metal compounds, the oxides, sulfides, and phosphides of cobalt, molybdenum, and ruthenium are the favorable candidates as the next generation electrode materials for SCs because of their superior specific capacity, cost-effectiveness, and abundance as the resources. Unfortunately, the oxides, sulfides, and phosphides of cobalt, molybdenum, and ruthenium have low conductivity, diffusion-limited capacity, and short cycle life in SC application. Therefore, utilizing transition metal compounds with carbons as the composite electrode materials for energy storage systems can solve the above issues. Carbon nanomaterials with distinct morphologies such as mesoporous carbons, hierarchical porous carbons, graphene, and carbon nanotubes have attracted great interest, mainly owing to their high electrical conductivity, outstanding mechanical flexibility, chemical stability, and huge surface area. In addition, the insertion of heteroatoms, i.e., P, S, and N into carbon-containing materials has drawn huge attention for improving storage capacity. The hybrid combination of the oxides, sulfides, and phosphides of cobalt, molybdenum, and ruthenium and carbon nanomaterials such as mesoporous carbons, hierarchical porous carbons, and graphene can enhance the electrochemical redox properties, electrical conductivity, reversibility, and cycle stability of the electrodes via a synergistic effect. The prepared nanocomposite shows an enhanced active surface area, and the carbon nanomaterials assist in the continual transport of electrons. The study results reveal that the composites have improved specific capacitance performance with better cyclic stability compared to single transition metal compound and carbon nanomaterial. Thus, the current research work suggests the easy and productive approaches for making supreme-performance transition metals-decorated heteroatomic-doped carbon electrode materials for next-generation high-performance energy storage devices, presenting significant market capability.

Abstract No. 0361 **Arumugam Manthiram**

The global increase in energy use and the rapidly growing environmental concerns have created enormous interest in the development of affordable clean energy technologies. Renewable energies, such as solar and wind, offer an appealing solution, but they are intermittent. A widespread adoption and utilization of renewable energy sources will need an economic and efficient storage of electricity produced from them; storage is currently the bottleneck to utilize renewable energies. Rechargeable batteries are the most viable option to store and utilize the electricity produced from renewable energies. However, a widespread adoption of battery technologies for grid electricity storage as well as for electric vehicles requires optimization of several parameters, such as cost, energy density, power density, cycle life, safety, and environmental impact, all of which are directly linked to severe materials challenges. Among them, cost, sustainability, supply chain issues will be the single dominant factor as we move forward with electrification and renewable energy use.

This presentation will focus on the development of sustainable next-generation battery chemistries and materials. Strategies and approaches for elimination of expensive and scarcely available cobalt, followed by eliminating nickel and ultimately any mined metal, including lithium, will be discussed. As an example, the progress on cobalt-free high-nickel lithium-ion cells, cobalt- and nickel-free lithium-ion and sodium-ion cells, lithium-sulfur cells, and sodium-sulfur cells will be presented. The challenges of bulk and surface instability and chemical crossover during charge-discharge cycling, limitations in charging rate, dynamics and stabilization of lithium or sodium plating and striping, advanced characterization methodologies to develop an in-depth understanding, and approaches to overcome the challenges will be presented.

Abstract No. 0362 **Wei-Ren Liu**

In this study, SiO_x/C composite anode is synthesized by a pitch coating technology to not only improve its electronic conductivity, but also stabilize its structural stability of SiO_x anode during charge and discharge process. We also improve the interface impedance through modification of oxygen low pressure plasma to reduce the electron transfer impedance of liquid-solid interface by means of hydrophilic characteristics of electrode. After modification, the contact angle of SiO-electrode reduced from 70^o to 10^o. The reversible capacity of plasma-modify SiO electrode was improved from 621 mAh/g to 901 mAh/g under the current density of 2 C. It is considered that the poor cycling stability and electrochemical performance of carbon coating, plasma modification and phosphorus doping are potential approaches for development SiO_x-based anode materials for lithium storage application.

Abstract No. 0363 **Gen Inoue**

In the research field of secondary batteries, various simulation methods have already been developed with the effect of electrochemical reaction and mass transport. However, in order to apply these simulations for design of optimal electrode structure, we have to focus on the heterogeneous structure and dynamic structure change of electrode structure. From this viewpoint, we developed various simulation models. I will introduce them in this presentation.

Abstract No. 0364 **Changhee Lee**

F^- anion intercalation into graphite has been studied due to the smallest ionic radius and the highest standard reduction potential, which can contribute to a large reversible capacity (864 mAh g^{-1}, based on the chemical formula of CF in principle) and energy density. Because F^- anions have very high electronegativity, however, they can break sp^2 C=C bonds and form covalent C–F bonds or hyperconjugated C–F bonds when intercalated into graphite layers, which makes the reversibility poor. This study reports that F^- anions can be electrochemically inserted/deinserted into/from carbon-based materials, respectively, using a combination of graphite fluoride (GF) and Li-based organic electrolytes with a suitably high potential (>5.0 V vs Li^+/Li). The GF materials used in this study produced amorphous carbon and LiF after the first discharge. As determined by subsequent electrochemical measurements, relatively large reversible capacities and superior capacity retention were obtained within a potential range of 1.5–5.3 V. Various analyses clearly demonstrated that the electrochemical properties resulted from the reversible insertion/deinsertion of F^- anions into/from amorphous carbon formed in the GF cathode, respectively, which was triggered by the formation of LiF, the source of the F^- anions.

Abstract No. 0365 Kasira Kaewplod

Herein, a nitrogen/sulfur dual-doped reduced graphene oxide (N/S-rGO)-coated $MoO_2/MoS_2/MoP$ heterojunction (MoO_2/MoS_2/MoP/N/S-rGO) architecture was developed, which exhibited favorable diffusion kinetics of electrolyte through an internal electric field built at heterointerfaces and alleviated the volume change through the core-shell structure, resulting in a MoO_2/MoS_2/MoP/N/S-rGO with the high adsorption of redox species, excellent electrical conductivity, and high reaction kinetics. This MoO_2/MoS_2/MoP/N/S-rGO can be used directly as a supercapacitive electrode with a high specific capacity of 723.5 F g^{-1} at 1 A g^{-1} and an excellent rate capability of 487.18 F g^{-1} when the current density was increased to 16 A g^{-1}. The prepared MoO_2/MoS_2/MoP/N/S-rGO electrode exhibited excellent cycle stability with a coulombic efficiency of 88.04 % at 16 A g^{-1} after 10,000 cycles, highlighting the promising prospect of the electrode for supercapacitor application.

Abstract No. 0366 Sudarat Laihang

The present work deals with the fabrication of electrode material, that is, ruthenium phosphide nanoparticle decorated phosphorous-rich hierarchical porous carbon (Ru_2P/P-HPC) with a three-dimensional (3D) architecture by the facile carbonization of celery root followed by chemical activation. Celery roots are used as the precursor to prepare HPC due to extensively cultivated worldwide as human food and an abundant 3D structure, which remain unused and produce enormous pressure on the environment. HPC serves as both a support and a current collector. The inclusion of Ru_2P into the P-HPC backbone, that is Ru_2P/P-HPC, serves as the electrochemically active species. Several spectroscopic and microscopic methods are used to characterize the fabricated electrode material. The prepared material possesses pore volume of 1.91 cm^3/g. Scanning electron microscopy image of material shows a unique 3D hierarchical porosity. The formation of this 3D hierarchical morphology depicts stable architecture showing improved electrochemical performance. Cyclic voltammetry, galvanostatic charge-discharge measurement, and electrochemical impedance spectroscopy are used evaluate the electrochemical performance of the prepared electrode material. The electrochemical study reveals a high specific capacitance of 2,525 F/g for Ru_2P/P-HPC. Finally, the strategy presented in this work provides valuable insights for designing electrode material for supercapacitors (SCs) with tunable specific capacitance that could be one among the future developments in flexible energy-storage systems.

Abstract No. 0367 Nae-Lih Wu

All-solid-state lithium-ion batteries (ASSLIBs) have been considered suitable alternatives to commercial lithium-ion batteries (LIBs) in the aspect of safety issues that come from the use of inflammable solid electrolytes to replace organic flammable electrolytes. Nevertheless, there apparently remains much room for a better understanding of their properties and behaviors in order to upgrade their performance to reach the practical application level. Ni-rich layered oxides, $LiNi_{1-x-y}Co_xMn_yO_2$ (NCM), are promising cathodes for high-energy ASSLIBs because of their high capacities and redox potentials, and low material cost when compared with conventional $LiCoO_2$. However, certain challenges associated with their use in ASSLIBs must be addressed for their effective use and industrialization. In particular, the structural integrity of the NCM electrodes during the long-term charge/discharge process suffers from the formation of an intergranular and/or intragranular cracking behavior. These microcracks are initiated at the grain boundaries from the anisotropic chemical strain of the randomly oriented polycrystal (PC) primary cathode particles. Solid evidence behind the electrochem-mechanical breakdown of an NCM cathode with liquid electrolytes has been well discussed and reported in the literature. However, the breakdown in ASSLIBs may not obey as same as in the liquid-electrolyte LIBs and display exclusive mechanics-oriented material damage in the presence of rigid solid-state electrolytes (SSEs). The primary objective of this research is to gain a deeper understanding of various cracking modes in ASSLIBs, which we believe is instrumental to improving the lifespan and cell performance as a whole. In this context, composite cathodes consisting of a $LiNi_{0.8}CoMn_{0.1}O2$ (NCM811) cathode and brittle Li_3InCl_6 (LIC) SSE have been assessed for ASSLIB applications under low operation stacking pressure (coin-cell configuration; ~2.0 MPa). The study reveals the effects of material and structural characteristics of the composite cathode, including the NCM particle size and size distribution, active-material spatial distribution, particle crystallinity (polycrystal or single-crystal), and electrochemical operation parameters (voltage range, current rates) on the cycle stability of the ASSLIBs as a result of the electrochem-mechanical behaviors of the oxide cathode.

Abstract No. 0368 Wen-Hui Cheng

At the gigaton per year scale, the capture and conversion of CO_2 from oceanwater can result in net-negative emissions and serve as a carbon source for synthetic fuels and chemical feedstocks. We present a direct connected electrochemical system that extracts and converts CO_2 from oceanwater using a bipolar membrane electrodialysis (BPMED) cell and a flow-by type gas diffusion electrode (GDE) CO_2 reduction (CO_2R) cell. For the CO_2 reduction reaction, the GDE with an Ag nanoparticle catalyst layer is built to realize low overpotentials and high CO_2 concentrations. The system achieves a CO_2 collection efficiency of 71% and a total Faradaic efficiency of up to 95%. We also demonstrate a solar-driven CO2R device using the GDE and a triple junction solar cell made of GaInP/GaInAs/Ge. With AM 1.5G illumination at 1 Suns, a solar-to-CO efficiency of 19% can be achieved. No efficiency degradation was observed after 150 hours of device stability. The proof-of-concept system offers a novel technological route for the capture and conversion of CO_2 with (photo)electrochemical process.

Abstract No. 0369 Yung-Jung Hsu

With the inherently high degree of complexity, heterostructures composed of two or more materials joined in unique architectures may exhibit superior synergetic properties that are difficult or impossible to acquire from their individual constituents. For semiconductor heterostructures, the relative band alignment of the constituents promotes effective charge separation to bring them desirable properties for photocatalysis applications. Among the different types of heterostructures, core-shell and yolk-shell nanocrystals have received particular interest due to their fascinating properties. Several representative works from our lab will be introduced to demonstrate the promising potentials of core-shell and yolk-shell nanocrystals for hydrogen production applications.

Abstract No. 0370 Wei-Yen Wang

Glass substrate is a material that has the potential to replace silicon in interposers because of its low dielectric constant and adjustable thermal expansion coefficient. In addition, the production cost is relatively low compared with silicon and there is no size limitation. However, the poor adhesion between glass substrate and copper layer, which causing the widespread use of glass substrate as interposer has been delayed. In order to solve this problem, a novel of wet-process technology for high adhesion glass metallization is developed. By coating an adhesion promoting layer (APL) on the glass with the distinctive synthetic paint and combining with wet-process metallization technology, the adhesion values between glass substrate and copper layer reached to 6.5 N/mm, which is exceed to the standard value of commercial one (5 N/mm). In addition, this technology can also be applied for high aspect ratio through-hole glass, which is achieving uniform and continuous copper layer coating.

Abstract No. 0371 Masashi Okubo

Lithium-ion batteries (LIBs) are the state-of-the-art electrochemical energy storage devices with high energy density, high energy efficiency, and long calendar life. However, flammable organic liquid electrolytes in LIBs involve the intrinsic risks of firing and explosion accidents, making them impractical for large-scale applications. Therefore, all-solid-state electrochemical energy storage (ASS-EES) devices with nonflammable inorganic solid electrolytes have been investigated enthusiastically as an alternative to LIBs.

Layered transition-metal carbides/nitrides (MXenes) are an emerging family of electrochemical energy storage materials. When used as an electrode material with a liquid electrolyte, MXenes exhibit pseudocapacitive behavior without large structural change, which enables fast ion transport as well as dense charge storage in the open interlayer space between MXene nanosheets. However, the charge storage of the MXene electrodes with solid electrolytes have rarely been investigated. It is an open question how the pseudocapacitive behavior of the MXene electrodes is influenced by the MXenes/solid electrolyte interface.

In this work, we study the pseudocapacitance of a MXene $Ti_3C_2T_x$ electrode with a $75Li_2S\cdot25P_2S_5$ glass electrolyte. $Ti_3C_2T_x$ is the best studied MXene owing to its large capacitance, high electronic conductivity, and high chemical stability while the $75Li_2S\cdot25P_2S_5$ glass electrolyte possesses high ionic conductivity as well as high ductility to fabricate efficient electrode-electrolyte interface. After clarifying the strain-free charge storage mechanism through the MXene-$75Li_2S\cdot25P_2S_5$ glass contact interface, we exploit it for the stable operation of an all-solid-state hybrid capacitor using MXene as a negative electrode material.

Abstract No. 0372 Tadesu Hailu Mengesha

Lithium-metal batteries (LMBs) using sandwich-type hybrid solid electrolytes (SHSEs) have been increasingly popular because of their high safety and improved electrochemical performance. To realize these advantages, we successfully fabricated a robust SHSE1 composite membrane using poly(vinylidene fluoride-co-hexafluoropropylene) (PVDF-HFP), LiTFSI, Succinonitrile (SN), and polydopamine (PDA)-modified LALZO (PDA@LALZO, 30 wt. %) suspensions as the middle layer, while the layers facing the anode and cathode comprise the same formulation but with 10 wt. % PDA@LALZO- and 1 wt. % PDA-treated vapor growth carbon nanofiber (PDA@VGCF), respectively, instead of 30 wt. % of PDA@LALZO filler. The counterpart SHSE0 membrane was synthesized using the same formulations but without PDA@VGCF fillers. The SHSE1 membrane showed greater ionic conductivity (~5.47×10^{-4} S cm^{-1}) and a considerably higher t_{Li^+} (~0.82) than the SHSE0 membrane. We added 10 μL of a lithium difluoro(oxalato)borate (LiDFOB)-based liquid electrolyte to simultaneously improve the interfacial wettability, cathode electrolyte interface (CEI) formation, and solid electrolyte interface (SEI) layer formation. Additionally, we modified the surface of the NCM811 cathode material with Li Nafion (Li-Nf: Li-Nf@NCM811) and a Li-metal anode with PDA@VGCF (mLi) to suppress particle cracking and Li dendrite growth, respectively. The mLi/SHSE1/mLi symmetric cell can run over 2500 h at a current density of 0.2 mA cm^{-2}. At 1C and 2C, the Li-Nf@NCM811/SHSE1/mLi 2032-type coin cell can run 450 and 400 cycles with improved capacity retention of ~80.16% and ~78.01%, respectively, at room temperature between 2.8–4.3 V. Thus, the novel SHSE membrane and cell design could be used for commercial LMBs.

Abstract No. 0373 Ming-Hao Huang

The use of synthetic latex as a binder for lithium-ion batteries has gained significant attention in recent years. In the manufacturing process of lithium-ion batteries, the conventional organic solvent-based procedures are gradually being phased out in favor of eco-friendly water-based processes. Synthetic latex, characterized by its components and manufacture process, brings about notable improvements in adhesion, mechanical strength, flexibility, and conductivity.

The choice of styrene in the binder is attributed to its capacity to form robust pi-pi stacking interactions with graphite, thus enhancing adhesion. However, styrene's high glass transition temperature and brittleness at room temperature necessitate the addition of 1,3-butadiene to enhance flexibility. Various monomers, including acrylates, acrylic acid, and acrylonitrile, are explored for their unique contributions to lithium-ion batteries. These attributes enhance the stability and cycling performance of lithium-ion batteries, reducing electrode cracking and ultimately improving overall battery performance.

This presentation explained the synthesis methods of synthetic latex binders, their impact on electrode performance, and their compatibility with various electrode materials such as silicon and graphite. The presentation also investigates the immiscibility of different polymer structures, facilitating the formation of core-shell and multiphase particles. Complex factors, such as monomer hydrophilicity and reaction conditions, play a crucial role in determining polymeric morphology. Furthermore, it addresses the challenges and opportunities associated with integrating synthetic latex binders into lithium-ion battery manufacturing processes.

In summary, Croslene Chemical Industry Company's synthetic latex binder exhibits promise in enhancing lithium-ion battery performance, with ongoing efforts aimed at further improving its properties and expanding its applications. The research and development efforts in this field continue to drive innovation and sustainability in battery technology, revolutionizing the energy storage landscape and paving the way for a more eco-friendly and efficient future. As the demand for high-performance batteries grows, the role of synthetic latex binders in meeting these needs becomes increasingly vital, ushering in a greener and more sustainable era in energy storage and electric vehicle battery.

Abstract No. 0374 Wei-Nien Su

In the quest for high-performance solid-state lithium-ion batteries (SSLIBs), the role of electrolyte materials cannot be overstated. This presentation delves into the multifaceted realm of lithium argyrodite sulfide electrolytes (Li_6PS_5X, x=F/Cl/Br/I), exploring the potential of cation doping strategies based on the Hard Soft Acid Base (HSAB) concept. Such doping enhances ionic conductivity and bolsters moisture stability, which is critical for SSLIBs' performance and safety. Furthermore, we investigate the intriguing role of anion doping and the structural disorder within the ortho-thiophosphate (PS_4^{3-}) structure. However, the journey towards all-solid-state lithium metal batteries encounters interfacial instability at the interface between high-voltage cathodes, lithium metal, and argyrodite electrolytes. Manufacturing lithium argyrodites is another pivotal aspect under scrutiny. This presentation scrutinizes the formidable challenges associated with interfacial stability and fabrication. Current approaches and potential solutions will be presented and discussed.

Abstract No. 0375 Jen-Hsien Huang

Since 2014, CPC corporation, Green Technology Research Institute (GTRI) has been collaborating with Industrial Technology Research Institute (ITRI) on the development of lithium titanium oxide ($Li_4Ti_5O_{12}$, LTO) anode materials. We have been working on process scaling, condition improvement, product applications, and performance verification. Currently, our research and development center in Chiayi has a production facility with a daily capacity of 100 kilograms, making it the only unit in Taiwan capable of mass-producing high-rate LTO. The LTO anode materials produced by GTRI can deliver a specific capacity of approximately 165 mAh/g at 0.1 C, which is very close to the theoretical capacity of titanium lithium (175 mAh/g). It also offers advantages such as rapid electrochemical kinetics (90% in 6 minutes, 80% in 3 minutes), a wide operating temperature range (-30°C to 60°C), high safety and high capacity utilization (90%).

Abstract No. 0376 Wen-Chin Chen

Lithium-ion batteries (LIBs) have been commercialized for electric products in 1991. Since then, rechargeable LIBs are regarded as promising energy storage devices for portable electronics and electric vehicles owing to their excellent energy density and long cycling lifetime. With increasing demand of power tool, super and racing car, electric heavy motor and electric airborne vehicles, the power density and cell resistance of LIBs became more and more critical as energy density.

E-one Moli Energy has invested in the development of LIBs over decade, and is a world-class manufacturer of high performance, superior quality rechargeable lithium-ion cells product. Recently we dedicate to design and manufacture ultra-high power cylindrical cell. MOLICEL®'s power cells can deliver more than 10C discharge rate and 3C charge rate. In this talk, recent development of technologies and material science for LIBs will be presented.

Abstract No. 0377 Sheng-Lun Chou

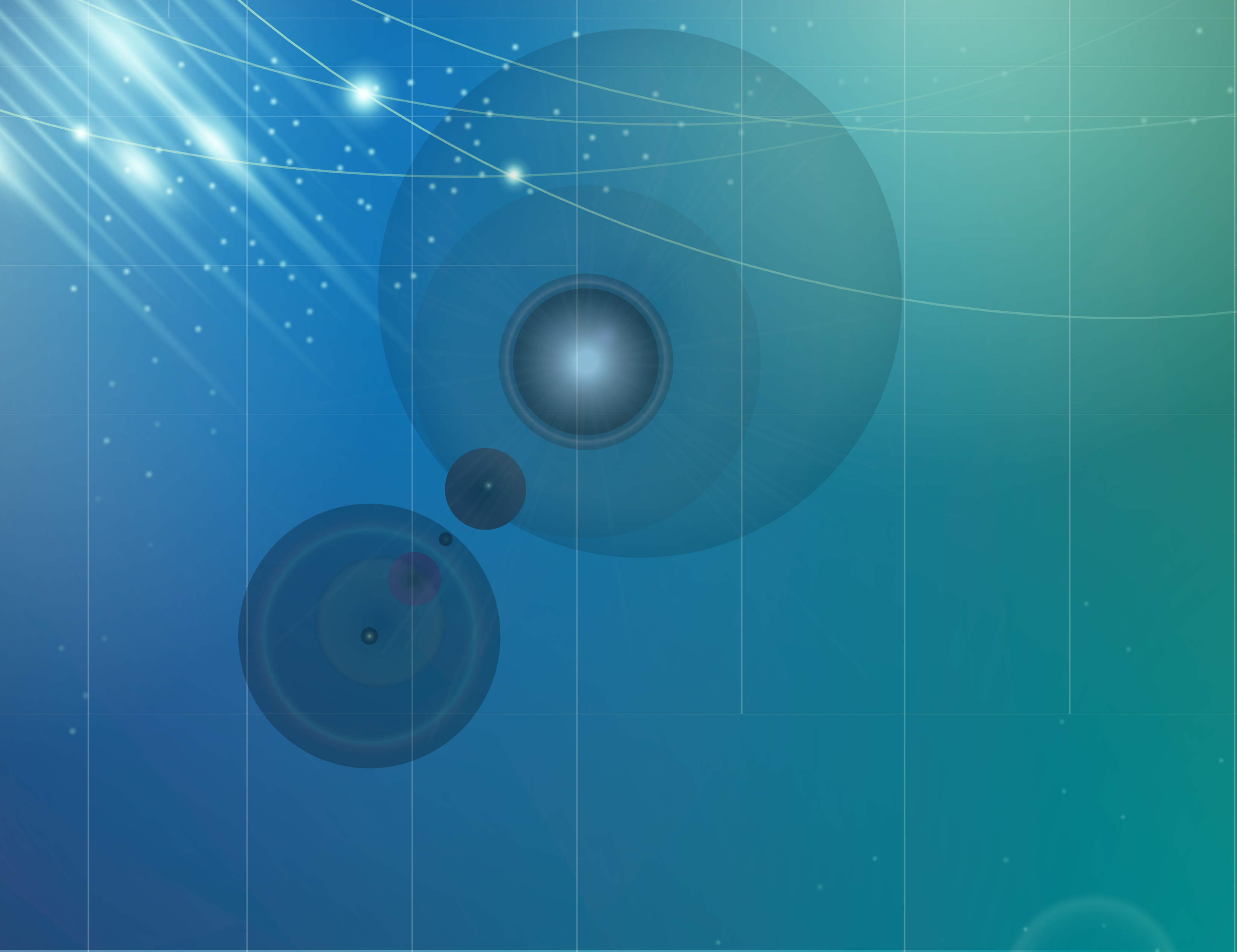
Lithium-ion batteries have been widely used in various fields such as mobile devices, electric vehicles, and energy storage systems due to their high cycle life and cost-effectiveness. However, the volatility of liquid electrolytes and the associated fire and explosion risks have highlighted the importance of developing non-volatile and highly stable solid-state electrolytes. In this study, we employed the casting method to prepare a PVDF-HFP/AL-LLZO/LiTFSI/SN composite solid-state electrolyte membrane (CSE membrane). This membrane consisted of polyvinylidene fluoride-hexafluoropropylene (PVDF-HFP) and succinonitrile (SN) dissolved in dimethylformamide (DMF), with the addition of dual(trifluoromethanesulfonyl) lithium (LiTFSI) and $Li_{6.28}Al_{0.24}La_3Zr_2O_{12}$ (Al-LLZO) ceramic fillers. The successful fabrication of the PVDF-HFP/AL-LLZO/LiTFSI/SN composite solid-state electrolyte membrane was achieved. The electrochemical performance evaluation was conducted using lithium iron phosphate (LFP) as the cathode material. After activation, the CSE(10) electrolyte membrane exhibited a maximum capacity of 143 mAh/g. Following 100 cycles of 0.2C/0.2C charge and discharge, the discharge capacity remained at 101 mAh/g, with a retention rate of 70.6%. During the electrochemical performance testing of the CSE(10/20) electrolyte membrane within the 2.0-3.8V range, a reduction peak of lithium oxide was observed at 2.26V. To prevent byproduct generation, the cell's electrochemical testing range was adjusted to 2.5-4.0V, enabling a high capacity exceeding 157 mAh/g to be achieved within this range. Its high specific capacity, excellent charge-discharge cycle stability, and suppression of byproduct generation provide a concrete theoretical and practical foundation for the application of solid-state electrolyte technology in lithium-ion batteries.

Abstract No. 0378 Wen-Chen Chien

Lithium iron phosphate (LFP) is the most popular cathode material for safe, high-power lithium-ion batteries in large format modules required for hybrid electric vehicles. On the other hand, used discarded batteries also contribute to environmental degradation and wastage of Earth's resources. Therefore, the recycling of waste batteries is of paramount importance. This study focuses on commercial discarded lithium-ion battery modules, where the battery cells use lithium iron phosphate as the positive electrode material. Firstly, the battery modules were disassembled to retrieve the battery cells. Then, the battery cells were soaked in a 0.3wt% saline solution for 72 hours. After their voltage dropped below 1.5V, they were subjected to carbonization in the presence of water ions at 600°C for 3 hours in a carburizing furnace. This process carbonized the polyvinylidene fluoride (PVDF) binder and the separator without generating carbon dioxide greenhouse gas. Subsequently, the battery cells were crushed using a crusher to obtain various fragments like black powder, aluminum foil, copper foil, and battery cell casings. The black powder was then collected through sieving. We analyzed the properties of the recovered black powder and compared them with those of fresh materials, serving as a reference for further synthesizing new cathode materials using the recovered black powder. The research results indicate that using a mixture of 80% fresh LFP cathode powder and 20% recycled LFP cathode powder with the powder ball-milled at 500 rpm for 5 h to form a coin cell and subjecting it to 0.1C/0.1C charge/discharge for 5 cycles, exhibits a more stable electrochemical performance compared to using a mixture of 50% fresh LFP and 50% recycled LFP cathode powder, as well as using a mixture of 70% fresh LFP and 30% recycled LFP cathode powder.

Abstract No. 0379 Wei-ting yeh

ArmaratorTM is a proprietary-design separator that offers a number of advantages over traditional separators. Figure 1 shows that ArmaratorTM has superb high-temperature mechanical strength below 250 °C , which makes it ideal for use in high-power batteries that have exacting high-safety requirements. With low direct current internal resistance (DCIR), ArmaratorTM is less likely to cause battery degradation. It is capable of high-speed winding and stacking, and accommodates the demands of mass production at scale. As it does not require modifications to existing production processes, ArmaratorTMis easy for seamless adoption as a cost-effective solution for battery manufacturers.



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