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UNIVERSIDADE DE MACAU
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應用物理及材料工程研究院
INSTITUTO DE FÍSICA APLICADA E ENGENHARIA DE MATERIAIS
INSTITUTE OF APPLIED PHYSICS AND MATERIALS ENGINEERING

# IAPME Newsletter

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## ✧ Content

## ❖ Publications (IF≥8, and/or nature Index; *corresponding author)

1. **Rui Li**, Shengwen Li, Zixing Wang, Jilei Liu, Hui Pan, Zhaohui Wang, Mingzheng Ge, Heng Li*, **Shi Chen***. A Ferroelectric Nanofiber Composite Anode for Stable Potassium Metal Batteries. *Advanced Functional Materials,* e28432 (2025). DOI: 10.1002/adfm.202528432. [2024 IF = 19.0]


RESEARCH ARTICLE | Full Access

**A Ferroelectric Nanofiber Composite Anode for Stable Potassium Metal Batteries**

Rui Li, Shengwen Li, Zixing Wang, Jilei Liu, Hui Pan, Zhaohui Wang, Mingzheng Ge, Heng Li, Shi Chen

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## ❖ Research Stories

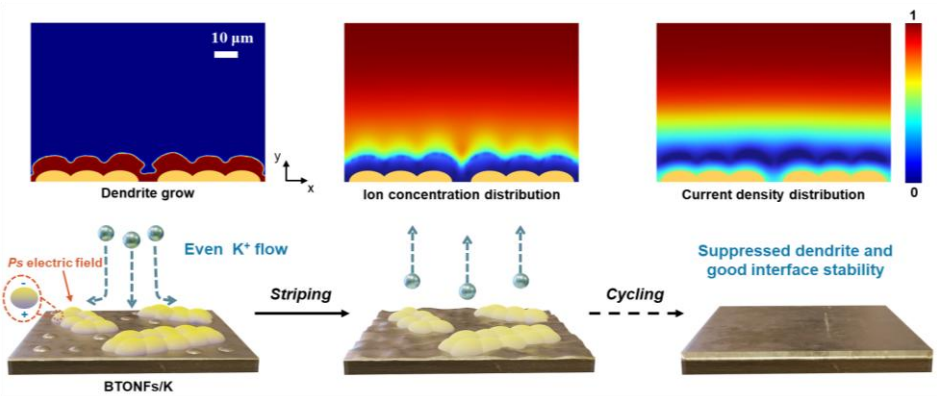
# UM research team developed a ferroelectric nanofiber composite anode for stable potassium metal batteries

- The dendritic growth and unstable interface of potassium metal anodes fundamentally stem from the inherent surface irregularities and ion concentration gradients during electrochemical deposition, which lead to uneven distribution of current and electric fields. This inhomogeneity promotes intense local growth of dendritic structures, causing repeated mechanical fracture and chemical reconstruction of the solid electrolyte interphase (SEI).

Ms. Rui Li
(李蕊)

Prof. Shi Chen
(陳石)

- Ferroelectric materials, barium titanate (BaTiO3, BTO), possess a stable spontaneous polarization (Ps) due to the non-centrosymmetric arrangement of ions in their crystal lattice, which creates a tunable built-in electric field. The research team designed the ferroelectric domain distributions and dimensionality of BTO with precise control over its polarization field distribution and ferroelectric response, thereby maximizing its optimizing effect on ion deposition behavior.
- The research team reported a ferroelectric polarization field regulation strategy by fabricating BTONFs network for a composite BTONFs/K anode. Through comparative studies with conventional BTO nanoparticles (BTONPs, isotropic single-domain wall structures) and non-ferroelectric strontium titanate nanofibers (STONFs).The rapid and uniform spontaneous polarization field, generated by the anisotropic multi-domain wall structure of the BTONFs, effectively homogenizes the electric field and K+ ion flux at the electrode surface, lowers the nucleation energy barrier, and guides a uniform and planar deposition of metallic potassium.




**Rui Li**, Shengwen Li, Zixing Wang, Jilei Liu, Hui Pan, Zhaohui Wang, Mingzheng Ge, Heng Li*, **Shi Chen***. A Ferroelectric Nanofiber Composite Anode for Stable Potassium Metal Batteries. *Advanced Functional Materials,* e28432 (2025). DOI: 10.1002/adfm.202528432. [2024 IF = 19.0]

This work was supported by the Macau Science and Technology Development Fund for funding (File No.0013/2021/AMJ and 0082/2022/A2), and also partially supported by multi-year research grant (MYRG2022-00266-IAPME, MYRG-GRG2023-00224-IAPME, and MYRG - GRG2025 - 00151 - IAPME) from the University of Macau. Heng Li would like to acknowledge the funding support from the National Natural Science Foundation of China (Grant Number. 52202328) and Shanghai Magnolia Talent Program Pujiang Project (24PJD128).

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## ❖ IAPME PhD Student Won Emerging Scientist Award

We are proud to announce that Xiao Yu (余瀟), a Ph.D. student of our Institute, has been honored with the Emerging Scientist Award (科學新銳獎) at the 3rd Symposium on Advanced Materials and Intelligent Sensing Devices, jointly organized by Beihang University and Beijing Institute of Technology.

The symposium convened leading researchers in advanced materials and intelligent sensing technologies, featuring keynote presentations by eight recipients of the National Science Fund for Distinguished Young Scholars. Topics ranged from nanomaterials and flexible electronics to intelligent sensors, providing a premier platform for high-level academic exchange.

During the Graduate Student Forum, Xiao Yu delivered an outstanding oral presentation titled "*Planar nanocavity-enabled 2D-perovskite photodetectors: High-speed, self-powered operation with exceptional ambient stability*." His talk was praised for its clarity, structure, and scientific depth, sparking active discussion among participants and drawing strong interest in the research led by Prof. Haomin Song's group.

In recognition of his exceptional presentation and research quality, Xiao Yu received the Emerging Scientist Award, a distinction that reflects both his individual excellence and the collaborative strength of our Institute and UM.

This achievement underscores Xiao Yu's research capability and communication skills, as well as the comprehensive academic support provided by the Institute and the generous funding from the Science and Technology Development Fund, Macao SAR (FDCT) (0002/2024/TFP).

Congratulations to Xiao Yu, his supervisor Prof. Haomin Song, and the entire research team! We look forward to their continued success and future contributions to cutting-edge materials research.

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## ❖ UM and IAPME Hosted Open Day Showcasing Innovation and Campus Culture

On January 11, 2026, our University and Institute welcomed the public to the Open Day, offering an opportunity to explore the university's latest developments and experience its dynamic campus culture.

The event featured a diverse program of activities designed to engage visitors of all ages. Highlights included academic and scientific talks, laboratory demonstrations, interactive booth games, and exhibitions that combined scientific knowledge with cultural experiences. These activities provided participants with hands-on learning opportunities while fostering a deeper appreciation for innovation and research.

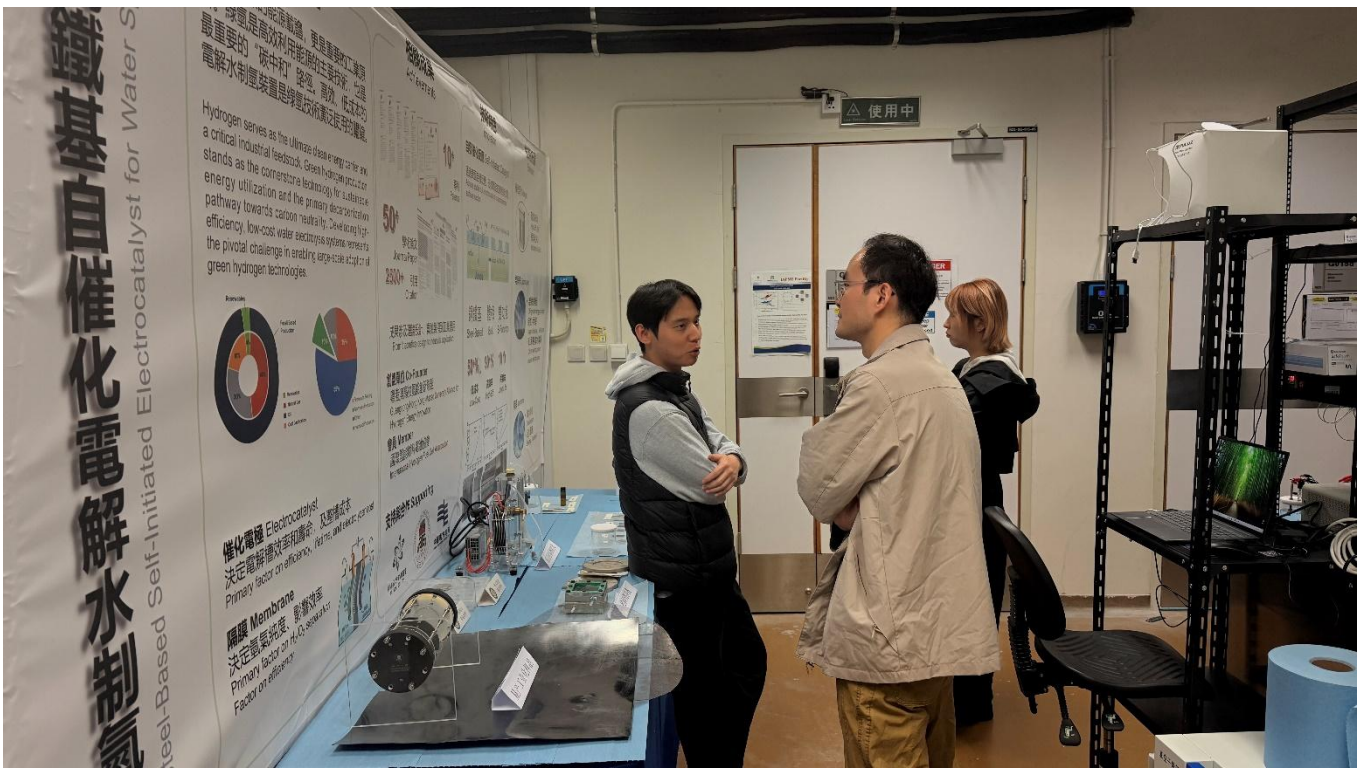

Mr. Chris Fong (馮崢), Prof. Kar Wei Ng (吳嘉偉), Mr. Jincheng Xu (徐錦城), Mr. Yasen Li (李亞森), Mr. Yangyang Xiang (向洋洋), Mr. Yabiao Li (李亞彪), Mr. Wei Hong (洪偉), Ms. Jingyi Zhao (趙靜怡), Mr. Chengcheng Zhong (仲程程), Ms. Zhaoyang Zu (祖朝陽), Ms. Chaojing Liu (劉超婧), Dr. Mike Chio (趙志康), Dr. Dickson Lao (劉思進), Dr. Ringo Pang (彭漢鋒), Dr. Terran Tang (湯軼蕊) and Dr. Monica Yang (楊曄)

As part of the academic programme, Prof. Kar Wei Ng, Associate Professor at IAPME, delivered an engaging presentation titled "*The Affair Between Light and Electricity*". His talk captivated attendees by exploring the fascinating interplay between optical and electronic phenomena, underscoring the institute's commitment to advancing cutting-edge research in applied physics and materials engineering.

The Open Day served as a vibrant platform for community engagement, reinforcing UM's mission to promote knowledge exchange and public understanding of science and technology.



A lemon looks yellow because it reflects yellow light. Which visible light does it absorb mostly?
檸檬看起來是黃色的，是因為它反射黃光。可見光中它最吸收的是哪一種？
University of Macau Anniversary Open Day


Hydrogen serves as the ultimate clean energy carrier and a critical industrial feedstock. Green hydrogen production stands as the cornerstone technology for sustainable energy utilization and the primary decarbonization pathway towards carbon neutrality. Developing high-efficiency, low-cost water electrolysis systems represents the pivotal challenge in enabling large-scale adoption of green hydrogen technologies.
使用中


糾纏不清光與電
The Affair between Light and Electricity
吳嘉偉 Billy Ng
Associate Professor
應用物理及材料工程研究院
Institute of Applied Physics and Materials Engineering


應用物理及材料工程
INSTITUTO DE FÍSICA APLICADA E ENGENHARIA DE MATERIAIS

## ❖ Seminar Series

On January 7, 2026, our Institute hosted two prominent scholars from China for a series of academic exchanges and seminars, reinforcing its commitment to advancing research in materials science. The event was organized and hosted by Prof. Binmeng Chen, who extended invitations to both speakers.

Prof. Wei Fan (樊瑋) from Jiangnan University, currently a Full Professor and PhD supervisor at the School of Chemical and Material Engineering, delivered a seminar titled "*Polymer Aerogel Composites for Thermal Management*". Prof. Fan's research spans aerogel composites, polymer-based nanocomposites, and thermal management materials. With over 90 publications and more than 7,400 citations (H-index: 51), she is recognized for her contributions to composite materials science. Her accolades include the Second Prize of Shanghai Natural Science (2020), and she serves on editorial boards of leading journals such as *Composites Science and Technology.*

Her presentation addressed critical challenges in polymer aerogel formation, pore regulation, and mechanical enhancement. Prof. Fan introduced a dynamic sol-gel transition strategy for stable aerogel composite formation and discussed nanoparticle integration for pore control and reinforcement. She highlighted advancements in flame-retardant, thermally insulating polyimide aerogels meeting aviation standards, underscoring their potential in aircraft cabin thermal insulation systems. These innovations provide theoretical and technical foundations for aerospace composite materials.

Prof. Yue-E Miao (繆月娥) from Donghua University, a leading researcher in polymer nanofiber composites, presented her seminar titled "*Highly Oriented Ceramic Nanofiber-Integrated Polymer Composites Solid Electrolytes*". Prof. Miao, who earned her PhD from Fudan University and completed joint training at Nanyang Technological University, has published over 50 papers and leads major research projects, including the National Excellent Youth Science Fund of China. She serves as Academic Editor of *Advanced Fiber Materials* and on editorial boards of *Composites Communications and eScience*.

Her talk explored the design of nanofiber-integrated polymer composites, emphasizing their multifunctionality in electrochemical energy storage. Prof. Miao detailed strategies for microstructure design using external field-assisted electrospinning and advanced methods for engineering organic-inorganic interfaces to enhance ion transport kinetics.

Both scholars toured our Institute's laboratories and engaged in in-depth discussions with our PhD students. They expressed strong appreciation for our research facilities and achievements, marking the visit as a significant step toward future collaboration in advanced materials research.


On January 9, 2026, our Institute welcomed Prof. Andrej Kuznetsov (安德烈・庫茲涅佐夫) from the Department of Physics, University of Oslo, for an engaging academic exchange. Prof. Kuznetsov delivered a lecture titled "*Quantum Initiatives in Norway and Discovery of Polymorph Heterostructures*", chaired by Prof. Shuangpeng Wang. The presentation introduced groundbreaking strategies for heterostructure construction and sparked lively discussions among students.

Prof. Kuznetsov is internationally recognized for his research in semiconductor physics and nanotechnology, particularly in wide-bandgap semiconductors such as gallium oxide ($Ga_2O_3$), radiation effects, and advanced semiconductor devices. He earned his Ph.D. in physics from the Russian Academy of Sciences in 1992 and completed his habilitation in solid-state electronics at the Royal Institute of Technology, Sweden, in 2000. Since joining the University of Oslo in 2001, he has advanced to full Professor and currently chairs the Centre of Excellence: Light and Electricity from Novel Semiconductors (LENS), focusing on discovering new semiconductor phenomena and enabling next-generation device functionalities.

During his lecture, Prof. Kuznetsov highlighted Norway's quantum technology initiatives, including the Centre for Defects in Semiconductors for Quantum Sensing (DSQS), active from 2025 to 2030. This program aims to bridge fundamental research and practical applications through national and international collaborations. He then introduced the concept of polymorph heterostructures, which leverage different crystalline forms of the same material—such as gallium oxide polymorphs—to create atomically sharp interfaces. Addressing challenges in conventional fabrication methods, Prof. Kuznetsov explained disorder-assisted epitaxy, a technique using ion irradiation to induce controlled phase transitions. Notably, he discussed the discovery of disorder-induced ordering in $Ga_2O_3$, where increased disorder paradoxically promotes crystallization rather than amorphization, resulting in exceptional radiation tolerance.

Following the lecture, Prof. Kuznetsov toured our laboratories, engaged in in-depth discussions with researchers and students, and explored opportunities for future collaboration. The visit underscored our Institute's commitment to fostering global partnerships and advancing research in quantum technologies and semiconductor materials.