澳門大學
UNIVERSIDADE DE MACAU
UNIVERSITY OF MACAU

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. **Yuxuan Xiao**, Xiaoling Lai, Jinxian Feng, Ziwen Feng, Wendi Zhang, Lun Li, Weng Fai IP*, and **Hui Pan***. Self-refreshing Bi-based active sites for efficient and durable electrochemical CO_2 reduction. *Advanced Functional Materials, e23592* (2025). DOI: 10.1002/adfm.202523592. [2024 IF=19.0]

RESEARCH ARTICLE

ADVANCED FUNCTIONAL MATERIALS
www.afm-journal.de

Self-Refreshing Bi-Based Active Sites for Efficient and Durable Electrochemical CO_2 Reduction

Yuxuan Xiao, Xiaoling Lai, Jinxian Feng, Ziwen Feng, Wendi Zhang, Lun Li, Weng Fai IP, and Hui Pan**

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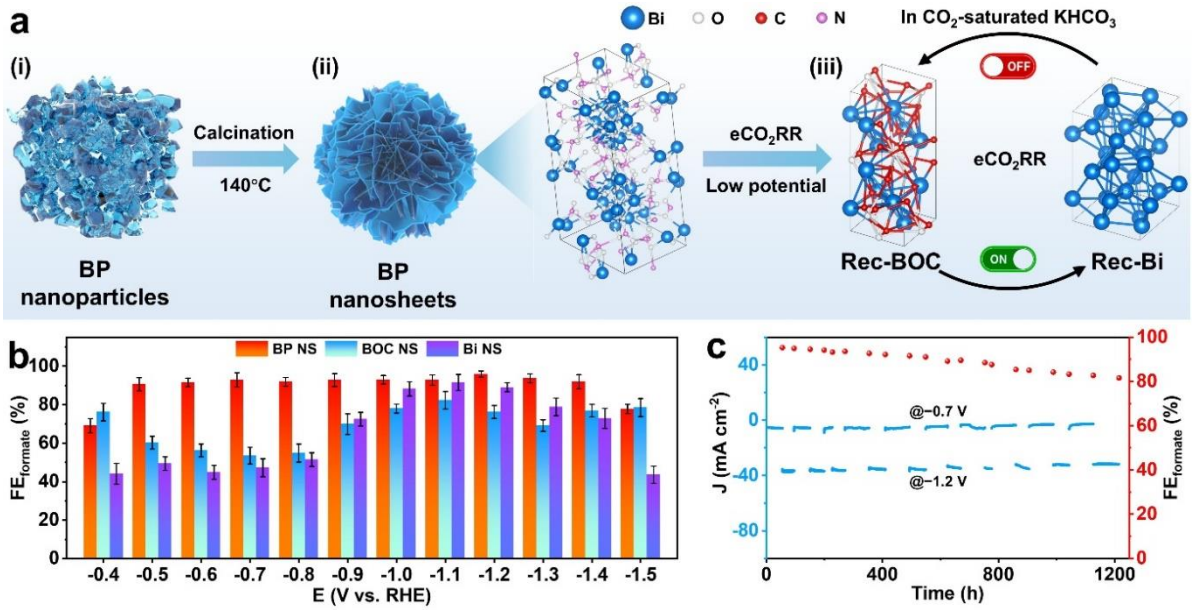
❖ Research Stories

UM research team developed self-refreshing Bi-based active sites for selective and durable electrochemical CO_2 conversion

- The electrochemical CO_2 reduction reaction (eCO_2RR) can convert CO_2 into value-added chemical or fuels, highly benefiting carbon neutrality. However, achieving a simultaneous wide-potential-window efficiency and prolonged durability for eCO_2RR still remains a significant challenge. To address this, the team developed a novel design for self-refreshing Bi-based active sites through rational engineering of pre-catalyst, a basic bismuth nitrate nanosheet.

(from left) Dr. Yuxuan Xiao (肖宇軒), Prof. Weng Fai Ip (葉穎暉), Prof. Hui Pan (潘暉)



- The pre-catalyst fabricated by the team will first evolve into $Bi_2O_2CO_3$ at low potentials (< −0.9 V) and then be reduced to metallic Bi at high potentials (> −0.9 V) during eCO_2RR operation, and finally spontaneously reconstruct back from metallic Bi to $Bi_2O_2CO_3$ when eCO_2RR terminates, establishing a closed-loop self-refreshing cycle. This unique self-refreshing mechanism endows the catalyst with a synergistically efficient formate selectivity (> 90%) across a wide potential window (−0.5 ~ −1.4 V) and a significantly enhanced operational durability (> 1200 h).

Yuxuan Xiao, Xiaoling Lai, Jinxian Feng, Ziwen Feng, Wendi Zhang, Lun Li, Weng Fai IP*, and **Hui Pan***.
Self-refreshing Bi-based active sites for efficient and durable electrochemical CO_2 reduction.
Advanced Functional Materials, e23592 (2025). DOI: 10.1002/adfm.202523592. [2024 IF=19.0]

The first author is Dr. Yuxuan Xiao, a post-doctoral fellow in the IAPME. Prof. Weng Fai Ip and Prof. Hui Pan are the corresponding authors of this study. This work was supported by the Science and Technology Development Fund from Macau SAR (FDCT) (0111/2022/A2, 0050/2023RIB2, 0023/2023/AFJ, 0002/2024/TFP, and 0087/2024/AFJ) and Multi-Year Research Grants (MYRG-GRG2025-00007-IAPME and MYRG-GRG2024-00038-IAPME) from the Research & Development Office at the University of Macau. The DFT calculations were performed at the High Performance Computing Cluster (HPCC) of the Information and Communication Technology Office (ICTO) at the University of Macau.

❖ Introduction of New Staff

It is our great pleasure to introduce our new institute member, **Prof. Rui Chen (陳銳)**, Associate Professor, who has recently joined IAPME.

Before joining UM, Prof. Chen was a Professor in the Department of Electrical and Electronic Engineering at the Southern University of Science and Technology (SUSTech), China. He has received several honors, including the Thousand Talents Program for Young Professionals (2014) and the Excellent Research Award for Young Scholars (2017). He has also been recognized with multiple teaching awards, such as Excellent Teacher of the Year (2019) and Most Popular Instructor (2024) at SUSTech.

Prof. Chen holds dual PhD degrees—one in Microelectronics and Solid-State Electronics from Xiamen University and another in Physics and Applied Physics from Nanyang Technological University. His research focuses on semiconductor optics, defect engineering for optical synapses, quantum light sources, and microlasers. He has led 18 research projects as Principal Investigator and has an impressive record of over 200 publications, including in journals such as *Advanced Materials, Advanced Functional Materials*, and *Nano Letters*. Several of his works have also been featured on journal covers. Prof. Chen's research has received over 12,000 citations, resulting in an h-index of 65 (Google Scholar).

Prof. Chen is also active in academic service, serving as an Associate Editor and Editorial Board Member for several journals, including *Scientific Reports* (Springer Nature), *VIEW* (Wiley), and *Chip* (Elsevier).

Let's warmly welcome Prof. Rui Chen, and we greatly appreciate your support for him.

For more information of Prof. Chen, please visit:
https://iapme.um.edu.mo/people/academic-staff/chen-rui/

❖ IAPME Seminar Explored AI-Enhanced Electron Microscopy for Next-Generation Materials Discovery

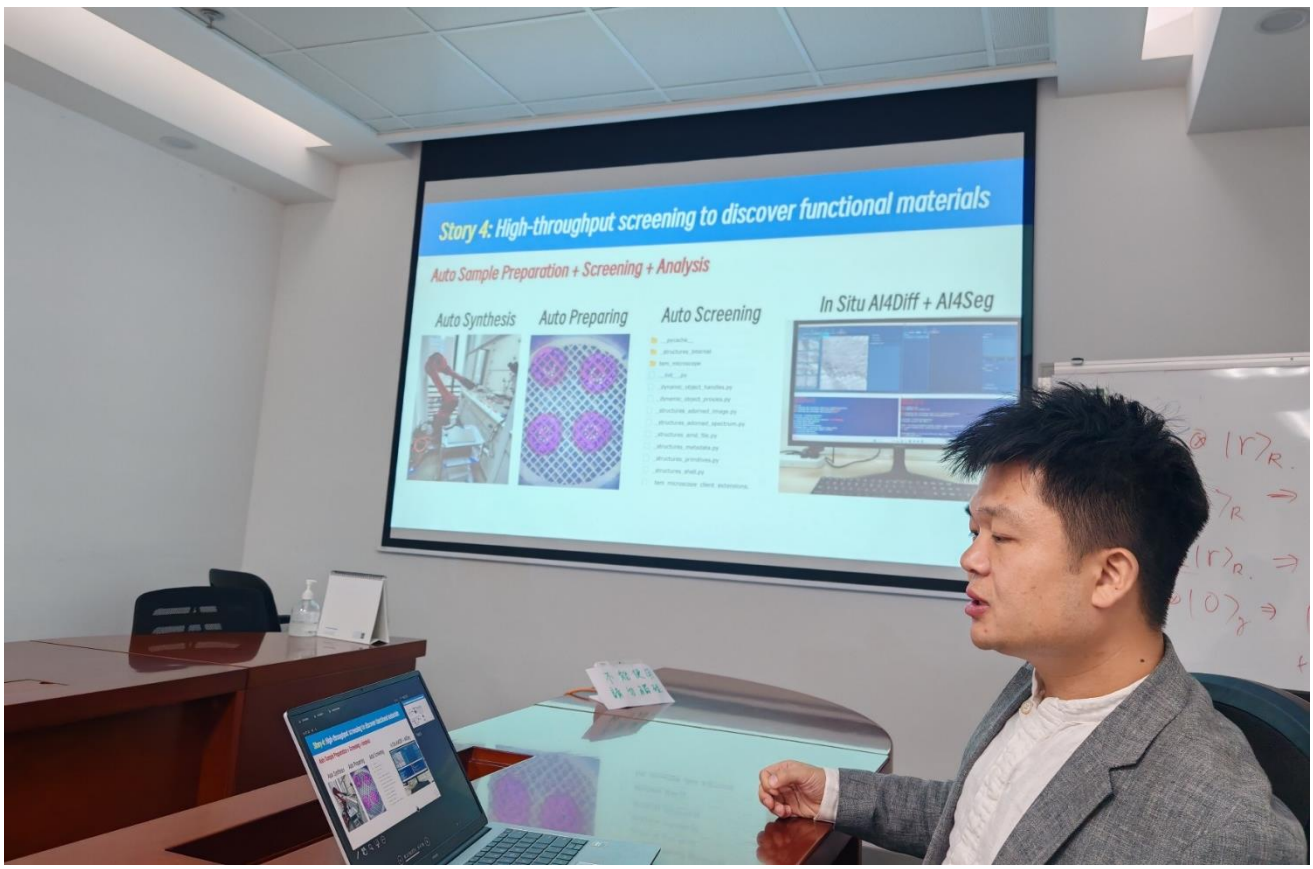
On January 16, 2026, our Institute hosted an academic seminar titled "Intelligent Electron Microscopy: Integrating AI for Next-Generation Materials Discovery". The lecture was delivered by Prof. Yu Wang (王宇) from South China University of Technology and chaired by Prof. Guichuan Xing.

Prof. Wang presented an engaging and forward-looking overview of how artificial intelligence (AI) is transforming advanced electron microscopy and accelerating discovery in chemistry and materials science. He introduced AI-driven analytical workflows that combine *in-situ*, high-throughput imaging with deep learning algorithms capable of real-time interpretation, modeling, and simulation. These integrated approaches, he explained, enable unprecedented insights into dynamic material processes and significantly enhance research efficiency.

The talk highlighted several key application areas where intelligent microscopy is proving transformative, including optoelectronics, electrocatalysis, and battery technology. Prof. Wang also shared his group's experience in promoting AI4Science education, offering innovative training programs to cultivate the next generation of interdisciplinary scientists equipped with both materials expertise and data-science literacy.

The seminar drew nearly 30 institute members and students, who engaged actively in the discussion session. The lively exchange of ideas led to the identification of promising avenues for future collaborative research between our Institute and Prof. Wang's research group.

The event provided valuable insights into the rapidly evolving frontier of intelligent materials characterization, while further strengthening academic ties and opening new opportunities for interdisciplinary cooperation in AI-enhanced materials research.



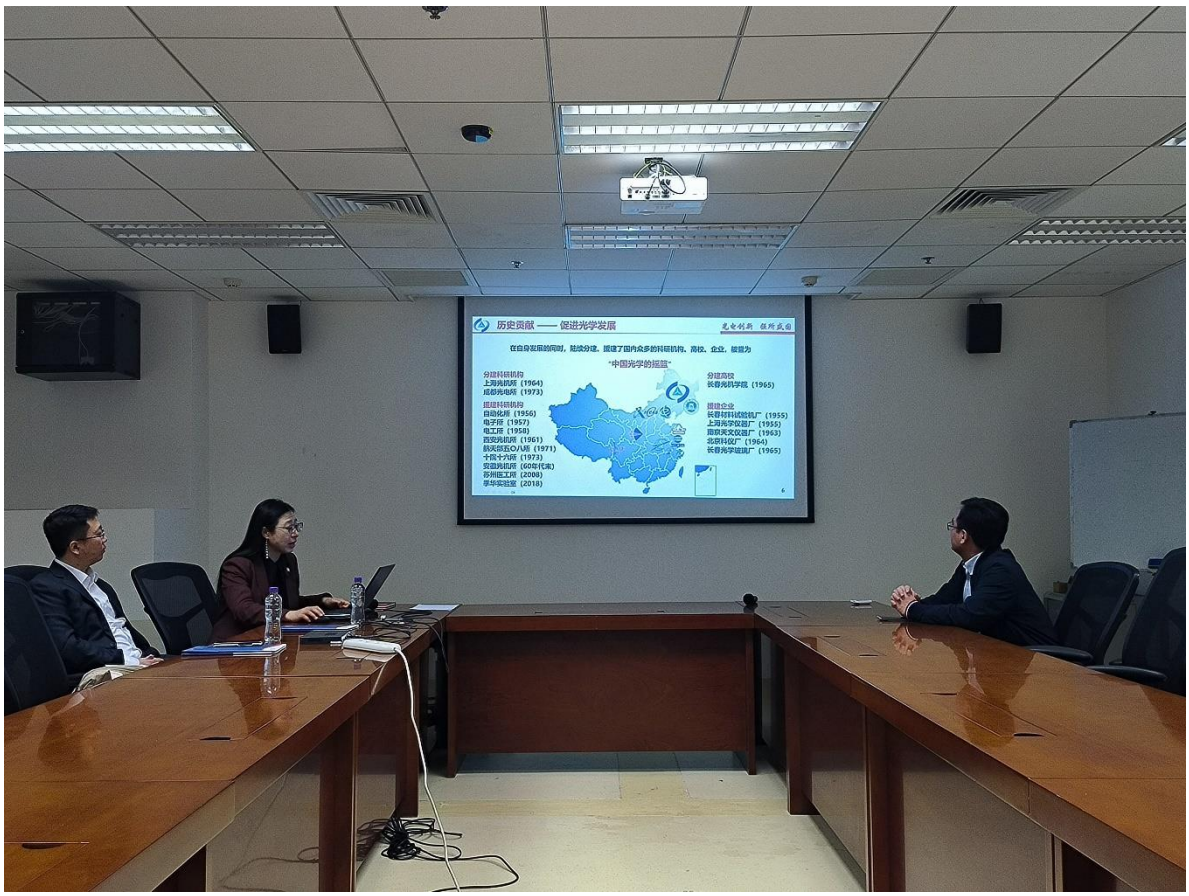
❖ IAPME Hosted CIOMP Delegate Ms. Hui Wang for Seminar on Institutional Achievements and Collaboration Opportunities

On January 16, 2026, our Institute welcomed Ms. Hui Wang (王卉), Deputy Director of the Graduate Education Department at the Changchun Institute of Optics, Fine Mechanics and Physics (CIOMP), Chinese Academy of Sciences (CAS), as part of the IAPME Seminar Series. Her visit was facilitated by Prof. Songnan Qu, who extended the invitation.

During her visit, Ms. Wang delivered an in-depth introduction to CIOMP, highlighting the institute's historical significance and scientific accomplishments. Founded in 1952, CIOMP has developed alongside the People's Republic of China and is recognized for its internationally leading technologies in optics, photonics, satellite development, optical detectors, and laser science. Notably, CIOMP developed China's first digital camera and continues to contribute to major national science and technology projects.

Ms. Wang's work focuses on the internationalization of graduate education at CIOMP. She was a founding member of Light: Science & Applications, a high-impact scientific journal jointly established by Nature Publishing Group and CIOMP in 2012. She has published over 40 articles across journals such as *Light: Science & Applications, International Talent, and Acta Editologica*. In 2015, she was invited to contribute to SPIE Women in Optics. She is also the initiator of Rose in Science and serves as co-sponsor and moderator of the iCANX Story series. Throughout her career, she has interviewed prominent scholars, including Nobel Laureates, the President of the Australian Academy of Science, and Fellows of the Royal Academy of Engineering.

In her seminar, Ms. Wang emphasized CIOMP's achievements in constructing critical national scientific infrastructure, underscoring the institute's long-standing commitment to advancing China's capabilities in high-end optical technology.



Following the presentation, our professors engaged in productive discussions with Ms. Wang. Optics specialists Prof. Songnan Qu, Prof. Shuangpeng Wang, and Prof. Hongchao Liu introduced their respective research areas, with Prof. Qu providing an overview of our Institute's development and research focus. Ms. Wang expressed strong appreciation for the institute's growth and research strengths, and both sides held preliminary discussions on potential avenues for future collaboration.

The visit strengthened academic ties between our Institute and CIOMP and marked an important step toward deepening cooperation in optical science and graduate education.

❖ UM CCE and IAPME Co-Organized Advanced Manufacturing Training for Guizhou University Students

During December 16-18, 2025, the Centre for Continuing Education (CCE) and the Macao Centre for Research and Development in Advanced Materials of our Institute jointly organized a Designated Training Course on Advanced Manufacturing and Manufacturing Systems for students from Guizhou University.

The three-day program featured a series of in-depth seminars and a guided campus visit, offering participants a comprehensive introduction to cutting-edge topics in advanced manufacturing. The lectures were delivered by senior professors from the University of Macau, including Prof. Guoxing Sun (孫國星), Prof. Pengzhan Sun (孫鵬展), and Prof. Shi Chen (陳石), covering the following topics:

- Interface Optimization Technology in the Manufacturing of New Energy Components
- Customized Assembly and Manufacturing of Two-Dimensional Crystal Functional Devices
- Manufacturing and Application of Nanocomposites

Participants responded positively to the training program, noting its clear structure, high academic value, and practical relevance to emerging technological fields.

This initiative reflected UM's continued commitment to strengthening academic collaboration and talent development with universities in mainland China. Both CCE and our Institute will continue to expand and deliver specialized training programs in the future, promoting deeper cooperation and contributing to the cultivation of high-caliber professionals in advanced manufacturing.

❖ Upcoming Events

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IAPME Seminar

Research and Applications of Green Low-Carbon Micro-Nano Composite Materials

3 February 2026

Prof. Yihe ZHANG
China University of Geosciences
Venue: N23-1004b
Time: 14:30 - 16:00
Hosted by: Prof. Guoxing SUN

Abstract

Focusing on the frontier of international materials science and the strategic demands of "dual carbon" goals, this paper reports the research and application of optical, electrical and environmental functional effects of green low-carbon micro-nano composite materials. The research scope covers nano-composite photocatalytic materials, graphene and polymer composite materials, comprehensive utilization of mineral resources, as well as new mineral composite materials.

Biography

Prof. Yihe ZHANG, Doctoral Supervisor; Academician of both the Russian Academy of Engineering and the Russian Academy of Natural Sciences; Fellow of the Chinese Society for Micro-Nano Technology; Expert receiving a special government allowance from the State Council. Main Research Areas: Comprehensive utilization of resources and materials for environmental energy and health, including polymer composite materials, graphene-based optoelectronic catalytic nanocomposites, full-component utilization of mineral resources, and green low-carbon mineral composite materials. Has undertaken over 40 projects, including the National Key R&D Program, the 863 Program, and the National Natural Science Foundation of China. Published over 700 SCI papers in journals such as Nat. Comm., Adv. Mater., and Angew. Chem. Int. Ed. (with nearly 40,000 SCI citations and an H-index of 111); Edited monographs and textbooks including Mineral Composite Materials, Composite Materials Science (a planned textbook by the Teaching Guidance Committee for Materials in Higher Education Institutions under the Ministry of Education), Material Preparation Chemistry, Low-Carbon Material Utilization of Geological Resources and Green Mine Construction, and Recycling of Mineral Resources and New Materials; Holds over 100 authorized domestic and international invention patents, with multiple technologies implemented and transferred; Received numerous scientific awards, including the Second Prize of Natural Science Award from the Ministry of Education, the Second Prize of Land and Resources Science and Technology Award, and the Second Prize of Natural Science Award of Beijing, and participated in the formulation of national or industry standards. Supervised over 160 doctoral and master's students. Prof. Yihe ZHANG is an authoritative expert in the field of Green Low-Carbon Mineral Composite Materials, with a focused research interest in Polymer composites and Graphene and Photocatalytic Nanocomposites.

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