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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
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✧ Content

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

1. **Juanjuan Wang**, Yuxuan Xiao, Jinxian Feng, Chunfa Liu, Lun Li, Youpeng Cao, Chengcheng Zhong, Ziwen Feng, Wendi Zhang, Zhi-Quan Liu*, **Hui Pan***. Phosphorus incorporation in cobalt molybdate: Controlling Mo leaching for surface reconstruction to improve hydrogen evolution. *Chemical Engineering Journal*, 525, 1385-8947 (2025). DOI: 10.1016/j.cej.2025.170812 . [2024 IF=13.2]

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Phosphorus incorporation in cobalt molybdate: Controlling Mo leaching for surface reconstruction to improve hydrogen evolution

Juanjuan Wang [a,b], Yuxuan Xiao [a], Jinxian Feng [a], Chunfa Liu [a], Lun Li [a], Youpeng Cao [a], Chengcheng Zhong [a], Ziwen Feng [a], Wendi Zhang [a], Zhi-Quan Liu [b,d,*], Hui Pan [a,c,**]

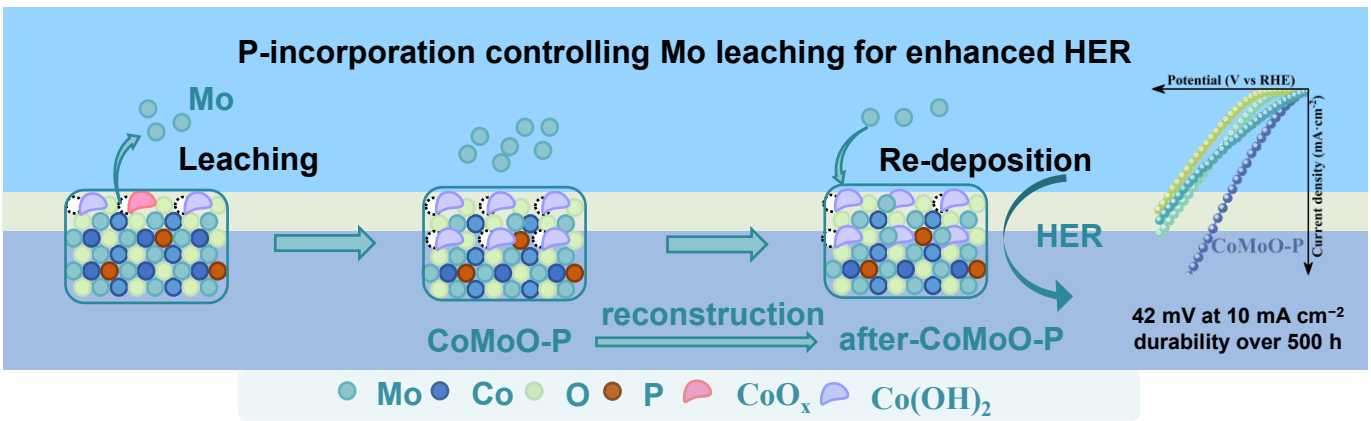
❖ Research Stories

Phosphorus incorporation in cobalt molybdate: Controlling Mo leaching for surface reconstruction to improve hydrogen evolution



Juanjuan Wang (王娟娟) Prof. Zhi-Quan Liu (劉志權) Prof. Hui Pan (潘暉)

- The quest for efficient, durable non-noble metal electrocatalysts for alkaline HER is crucial for scalable green hydrogen production, yet sluggish kinetics and structural instability remain key hurdles. Here, we develop phosphorus-incorporated cobalt molybdate (CoMoO-P) to regulate Mo-based dynamic reconstruction during HER. Beyond prior P-doping focused on electronic modulation, P enhances electron density at Mo/Co sites for optimal H* adsorption while controlling Mo leaching-redeposition, promoting $Co(OH)_2$ formation to accelerate water dissociation and enhance kinetics.
- The team demonstrates that CoMoO-P achieves an ultralow overpotential of 42 mV at 10 mA cm^{-2}, a Tafel slope of 30.3 mV dec^{-1}, and exceptional durability over 500 hours at 100–1000 mA cm^{-2}. In-situ Raman and ICP-MS analyses reveal the role of P in stabilizing the β-$CoMoO_4$ phase and enabling reversible Mo redeposition, forming synergistic $CoMoO_4$/$Co(OH)_2$ interfaces that boost water dissociation and H* adsorption. This strategy outperforms commercial Pt/C at high current densities and state-of-the-art catalysts, offering insights into reconstruction engineering for robust alkaline HER electrocatalysts.



Juanjuan Wang, Yuxuan Xiao, Jinxian Feng, Chunfa Liu, Lun Li, Youpeng Cao, Chengcheng Zhong, Ziwen Feng, Wendi Zhang, Zhi-Quan Liu*, **Hui Pan***. Phosphorus incorporation in cobalt molybdate: Controlling Mo leaching for surface reconstruction to improve hydrogen evolution. *Chemical Engineering Journal*, 525, 1385-8947 (2025).
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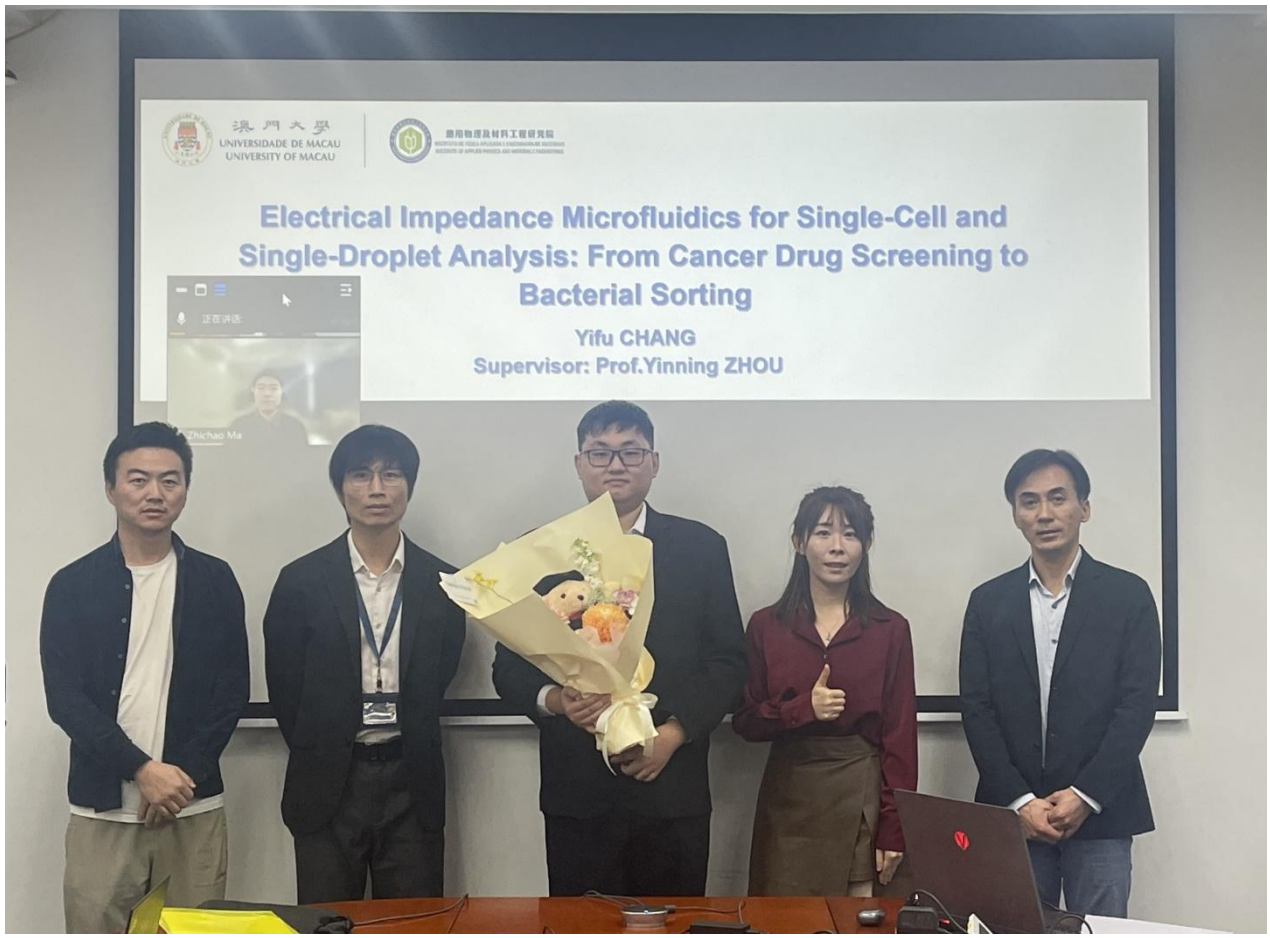
The first author, Ms. Juanjuan Wang, is the PhD student in IAPME. This work was supported by the Science and Technology Development Fund (FDCT) from Macau SAR (0111/2022/A2, 0050/2023RIB2, 0023/2023/AFJ, and 0002/2024/TFP) and Multi-Year Research Grants (MYRG-GRG2025-00007-IAPME and MYRG-GRG2024-00038-IAPME) from Research & Development Office at University of Macau.

❖ Ph.D. Student Thesis Oral Defenses

Yifu Chang of Prof. Yinning Zhou's group presented "Electrical Impedance Microfluidics for Single-Cell and Single-Droplet Analysis: From Cancer Drug Screening to Bacterial Sorting" in his oral defense on December 12, 2025.

Congratulations to Dr. Yifu Chang!



(from left) Prof. Binmeng Chen (陳斌猛), Prof. Bingpu Zhou (周冰朴), Dr. Yifu Chang (常譯夫), Prof. Yinning Zhou (周胤寧), Prof. Hui Pan (潘暉) and Prof. Zhichao Ma (馬智超, SJTU)

Annan Zhu of Prof. Guichuan Xing's group presented "Synergistic Optimization of Electron Transport Materials for Inverted Perovskite Solar Cells" in his oral defense on December 16, 2025.

Congratulations to Dr. Annan Zhu!

(from left) Prof. Yongqing Cai (蔡永青), Prof. Songnan Qu (曲松楠), Dr. Annan Zhu (朱安楠), Prof. Guichuan Xing (邢貴川), Prof. Guoxing Sun (孫國星), Prof. Shi Chen (陳石) and Prof. Kai Wang (王愷, SUSTech)

❖ IAPME Co-Hosted 2025 PhD Student Visiting Programme for Beijing Institute of Technology, Zhuhai

The Centre for Continuing Education (CCE) and the Macao Centre for Research and Development in Advanced Materials of our Institute successfully organized the 2025 PhD Student Visiting Programme for participants from the Beijing Institute of Technology, Zhuhai. The two-day event, held from December 16 to 17, aimed to foster academic exchange and strengthen collaboration between UM and leading universities in Chinese mainland.

The programme featured a series of specialized seminars and campus tours, offering participants insights into cutting-edge research and innovation. Key topics included:

- Robotics and Automation
- Intelligent Control and Artificial Intelligence
- Green Energy for a Global Society

These sessions were delivered by senior professors from UM, including Prof. Huaiyu Shao, an Associate Professor at our Institute, and provided participants with valuable knowledge and exposure to advanced technologies. Feedback from attendees was overwhelmingly positive, highlighting the programme's role in enhancing academic and research capabilities.

Looking ahead, CCE and our Institute reaffirm the commitment to promoting cross-border academic cooperation. Plans are underway to continue offering training programmes for universities in Chinese mainland, further strengthening ties and advancing research collaboration in emerging fields.

❖ Seminars

On December 9, 2025, our Institute successfully hosted a seminar on nonlinear transport properties in topological materials, chaired by Prof. Hongchao Liu. The event featured Prof. Hui Li (李惠) from Anhui University and attracted a diverse audience of researchers, institute members, and students eager to delve into cutting-edge developments at the intersection of quantum geometry and condensed matter physics.

Prof. Hui Li, currently a Professor at the Institute of Physical Science and Information Technology, Anhui University, earned his Ph.D. from the University of Science and Technology of China in 2014. He completed postdoctoral research at Hong Kong University of Science and Technology (HKUST) from 2014 to 2018 and later served as a Research Assistant Professor at HKUST (2021–2023) before joining Anhui University. His research focuses on novel magnetotransport properties of low-dimensional quantum materials, positioning him as a leading voice in topological physics.

The seminar showcased Prof. Li's latest experimental findings on how quantum geometry influences nonlinear transport in topological materials, including:

1. Second-order nonlinear transport in bulk Weyl semimetal Td-WTe_2, controlled via electric and magnetic fields, with observed out-of-plane B-field quantum oscillations.
2. Third-order transport in $MnBi_2Te_4$ flakes, driven by quantum metric and Berry curvature quadrupoles.

The presentation concluded with a dynamic Q&A session, where participants explored topics such as experimental design, potential applications of nonlinear transport phenomena, and future research directions in topological materials. Prof. Li's expertise in low-dimensional quantum systems fostered rich technical exchanges that resonated with both early-career researchers and seasoned faculty.