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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. **Yuxuan Xiao**, Di Liu, Jiao Yang, Jinxian Feng, Wenhao Gu, Lulu Qiao, Weng Fai IP, and **Hui Pan***. Controllable Reconstruction of β-Bi_2O_3/$Bi_2O_2CO_3$ Composite for Highly Efficient and Durable Electrochemical CO_2 Conversion. *Nano Letters*, 25, 6548-6555 (2025). DOI:10.1021/acs.nanolett.5c00417. [2023 IF=9.6]

NANO LETTERS

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Letter

Controllable Reconstruction of β-Bi_2O_3/$Bi_2O_2CO_3$ Composite for Highly Efficient and Durable Electrochemical CO_2 Conversion

Yuxuan Xiao, Di Liu, Jiao Yang, Jinxian Feng, Wenhao Gu, Lulu Qiao, Weng Fai Ip, and Hui Pan*

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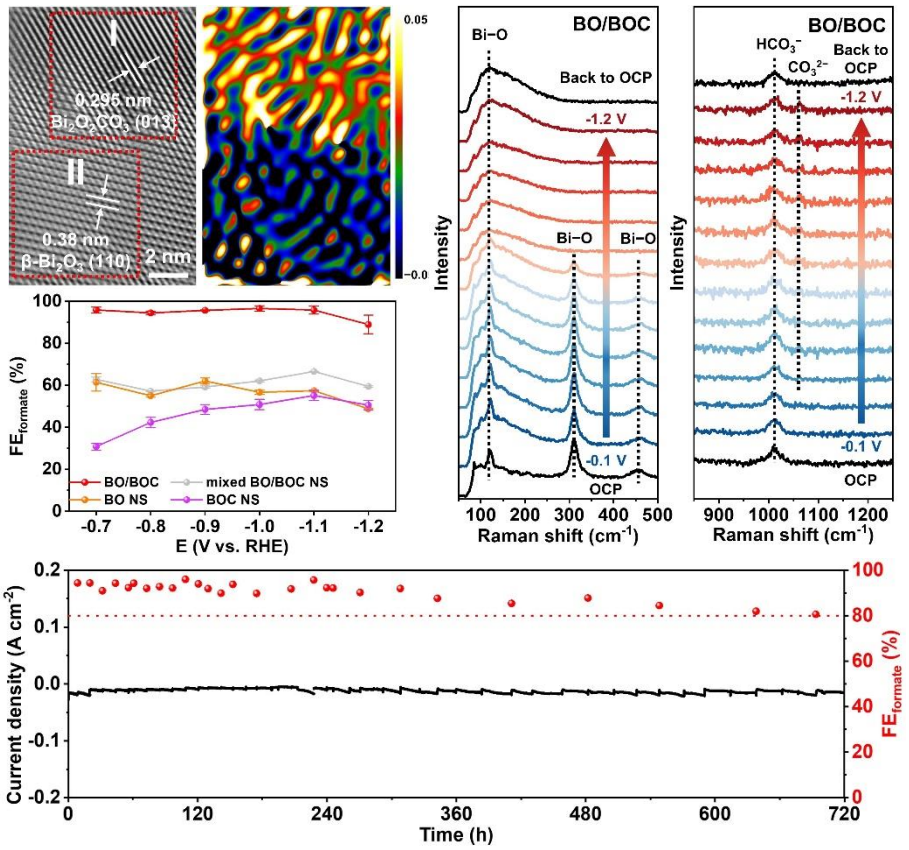
❖ Research Stories

UM research team successfully developed controllably reconstructed catalyst for highly selective and durable electrochemical CO2 conversion

- The uncontrollable electrochemical reduction reconstruction, leading to the destruction of well-defined structure and subsequence low durability, is the main obstacle to the catalytic performance of Bi-based composites toward electrochemical CO_2 reduction reaction (eCO_2RR).
- The team addressed this issue through construction of a novel β-Bi_2O_3/$Bi_2O_2CO_3$ composite, which could resist the reduction reconstruction of Bi-based materials to metallic Bi during the eCO_2RR process by modulating a more alkaline microenvironment that facilitates the formation of new Bi–O bonds.
- The research results indicate the synergistic interactions and the directional electron transfer between the β-Bi_2O_3 and $Bi_2O_2CO_3$ components, together with the stable composite structure, result in its superior activity and selectivity for formate production with high faradaic efficiencies (FEs) over 94% from −0.7 ~ −1.1 V, and a remarkable durability with a maintenance of 80% FE after a continuous electrocatalysis of 720 h. This work sheds new lights on designing advanced high-performance nanomaterials toward eCO_2RR and other practical applications.

Dr. Yuxuan Xiao
(肖宇軒)

Prof. Hui Pan
(潘暉)



Yuxuan Xiao, Di Liu, Jiao Yang, Jinxian Feng, Wenhao Gu, Lulu Qiao, Weng Fai IP, and **Hui Pan***. Controllable Reconstruction of β-Bi_2O_3/$Bi_2O_2CO_3$ Composite for Highly Efficient and Durable Electrochemical CO_2 Conversion. *Nano Letters*, 25, 6548-6555 (2025). DOI:10.1021/acs.nanolett.5c00417. [2023 IF=9.6]

The first author is Dr. Yuxuan Xiao, a post-doctoral fellow in the IAPME. This work was supported by the Science and Technology Development Fund from Macau SAR (FDCT) (0111/2022/A2, 0050/2023RIB2, 0023/2023/AFJ, 006/2022/ALC, and 0087/2024/AFJ) and Multi-Year Research Grants (MYRGGRG2023-00010-IAPME and MYRG-GRG2024-00038-IAPME) from Research & Development Office at the University of Macau.

❖ Seminars

On April 22, 2025, IAPME had the pleasure of hosting an insightful seminar led by Prof. Dr. Li Song (宋禮) from the University of Science and Technology of China. Prof. Song is a prominent figure in the field of synchrotron radiation, with over 400 published scientific papers and more than 50,000 citations, achieving an impressive H-index of 118. He has been recognized as a global highly cited scientist by Clarivate from 2019 to 2024. The event was expertly hosted by Prof. Hai-Feng Li from IAPME.

Prof. Li Song earned his Ph.D. from the Institute of Physics, Chinese Academy of Science, in 2006. His postdoctoral research took him to the University of Munich, Rice University, and Shinshu University. In 2012, he became a Professor at the University of Science and Technology of China, where he leads a research team focusing on synchrotron radiation applications in nanomaterials and devices.

The seminar, titled "Synchrotron Radiation Study on 2D MXene-based Energy Materials," explored the innovative use of synchrotron radiation to investigate MXenes—two-dimensional materials with potential in energy storage and conversion. Prof. Song detailed the process of creating MXenes from their MAX phases using HCl-assisted hydrothermal etching, which avoids the use of hazardous hydrofluoric acid. This method has led to the development of fluoride-free Mo_2CT_x, significantly enhancing battery performance.

Prof. Song also discussed the integration of MXenes with MoS_2 to form endogenous heterojunctions, which is crucial for improving ion storage capabilities. He highlighted the use of operando techniques to explore phase evolution and the chemistry of these materials during operation. Additionally, he presented insights into the in-situ detection of electrode-electrolyte interfaces, which is vital for understanding the real-time mechanisms of MXenes in energy applications.

The seminar concluded with a lively discussion on the transformative potential of synchrotron radiation techniques in advancing material science. Attendees were inspired by the detailed exploration of MXenes and their applications, gaining valuable insights into cutting-edge research methods. The event fostered a collaborative atmosphere, encouraging further exploration and partnerships in the field. Prof. Song's presentation not only showcased groundbreaking research but also emphasized the importance of interdisciplinary collaboration in pushing the boundaries of scientific understanding. The seminar was a resounding success, highlighting the role of innovative techniques in addressing global energy challenges.