澳門大學
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. **Jinxian Feng,** Wendi Zhang, Lun Li , Yuxuan Xiao, Yatai Li, Xiaoling Lai, Weng Fai Ip, **Hui Pan***. Self-adaptive reconstructed Sn-Zn metal/oxide-hydroxide hybrid for selective electrochemical CO_2 reduction to formate. *Applied Catalysis B: Environment and Energy,* 126380 (2025). DOI: 10.1016/j.apcatb.2025.126380. [2024 IF=21.1]

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Self-adaptive reconstructed Sn-Zn metal/oxide-hydroxide hybrid for selective electrochemical CO_2 reduction to formate

Jinxian Feng [a], Wendi Zhang [a], Lun Li [a], Yuxuan Xiao [a], Yatai Li [a], Xiaoling Lai [a], Weng Fai Ip [b], Hui Pan [a,b,*]

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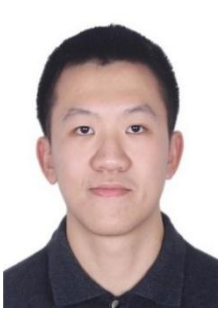
❖ Research Stories

UM research team developed surface reconstruction optimization strategy by modulating element ratio of pre-catalyst

- The composition of a catalyst significantly influences its reconstruction, which is critical for electrochemical CO_2 reduction reaction (e-CO_2RR). However, the mechanisms of how elemental composition affect the reconstructed structure and enhance e-CO_2RR performance require further exploration.

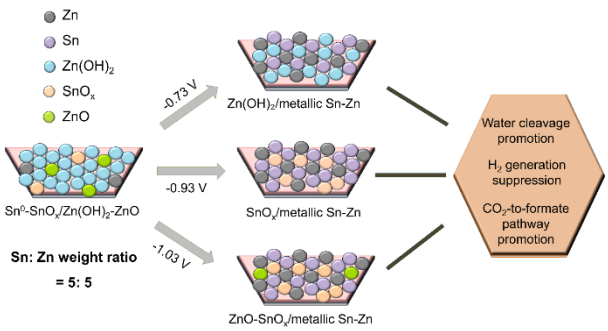
- The research group modulate the Sn/Zn ratios in Sn-Zn alloy precursors to promote CO_2-to-formate ($HCOO^-$) conversion through a self-adaptive reconstructed structure with potential changing. Notably, the electrocatalyst exhibits exceptional CO_2-to-$HCOO^-$ performance at a Sn/Zn mass ratio of 1:1 (SnZn-55), achieving a Faraday efficiency (FE) > 82 % across a wide potential range (-0.73 to −1.13 V), a high $HCOO^-$ partial current density of 45.75 mA cm^{-2} at potential of highest HCOO- FE (92.3 % at −0.93 V) and stability for up to 2000 h. SnZn-55 maintains high $HCOO^-$ FEs of ~75 % at 3.22 V (0.39 A cm^{-2}) and ~78 % at 5.78 V (0.7 A cm^{-2}), $HCOO^-$ production rate of 100.2 mol h^{-1} m^{-2} at 0.7 A cm^{-2}, with robust stability over 50 h and energy consumption of 207.14 kWh $kmol^{-1}$ (4.50 kWh kg^{-1}) HCOOH in flow cell reactor.

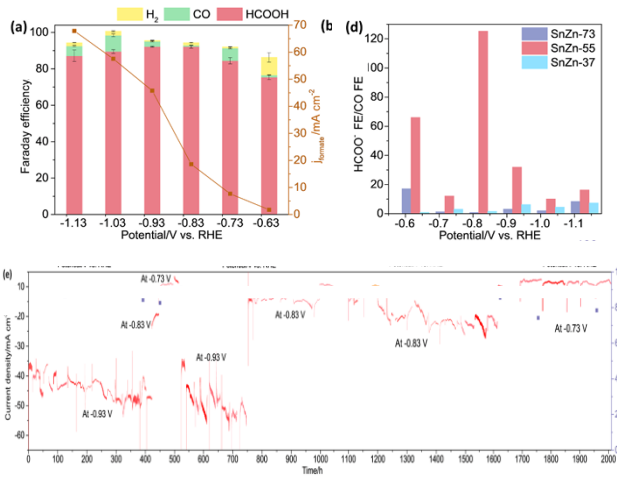
- Systematic studies reveal that the SnZn-55 undergoes reconstruction to form $Zn(OH)_2$/metallic Sn-Zn, SnO_x/metallic Sn-Zn and SnO_x-ZnO/metallic Sn-Zn hybrid structure at −0.73, −0.93 and −1.13 V, respectively through element dissolution and redeposition processes. The interplay between the optimal Sn:Zn ratio in the pre-catalyst, reconstructed structures and dissolved Zn/Sn species enhances CO_2-to-$HCOO^-$ conversion performance by optimizing basic reaction pathways for enhancing the CO_2-to-$HCOO^-$ conversion.



Dr. Jinxian Feng
(馮錦先)

Prof. Hui Pan
(潘暉)





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The first author is Dr. Jinxian Feng, who got PhD degree from IAPME. This work was supported by the Science and Technology Development Fund (FDCT) from Macau SAR (0050/2023/RIB2, 0023/2023/AFJ, 0087/2024/AFJ, 0002/2024/TFP and 0111/2022/A2) and Multi-Year Research Grants (MYRG-GRG2024–00038-IAPME and MYRG-GRG2025–00007-IAPME) from the University of Macau. Dr. Jinxian Feng thanked the Talent programme for Postdoctoral Fellow from the University of Macau.

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❖ Dalian University of Technology Students Visited IAPME for Postgraduate Exchange Activities

On January 23 & January 31, 2026, our Institute welcomed two student groups from Dalian University of Technology (DUT) as part of an ongoing effort to strengthen academic exchange and introduce prospective students to the University of Macau's postgraduate education environment. The first group, consisting of 34 students, visited on January 23, followed by a second group of 20 students on January 31.

Both visits were hosted by Prof. Guoxing Sun, who warmly received the DUT delegations. During the sessions, Prof. Sun provided an overview of the University of Macau's main campus and introduced the mission, development, and academic structure of IAPME. He highlighted the institute's key research areas, current programmes, and recent scientific advancements, and showcased several innovative products derived from IAPME's research outcomes—sparking strong interest among the visiting students.

The DUT students also actively engaged in discussions, sharing their own academic pursuits and research interests. Many took the opportunity to inquire about postgraduate programmes at UM, including admission pathways and research opportunities. The interactive exchanges fostered meaningful dialogue and generated enthusiasm for potential collaboration between the two institutions, particularly in areas such as student mobility, joint training, and collaborative learning.

These visits not only enhanced the students' understanding of UM's graduate education and research environment but also helped to strengthen the foundation for sustained academic engagement between Dalian University of Technology and the University of Macau. Both institutions expressed interest in furthering cooperation to support student development and deepen academic ties.

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