



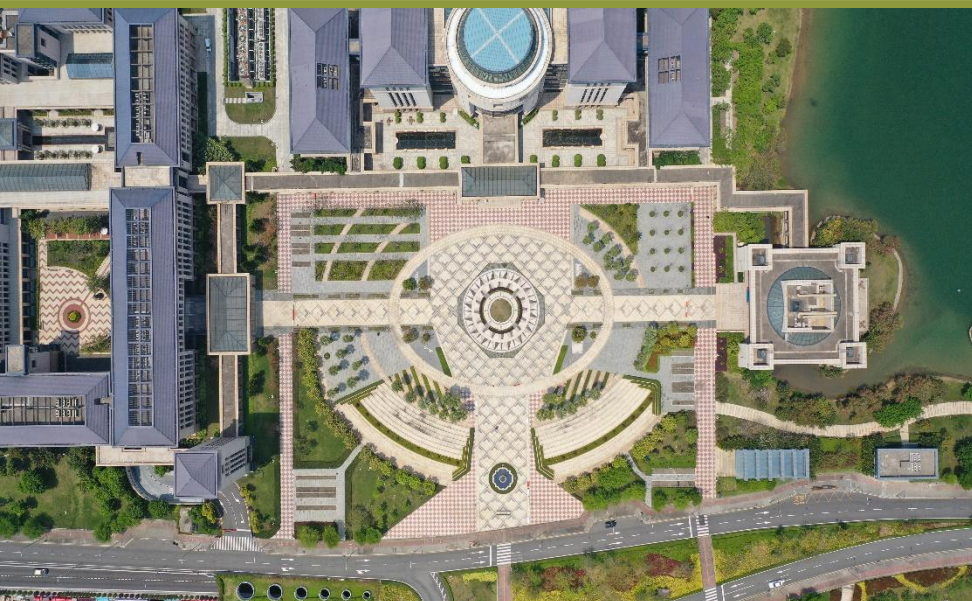
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應用物理及材料工程研究院  
INSTITUTO DE FÍSICA APLICADA E ENGENHARIA DE MATERIAIS  
INSTITUTE OF APPLIED PHYSICS AND MATERIALS ENGINEERING

# IAPME Newsletter

<https://iapme.um.edu.mo/>



**ISSUE 52**

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

1. Huifang Xu, Qingbin Jiang, Kang Gao, Kwan San Hui, Shuo Wang, Yan Wang, Cheng-Zong Yuan, Chenyang Zha, Duc Anh Dinh, and Kwun Nam Hui\*. Synergistic Nitrogen-Catalytic Engineering Direct K<sub>2</sub>S<sub>3</sub>-to-K<sub>2</sub>S Conversion in High-Performance Potassium-Sulfur Batteries." *Advanced Energy Materials*, e02553 (2025). DOI: 10.1002/aenm.202502553. [2024 IF=26.0]

## RESEARCH ARTICLE

ADVANCED  
ENERGY  
MATERIALS

[www.advenergymat.de](http://www.advenergymat.de)

# Synergistic Nitrogen-Catalytic Engineering Direct K<sub>2</sub>S<sub>3</sub>-to-K<sub>2</sub>S Conversion in High-Performance Potassium-Sulfur Batteries

Huifang Xu, Qingbin Jiang, Kang Gao, Kwan San Hui, Shuo Wang, Yan Wang, Cheng-Zong Yuan, Chenyang Zha, Duc Anh Dinh, and Kwun Nam Hui\*

## ❖ Research Stories

### UM research team successfully developed Synergistic Nitrogen-Catalytic Engineering, effectively achieved Direct $K_2S_3$ -to- $K_2S$ Conversion in High-Performance Potassium-Sulfur Batteries

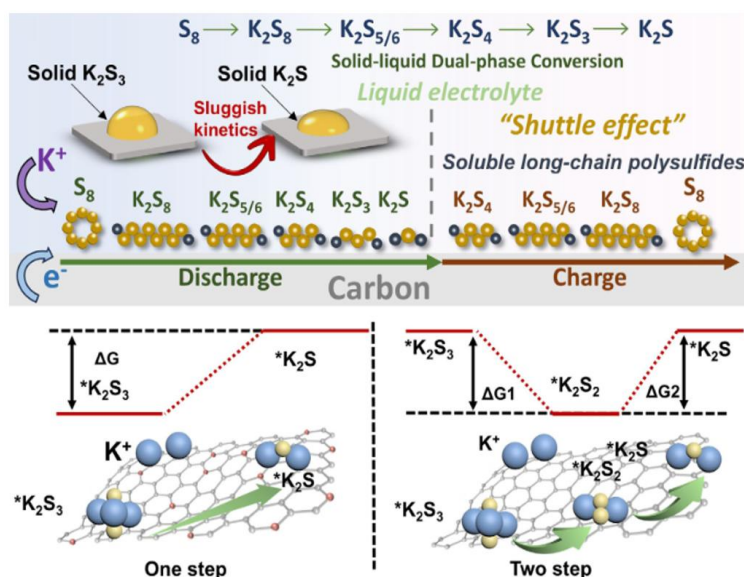
- A systematic experimental and theoretical investigation of the  $K_2S_3$  to  $K_2S$  transition and elucidate the catalytic role of specific nitrogen configurations. Specifically, during the solid-solid conversion stage,  $K_2S_3$  initially transforms into  $K_2S_2$  and subsequently into  $K_2S$  on the surface of pristine carbon materials, a process associated with a high energy barrier. The incorporation of pyridinic N and pyrrolic N significantly enhances the binding energy of potassium polysulfides on the carbon surface and effectively lowers the energy barrier, facilitating a direct one-step conversion from  $K_2S_3$  to  $K_2S$ .
- The superior catalytic performance of pyridinic N and pyrrolic N can be attributed to their ability to enhance electronic conductivity and electrochemical activity. This enhancement arises from their localization at defect sites, which disrupts the stability of  $\pi$ -orbital resonance and induces a positively electron-rich state, thereby facilitating redox reactions.
- Particularly noteworthy is the NCG framework provides abundant active sites, which not only promote the dynamic adsorption of sulfur species but also exhibit strong electrocatalytic activity to accelerate the solid-solid conversion from  $K_2S_3$  to  $K_2S$ .



Dr. Huifang Xu  
(徐惠芳)



Prof. Kwun Nam Hui  
(許冠南)



Huifang Xu, Qingbin Jiang, Kang Gao, Kwan San Hui, Shuo Wang, Yan Wang, Cheng-Zong Yuan, Chenyang Zha, Duc Anh Dinh, and Kwun Nam Hui\*. Synergistic Nitrogen-Catalytic Engineering Direct  $K_2S_3$ -to- $K_2S$  Conversion in High-Performance Potassium-Sulfur Batteries." *Advanced Energy Materials*, e02553 (2025). DOI: 10.1002/aenm.202502553. [2024 IF=26.0]

Prof. Kwun Nam Hui is the corresponding author of this study. The first author, Dr. Huifang Xu, was a Ph.D. student in IAPME. This work was supported by the Science and Technology Development Fund (FDCT) of Macao S.A.R (0033/2023/ITP1, and 0022/2023/RIB1, 046/2019/AFJ,0007/2021/AGJ, and 0070/2023/AFJ), the Macau Young Scholars Program(AM2020005), Guangdong Basic and Applied Basic Research Foundation (2022A1515110994, 2024A1515030228, and 2022A0505030028), the Multi-Year Research Grants (MYRG-2024-00166-IAPME and MYRG2022-00223-IAPME) from the Research Services and Knowledge Transfer Office at the University of Macau, and the UEA funding.



## ❖ Seminars

Prof. Junling Wang (王峻嶺), Chair Professor at City University of Hong Kong (CityU) in Physics, visited our institute on September 5, 2025. During his visit, he delivered an insightful presentation titled “*Electric-field Control of Spin in Ferroelectric vdW Heterostructures*” The seminar was hosted by Prof. Yongqing Cai, who extended the invitation to Prof. Wang.

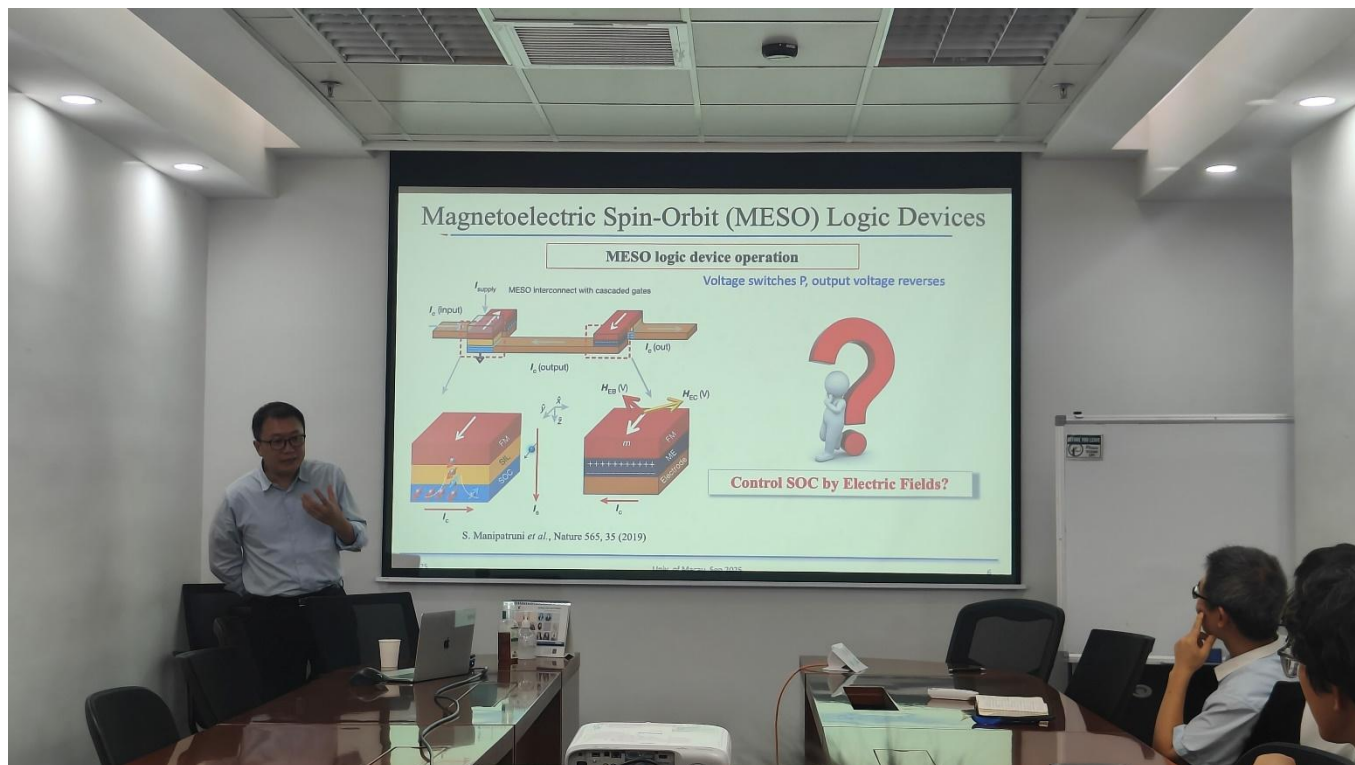
Prof. Wang obtained his B.S. degree from Nanjing University, China in 1999, and Ph.D. degree from University of Maryland, College Park in 2005. He joined Nanyang Technological University, Singapore as an Assistant Professor in 2006. He was promoted to Associate Professor with tenure in 2011 and Full Professor in 2017. In 2024, he joined CityU as a Chair Professor in Physics. Prof. Wang’s research activities focus on multiferroic materials. His pioneering work on  $\text{BiFeO}_3$  thin films has attracted much attention in the field. His recent interests also include 2D vdW materials that possess ferroelectric and/or magnetic properties.





During his talk, Prof. Wang shared the latest progress on the control of spin by electric field on the basis of two-dimensional vdW heterostructures by his research group. The seminar covered the discovery and development of the unique layered structure of  $\text{WTe}_2$  for its coexistence of switchable polarization and high conductivity, ideally for realizing the electric-field control of spin and magnetization.

Through this visit, Prof. Wang expressed great interests in potential collaborations on 2D vdW heterostructures with our members. Potential collaborative works on spintronics are also promised.





## ❖ Visits

A delegation of 23 members from Associação das Empresas de Construção Civil da Região dos Vinhedos (ASCON), led by Prof. Bernardo Fonseca Tutikian and Prof. Zongjin Li (李宗津, Emeritus Professor of IAPME), visited our institute on September 2, 2025.

Prof. Guichuan Xing and Prof. Binmeng Chen attended the reception. During the visit, Prof. Chen firstly gave an introduction to our institute, covering its history, teaching and research areas, as well as its achievements. In addition, Prof. Chen provided a detailed overview of five key research areas.







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After that, Prof. Guoxing Sun's research group introduced their commercialized products and presented related research videos to the visitors. The guests were all impressed and showed great interest in the institute's research outcomes. Lastly, Prof. Bernardo Tutikian from ASCON invited members of our institute to visit their association in Brazil for further discussions and potential collaboration.



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