



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

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



ISSUE 2

2 October 2024

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❖ Publications (IF \geq 10; *corresponding author)

1. Yunshan Zheng, Huixian Xie, Junfeng Li, Kwan San Hui*, Zhenjiang Yu, Huifang Xu, Duc Anh Dinh, Zhenqing Ye, Chenyang Zha, **Kwun Nam Hui***, “Insights into the Jahn-Teller Effect in Layered Oxide Cathode Materials for Potassium-Ion Batteries”, *Advanced Energy Materials*, 2024, 11, 2400461. DOI: 10.1002/aenm.202400461. [2023 IF=24.4]
2. Qingcheng Wang, Tesen Zhang, Quansheng Cheng, Bingzhe Wang, Yupeng Liu, **Guichuan Xing, Zikang Tang, Songnan Qu***, “Combination of Efficient Red Fluorescence and High Photothermal Conversion in the Second Near-Infrared Window from Carbon Dots through Photoinduced Sodium-Doping Approach”[J]. *Advanced Functional Materials*, 2024: 2402976. DOI:10.1002/adfm.202402976. [2023 IF=18.5]
3. Q. Jiang, H. Xu, K. S. Hui*, Z. Ye, C. Zha, Z. Lin, M. Zheng, J. Lu*, **K. N. Hui***, Breaking the Passivation Effect for MnO₂ Catalysts in Li-S Batteries by Anion-Cation Doping”. *Angew. Chem., Int. Ed.* 2024, e202408474. DOI: 10.1002/anie.202408474. [2023 IF=16.1]



4. Xianming Zhang, Lingyun Li, Bingzhe Wang, Zhipeng Cai, Bohan Zhang, Feng Chen, **Guichuan Xing**, Kai Li*, **Songnan Qu***, “Donor-Acceptor Type Supra-Carbon-Dots with Long Lifetime Photogenerated Radicals Boosting Tumor Photodynamic Therapy”. *Angew Chem Int Ed*, e202410522. DOI: 10.1002/anie.202410522. [2023 IF=16.1]
5. Huifang Xu, Qingbin Jiang, Zheng Shu, Kwan San Hui,* Shuo Wang, Yunshan Zheng, Xiaolu Liu, Huixian Xie, Weng-Fai (Andy) Ip, Chenyang Zha, **Yongqing Cai,* Kwun Nam Hui***, “Fundamentally Manipulating the Electronic Structure of Polar Bifunctional Catalysts for Lithium-Sulfur Batteries: Heterojunction Design versus Doping Engineering.” *Advanced Science* 2024, 11, 2307995. DOI: 10.1002/advs.202307995. [2023 IF=14.3]

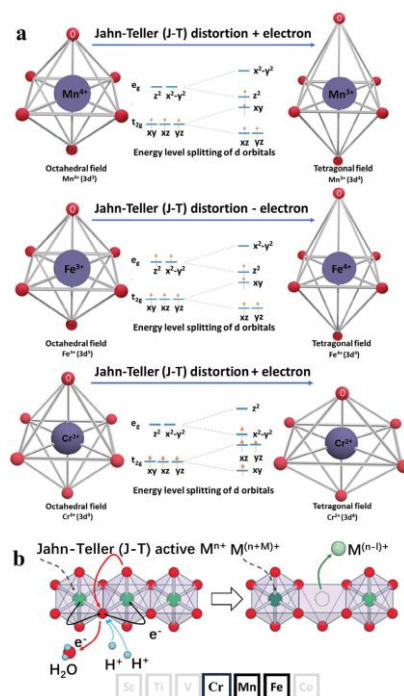
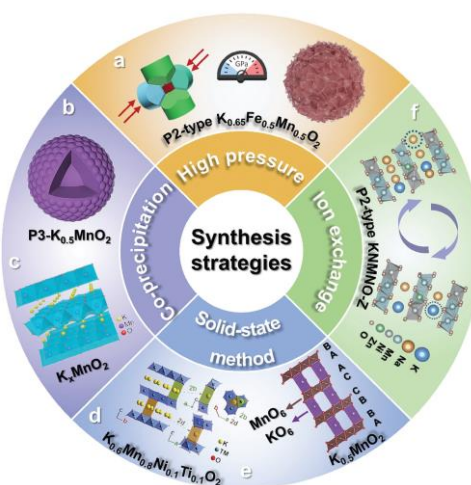
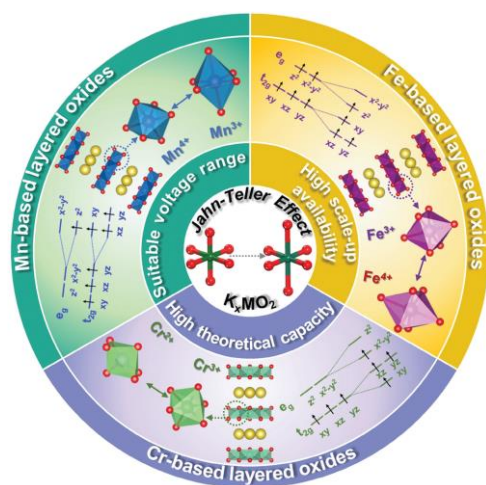
❖ Research Stories

UM research team has successfully introduced groundbreaking insights into the Jahn-Teller Effect in Layered Oxide Cathode Materials for Potassium-Ion Batteries.

- This review provides a thorough understanding of the structural disorder and irreversible phase transitions affecting K_xMO_2 cathodes due to the Jahn-Teller effect. Specifically, it summarizes the present status of K_xMO_2 cathodes for potassium-ion batteries (PIBs), emphasizing the challenges brought about by the Jahn-Teller effect.
- As a result, the team put forward promising strategies, including composition modulation, various synthesis approaches, and surface modification, to alleviate and suppress the Jahn-Teller effect. These strategies provide valuable insights into the potential of innovative cathode materials and establish a solid foundation for future research in the field of PIBs.



(from left) Dr. Yunshan ZHENG, Ms. Huixian XIE, and Prof. Kwun Nam HUI



Y. S. Zheng, H. X. Xie, J. F. Li, K. S. Hui*, Z. J. Yu, H. F. Xu, D. A. Dinh, Z. Q. Ye, C. Y. Zha, K.N. Hui*, "Insights into the Jahn-Teller Effect in Layered Oxide Cathode Materials for Potassium-Ion Batteries", *Advanced Energy Materials*, 2024, 11, 2400461. DOI: 10.1002/aenm.202400461. [2023 IF=24.4]

Prof. Kwun Nam HUI is the corresponding author of this study. The first authors are Ms. Yunshan ZHENG and Ms. Huixian XIE, two Ph.D. students in the IAPME. This work was supported by the Science and Technology Development Fund, Macau SAR (File no., 0033/2023/ITP1, 0022/2023/RIB1, 0046/2019/AFJ, 0007/2021/AGJ, 0070/2023/AFJ, and 006/2022/ALC), University of Macau (File no. MYRG2020-00187-IAPME and MYRG2022-00223-IAPME), the UEA funding.

❖ Research Stories

UM research team successfully develops Na-doping carbon-dots with efficient red fluorescence and high PTCE in the NIR-II for tumor photothermal therapy

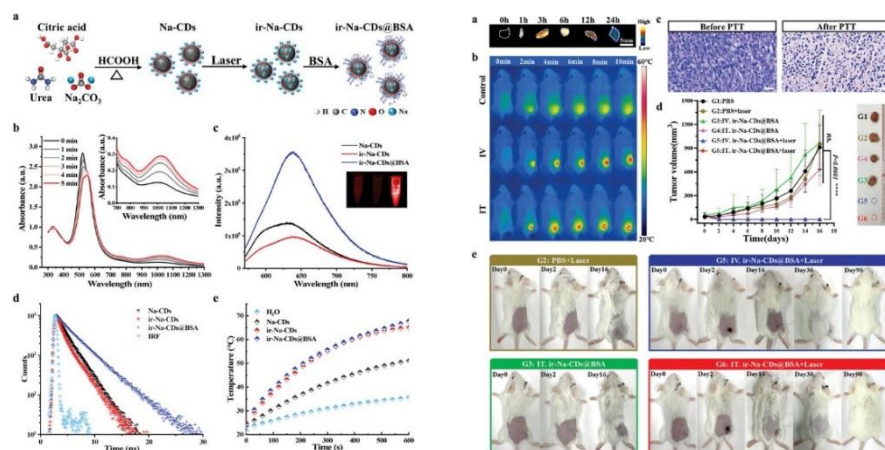
- Efficient aqueous red-emissive CDs with surface modification of light metals were synthesized through one-step method (Na-CDs), with a PL quantum yield (PLQY) of up to 14% in water.
- Charge transfer on the surface of CDs were achieved through laser irradiation, some sodium ions were reduced and entered the core to coordinate with the sp² C domain, resulting in the enhanced NIR-II absorption for the first time in the irradiated Na-CDs (ir-Na-CDs).
- After composing with Bovine serum albumin (BSA), ir-Na-CDs@BSA demonstrated efficient red emission with a 31% PLQY in aqueous solution and exhibited a high PTCE of 43% under 1064 nm laser irradiation (1 W cm⁻²). Moreover, the ir-Na-CDs@BSA exhibited none or low cytotoxicity and demonstrated tumor accumulation capacity after intravenous injection, enabling effective tumor NIR-II PTT.



(from left)
Mr. Qingcheng WANG and
Mr. Tesen ZHANG



(from left)
Mr. Quansheng CHENG
and Prof. Songnan QU



Wang Q, Zhang T, Cheng Q, et al. Combination of Efficient Red Fluorescence and High Photothermal Conversion in the Second Near-Infrared Window from Carbon Dots through Photoinduced Sodium-Doping Approach[J]. *Advanced Functional Materials*, 2024: 2402976. DOI:10.1002/adfm.202402976. [2023 IF=18.5]

Prof. Songnan QU (UM) is the corresponding author of this study. The first authors are Mr. Qingcheng WANG, Mr. Tesen ZHANG, Mr. Quansheng CHENG, three Ph.D. students in the IAPME. This project was funded by Science and Technology Development Fund of Macau SAR (0139/2022/A3, 0007/2021/AKP, 006/2022/ALC), and Department of Science and Technology of Guangdong Province (2019ZT08Y191, 2019QN01Y640, 2022B1212010003).

❖ UM Scholar Talk

On 24 September, the University of Macau (UM) held a talk titled ‘How Permeable is the Impermeable Graphene?’ as the 20th UM Scholar Research Forum. Sun Pengzhan, assistant professor in the Institute of Applied Physics and Materials Engineering, was the speaker. The talk attracted a full house, with many local secondary school students and teachers also participating online.

During the talk, Prof Sun mentioned that graphene, which consists of only one atomic layer of carbon atoms, is a two-dimensional material with excellent electronic, optical, and mechanical properties. He also explained how his innovative device, which consists of small monocrystalline containers tightly sealed with graphene, can significantly improve the accuracy of detecting gas permeation through membranes by eight to nine orders of magnitude compared to the previous highest standards in the field. The relevant research provides new perspectives to the research community and helps promote the applications of nanotechnology and new materials.





❖ Tea with Professor

On 04 September 2024, Prof. Liu Hongchao from IAPME participated the "Tea with Professor" organized by Career Development Centre, Student Affairs Office, UM. During the one-hour activity, Prof. Liu shared his knowledge and experiences in Master applications of UK, PhD study and research, his own research directions with the students. The students were delighted to receive Prof. Liu's valuable advice and guidance regarding their future plans during this enriching event.

"Tea with Professor" is an engaging platform where a small group of students can discuss further study and career planning with professors in an informal setting.



❖ Times Higher Education (THE) article on UM's Materials Sciences

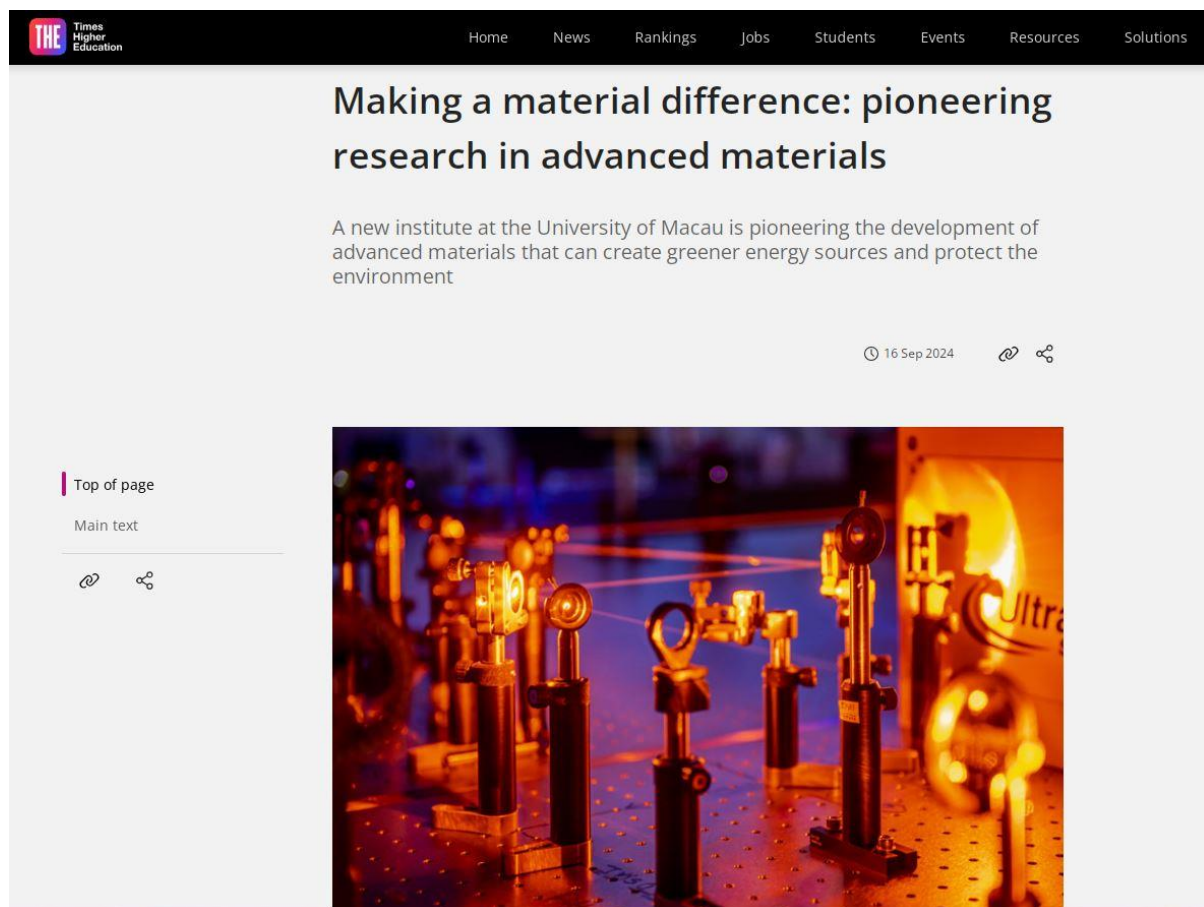
In September, Times Higher Education (THE) invited Prof. Zikang TANG to be interviewed and produced an online editorial on UM's Materials Sciences.

The article, "Making a material difference: pioneering research in advanced materials", published by THE mainly explores the research breakthroughs achieved by scientists at the IAPME and Macao Centre for Research and Development in Advanced Materials in the fields of energy materials, environmental materials and health materials.



For more detailed information, please visit

<https://academic-ui.prд.timeshighereducation.com/research/university-macau/making-material-difference-pioneering-research-advanced-materials>



❖ UM professor named MIT Technology Review's 35 Innovators Under 35 for China

MIT Technology Review, in collaboration with DeepTech, hosted the Meet 35 Summit 2024 and the MIT Technology Review 35 Innovators Under 35 China Award Ceremony. Sun Pengzhan, assistant professor at the Institute of Applied Physics and Materials Engineering (IAPME) at the University of Macau (UM), was named one of the 35 Innovators Under 35 for China (TR35 China), making him the only scholar from Macao on the list.

MIT Technology Review was founded in 1899. Since 1999, the magazine has annually selected a group of young leaders under the age of 35 who are the most innovative and influential in the field of technology, forming the '35 Innovators Under 35' list. Over the past two decades, many of the winners have gone on to become industry leaders. They include Zhuang Xiaowei, a bio-imaging technology pioneer; Larry Page and Sergey Brin, founders of Google; JB Straubel, co-founder of Tesla; and Zhang Feng, inventor of CRISPR gene editing technology.





Prof Sun was selected for his dedication to the precise construction of atomic-scale confinement channels and the experimental elucidation of the mechanisms and novel phenomena of mass transport processes therein, as well as the application of the new membrane separation technology he has developed to solve common separation problems such as high energy consumption and low efficiency in the fields of energy and environment. His research primarily focuses on the development of novel two-dimensional separation membranes and the solution of fundamental scientific problems associated with two-dimensional separation membranes. Prof Sun's research findings have been published in leading scientific journals such as *Nature*, *Proceedings of the National Academy of Sciences (PNAS)*, *Nature Communications*, and *Science Advances*. He has also received many awards, including the Excellent Young Scientists Fund (Hong Kong and Macao) from the National Natural Science Foundation of China, the Materials Research Society (MRS) Graduate Student Award, Top Scholarship from Tsinghua University, First Prize in the China International Graphene Innovation and Entrepreneurship Competition, and Grand Prize in the Tsinghua-Dow Sustainable Development Innovation Challenge Competition.



❖ Joint Annual Conference of Physical Societies in Guangdong-Hong Kong-Macao Greater Bay Area

The 2024 Joint Annual Conference of Physical Societies in Guangdong-Hong Kong-Macao Greater Bay Area was held in Macao. Rector Song Yonghua and Vice Rector Ge Wei of the University of Macau (UM), together with more than 320 experts and scholars in the field of physics from around the world, attended the conference to discuss the latest research findings and development trends in physics, and to strengthen exchanges and cooperation in the field in the Guangdong-Hong Kong-Macao Greater Bay Area (GBA).

Speaking at the opening ceremony, Song stressed the importance of innovation and cooperation in the field of physics in the GBA. He also pointed out that in recent years, UM has been committed to research in applied physics and materials engineering, and has established the Macao Centre for Research and Development in Advanced Materials to promote industry-academia collaboration. Sun Handong, president of the Physical Society of Macao and associate director of the Institute of Applied Physics and Materials Engineering (IAPME) at UM; Wang Biao, chair of the Guangdong Physics Society; and Wang Xin, representative of the Physical Society of Hong Kong, also delivered speeches at the ceremony, sharing their visions for the future development of the physics community in the GBA.



Experts and scholars in the field of physics from home and abroad were invited to deliver master lectures at the conference: Ge Wei, Vice Rector of UM; Yang Wei, professor in the School of Aeronautics and Astronautics at Zhejiang University; Cheng Huiming, honorary dean of the Faculty of Materials Science and Engineering at the Shenzhen University of Advanced Technology; Zhao Gang, researcher at the National Astronomical Observatory of the Chinese Academy of Sciences; Hyoung Joon Choi, president of the Association of Asia Pacific Physical Societies; Zhang Baile, assistant chair of the School of Physical and Mathematical Sciences at Nanyang Technological University; Ou Zheyu, chair professor in the Department of Physics at the City University of Hong Kong; Pan Hui, associate director of IAPME at UM; and Xing Guichuan, professor at IAPME at UM.

In addition, the conference received a total of 211 submissions from Chinese and international experts and scholars, including 165 oral presentations and 46 posters. The presentations and posters covered eight frontier areas: 'Astrophysics and Astronomy', 'Atomic, Molecular, and Optical Physics', 'Biophysics and Soft Matter', 'Condensed Matter Physics', 'Interdisciplinary Physics', 'Materials Physics and Engineering', 'Scattering, Particle, Nuclear, and Plasma Physics' and 'Quantum and Statistical Physics', providing participants with a platform for in-depth exchanges and discussions and laying a solid foundation for future research collaboration.



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