Materials Horizons

EDITORIAL

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Two decades of materials research excellence at NIMTE: celebrating the 20th anniversary of Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences

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In celebration of the 20th anniversary of Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences (NIMTE, CAS), *Materials Horizons* has published this collection showcasing some of the recent and impactful research from the institute.

NIMTE, as a research institute affiliated to the CAS, was officially founded in April 2004. NIMTE aims to strengthen the cross-integration of materials science, as its main discipline, with other disciplines in chemistry, physics, information technology, medical engineering and mechanical engineering. NIMTE primarily pursues research conducting fundamental, forward-looking and world-leading developments in the field of materials science. This collection, including more than 40 research articles and reviews, features work previously and recently published in *Materials Horizons* from researchers based at the institute. We hope that the broad range of research showcased in the collection in the following fields: marine materials and related technologies, magnetic functional materials and devices, optoelectronic information materials and devices, polymers and composites, new energy materials and system technology, biomedical materials and technology *etc.*, will serve as an indicator of the impactful work being published at the NIMTE.

The Marine Materials and Related Technologies section focuses on significant scientific challenges involving the interaction between complex marine environments and materials, aiming to

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Zhiyi Lu

Zhiyi Lu received his PhD in chemical engineering and technology from the Beijing University of Chemical Technology (BUCT) in 2015. Afterward, he joined Stanford University as a postdoctoral fellow. Currently, he is a professor at Ningbo Institute of Materials Technology and Engineering (NIMTE), Chinese Academy of Sciences (CAS). His research interest is mainly focused on the multi-scale surface interface regulation of low-cost electrocatalytic electrodes.

Tao Chen

Tao Chen (Fellow of the Royal Society of Chemistry, FRSC) received his PhD from Zhejiang University in 2006. After his postdoctoral training at the University of Warwick (UK), he joined Duke University (USA) as a research scientist. He then moved to Technische Universität Dresden (Germany) as an Alexander von Humboldt research fellow. Since 2012, he has been a full-time professor at the Ningbo Institute of Materials Technology and Engineering (NIMTE), Chinese Academy of Sciences (CAS). His research interests include smart polymeric materials in marine biomimetics, soft robots, camouflage and anti-counterfeiting, energy management etc.

develop innovative methods and transformative technologies for marine key materials, supporting strategic initiatives in the South China Sea, deep sea, and polar regions. For example, Wang's group presents a ''sandwich-like'' MoS_2/Ag/WC nanomultilayer film with enhanced environmental adaptability through self-repair *via* Ag nanoparticle diffusion. This structure significantly improves corrosion resistance and reduces wear, maintaining low friction even after extended exposure to harsh environments (**https://doi.org/10.1039/D4MH00867G**).

The Magnetic Functional Materials and Devices section is committed to conducting applied basic research and high-tech development of novel magnetic materials and devices. It aims to solve key scientific challenges in the application of magnetic materials and devices, creating a balanced discipline layout that emphasizes both exploratory research and applied studies, as well as integrating basic research with technology development. Li's group discusses the construction of atomic point contact (APC) structures enabled by nanoionics technology and their quantum conductance effects, highlighting fabrication methods, modulation under external fields, and potential applications in information technology. It also addresses the advantages of electric field-driven approaches and future prospects for miniaturized and multifunctional devices (**https://doi.org/10.1039/D4MH00916A**).

The Optoelectronic Information Materials and Devices section focuses on application-driven research; the laboratory emphasizes refining and solving fundamental scientific problems, aiming to make breakthroughs in key technologies of core materials and devices for photovoltaics, displays, and semiconductors. We highlight the research from Ge's group which explores the use of acylhydrazone-bonded waterborne polyurethane (Ab-WPU) as a dynamic covalent polymer to enhance the stability and self-healing capability of perovskite solar cells (PSCs). By improving mechanical and thermal properties, the Ab-WPU modification increases power conversion efficiency and facilitates self-repair of flexible devices, enabling significant recovery of efficiency after stress-induced damage (**https://doi.org/10.1039/D3MH01293J**).

The Polymers and Composites section is primarily engaged in basic research, applied basic research, engineering application research, and technology development in the design, synthesis, processing, and modification of polymers and their composites; it aims to solve technical challenges faced by enterprises, conduct research and exploration of new technologies and processes in polymer materials with significant application prospects and strategic importance, and develop novel polymer materials and products. For example, Chen's group introduces a dynamic metal–ligand coordinated hydrogel that allows for rewritable dual-mode pattern display, combining structural and fluorescent color changes. The system uses pDGI for a rigid lamellar structure and a PAAm/PAAc network with carbon dots, which, upon coordination with Al^{3+} ions, allows for erasable information display through EDTA treatment, opening pathways for secure and interactive information technologies (**https://doi.org/10.1039/D4MH00996G**).

The New Energy Materials and System Technology section focuses on the rapid, sustainable development of advanced materials essential for energy carrier generation, conversion, storage, and transport. The objective is to gain insights into the fundamental properties and processes involved in creating and utilizing complex materials, ultimately contributing to the building blocks of a sustainable energy system. Lu's group presents a novel sulfur-doped $CoSe_2$ nanowire designed for the electrochemical reduction of nitrate to ammonia. Sulfur doping regulates both the electronic and microstructural properties of $CoSe_2$, transforming it from a 2D to a 1D morphology and enhancing the activity and selectivity of nitrate reduction. The S-$CoSe_2$ NWs achieved a peak faradaic efficiency of 93.1% and a high NH_3 yield rate, demonstrating significant promise for ammonia production and environmental remediation applications (**https://doi.org/10.1039/D4MH00593G**).

The Biomedical Materials and Technology section focuses on the interaction mechanisms and performance regulation between biomedical diagnostic and therapeutic materials and biological systems; it aims to make breakthroughs in key materials, technologies, and equipment for precision diagnosis and therapy. For example, Wu's group summarizes strategies for utilizing covalent organic frameworks (COFs) as host materials for the integration and delivery of various bioactives, including drugs, proteins, nucleic acids, and exosomes. COF properties, such as large surface area, tunable porosity, and diverse active sites, make them excellent candidates for applications in tumor therapy, central nervous system modulation, biomarker analysis, bioimaging, and antibacterial therapy. Three primary synthetic strategies are discussed: encapsulation, covalent binding, and coordination bonding, along with their biomedical applications (**https://doi.org/10.1039/D3MH01492D**).

Liping Wang

Liping Wang received his PhD from Lanzhou Institute of Chemical Physics (LICP), Chinese Academy of Sciences, in 2007. Since 2015, he has been a full-time professor at Ningbo Institute of Materials Technology and Engineering (NIMTE), Chinese Academy of Sciences (CAS). Currently, he is the president of NIMTE, CAS. His research areas cover the creation of new materials such as DLC and graphene, degradation and protection coatings under marine, nuclear, as well as aeronautics environments.

The guest editors are excited and honored to present this carefully curated collection of research papers, showcasing a wide range of multidisciplinary materials research with a significant cross-section at NIMTE. We thank all the contributing authors for their invaluable contributions to this collection. We trust that the readers of *Materials Horizons* will find this collection both enjoyable and enlightening, gaining insight into the forefront of NIMTE contributions to fundamental and applied materials science. We are optimistic that this collection will spark further fruitful interdisciplinary and international collaborations, strengthening NIMTE's position. NIMTE is also looking forward to the next 20 years and will strive to become a cradle of original innovation and integrated innovation of key technologies in the new materials field, growing into a world-class scientific research institution.