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NIMTE's rising young scientists: celebrating 20 years of Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences

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In celebration of the 20th anniversary of the Ningbo Institute of Materials Technology and Engineering (NIMTE), Chinese Academy of Sciences (CAS), *Materials Horizons* has launched a collection that showcases the institute's rich history of innovation and scientific progress. The collection brings together a wide range of cutting-edge research, highlighting the multidisciplinary approach that has become a hallmark of NIMTE's work over the past two decades. This collection of articles spans several areas of materials science, from fundamental advancements in materials synthesis to transformative applications in fields such as renewable energy, environmental sustainability, and electronic devices. The featured papers emphasize NIMTE's commitment to tackling some of the most pressing global challenges through the development of novel materials and technologies.

Notably, the collection highlights the work of young scientists at NIMTE, many of whom are making significant contributions to their respective fields. These rising stars have already demonstrated their potential through pioneering research that is shaping the future of materials science. Their work is expected to play a key role in driving further advancements and influencing future trends in both academic and industrial sectors. By highlighting these dynamic researchers and their groundbreaking work, this collection not only celebrates NIMTE's remarkable achievements but also looks ahead to the continued evolution of materials science, which will undoubtedly be propelled by the creativity, collaboration, and excellence of the next generation of scientists.

In this article, we highlight the rising stars of NIMTE who have contributed their latest work to this celebratory collection.

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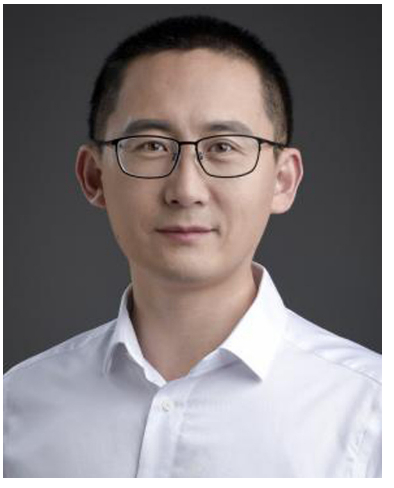
Rising young scientists



Yanwei Cao is currently a full professor at NIMTE, Chinese Academy of Sciences. He completed his PhD in condensed matter physics at the Institute of Physics, Chinese Academy of Sciences in 2013. From 2013–2017, he worked as a postdoc at the University of Arkansas and Rutgers University in the United States. His research interests focus on the interface science of transition-metal nitride and oxide films. He has previously developed a high-pressure magnetron sputtering epitaxy for the synthesis of wafer-scale single-crystalline films.

Compared to most superconductors being highly sensitive to environmental attacks, it is demonstrated that single-crystalline TiN (111) films show superior corrosion resistance to strong acid and alkaline attacks. The unexpected stability and durability of superconducting TiN films offer potential benefits for their wide applications (**https://doi.org/10.1039/d4mh00959b**).

Haiming Chen is an associate professor at NIMTE, Chinese Academy of Sciences. He received his PhD in polymer chemistry and physics from the Institute of Chemistry, Chinese Academy of Sciences in 2018. Then he moved to the National University of Singapore as a postdoctoral research fellow and joined NIMTE in 2021. His research interests focus on the construction of advanced functional polymeric materials and their structure–performance regulation, making efforts to achieve cutting-edge properties including self-healing, smart sensing and triboelectric nanogeneration.

Enhancing soft and long-range stretchable elastomers with exceptional strength, resilience, and ion-conductivity is crucial for high-performance flexible sensors. However, achieving this entails significant challenges due to intrinsic yet mutually exclusive structural factors. Haiming Chen designed a series of self-reinforcing ion-conductive elastomers (SRICE) to meet the advanced but challenging requirements. The unique combination of properties reported makes it suitable for advanced flexible applications, *e.g.* grid-free position recognition sensors (**https://doi.org/10.1039/d4mh01003e**).

Wen Dai earned his PhD from NIMTE in 2020. In 2020, he joined the research groups of Prof. Cheng-Te and Prof. Nan Jiang at NIMTE as a postdoctoral fellow. His research interests focus on the development of carbon-based thermal management materials for electronic packaging.

Wen Dai developed graphene clusters composed of tightly aligned and overlapping graphene sheets as fillers, integrating them with phase-change microcapsules and compression moulding techniques to create functional and user-friendly composites. These shape-configurable graphene composites exhibit exceptional thermal management performance, making them highly suitable for advanced energy applications such as high-power device cooling, photothermal power conversion, and thermal regulation in next-generation energy batteries (**https://doi.org/10.1039/d4mh00792a**).

Yajie Ding is an assistant researcher at NIMTE, Chinese Academy of Sciences. She focuses on the preparation and application of polymeric membranes for oil/water separation and organic solvent nanofiltration.

Establishing an efficient and sustainable membrane module is of great significance for practical oil/water emulsion separation. Yajie Ding constructed a hydrogel-mediated slippery surface on polytetrafluoroethylene (PTFE) hollow fibers and then designed a flexible and swing hollow fiber membrane module inspired by fish gill respiration, which achieved sustainable emulsion separation (**https://doi.org/10.1039/d4mh00946k**).

Meng Gao is a professor at NIMTE, Chinese Academy of Sciences. He received his PhD at the Institute of Physics, CAS in 2016. He moved to the University of Wisconsin-Madison as a postdoctoral research fellow from 2016 to 2021. In 2021, he entered NIMTE, CAS as a professor. His research interests include the high-throughput preparation, characterization and screening of novel metal materials, and the investigation of the intrinsic correlation between macroscopic properties and microstructure. He serves on the Young Editorial Boards of *Acta Metallurgica Sinica*, *Rare Metals* and *National Science Open*.

Metallic glass films, with their excellent electrical conductivity, low roughness, and large elastic limit, show strong potential as strain-sensing materials. Meng Gao introduced a high-throughput experimental framework for developing tough metallic glass films for strain-sensing applications (**https://doi.org/10.1039/d4mh00815d**).

Ben-Lin Hu earned his PhD in polymer chemistry and physics at the University of Chinese Academic Sciences, and then he worked at Nanyang Technological University and the Max-Planck Institute for Polymer Research as a postdoctoral researcher. Now he is a professor at NIMTE, Chinese Academy of Sciences. His current research interest is to develop elastic ferroelectric materials and devices. He has obtained 8 authorized Chinese patents and 1 European patent.

With the rapid growth of wearable electronics, the demand for elastic dielectric energy storage has become increasingly significant. Ben-Lin Hu presents a strain-insensitive, highly elastic relaxor ferroelectric material prepared *via* peroxide crosslinking of a poly(vinylidene fluoride) (PVDF)-based copolymer at low temperature (120 °C). It exhibits an intrinsic high dielectric constant (∼20 at 100 Hz) alongside remarkable thermal, chemical, and mechanical stability (**https://doi.org/10.1039/d4mh00998c**).

Xiaoxia Le received her PhD in polymer chemistry and physics from NIMTE, Chinese Academy of Sciences (2019). Currently, she is an associate professor at NIMTE. Her research focuses on the construction and functionalization of stimuli-responsive hydrogels for applications in the soft actuator and fluorescence information anti-counterfeiting fields.

Dual-mode information display in a single material is key to enhancing information capacity and security. However, existing systems lack re-encoding ability. Xiaoxia Le introduced dynamic metal–ligand coordination into a hydrogel-based optical platform for rewritable dual-mode display. The system combines a rigid poly(dodecylglyceryl itaconate) (pDGI) network with a soft poly(acrylamide)/poly(acrylic acid) (PAAm/PAAc) hydrogel network containing fluorescent carbon dots (CDs) (**https://doi.org/10.1039/d4mh00996g**).

Wei Li is an associate professor at NIMTE, Chinese Academy of Sciences. He received his PhD in polymer chemistry and physics from Dalian University of Technology in 2016, then moved to the South China University of Technology as a postdoctoral research fellow. In 2021, he joined the Ningbo Institute of Materials Technology and Engineering, Chinese Academy of Sciences, as an associate researcher of Spring Lei Talent. In 2023, he was selected for the "Leading Talent Recruitment Program" of the Chinese Academy of Sciences.

He confirmed that it is crucial for hot exciton emitters to attain a narrow energy gap ($\Delta E_{S_1\text{-}T_2}$) between the lowest singlet excited (S_1) state and second triplet excited (T_2) state, while ensuring that T_2 slightly exceeds S_1 in the energy level (**https://doi.org/10.1039/d4mh00441h**).

Kun Liang has been a professor at NIMTE, Chinese Academy of Sciences, since 2021. After receiving his PhD in materials science and technology from the University of Electronic Science and Technology of China in 2015, he moved to the University of Central Florida and Tulane University (USA) as a postdoctoral research fellow. His research interests focus on the structural editing of two-dimensional transition metal carbide and/or nitride materials, functional control and integration, with potential in energy storage, electrocatalysis, flexible devices, *etc.*

Kun Liang's review underscores the potential of MXenes in transforming electrocatalytic processes and highlights future research directions to optimize their catalytic efficiency and stability (**https://doi.org/10.1039/d4mh00845f**).

Jie Lin is a professor at NIMTE, Chinese Academy of Sciences. His research interests include semiconductor material SERS nanobiosensors, investigating the SERS chemical enhancement mechanism, establishing highly sensitive, highly specific, and highly stable semiconductor SERS nanobiosensors, and exploring the application of precise diagnosis of circulating tumor cells based on SERS nanobiosensors.

Jie Lin developed an innovative flower-like semiconductor-based diagnostic system combining a highly sensitive SERS bioprobe with an efficient microfluidic chip for rapid tumor cell enrichment and identification. This work highlights the innovative integration of high-performance SERS, microfluidics, and machine learning, offering a novel approach for the future of precise tumor diagnostics using SERS-based bioprobes (**https://doi.org/10.1039/d4mh00791c**).

Jingkai Liu is an assistant professor at NIMTE, Chinese Academy of Sciences. He received his PhD from Ningbo Institute of Materials Technology and Engineering, CAS, in 2022. His research interests mainly focus on sustainable thermosetting resins and its composite materials.

He designed a thermal-triggered crosslinking reaction to endow the polymeric phase-change composite with intrinsic flame retardancy, which was due to the formation of polybenzoxazine, while balancing thermal storage density (**https://doi.org/10.1039/d4mh00831f**).

Yiwei Liu is a full professor at NIMTE, Chinese Academy of Sciences. He received his PhD in materials physics and chemistry from the University of the Chinese Academy of Sciences in 2015. His research interests focus on the design and preparation of flexible sensitive materials, property control, sensor construction, and their applications in fields such as smart healthcare and humanoid robots.

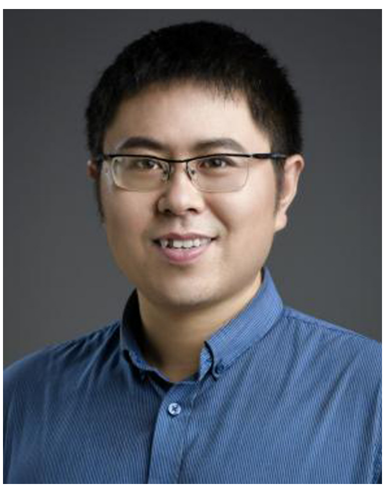
Yiwei Liu shows a novel flexible dual-modal temperature strain sensor for intelligent robots with a high temperature range, low detection limit, and good decoupling ability. This is achieved through the use of the "neutral surface" in the structural design to accurately isolate strain and temperature stimuli. This innovation provides a new method for the fabrication of flexible dual-modal sensors, highlighting its significant potential for application in the field of tactile perception in intelligent robots (**https://doi.org/10.1039/d4mh00841c**).

Ming Lou received his PhD in engineering materials from the University of Windsor in 2019. Then he joined NIMTE, Chinese Academy of Sciences as a postdoctoral researcher in 2020, and now he serves as an associate professor. His research focuses on the phase transitions of ceramic–metal composites and protective coatings in harsh environments.

He proposed a novel interface-engineering strategy consisting of the deliberate control of phase transformation direction and interface diffusion reaction based on a combination of thermodynamics and kinetics, and successfully attained self-organized surfaces and interfaces desired for components used under harsh conditions (**https://doi.org/10.1039/D4MH00698D**).

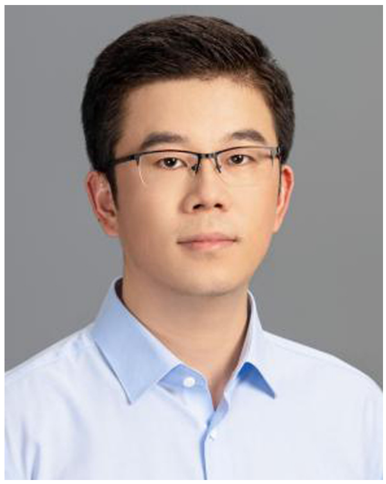
Zhiyi Lu received his PhD in chemical engineering and technology from the Beijing University of Chemical Technology (BUCT) in 2015. Afterward, he joined Stanford University as a postdoctoral fellow. Currently, he is a professor at NIMTE, Chinese Academy of Sciences. His research interest is mainly focused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

Zhiyi Lu proposed a viable strategy involving sulfur doping to modulate both the microstructure and electronic properties of $CoSe_2$ for nitrate reduction (**https://doi.org/10.1039/d4mh00593g**).



Wei Lu is a professor at NIMTE, Chinese Academy of Sciences. He received his PhD in polymer chemistry and physics from Zhejiang University in 2014. Soon afterwards he joined NIMTE and was promoted to professor in 2020. His research interests focus on dynamically crosslinked polymeric materials for sensing and actuating uses.

Inspired by the bioelectricity-controlled synergistic discoloration/deformation behaviour of chameleons to enable reversible and programmable information delivery to their coexisting organisms, Wei Lu developed novel electroheat/humidity-responsive polymeric gel actuators. This work represents an important advance towards the development of luminescent rewritable information display materials (**https://doi.org/10.1039/d4mh01172d**).



Siming Ren received his PhD from NIMTE, Chinese Academy of Sciences, in 2019. Then he joined the Key Laboratory of Advanced Marine Materials, Ningbo Institute of Materials Technology and Engineering, CAS. His current position is as an associate professor in the laboratory. His current research focuses on functional protective coatings in extreme environments.

Robustness and environmental adaptability are crucial for molybdenum disulfide (MoS_2) films to minimize friction and wear in industrial applications. Siming Ren presented a sandwich-like nanomultilayer architecture comprising alternating MoS_2 and tungsten carbide (WC) layers integrated with Ag nanoparticles. This study offers a general route for designing MoS_2-based materials toward long-lifetime and environmental adaptability *via* self-repair mechanisms (**https://doi.org/10.1039/d4mh00867g**).

Gang Wang is an associate professor at NIMTE, Chinese Academy of Sciences. He is also a Marie Curie Research Fellow. He received his PhD in applied chemistry from Shanghai Jiao Tong University in 2016. In 2019, he moved to the UK as a Marie Curie Research Fellow at the University of Bristol, for two years. His research interests focus on bionic functional materials and surfaces. The research scope covers bioinspired superwetting surfaces, bionic drag reduction materials, antifouling and self-cleaning coating, and heat conduction and dissipation materials.

Gang Wang reviewed the scientific advancements of GPNs in thermal management from microscopic and macroscopic perspectives. The insights presented in this review aim to equip researchers with a thorough understanding of recent advancements in GPNs for thermal management and serve as a guide for creating the next generation of thermally conductive polymer composites (**https://doi.org/10.1039/d4mh00846d**).

Rong Wang is a professor at NIMTE, Chinese Academy of Sciences. He received his PhD in chemical and biomolecular engineering from the National University of Singapore in 2015, and then worked as a research engineer/R&D manager at ACI Medical Pte. Ltd (Singapore) from 2015 to 2017. He joined NIMTE CAS in 2018. His research interests focus on biomedical polymeric materials, including tissue engineering and biofunctional hydrogels.

Taking advantage of the strong dissociation capability of phytic acids (PA) even in extremely acidic conditions, Rong Wang developed a feasible hemostatic powder (HP powder) by ionic assembly of *N*-[(2-hydroxy-3-trimethylammonium)propyl]chitosan chloride (HTCC) and PA. The HP powder showed fast gelation capability, appropriate adhesion, high blood adsorption, and strong acid resistance (**https://doi.org/10.1039/d4mh00837e**).

Zhenyu Wang is a professor at NIMTE, Chinese Academy of Sciences. He received his PhD in material processing engineering from NIMTE in 2017, and then worked as a postdoc at NIMTE. His research interests focus on the design and fabrication of MAX phase and nitrogen-based hard coatings, multi-factor coupled corrosion damage mechanisms, and the exploration of their applications in marine, nuclear, and aerospace fields.

$M_{n+1}AX_n$ (MAX) phases are a novel class of materials with a closely packed hexagonal structure that bridge the gap between metals and ceramics, garnering tremendous research interest worldwide in recent years. Zhenyu Wang provides a comprehensive review of the significant advancements in MAX-phase protective coatings, focusing on composition and structural design, controlled fabrication, and their performance in oxidation resistance, corrosion resistance, mechanical protection, and novel functional applications. The review aims to offer theoretical guidance and innovative approaches for the preparation of high-performance MAX-phase coatings (**https://doi.org/10.1039/D4MH01001A**).

Junjie Wei is an associate professor at NIMTE, Chinese Academy of Sciences. He received his PhD in chemistry from Tongji University in 2020, he then moved to NIMTE as a postdoctoral research fellow. His research interests focus on the design strategies of functional conductive polymer gels, and their potential in wearable sensing and flexible energy storage, especially in underwater sensing applications in marine environments.

Junjie Wei reported a fully hydrophobic ionogel with long-term underwater adhesion and stability as a highly efficient wearable underwater sensor displaying excellent sensing performance, including high sensitivity, rapid responsiveness and superb durability. Of greater significance, the ionogel sensor showed tremendous potential in underwater sensing applications for communication, posture monitoring and marine biological research (**https://doi.org/10.1039/d1mh00998b**).

Peng Xiao received his PhD in 2017 from the University of Chinese Academy of Sciences. He is currently a professor at NIMTE, Chinese Academy of Sciences. His current research interests focus on the design of flexible and soft sensory materials and exploiting their applications in underwater sensors.

Peng Xiao proposed a self-supported membrane based on a Janus graphene/carbon sphere-elastomer composite to sensitively perceive airflow. An artificial smart spiderweb array system was delicately designed to efficiently distinguish the acting position and intensity of the applied airflow, enabling significant potential in the development of advanced soft electronics and smart biomimetic systems (**https://doi.org/10.1039/d2mh01482c**).

Boxin Xue received her PhD from the University of Science and Technology of China in 2020. Her research interests span across ion exchange membranes and related processes, polyelectrolyte synthesis methodology including polymerization and post-modification, and membrane application for energy-related technology including fuel cells, water electrolysis, aqueous flow batteries, *etc.*

Anion exchange membrane water electrolyzers (AEMWEs) suffer from low efficiency and durability, due to the unavailability of appropriate anion exchange membranes (AEM). A rigid ladder-like polyxanthene crosslinker was developed for the preparation of ultramicroporous crosslinked polyxanthene-poly(biphenyl piperidinium)-based AEMs. The crosslinked AEMs developed in this study showed significant potential for applications in AEMWEs fed with concentrated alkaline solutions (**https://doi.org/10.1039/d4mh00836g**).

Minglong Yan earned his PhD from Harbin Engineering University in 2020, and then joined the Key Laboratory of Advanced Marine Materials, NIMTE, Chinese Academy of Sciences. His research focuses on the development of marine functional materials, with a particular emphasis on their preparation, anti-biofouling characteristics, and the underlying mechanisms of interfacial adhesion.

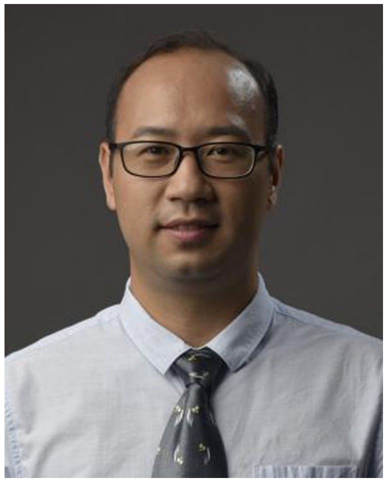
Minglong Yan demonstrated a new long-term anti-biofouling composite coating combining g-C_3N_4 nanosheet photocatalysts with degradable green poly-Schiff base resins, which integrates the dual functions of enhanced dynamic self-renewal and photocatalytic antibacterial activity (**https://doi.org/10.1039/d4mh00550c**).

Fang Yang is currently an associate professor as well as a member of the Youth Innovation Promotion Association of CAS, international members of the European Cooperation in Science and Technology (E-COST) and of the Action CA19118 ESSENCE program. He was a visiting professor at the Polytechnic University of Bucharest, Romania and a visiting associate professor at the University of Oslo, Norway. He is committed to the development of novel functional nanomaterials, their physical and chemical properties and biological applications, and based on the biological effects of nanomaterials, he has built a dynamic real-time quantitative detection and analysis system for cytotoxicity.

Fang Yang summarized the current advancements in NIR-II-activated photosensitizers and their applications in treating deep-seated tumors, and further explored the combination of photodynamic therapy with other therapies to address the limitations of photodynamic therapy and to enhance its efficiency (**https://doi.org/10.1039/d4mh00819g**).

Guangqiang Yin received his PhD from East China Normal University in 2019. He then joined NIMTE, Chinese Academy of Sciences, as a research scientist. His current research is focused on the design and construction of polymeric optical materials by dynamic assembly for applications in sensing and information encryption.

Guangqiang Yin highlighted the research advances in visible light-excited RTP materials from construction strategies and optical properties to underlying emission mechanisms and innovative applications. His review will provide an in-depth understanding of the underlying construction principles and emission mechanisms of visible-light-excited RTP, and promote the development of this highly exciting field (**https://doi.org/10.1039/d4mh00873a**).



Jinhong Yu is a professor at NIMTE, Chinese Academy of Sciences. His research interests focus on highly thermal conductive composites and semiconductor materials.

Jinhong Yu successfully accomplished the continuous preparation of large-sized, high-adhesion BN films. This pioneering feat not only contributes valuable technical insights for the development of high-performance insulating TIMs, but also establishes a solid foundation for widespread implementation in thermal management applications (**https://doi.org/10.1039/d4mh00626g**).

Qiang Zhang is a specially appointed young researcher at NIMTE, Chinese Academy of Sciences. His primary research focuses on the performance optimization of telluride-based thermoelectric materials and device integration.

Bismuth telluride (Bi_2Te_3)-based thermoelectric (TE) generators are effective for low-grade heat recovery. Qiang Zhang employs Ag and Ga co-doping from Ag_9GaTe_6 to enhance the ZT of p-type $Bi_{0.4}Sb_{1.6}Te_3$ (**https://doi.org/10.1039/d4mh00977k**).

Tao Zhang is a full professor and the head of the Interface-functional Polymer Materials research group at NIMTE. His scientific interests encompass the synthesis of novel 2D polymers, conjugated polymers, polymer brushes, along with their applications in photocatalysis, organic electronics, and marine technologies.

Tao Zhang shows the preparation of robust sp^2C-CPP based aerogels *via* surface-initiated aldol polycondensation. This work shows a strategy for the preparation of uniform and high stability sp^2C-CPP-based aerogels to simultaneously enhance their photothermal and photocatalytic performance (**https://doi.org/10.1039/d4mh01055h**).

