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HIT TIMES

HIT PRESIDENT HAN JIECAI ATTENDED THE GLOBAL UNIVERSITY PRESIDENTS' FORUM

HIT TIMES

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Contents

AWARDS & HONORS

Congratulations! IEEE Industrial Electronics Society IES | IEEE

PROFESSOR GAO HUIJUN WON THE DR.-ING. EUGENE MITTELMANN ACHIEVEMENT AWARD

In 2022, the Institute of Electrical and Electronics Engineers (IEEE) Industrial Electronics Society announced the winners of the Dr.-Ing. Eugene Mittelmann Achievement Award in Brussels, Belgium. Professor Gao Huijun from Harbin Institute of Technology won this award for his outstanding contributions to advanced control theory and industrial applications.

As the Industrial Electronics Society's major award, the Dr.-Ing. Eugene Mittelmann Achievement Award was established to recognize outstanding contributions to the field of industrial electronics in 1975. It may be given for a single major accomplishment or for a career of recognized achievements. The award is not necessarily given yearly: awarded only when suitable candidates can be identified.

Professor Gao Huijun received the Ph.D. degree in control science and engineering from Harbin Institute of Technology (HIT) in 2005. From 2005 to 2007, he carried out his postdoctoral research with the Department of Electrical and Computer Engineering, University of Alberta, Canada. Since November 2004, he has been with HIT, where he is currently a Chair Professor. He is the founder and the director of the Research Institute of Intelligent Control and Systems, HIT.

Professor Gao's research interests include intelligent and robust control, robotics, mechatronics, and their engineering applications. He has published more than 300 papers in international journals and has been authorized for over 100 patents of invention. He is also a highly-cited researcher since 2014.

Professor Gao is a member of Academia Europaea, an IEEE Fellow, a Vice-President of IEEE Industrial Electronics Society (IES), and a Council Member of IFAC. He was a Co-Editor-in-Chief of *IEEE Transactions on Industrial Electronics*. He is also the Editor-in-Chief Elect of *IEEE/ASME Transactions on Mechatronics*, and an Associate Editor of *Automatica*, *IEEE Transactions on Industrial Informatics*, *IEEE Transactions on Cybernetics*, *IEEE Transactions on Fuzzy Systems*, etc. He was a recipient of the IEEE IES J. David Irwin Early Career Award in 2013.■

PROFESSOR LI LONGQIU WON THE 17TH CHINA YOUTH SCIENCE AND TECHNOLOGY AWARD

Professor Li Longqiu from the School of Mechatronics Engineering at HIT won the 17th China Youth Science and Technology Award at the World Young Scientist Summit on November 12th, 2022, in Wenzhou, China. Professor Li has long been working on fundamental theories and practical applications of micro/nano structure design and device manufacturing. His research results have been applied in the fields of aerospace, energy extraction, and so on. He has led many research projects, including key projects of the National Natural Science Foundation of China's Regional Joint Fund, major national science and technology projects, and so on. He has published more than 100 academic

papers, obtained more than 80 authorized invention patents, and won four provincial and ministerial awards (including two first place prizes). He has also won the Heilongjiang Provincial Youth Science and Technology Award and has been selected into the National High-Level Talents Program. He serves as secretary general and council member of the Micro-Nano Actuator and Microsystem Branch of the Chinese Society of Micro-Nano Technology and as executive director of the Extreme Manufacturing Institution of Chinese Mechanical Engineering Society.

The China Youth Science and Technology Award was established in 1987. The award is presented to no more than 100 people bi-annually. The award was proposed by the older generation of scientists such as Qian Xuesen. It was jointly established and implemented by the Central Organization Department, the Ministry of Human Resources and Social Security, and the China Association for Science and Technology. It aims at rewarding young scientists who have made outstanding contributions to national economic development, social progress, and scientific and technological innovation.■

HIT TEAM WON THE CHAMPIONSHIP IN THE 13TH CHINA UNDERGRADUATE PHYSICS TOURNAMENT BECOMING THREE-PEAT CHAMPIONS

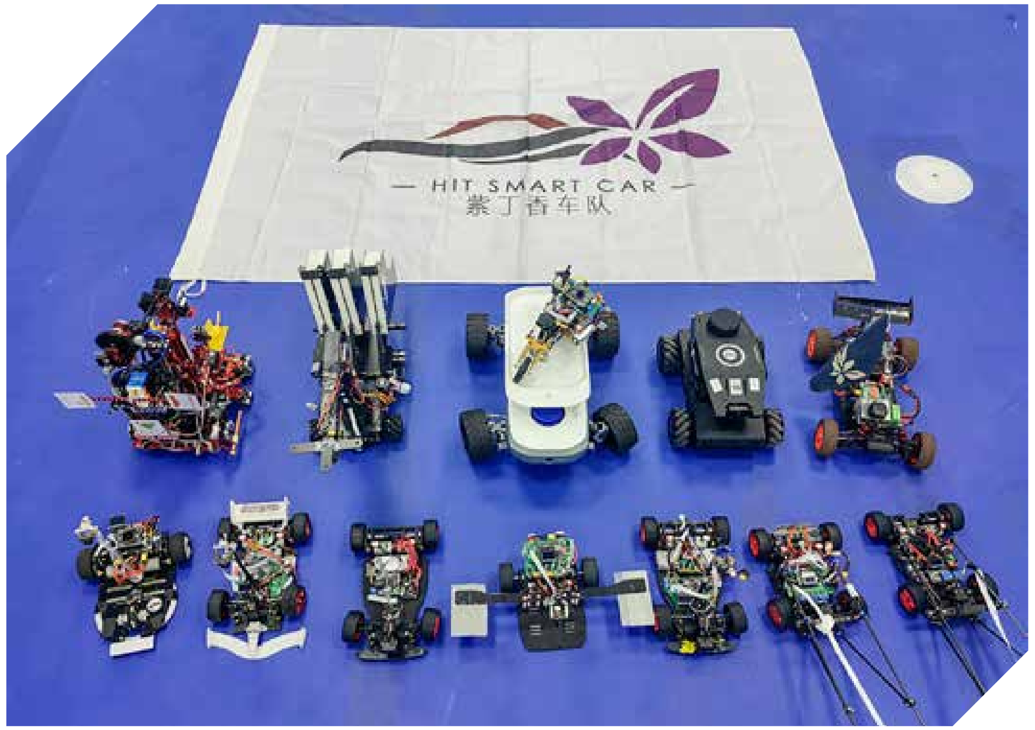
From October 3rd to 6th, the 13th China Undergraduate Physics Tournament (CUPT) was held online. The HIT team won one national grand prize (the championship), one first place prize and one second place prize. Since 2012, HIT has won the Grand Prize nine times and the championship seven times, becoming three-peat champions.

The 13th CUPT attracted 65 teams from 64 universities across the country. Our championship team was composed of Zhang Bohao, Chen Junrong, and Wen Zitao from the School of Physics, Song Bingrong and Jiang Zhizhen from the School of Astronautics, Lin Chengqian, from the School of Future Technology, and Xiao Fabo, Wu Kexun, and Xu Haopei from the School of Physics. The leading teachers are Professor Tian Hao, executive dean of the School of Physics, and

Professor Zhang Yu, deputy dean of the School of Physics. The guiding teachers are Professor Zhang Yu, Professor Wang Yuxiao, Professor Hou Chunfeng, Professor Lv Zhe, and Associate Professor Huang Li.

The CUPT is a national research discipline competition for university students based on the model of the International Young Physicists' Tournament (IYPT). The contestants conduct theoretical analysis and experimental research and discuss results of practical problems. It aims to improve the students' ability to comprehensively use their knowledge to analyze and solve practical physical problems, cultivate creative thinking, teamwork and communication, and expressiveness, so as to instill within students knowledge, sharpen their ability, and develop comprehensive capabilities.

HIT STUDENTS WON AWARDS IN SMART CAR RACE 2022



In 2022, HIT's team did well in the 17th Smart Car Race, winning ten national first place prizes (including one national championship, two national second place prizes, and two national third place prizes), nine second place prizes and four third place prizes.

The HIT-Lilac-No.10 Team, composed of Dong Xinyu and Wang Lurenhang, from the School of Electrical Engineering and Automation, Shen Wuxin, from the Faculty of Computing, and Chen Jiahui and Zhang Xu from the School of Astronautics, won the national championship in the full model group. The HIT-Lilac-No.5 Team, composed of Wang Chenyi, Han Jiajian, and Peng Hengyi from the School of Electrical Engineering and Automation, won second place in the balancing beacon group (online). The HIT-Lilac-No.3 Team, composed of Zhou Xubin and Yu Xinhang from the School of Astronautics, and Li Zikang from the School of Electrical Engineering and Automation, won second place in the four-wheel electromagnetic group (online).

The competition is an exploratory engineering practice for college students all over the country, advocated by the Ministry of Education. The concept of the competition is "based on training, focusing on participation, encouraging exploration, and pursuing excellence." It aims to promote quality education in colleges and universities, cultivate students' comprehension skills, knowledge application, and basic engineering skills, foster an innovative spirit, and stimulate an interest in scientific research and exploration.

RESEARCH & ACADEMIA

3D PRINTED BIOINSPIRED STENTS WITH PHOTOTHERMAL EFFECTS FOR MALIGNANT COLORECTAL OBSTRUCTION

Colorectal cancer is the third most common cancer worldwide. Approximately 7%-29% of patients with colorectal cancer suffer from acute colorectal obstruction, a life-threatening condition requiring urgent decompression. If not treated effectively, the mortality rate can be as high as 80% to 90% within five years. Stent placement is an effective palliation therapy for malignant colorectal obstruction. However, recurrent obstruction is a common and severe complication caused by tumor ingrowth in the stent lumen. Conventional covered stents play a part in preventing the tumor from growing inward but at the expense of significantly increasing the risk of stent migration. Therefore, there is an urgent demand to develop stents with sustained antitumor and antimigration abilities.

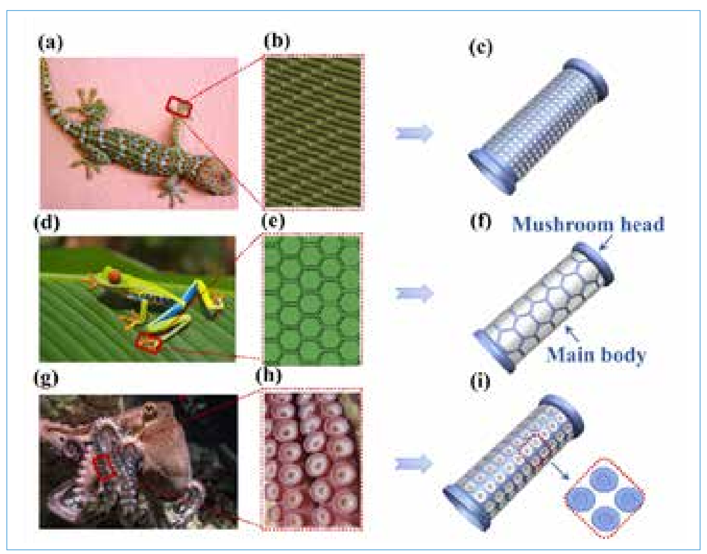


Figure 1 Design of bioinspired colorectal stents: (a) Gecko (b) Schematic illustration of gecko foot setae (c) Gecko-inspired colorectal stent (d) Tree frog (e) Schematic illustration of the hexagonal microstructure of the tree frog toe pad (f) Tree frog-inspired colorectal stent (g) Octopus (h) Image of the octopus sucker (i) Octopus-inspired colorectal stent

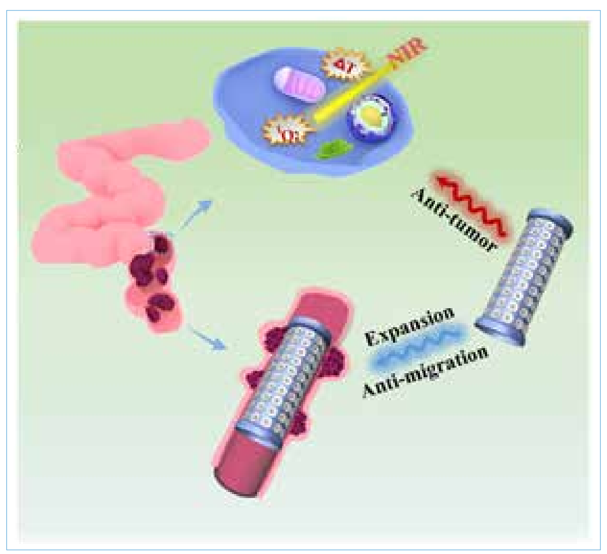


Figure 2 Multifunctional bioinspired stents for malignant colorectal obstruction

Professor Leng Jinsong's team, from the Centre for Composite Materials and Structures, the School of Astronautics, proposed a simple and effective strategy to successfully integrate anti-tumor, anti-migration, and drug-loading capabilities into a single 3D printed bioinspired colorectal stent. Inspired by high-adhesion biological structures (gecko feet, tree frog toe pads, and octopus suckers) in nature, different types of bioinspired colorectal stents were designed to reduce migration. After functionalization with graphene oxide (GO), bioinspired colorectal stents showed excellent and controllable photothermal performance, which was validated by effective ablation of colon cancer cells in vitro and tumors in vivo. Besides, the bioinspired colorectal stents demonstrated the feasibility of transanal placement and opening of the obstructed colon.

The advancement of this work lied in:

01 The functionalized non-mesh bioinspired stent minimized the risk of tumor growth into the lumen of the stent. It not only physically prevented tumor inward growth but also ensured complete ablation of the tumor through prominent photothermal performance.

02 The stent with bioinspired surface microstructures greatly improved the anti-migration force of the stent and reduced the probability of stent migration. The anti-migration force of the bioinspired stent was increased by up to 470% compared to the stent without surface microstructure. Braided mesh stents in previous works increased the risk of tumor growth in the lumen of the stent and increased the tendency for re-obstruction, which may require a second operation.

03 In addition, compared with the traditional braiding method, the bioinspired stent was prepared by additive manufacturing, which allowed for the customization of the stent and the implementation of precision medicine, thus avoiding tissue wear and other complications caused by the mismatch.

It is worth noting that the manufacturing process of the multifunctional bioinspired colorectal stents does not involve any complex reaction fluid, which is attractive for large-scale production of clinical applications. In addition, the design and preparation approach of stents is in line with the zeitgeist of personalized medicine and is expected to show broad application potential.

REFERENCE

Cheng Lin, Zhipeng Huang, Qinglong Wang, Wantao Wang, Wenbo Wang, Zhen Wang, Liwu Liu, Yanju Liu, Jinsong Leng. 3D printed bioinspired stents with photothermal effects for malignant colorectal obstruction. Research, 2022, 9825656. DOI: 10.34133/2022/9825656

4D PRINTED ORBITAL STENT FOR THE TREATMENT OF ENOPHTHALMIC INVAGINATION

Professor Leng Jinsong's group from the Centre for Composite Materials and Structures published a research paper titled "4D Printed Orbital Stent for the Treatment of Enophthalmic Invagination" in *Biomaterials*. This paper reported a 4D printed orbital stent based on a CT-developed shape memory composite, bionic design idea, and CT reconstruction technology, which met the urgent needs of minimally invasive implantation and personalized treatment for enophthalmos.

Enophthalmos refers to a phenomenon in which a normal-sized globe shows relative posterior displacement in relation to the bony orbital margin. Commercial implants used for treating enophthalmos have some disadvantages, such as difficult precision and shape, weak filling volume ability, large surgical wounds, and insufficient CT imaging. In this work, a multifunctional AuNPs/nHA/PU (AHP) composite with transition temperature close to body temperature and good CT-development was prepared by introducing gold nanoparticles (AuNPs) and nano-hydroxyapatite (nHA) into the shape memory polyurethane (PU) matrix. Inspired by some natural structures with excellent mechanical properties, the bionic honeycomb structure was introduced into the design of the orbital stent. Combined with CT reconstruction technology, a personalized 4D printed orbital stent model with an outer contour matching with the orbital defect was established. Subsequently, the 4D printed orbital stent was fabricated by direct writing bio-printing of AHP composite melt, which had sufficient mechanical

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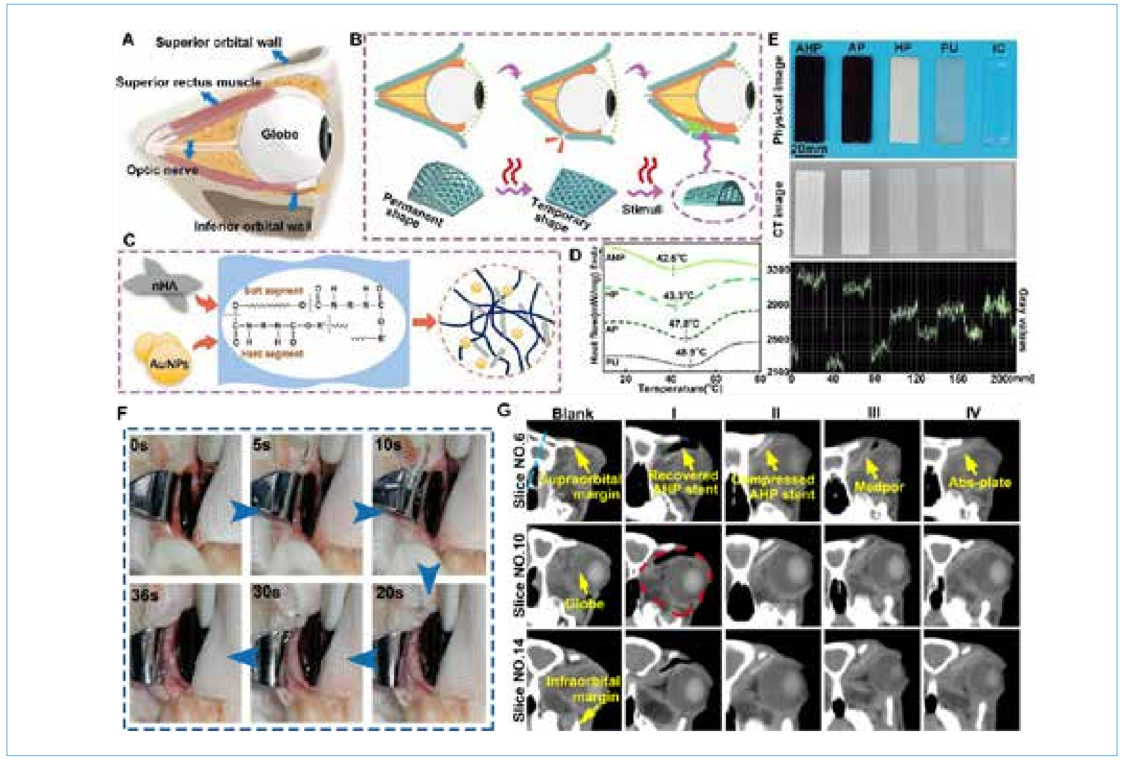

(A)Schematic illustration of the ocular region (B) Schematic illustration of the orbital stents before and after implantation for the treatment of enophthalmos (C) Schematic diagram of preparing the AHP composite (D) The DSC curves of AHP, AP, HP, and PU (E) Real photos, CT images, and gray value atlas of AHP, AP, HP, PU, and iohexol developer (F) Shape recovery process of the AHP stent under the stimulation of saline solution (44℃) in the orbit of the rabbit (G) CT slices of the intraorbital area without implant, after implantation with the recovered AHP stent, the compressed AHP stent, Medpor and Abs-plate

properties to support the orbital tissue according to compressive test and creep behavior simulation.

The 4D printed orbital stent with a flat temporary shape can be easily implanted into the orbit, and expanded and fitted to the orbital defect within 36 s after rinsing with normal saline at 44℃. Postoperative CT images clearly showed that the expanded 4D printed orbital stent provided 150% more volume filling than the commercial Medpor and Abs-plate with implants of the same shape, size, and volume. The three-month follow-up showed that the orbital tissue grew well into the stent, indicating that the 4D printed orbital stent met the urgent needs of minimally invasive implantation, visual therapy and personalized treatment of enophthalmic invagination.

REFERENCE

Yongdie Deng, Binbin Yang, Fenghua Zhang, Yanju Liu, Jingbo Sun, Shiqi Zhang, Yutong Zhao, Huiping Yuan, Jinsong Leng. 4D printed orbital stent for the treatment of enophthalmic invagination. Biomaterials, 2022, volume 291, 121886. DOI: https://doi.org/10.1016/j.biomaterials.2022.121886

CERAMIC AEROGEL THERMAL SUPERINSULATING MATERIALS

Recently, Professor Li Hui and Professor Xu Xiang from the School of Civil Engineering published a research paper titled "Hypocrystalline Ceramic Aerogels for Thermal Insulation at Extreme Conditions" in *Nature*. Professor Li Hui, Professor Xu Xiang and Professor Duan Xiangfeng (UCLA) were the co-corresponding authors. Doctor Guo Jingran, Fu Shubin and Deng Yuanpeng were the co-first authors. HIT was the first and corresponding affiliation.

Thermal control under extreme conditions, such as complex mechanical loadings and large thermal gradients in deep-space and deep-earth environments, requires reliable structural stability and exceptional insulating capability. However, the unusual combination of mechanical flexibility, high thermal stability, and low thermal conductivity across a wide temperature range exhibit intrinsic trade-offs with each other for most ceramic aerogels. For example, the amorphous toughening ceramics are usually causing crystallization and pulverization at high temperatures; the low thermal expansion effect is limited by structural geometry and mechanical properties, sacrificing high-temperature thermal insulating performance while retaining robust thermomechanical stability, etc.

The researchers reported a multiscale design and synthesis of hypocrystalline zircon nanofibrous aerogels with a zig-zag architecture to realize near-zero Poisson's ratio (3.3×10^{-4}) and near-zero thermal expansion coefficient (1.2×10^{-7}/℃) for superior thermomechanical properties. The three-dimensional ceramic aerogel matrix was first fabricated by electrospinning with the assistance of air turbulent flow. This turbulent field could overcome the electrical orientation effect and move the resulting nanofibres in a complex trajectory to entangle with each other and form a randomly twined fibrous aerogel structure. Then, using a secondary sintering treatment could further crosslink the building blocks to produce the large-scale, low-cost, and high-performance hypocrystalline ceramic aerogels.

The designed aerogels display an exceptional thermomechanical stability with mechanical flexibility of up to 95% compressive strain, > 40% fracture strain, > 90% bending strain, and a high thermal stability with ultralow strength degradation < 1% after sharp thermal shocks (200℃ per second), a high working temperature up to 1300℃. By deliberately entrapping residue carbon species in the constituent hypocrystalline zircon fibres, the authors substantially reduce the thermal radiation heat transfer and achieve one of the lowest high-temperature thermal conductivities among ceramic aerogels so far—104 mW/m·K at 1000℃. The combined thermomechanical and thermal insulating properties offer an attractive material system for robust thermal insulation under extreme conditions. In addition, the aerogels exhibit a low permittivity relative to air of about only 1.437 and can be used for

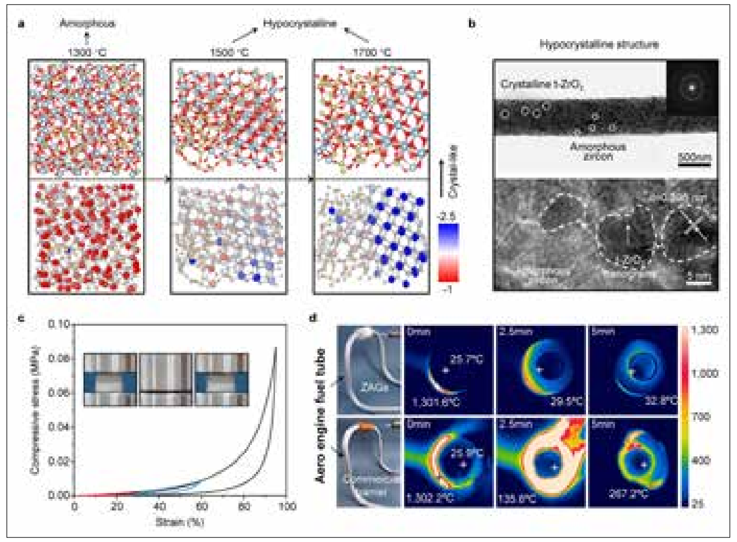

Diagram of the hypocrystalline ceramic aerogels for their structure, superelasticity and high-temperature thermal insulation properties

a capacitive strain sensor for condition monitoring. Moreover, the double-near-zero-index aerogels also provide opportunities for thermal management of strain-sensitive electronic devices, optical devices, and superconductive devices.

This research is an extension work of "Double-Negative-Index Ceramic Aerogels for Thermal Superinsulation" published in *Science* (2019, 363, 723-727) and supported by the Creative Research Groups of National Natural Science Foundation of China, the Heilongjiang Touyan Innovation Team Program of China and the National Natural Science Foundation of China.

REFERENCE

Jingran Guo, Shubin Fu, Yuanpeng Deng, Xiang Xu, et al. Hypocrystalline ceramic aerogels for thermal insulation at extreme conditions. Nature, 2022, 606, 909-916.

Research & Academia
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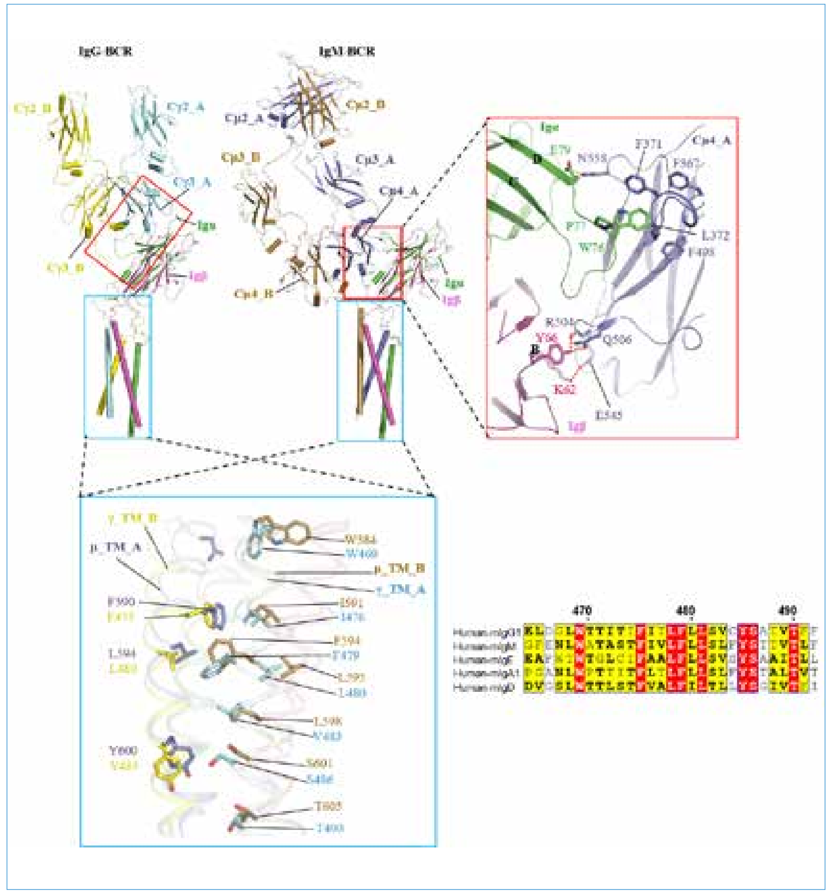
Cryo-EM STRUCTURES OF TWO HUMAN B CELL RECEPTOR ISOTYPES

A group led by Professor Huang Zhiwei published a paper titled "Cryo-EM Structures of Two Human B Cell Receptor Isotypes" in *Science*, revealing the assembling and recognition mechanism of BCR complex subunits, and found the assembling pattern of different subtypes of BCR was conserved in the membrane but different in the exocytosis.

Human adaptive immune cells (T cells and B cells) play a key role in pathogenic infections, carcinogenesis, and autoimmune diseases. T and B cells recognize antigenic signals through T cell receptor (TCR) and B cell receptor (BCR), respectively, and transmit the signals across the membrane into the cell to activate the immune response of T and B cells. T and B cell receptors belong to a class of the most complex cell receptors composed of multiple proteins, which play a crucial role in the development, differentiation and function of T and B cells. The complex signal transduction, structural basis, and molecular mechanism of immune activation of TCR and BCR have always been an important basic scientific problem in immunology.

There are five subtypes of human B-cell receptors. In this study, the group analyzed the structure of two BCR complexes which are human IgG and IgM. The BCR complex contains a membrane-bound form of immunoglobulin (mIg) homodimer, which is used to recognize antigens, and a membrane-bound form of Igα/β (CD79α/CD79β) heterodimer for signaling (stoichiometric ratio 1:1). Among them, the mIg dimer contains Fab and Fc domains, connecting peptide (CPs) and TM helices, and the Igα/β structure consists of two extracellular Ig-like domains, CPs and TM helices. The assembly of BCR complex is carried out by extracellular mIg homodimer (IgG-Cγ3 and IgM-Cμ4, respectively), Ig-like domains of Igα/β, connecting peptides and transmembrane helices. Through structural comparison of the two isoforms, the group found that the transmembrane helical regions of mIgG and mIgM bind to Igα/β through conserved hydrophobic and polar interactions. In contrast with the extracellular assembly of Ig-like domains of Igα/β with IgG-Cγ3 through the head-to-tail mode, IgM-Cμ4 forms side-to-side contacts with the Ig-like domains of Igα/β. The CD loop of Igα swings about 90° to contact IgG-Cγ3 and IgM-Cμ4. Whether the structurally observed different isoform assembly patterns are related to activity warrants further investigation.

Secretory IgM usually forms pentamers, but only the monomeric state of IgM is observed on the membrane-bound BCR in resting state. The Ig-like domain of Igα and membrane-bound IgM-Cμ4 completely coincide, which explains the monomeric state of membrane-bound IgM-BCR. The activation of BCR is usually accompanied by the clustering of BCR. In the resting state, the Ig-like domain of Igα/β binds to Cμ4 or Cγ3, which sterically blocks mIg oligomerization, while the binding of antigen


Structure comparison of human IgG-BCR and IgM-BCR complex

may exert mechanical force on the Fab domain to trigger structural changes of mIg_Fc, thereby releasing the clustering interface of Cγ3 or Cμ4 shaded by Igα/β, leading to IgM-BCR clustering and signaling. The underlying mechanism needs to be further investigated. Electron densitometric analysis clearly identified 6 and 14 glycosylation sites on IgG and IgM-BCR, respectively.

The data above not only resolves the long-standing mystery about the structure and assembly mechanism of BCR but also provides a key structural basis for understanding the molecular mechanism of BCR initiating immune response and developing immunotherapies targeting BCR for the treatment of related diseases.

The contemporary-published commentary article "Unveiling the B cell Receptor Structure - Molecular Structures Provide a Road Map for Understanding and Controlling B Cell Receptor Activation" in *Science* introduced the research results.

In recent years of studying of the structure and molecular mechanism of human immune cell receptors, the group first resolved the three-dimensional structure of human TCR complex by solving technical problems such as the dynamic complexity of TCR and BCR complex and revealed the subunit assembly and recognition mechanism of TCR complex (*Nature*, 2019). Through further analysis of the high-resolution TCR complex structure, the group found that there was a "cholesterol binding channel" in the transmembrane region of TCR (*Molecular Cell*, 2022). Cholesterol molecules bind to this channel to inhibit TCR activation, and the structural basis of TCR activation is revealed by removing cholesterol molecules to cause TCR constitutive activation. Thus, the "cholesterol - deadbolt" control theory of TCR is proposed, which provides a theoretical basis for rational design of immunotherapy targeting TCR to regulate T cell activity.

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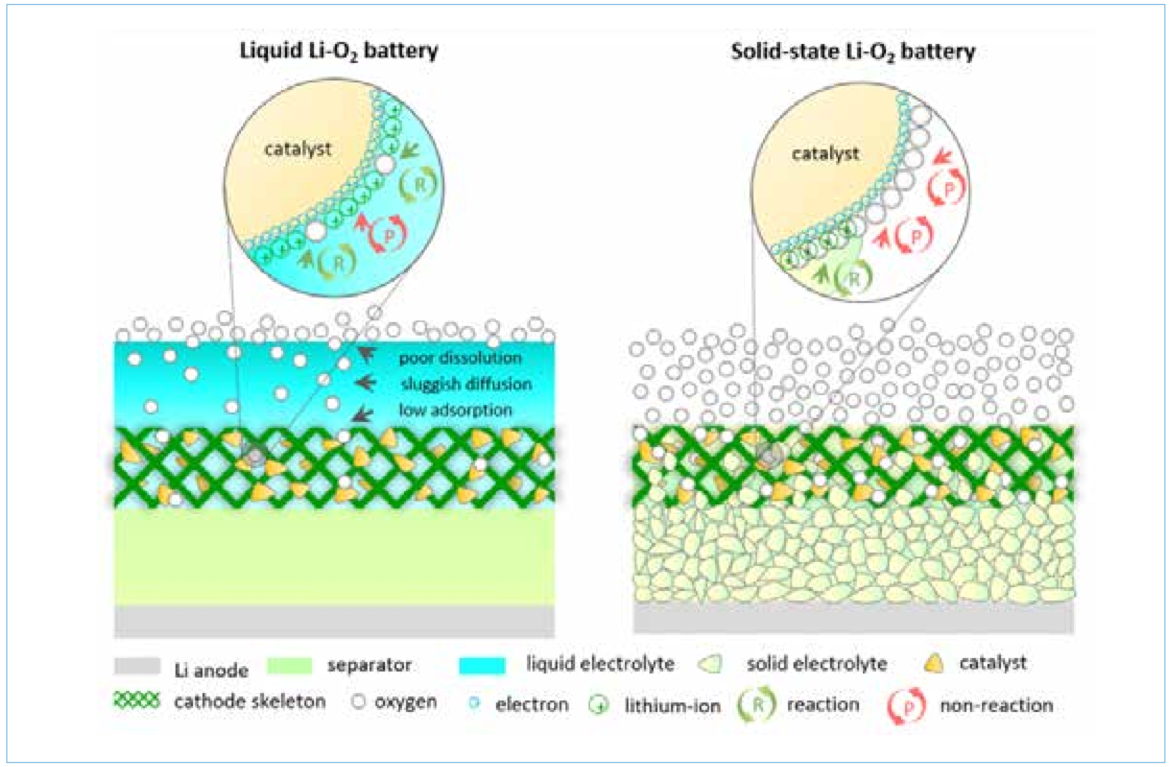
Xinyu Ma, Yuwei Zhu, De Dong, Yan Chen, Shubo Wang, Dehui Yang, Zhuo Ma, Anqi Zhang, Fan Zhang, Changyou Guo, Zhiwei Huang. Cryo-EM structures of two human B cell receptor isotypes. Science, 2022, 19;377(6608):880-885. DOI: 10.1126/science.abo3828

TAILORING ELECTRONIC-IONIC LOCAL ENVIRONMENT FOR SOLID-STATE Li-O_2 BATTERY BY ENGINEERING CRYSTAL STRUCTURE

Recently, a team led by Professor Wang Jiajun, from the School of Chemistry and Chemical Engineering, Harbin Institute of Technology, published a research paper titled "Tailoring Electronic-Ionic Local Environment for Solid-State Li-O_2 Battery by Engineering Crystal Structure" in *Science Advances*.

Solid-state Li-O_2 batteries (SSLOBs) have attracted considerable attention due to their high energy density and superior safety features. However, their sluggish kinetics have severely impeded their practical application. Despite efforts to design highly efficient catalysts, efficient oxygen reaction evolution at gas-solid interfaces and fast transport pathways in solid-state electrodes remain challenging. Here, a dual electronic-ionic microenvironment is utilized to significantly enhance oxygen electrolysis in



Liquid and solid-state Li-O_2 battery

solid-state batteries. By designing a lithium-decorative catalyst with an engineering crystal structure, the coordinatively unsaturated sites and high concentration of defects alleviate the limitations of electronic-ionic transport in solid interfaces and create a balanced gas-solid microenvironment for solid-state oxygen electrolysis. This strategy facilitates oxygen reduction reaction, mediates the transport of reaction species, and promotes the decomposition of the discharge products, contributing to a high specific capacity with a stable cycling life. This work provides new insight into structure-property relationships in solid-state electrolysis for SSLOBs.

Professor Wang Jiajun from HIT is the corresponding author. PhD strudent Sun Xue is the first-author. This work was financially supported by the National Natural Science Foundation of China.

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Xue Sun, Yajie Song, Qingsong Liu, Xueyan Zhang, Hanwen An, Nan Sun, Yifan Shi, Chuankai Fu, Hua Huo, Ying Xie, Yujin Tong, Fanpeng Kong, Jiajun Wang. Tailoring electronic-ionic local environment for solid-state Li-O_2 battery by engineering crystal structure. Science Advances, 2022, Sep 2;8(35):eabq6261. DOI: 10.1126/sciadv.abq6261

COMPETITIVE FAST-CHARGING VANADIUM FLUOROPHOSPHATE ELECTRODE FOR FUTURE SODIUM ION BATTERIES

Recently, Professor Wang Zhenbo and his team, from the School of Chemistry and Chemical Engineering, published a research article titled "Constructing Stable Anion-Tuned Electrode/Electrolyte Interphase on High-Voltage $Na_3V_2(PO_4)_2F_3$ Cathode for Thermally-Modulated Fast-Charging Batteries" in *Angewandte Chemie International Edition*.

Sodium ion battery technology is considered as the basis of the next generation large-scale energy storage system. In particular, vanadium-based polyanionic compounds are competitive potential electrode materials for sodium ion batteries because of their high working voltage and good structural stability. However, the high-voltage vanadium-based material decays rapidly under the high temperature environment, accompanied by severe gas production and

other security problems, which seriously limit the practical application of these candidate materials.

To improve the compatibility of the electrode and electrolyte, Professor Wang's team constructed more stable anion-tuned electrode/electrolyte interphase on the high-voltage vanadium-based electrode by making use of the electrolyte concentration effect to optimize the configuration of solvation structure and the properties of the derived electrode/electrolyte interphase. Molecular dynamics simulation confirmed the rationality of the modification strategy of integrating electrolyte solvation structure to adjust the composition and properties of electrode/electrolyte interphase. Through the high-resolution time-of-flight secondary ion mass spectrometry technology, it was found that the excessive anion derivatives in the electrode/electrolyte interphase were the key inducement for the instability and the deterioration of the electrochemical performance. Interestingly, it was revealed that the cycle stability and interfacial reaction kinetics of deteriorated vanadium-based cathode materials can be largely restored by decomposing the undesirable anion derivatives. In turn, restructuring the electrolyte solvation configuration would help to avoid the formation of such harmful contents and result in better performance.

Professor Wang received his Bachelor's degree (1998), Master's degree (2003) and Ph.D. degree (2006) from Harbin Institute of Technology. He has published more than 200 journal articles including *Nature Catalysis*, *Advanced Materials*, *Angewandte Chemie International Edition*, *Energy & Environmental Science*, *Advanced Functional Materials*, etc. His research interests include energy storage materials for battery applications and fuel cell catalysts, especially novel composite materials.

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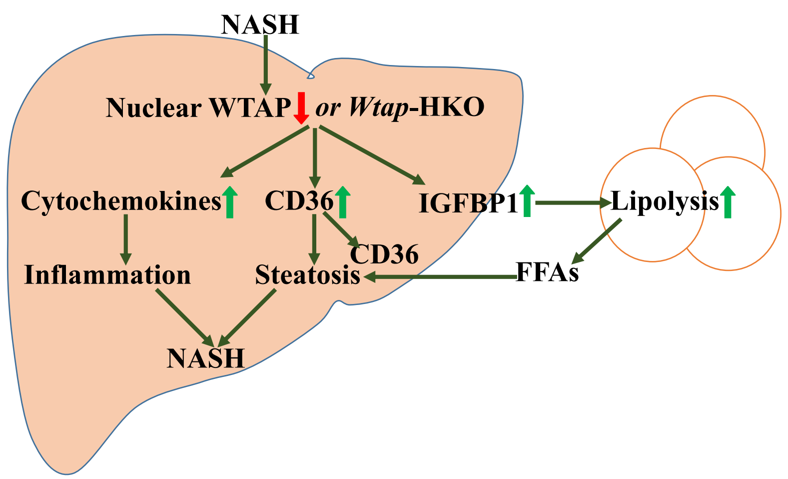
Liang Deng, Fu Da Yu, Gang Sun, Yang Xia, Yun Shan Jiang, Yin Qi Zheng, Mei Yan Sun, Lan Fang Que, Lei Zhao, Zhen Bo Wang. Constructing stable anion-tuned electrode/electrolyte interphase on high-voltage $Na_3V_2(PO_4)_2F_3$ cathode for thermally-modulated fast-charging batteries. Angewandte Chemie International Edition, 2022, e202213416. DOI: 10.1002/anie.202213416

MOLECULAR MECHANISMS OF ECTOPIC LIPID ACCUMULATION AND INFLAMMATION DURING NASH PROGRESSION

Dr. Chen Zheng's group from the HIT Center for Life Science (HCLS) reveals the molecular mechanisms of ectopic lipid accumulation and inflammation during NASH progression. The research group identified WTAP as a key integrative regulator of ectopic lipid accumulation and inflammation during pathogenesis of NASH. The research paper titled "Deficiency of WTAP in Hepatocytes Induces Lipoatrophy and Non-Alcoholic Steatohepatitis (NASH)" was recently published in *Nature Communications*.

Ectopic lipid accumulation and inflammation are the essential signs of NASH. However, the molecular mechanisms during NASH progression are not fully understood. In this study, Dr. Chen Zheng's group showed that hepatic Wilms' tumour 1-associating protein (WTAP) is a key integrative regulator of ectopic lipid accumulation and inflammation. Hepatic deletion of *Wtap* (*Wtap*-HKO) leads to NASH (steatosis, liver inflammation and injury, and fibrosis) at normal chow feeding condition. This is a very interesting phenotype. Further analysis shows that lipolysis-related



signaling pathway including p-HSL, HSL, p-PKA substrate and ATGL in epididymal white adipose tissue (eWAT) of *Wtap*-HKO mice is significantly upregulated, leading to elevated serum free fat acids (FFAs). Hepatic CD36, mediated FFAs uptake into the liver, is also upregulated, which contributes to steatosis in the liver. Hepatic deletion of *Wtap* also increases the expression of cytochemokines such as CCL2 both *in vivo* and *in vitro*, which leads to liver inflammation. Therefore, the increased lipolysis in white adipose tissue; enhanced hepatic FFAs uptake and induced inflammation lead to NASH in *Wtap*-HKO mice. The primary cause is the increased lipolysis in eWAT.

Next, Dr. Chen Zheng's group asked how liver affects lipolysis in eWAT. One possible reason is that hepatic deletion of *Wtap* may promote expression and secretion of secreted factors that further induce lipolysis in eWAT. To investigate which secreted proteins in the liver of *Wtap*-HKO mice promote lipolysis in eWAT, Dr. Chen Zheng analyzed the mouse secretome gene set between *Wtap*-HKO and *Wtap*$^{flox/flox}$ mice and found that IGFBP1, a liver-specific expressed and secreted protein, is dramatically upregulated in the liver, which mediates the induction of lipolysis. Interestingly, IGFBP1 is also elevated in human patients with NASH and MCD-induced NASH mouse model, which promotes lipolysis in eWAT. Neutralization of IGFBP1 by an anti-IGFBP1 antibody in *Wtap*-HKO mice largely ameliorates lipolysis in eWAT and NASH in liver. These data indicate that elevated IGFBP1 may be the primary cause for the increased lipolysis in the white adipose tissue and NASH.

Since increased expression of IGFBP1, CD36, and cytochemokines such as CCL2 promotes NASH progression, Dr. Chen Zheng's group next asked how WTAP regulates their expression. WTAP has been shown to interact with METTL3 in the nucleus and serves as a regulatory protein of m^{6}A methyltramsferase complex. MeRIP-seq analysis shows that deletion of either *Wtap* or *Mettl3* does not affect m^{6}A modification in *Igfbp1*, *Cd36* and *Ccl2* transcripts, indicating that WTAP regulates the expression of *Igfbp1*, *Cd36* or *Ccl2*, but it is unlikely due to an m^{6}A modification in their transcripts.

It has been reported that RNA binding proteins also regulate chromatin accessibility and gene transcription. Dr. Chen Zheng's group tested this hypothesis. Assay for transposase-accessible chromatin-sequencing (ATAC-seq) and ChIP-seq analysis showed that WTAP directly binds to the promoters and inhibits gene transcription. Motif analysis showed that the consensus of DNA binding motif is TGASTCA. The top five DNA binding motifs were related to transcription factors Jun-AP1, Fosl2, Fra2, JunB, and Fra1. Interestingly, these transcription factors were also associated with the significantly upregulated peak-related genes in *Wtap*-HKO mice by mapping the open chromatin using ATAC-seq. Promoter luciferase, ChIP-RT-qPCR, and Co-IP assays showed that WTAP binds to the promoters of *Igfbp1*, *Cd36* and *Ccl2* and inhibits their transcription depending on HDAC1. Recently, Dr. Chen Zheng's group reported that hepatic deletion of *Mettl3* promotes diet-induced NASH by increasing the transcription of *Cd36* and *Ccl2*, which is due to increased chromatin accessibility in the promoter regions of *Cd36* and *Ccl2* with the involvement of HDAC1/2. *Mettl3*-HKO mice do not show NASH phenotype under a normal chow feeding condition, which may be due to the normal IGFBP1 expression in *Mettl3*-HKO mice. In NASH, WTAP and METTL3 are translocated from nucleus to cytosol, which is related to CDK9-mediated phosphorylation. This data uncovers a mechanism by which hepatic WTAP regulates ectopic lipid accumulation and inflammation during NASH progression.

Postdoctoral fellow Li Xinzhi and PhD student Ding Kaixin performed most of the experiments. Other contributors include Li Xueying, Yuan Bingchuan, Wang Yuqin, Yao Zhicheng, Wang Shuaikang, Huang He, Xu Bolin, Xie Liwei, Deng Tuo, and Chen Xiao-Wei. This work was financially supported by the National Natural Science Foundation of China.■

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MECHANISM OF aGPCR ACTIVATION AND G-PROTEIN COUPLING SELECTIVITY

Recently, Dr. He Yuanzheng's group at the HIT Center for Life Science (HCLS) reported major progresses on the cryo-EM structures of adhesion G protein-coupled receptors (aGPCRs). The studies titled "Structural Insights into Adhesion GPCR ADGRL3 Activation and G_q, G_s, G_i, G_{12} Coupling" and "Structural Basis of Adhesion GPCR GPR110 Activation by Stalk Peptide and G-Proteins Coupling" were published in *Molecular Cell* and *Nature Communications*, respectively.

aGPCRs play crucial roles in the nervous, immune, and cardiovascular systems and are associated with various diseases. A hallmark of aGPCR activation is the removal of the inhibitory GAIN domain and the dipping of the cleaved stalk peptide into the ligand binding pocket of the receptor; however, the detailed mechanism remains obscure. Based on this, Dr. He Yuanzheng's group used the aGPCR latrophilin 3 (ADGRL3) and GPR110 as models to study the structure of aGPCRs. The studies revealed unique ligand engaging mode, distinctive activation conformation and key mechanism of aGPCR activation. In comparison of all 4 major G-protein couplings to the same receptor, the studies also unveiled the key determinant of G-protein coupling selectivity. Furthermore, the structural insights into G-protein coupling can be translated into biased agonism via designing mutants that selectively activate one pathway over others, which provides a rational basis for design biased agonists targeting the associated diseases. ■

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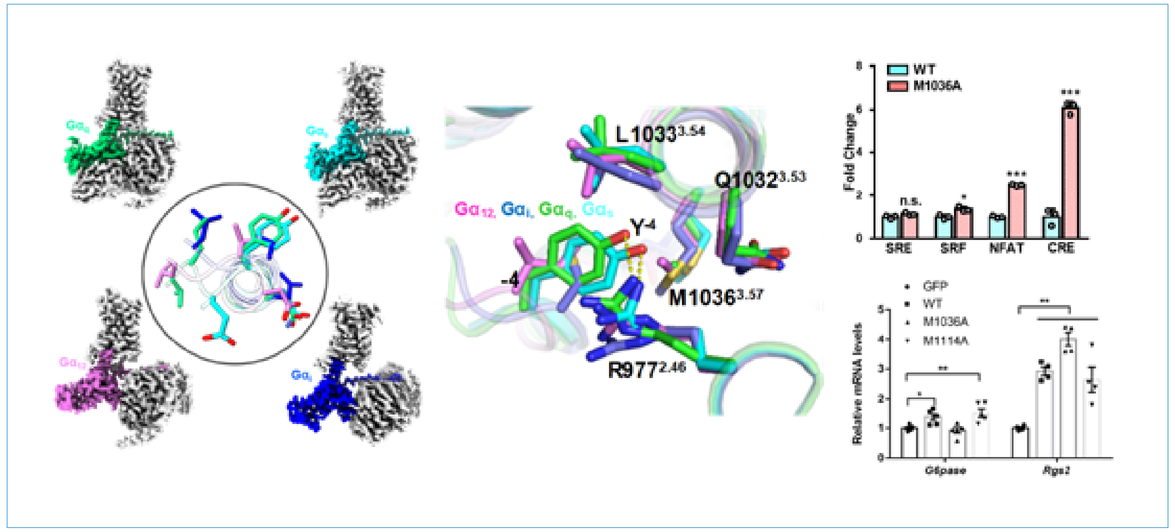

G-protein coupling selectivity mechanism of ADGRL3

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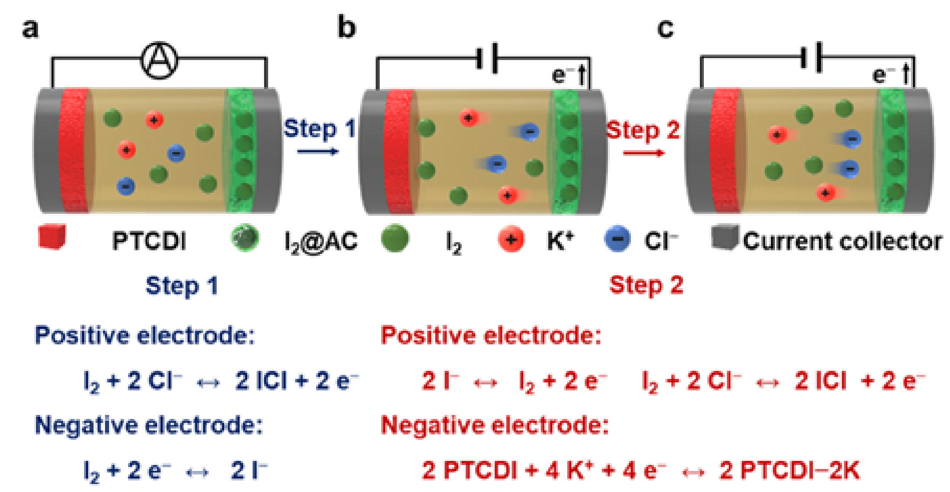
LONG LIFESPAN HIGH-ENERGY ORGANIC||I_2 RECHARGEABLE BATTERIES WITH CASCADE CONCEPT

Professor Yu Miao from the School of Chemistry and Chemical Engineering, cooperating with Professor Huang Yan from the School of Materials Science and Engineering, recently published an article titled "Development of Long Lifespan High-Energy Aqueous Organic||Iodine Rechargeable Batteries" in *Nature Communications*.

In recent years, rechargeable metal-halogen batteries, which rely on strict redox chemistry to achieve high energy and power density, have attracted considerable attention. In particular, solid iodine (I_2) has shown better operability and (electro)chemical stability than its liquid bromine and gaseous chlorine analogs. Because of its high abundance, high theoretical capacity (422 mAh g^{-1}), and theoretical redox potential of I^0/I^+ (1.07 V vs. standard hydrogen electrode), I_2 stands out as a particularly promising cathode material for aqueous batteries. Moreover, the solid–liquid $I^-/I^0/I^+$ conversion of the I_2 cathode avoids the issue of electrode structural degradation that commonly occurs in other intercalation materials. Major success has been achieved in the development of various aqueous metal||I_2 batteries, e.g., Fe||I_2, Al||I_2 and Zn||I_2. However, these batteries are affected by the detrimental (electro)chemical behavior of the metal electrode upon cycling. The dendrite growth and corrosion of the metal anodes cause rapid attenuation of the capacity and short circuit; the iodine anionic species lead to the formation of electrochemically inactive complexes with the metal anode, which induces the irreversibility of the I_2 cathode and limited lifespan, similar to the shuttle effect in lithium-sulfur batteries.

Considerable efforts have been made to modify the metal anode and firmly anchor iodine species onto the cathode to address these issues. However, it remains challenging to substantially increase the performance of metal||I_2 batteries. A novel alternative system has been proposed recently, i.e., replacing the anode materials with hydrogen (H_2). The H_2||I_2 system shows promise but has certain limits: It is limited to Swagelok cell type for operation and involves a time-consuming fabrication process also



using costly Pt-based catalysts. Furthermore, the cell discharge voltage is <1.2 V, and the capacity is ~0.5 mAh at 2.5 mA cm^{-2}. Therefore, a breakthrough strategy is needed to improve the lifespan, energy, and power content of I_2-based batteries.

Herein, we report an aqueous organic||I_2 battery with cascade concept. Distinct from the previously reported aqueous metal||I_2 and H_2||I_2 battery systems, 3,4,9,10−perylenetetracarboxylic diimide (PTCDI) is employed as negative electrode active material and a saturated mixed KCl/I2 aqueous electrolyte solution. Because PTCDI is inert to various iodine anionic species and the fast conversion of $I^-/I^0/I^+$ in the saturated KCl electrolyte, a long lifespan (92,000 cycles at 40 A g^{-1}), an initial specific discharge capacity of 900 mAh g^{-1} (electrode mass of iodine only), an average cell discharge voltage of 1.25 V at 40 A g^{-1}, and 25 ± 1°C together with appealing discharge capacity performance at high currents (*e.g.*, 104 mAh g^{-1} at 160 A g^{-1}), high specific energy (434 Wh kg^{-1} at 40 A g^{-1}) and power (155,072 W kg^{-1} at 160 A g^{-1}) can be delivered. Finally, we also report the assembly and testing of a PTCDI|KCl-I2| carbon paper multilayer pouch cell prototype with discharge capacity retention of about 70% after 900 cycles at 80 mA and 25 ± 1°C.■

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A SELF-POWERED DIELECTROPHORETIC MICROPARTICLE MANIPULATION PLATFORM BASED ON A TRIBOELECTRIC NANOGENERATOR

Microfluidics, also known as "lab-on-a-chip", is an interdisciplinary technology that can process or manipulate tiny fluids in micro- and nano-scale channels and has shown great potential in chemistry, fluid physics, microelectronics, new materials, and biomedical engineering. It is worth mentioning that microfluidic chips are undergoing a new technological revolution in the fields of digital polymerase chain reaction (dPCR), liquid biopsy, and other medical detection.

However, realizing the function of microfluidic chip usually requires the support of large power sources, microscope systems, and other auxiliary equipment from the perspective of engineering technology. Therefore, the portability of the microfluidic system is the key to its wide application.

Recently, Professor Ren Yukun's group from the State Key Laboratory of Robotics and System at Harbin Institute of Technology published a paper "A Self-Powered Dielectrophoretic Microparticle Manipulation Platform Based on a Triboelectric Nanogenerator" in *Advanced Materials*.

In this study, triboelectric nanogenerator (TENG) technology was introduced into the field of microfluidics. TENG, as a sustainable power source, can continuously convert mechanical energy (such as wind energy, wave energy, etc.) in the natural environment into electrical energy, thus effectively avoiding the use of traditional large power sources and realizing the portability of the microfluidic system. The achievement consists of three parts: TENG, rectifier/filter circuit, and microfluidic chip. The rectifier/filter circuit converted the high-voltage AC signal generated by the TENG into DC signal and applied it to the microfluidic chip. The high-efficient separations of standard microparticles and biological cells were successfully achieved, respectively, by using DEP technology, which verified the rationality of the study.

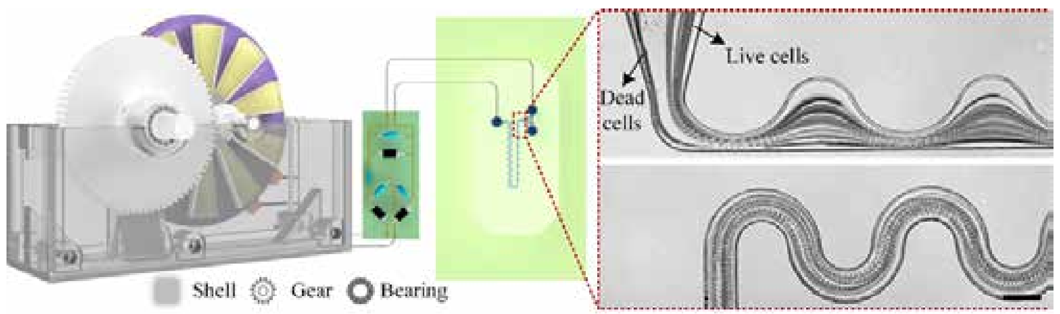

Diagram of cell separation results performed on a portable microfluidic detection platform

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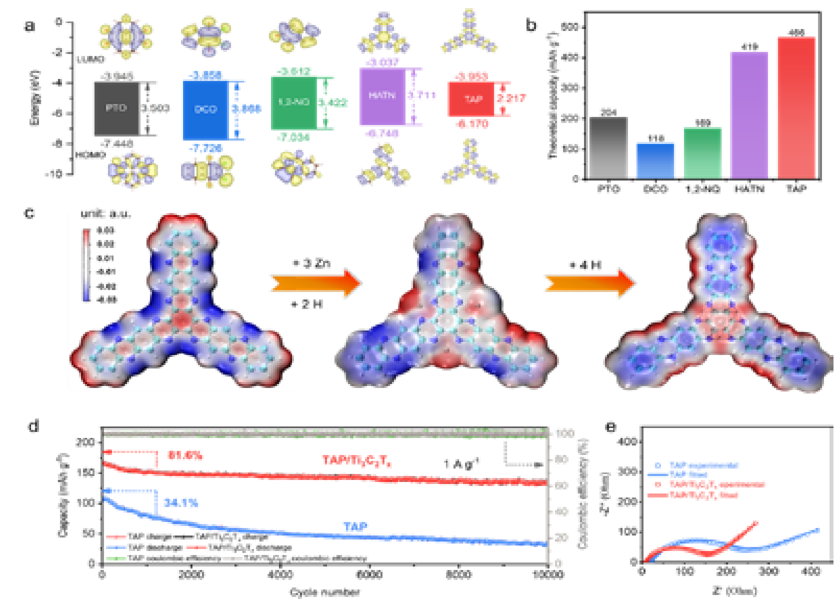
MXENE-BOOSTED IMINE CATHODES WITH EXTENDED CONJUGATED STRUCTURE FOR AQUEOUS ZINC-ION BATTERIES

In 2022, Professor Huang Xiaoxiao, from Professor Zhou Yu's group at the School of Materials Science and Engineering, published a research paper titled "MXene-Boosted Imine Cathodes with Extended Conjugated Structure for Aqueous Zinc-Ion Batteries" in *Advanced Materials*.

As a clean electrochemical energy storage (EES) technology, aqueous zinc-ion batteries (ZIBs) have entered the spotlight owing to their intrinsic safety, fast kinetics, and low cost. Compared to inorganic compounds, organic materials stand out in the EES field due to the merits of soft lattice, tunable structure, and inherent ductility. Organic materials with redox functional groups are capable of reversible Zn^{2+} storage by the coordination reactions between Zn^{2+} ions and active sites, avoiding the structural collapse that prevails among inorganic cathodes. Despite the as-mentioned advantages, organic compounds still confront some intractable issues: (1) Insufficient conductivity lowers the utilization of active redox sites, hindering the release of charge storage capacities; (2) Easy dissolution of organic molecules or discharged products in aqueous electrolytes chronically decay the lifespan of ZIBs.

To tackle these challenges, the researchers proposed an imine-based tris(aza)pentacene (TAP) with extended conjugated effects along the C=N backbones, which is in situ injected into layered MXene to form a TAP/$Ti_3C_2T_x$ cathode. Theoretical and electrochemical analyses reveal a selective H^+/Zn^{2+} co-insertion/extraction mechanism in TAP, which is ascribed to the steric effect on the availability of active C=N sites. Moreover, $Ti_3C_2T_x$, as a conductive scaffold, favors fast Zn^{2+} diffusion to boost the electrode kinetics of TAP. Close electronic interactions between TAP and $Ti_3C_2T_x$ preserve the structural integrity of TAP/$Ti_3C_2T_x$ during the repeated charge/discharge. Accordingly, the TAP/$Ti_3C_2T_x$ cathode delivers a high reversible capacity of 303 mAh g^{-1} at 0.04 A g^{-1} in aqueous ZIBs, which also realizes an ultra-long lifetime over 10,000 cycles with a capacity retention of 81.6%. Furthermore, flexible Zn||TAP/$Ti_3C_2T_x$ batteries with a quasi-solid-state electrolyte demonstrate the potential application in wearable electronic devices.



Energy storage mechanism and electrochemical performance of TAP/$Ti_3C_2T_x$ cathode

The paper was financially supported by the National Natural Science Foundation of China, the Heilongjiang Touyan Team Program, and the Fundamental Research Funds for the Central Universities.

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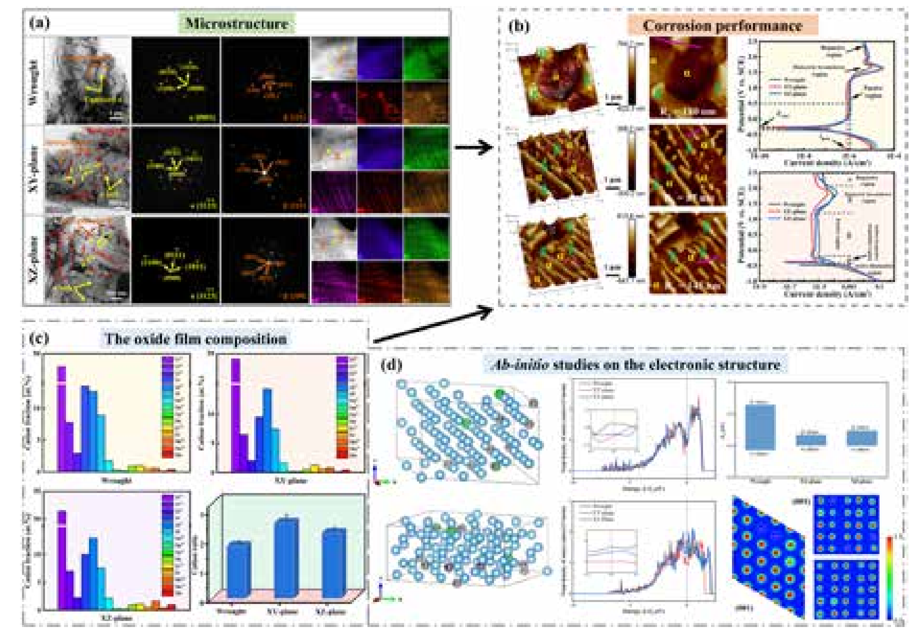
A NOVEL WAY TO IMPROVE THE CORROSION RESISTANCE OF TITANIUM ALLOYS

In 2022, a team led by Professor Su Yanqing from the National Key Laboratory for Precision Hot Processing of Metals, the School of Materials Science and Engineering at HIT, reported their recent research results titled "Tuning Microstructure and Improving the Corrosion Resistance of Ti-6Al-3Nb-2Zr-1Mo Alloy Using the Electron Beam Freeform Fabrication" in *Chemical Engineering Journal*.

Titanium (Ti) alloys are increasingly used in chemical industries, the desalination of seawater, and offshore drilling due to the excellent corrosion resistance. Among Ti alloys for marine engineering, a near-α Ti alloy, Ti-6Al-3Nb-2Zr-1Mo (Ti6321), is pertinent as it is widely used as a pivotal structural material in aqueous corrosive environments, where the service life of any component is closely related to its corrosion resistance. Although the Ti6321 alloy exhibits a superior corrosion resistance in most environments due to the spontaneously formed oxide film, the insufficient corrosion resistance in some extremely harsh conditions, originating from the destruction of the protective oxide film, severely limits its practical applications. Therefore, investigations into the potential improvement in the corrosion resistance of Ti6321 alloy have been popularized in academic and industrial communities.

In the recent research, Professor Su's team employed the electron beam freeform fabrication (EBF^3) technique to manufacture the Ti6321 alloy and thoroughly investigated the microstructure and corrosion behavior of different planes (i.e., XY-plane, perpendicular to the building direction; XZ-plane, parallel to the building direction) of EBF^3-manufactured Ti6321 alloy. The Widmanstätten microstructure is the evident prior-β grain boundary, the inside of which is composed of predominant α-lath and slight β-phase is achieved, compared to that of equiaxed α-phase and intergranular β-phase in the traditional wrought alloy. The EBF^3-manufactured alloy, especially the XY-plane, displays a significantly improved



Comparison of (a) microstructure and (b) corrosion behavior of EBF^3-manufactured and wrought Ti6321 alloys. The distinct corrosion behaviors of EBF^3-manufactured and wrought Ti6321 alloys are attributed to the differences in (c) the oxide film composition and (d) the electronic structures of constituent phases.

corrosion resistance, compared to the wrought alloy. The X-ray photoelectron spectroscopy results reveal the formation of a more stable oxide film for the EBF^3-manufactured alloy due to a higher fraction of phase boundaries induced by the fine α-laths; in addition, the heterogeneous distribution of compositions between α- and β-phases can be effectively alleviated during the EBF^3 process, resulting in the absence of a strong galvanic corrosion, which is confirmed by combining experiments and ab-initio calculations. This research paper fills the knowledge gap regarding the relationship between the microstructure and corrosion behavior of EBF^3-manufactured Ti alloys, and provides a new direction for the future improvement of the corrosion resistance of Ti alloys.

This work was supported by the National Natural Science Foundation of China, the Major Special Science and Technology Project of Yunnan Province, and the fellowship of China Postdoctoral Science Foundation.■

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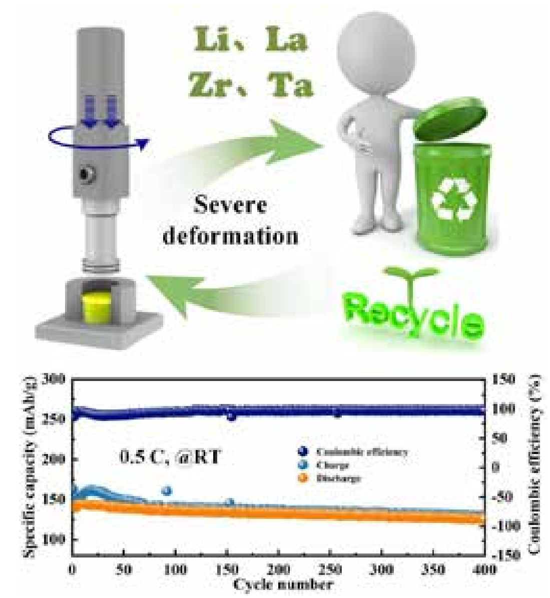
RECYCLING GARNET-TYPE ELECTROLYTE TOWARD SUPERIOR CYCLING PERFORMANCE FOR SOLIC-STATE LITHIUM BATTERIES

Professor Huang Yongxian's group from the State Key Laboratory of Advanced Welding and Joining, Harbin Institute of Technology, proposed a green method of deformation-driven re-sintering to recycle spent SSLBs with emphasis on garnet-type solid-state electrolyte recovery. The research article titled "Recycling Garnet-Type Electrolyte toward Superior Cycling Performance for Solid-State Lithium Batteries" was recently published in a high impact international journal, *Energy Storage Materials*.

Green-sustainable approaches prompt urgent attention for recycling end-of-life spent solid-state lithium batteries (SSLBs), which are candidates for next-generation energy storage systems. Here, we propose a green method of deformation-driven re-sintering (DDR) to recycle spent SSLBs with emphasis on garnet-type solid-state electrolyte (SSE) recovery. The recycled fine SSE particles, via DDR, provide sufficient sintering activity for grain fusion and promote Li absorption with the Li_2O atmosphere. The severe deformation accelerates the phase transformation process from the tetragonal phase to cubic phase and inhibits the proton/lithium exchange process. The homogeneous distribution of Li-ions eliminates discontinuous connection areas, facilitating the establishment of fast ionic pathways. The critical current density of DDR-SSE reaches 1.24 mA·cm^{-2}, indicating a stable process of the stripping and plating lithium. SSLBs assembled by the DDR-SSE and $LiFePO_4$ cathode show a superior cycling performance with a discharge capacity of 126.7 mAh·g^{-1} and capacity retention of 89.7% after 400 cycles (0.5 C) at room temperature. The work firstly provides a feasible green-sustainable method for spent SSEs with high performances, promoting the environmental benignity and economic viability for the sustainable solution of resources. This published paper will further promote the international impact of the State Key Laboratory of Advanced Welding and Joining.



Professor Huang Yongxian from HIT is the corresponding author. Qin Zhiwei, Dr. Xie Yuming and Dr. Meng Xiangchen from HIT are the co-first authors. Qian Delai, Mao Dongxin, Ma Xiaotian, Shan Cheng, Chen Jialin, and Professor Wan Long from HIT are the co-authors.

The paper was jointly supported by the National Natural Science Foundation of China.

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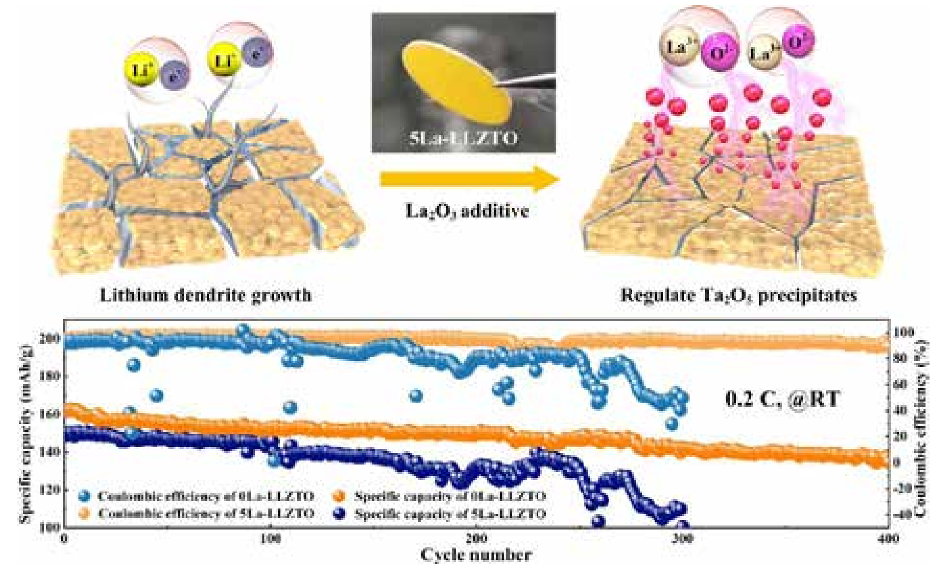
GRAIN BOUNDARY ENGINEERING IN Ta-DOPED GARNET-TYPE ELECTROLYTE FOR LITHIUM DENDRITE SUPPRESSION

Professor Huang Yongxian's group from the State Key Laboratory of Advanced Welding and Joining, Harbin Institute of Technology, employed a grain boundary engineering strategy to regulate the distribution of Ta element and enhance the density of LLZTO. The research article titled "Grain Boundary Engineering in Ta-Doped Garnet-Type Electrolyte for Lithium Dendrite Suppression" was recently published in a well-known international journal, *ACS Applied Materials and Interfaces*.

Solid-state lithium batteries (SSLBs) based on Ta-doped $Li_{6.5}La_3Zr_{1.5}Ta_{0.5}O_{12}$ (LLZTO) suffer from lithium dendrite growth, which hinders their practical application. Herein, first principle simulations indicate that the Ta element prefers to segregate along grain boundaries in the form of Ta_2O_5 precipitates due to a high energy difference induced by Ta doping. Grain boundary engineering is employed to regulate the distribution of the Ta element and enhance the density of LLZTO by introducing the La_2O_3 additive. The sufficient La_2O_3 additive reacts with the Ta_2O_5 precipitates, while the residual La_2O_3 nanoparticles fill up void defects, promoting the homogeneous distribution of the Ta element and improving the relative density to ~98%. Critical current density of the symmetric Li battery



reaches 2.12 mA·cm^{-2} at room temperature with the solid-state electrolyte (LLZTO+5 wt% La_2O_3), which increases by 41% compared to pure LLZTO. SSLBs with the $LiFePO_4$ cathode achieve a stable cycling performance with a discharge capacity of 138.6 mA·h·g^{-1} after 400 cycles at 0.2 C. This work provides theoretical insights into the distribution of Ta-doped LLZTO and inhibits lithium dendrite growth through grain boundary engineering. This published paper will further promote the international impact of the State Key Laboratory of Advanced Welding and Joining.

Professor Huang Yongxian from HIT is the corresponding author. Qin Zhiwei, Dr. Xie Yuming and Dr. Meng Xiangchen from HIT are the co-first authors. Qian Delai, Mao Dongxin, Dr. Zheng Zhen, and Professor Wan Long from HIT are the co-authors. The paper was jointly supported by the China National Postdoctoral Program for Innovative Talents and the National Natural Science Foundation of China.

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LIGHT-HARVESTING ARTIFICIAL CELLS CONTAINING CYANOBACTERIA FOR CO_2 FIXATION AND FURTHER METABOLISM MIMICKING

Professor Han Xiaojun's group from the State Key Laboratory of Urban Water Resource and Environment, the School of Chemistry and Chemical Engineering, has made a significant progress on energy supply and metabolism mimicry inside artificial cells. The research article titled "Light-Harvesting Artificial Cells Containing Cyanobacteria for CO_2 Fixation and Further Metabolism Mimicking" was recently published

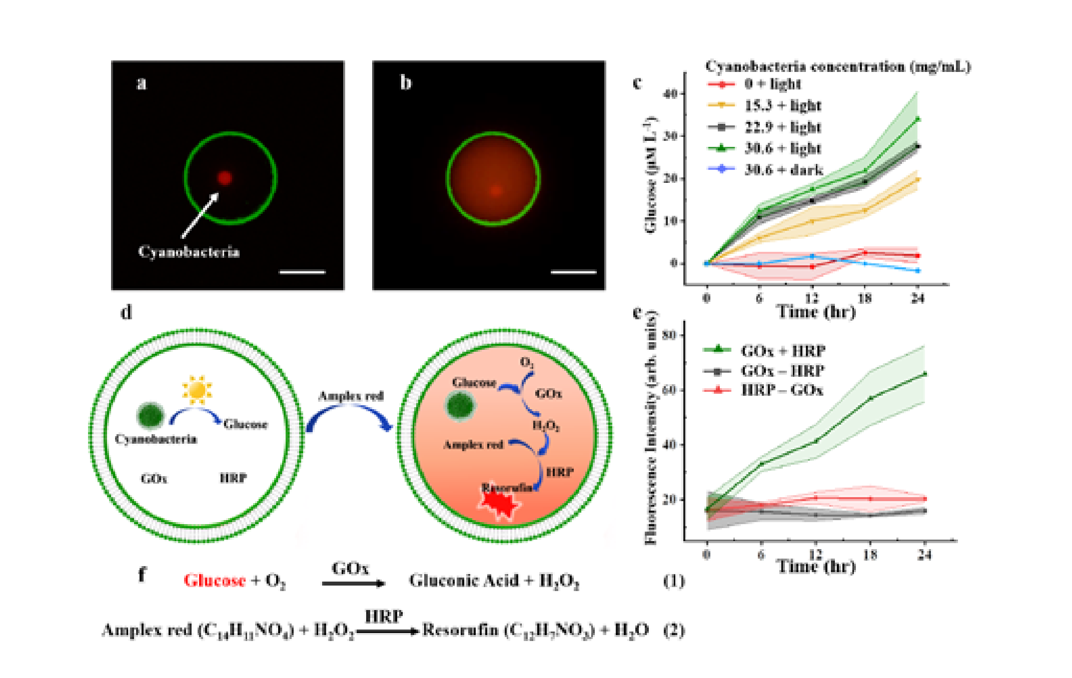

Figure 1 Chemical communications between cyanobacteria and "cytoplasm" inside the artificial cells

in the well-known journal *Small*.

Artificial cells are defined as the bottom-up built structures that mimic one or more cell characteristics (membrane, metabolism, reproduction, etc.). Those structures help to better understand the working mechanism of the cell and provide the evolution clues for organisms. The energy supply and metabolism mimicry are the key issues in the field of artificial cells. It is challenging to construct an artificial cell that converts light energy to fix carbon dioxides into glucose molecules.

Targeting these challenges, Professor Han Xiaojun's group constructed an artificial cell containing cyanobacteria, where cyanobacteria were "chloroplasts" for energy supply. This artificial cell was able to fix carbon dioxide into glucose molecules by converting light energy into chemical energy upon illumination due to the photosynthetic capability of cyanobacteria. Two follow-on metabolism pathways were investigated. One was the cascade enzyme reactions involving glucose oxidase (GOx) and horseradish peroxidase (HRP). The glucose molecule was oxidized by GOx to produce H_2O_2, which further oxidize Amplex red to resorufin in the presence of HRP (Figure 1). The other pathway was to synthesize nicotinamide adenine dinucleotide hydride (NADH) from nicotinamide

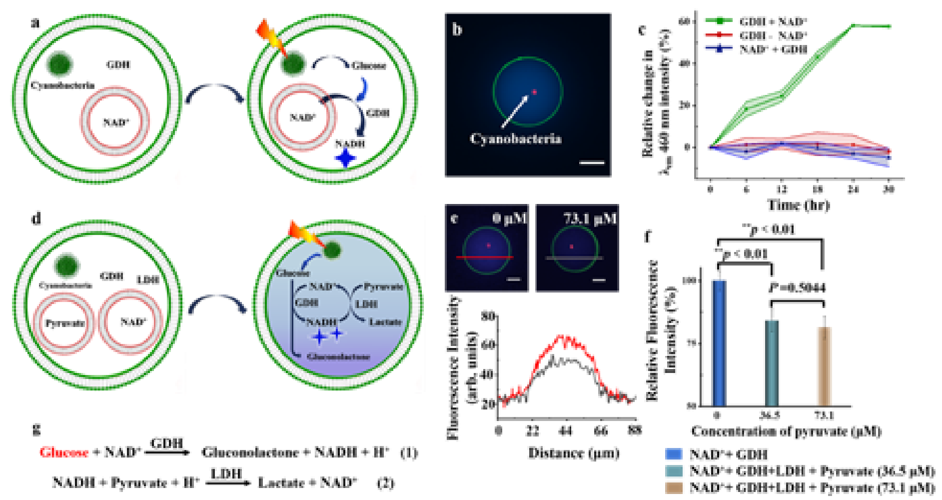

Figure 2 The cascade cycling of NADH/NAD^+ inside cyanobacteria-containing artificial cells

adenine dinucleotide (NAD^+) and glucose catalyzed by glucose dehydrogenase (GDH). With the energy supply of NADH, pyruvate was transformed into lactate catalyzed by lactate dehydrogenase (LDH). The produced NAD^+ re-entered the previous reaction to form NADH recycle, which was important for the metabolic network inside cells (Figure 2). The artificial cell built here simulates the function of chloroplasts and provides an advanced cell model for complicated intracellular energy supply and metabolism mimicking.

The paper was financially supported by the National Natural Science Foundation of China.■

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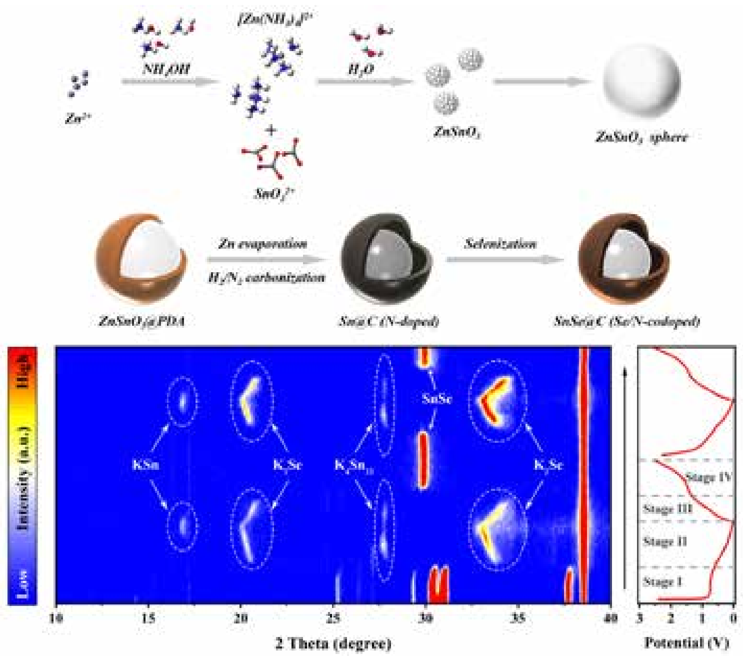
INSIGHTS INTO THE POTASSIUM ION STORAGE BEHAVIOR AND PHASE EVOLUTION OF A TAILORED YOLK–SHELL SnSe@C ANODE

In 2022, Professor Ci Lijie's team from the State Key Laboratory of Advanced Welding and Joining, Harbin Institute of Technology (Shenzhen), reported their investigation on the potassium ion storage behavior of SnSe@C anode, which is an alloying-type anode. The research results were published in the high-impact international journal *Small*, titled "Insights into the Potassium Ion Storage Behavior and Phase Evolution of a Tailored Yolk–Shell SnSe@C Anode."

Tin chalcogenides being a promising high-capacity anode material for potassium ion batteries, its application potential is hindered by the severe volume effect, limited electronic conductivity, and the shuttle effect of the potassiation product. Professor Ci's team proposed a facile structural engineering strategy for yolk–shell SnSe encapsulated in carbon shell (SnSe@C) based on the metal evaporation reaction. The internal void can accommodate the volume change of the SnSe core, and the carbon shell can enhance the electronic conductivity. Combining qualitative and quantitative electrochemical analyses, the distinguished electrochemical performance of SnSe@C anode is attributed to the contribution of enhanced capacitive behavior. Additionally, first-principles calculations elucidate that the heteroatomic doped carbon exhibits a preferable affinity toward potassium ions and the potassiation product K_2Se, consequently boosting the rate



performance and capacity retention. Furthermore, the phase evolution of the SnSe@C electrode during the potassiation/depotassiation process is clarified by in situ X-ray diffraction characterization, and the crystal transition from the SnSe Pnma(62) to Cmcm(63) point group is discovered unpredictably. This work demonstrates a pragmatic avenue to tailor the SnSe@C anode via a facile structural engineering strategy and chemical regulation, providing substantial clarification for the phase evolution mechanism of SnSe-based anode for PIBs.

This paper was financially supported by the National Natural Science Foundation of China, the School Research Startup Expenses of Harbin Institute of Technology (Shenzhen), the Shenzhen Science and Technology Program, the High-Level Talents' Discipline Construction Fund of Shandong University, and the research projects from the Department of Science and Technology of Shandong Province.

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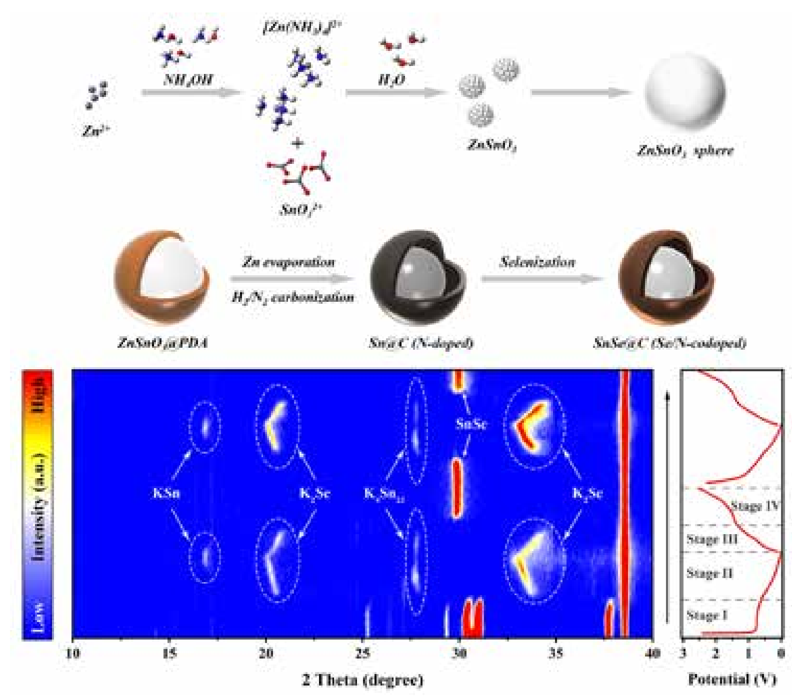
A BRIDGE BETWEEN CERAMICS ELECTROLYTE AND INTERFACE LAYER TO FAST Li^+ TRANSFER FOR LOW INTERFACE IMPEDANCE SOLID-STATE BATTERIES

On November 7th, 2022, Professor Zhang Naiqing's group from the State Key Laboratory of Urban Water Resource and Environment published a research paper titled "A Bridge between Ceramics Electrolyte and Interface Layer to Fast Li^+ Transfer for Low Interface Impedance Solid-State Batteries" in *Advanced Functional Materials*.

Solid-state batteries (SSBs) are regarded as next generation advanced energy storage technology to provide better safety and energy density. However, a practical application is plagued by large interfacial resistance, owing to solid-solid interface contact between ceramic electrolytes and Li anode. Introducing polymer-based coating between electrolytes and Li anode is a feasible strategy to solve this issue. Unfortunately, it is hard to achieve intimate contact at the atomic scale with current polymer as it lacks a bridge to transfer Li^+ quickly between electrolytes and polymer coating. This gives rise to sluggish Li^+ transfer dynamics, huge interface impedance and greatly limits the effectiveness of this strategy.

The researchers demonstrated high interface compatibility, electronically blocking interface layer. Poly(lithium 4-styrenesulfonate)(PLSS) was successfully introduced between solid electrolytes and Li anode. The PLSS, containing large amounts of lithium sulfonate groups(-SO3Li), formed strong coordination interaction with metal atoms (La,



Zr, Ta, Li) exposed on the surface of LLZTO. This atomic level interaction successfully builds a fast Li^+ migration bridge and exhibits low energy barrier and high Li^+ diffusion coefficient at the LLZTO/PLSS interface. This interaction maintained extraordinarily robust and seamless interface contact between LLZTO and Li anode under long-term cycling. The interface impedance is reduced by ensuring desirable interface contact and the rapid conduction of Li^+ across interface, which is as low as 9 Ω cm^2. The electronic insulation nature of PLSS was parsed from the density of states (DOS) and electrostatic potential (ESP) profiles. Hence, this polymer-based coating achieved compatible interface contact, high-speed Li^+ mobility bridge across the interface, and encouraging electrically insulating features.

This work was financially supported by the National Natural Science Foundation of China.

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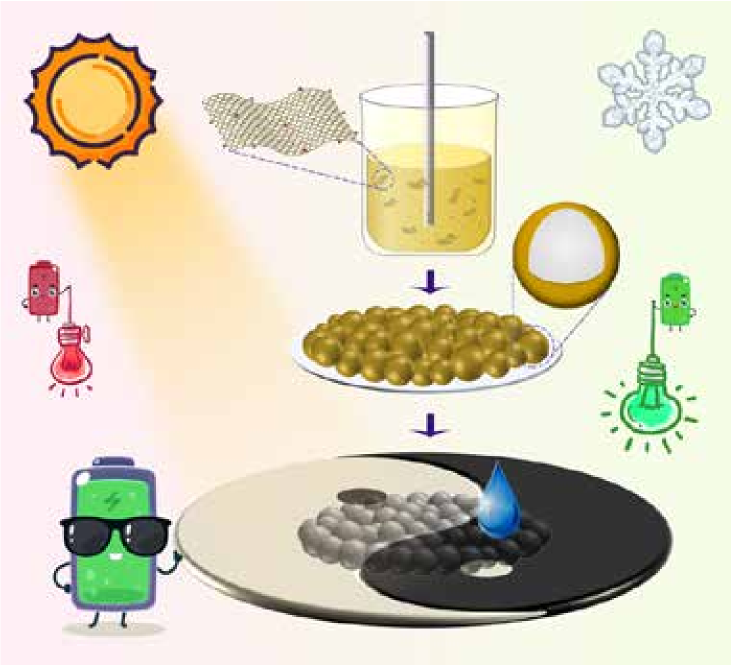
Yang G., Bai X., Zhang Y., Guo Z., Zhao C., Fan L., Zhang N. A bridge between ceramics electrolyte and interface layer to fast Li^+ transfer for low interface impedance solid-state batteries. Advanced Functional Materials, 2022, 2211387. DOI: https://doi.org/10.1002/adfm.202211387

MICROSPHERE STRUCTURE COMPOSITE PHASE CHANGE MATERIAL FOR THERMAL ENERGY HARVESTING AND MULTI-FUNCTIONAL SENSOR

Recently, Professor He Xiaodong and Professor Jiao Weicheng, from the School of Astronautics, published a research paper titled "Microsphere Structure Composite Phase Change Material with Anti-Leakage, Self-Sensing, and Photothermal Conversion Properties for Thermal Energy Harvesting and Multi-Functional Sensor" in *Advanced Functional Materials*.

In the development, conversion, transportation, and utilization of energy, there are always quantitative, morphological, and temporal differences between supply and demand. The efficient harvesting of the thermal energy utilizing phase change materials has great potential for thermal management and energy storage applications. They absorb solar and industrial waste heat energy from the ambient environment and use it for suitable scenarios. Moreover, they are used for electronic devices and traction batteries to avoid thermal runaway and performance limitations when the temperature is too high or too low, forming a microclimate with slow temperature changes around them, thus enabling rapid temperature regulation. However, liquid leakage during solid-liquid phase transition and the low thermal conductivity are two long-standing bottlenecks that limit the large-scale use of this kind of phase change materials.

In this work, the research team proposed a strategy to synthesize microsphere-structured phase change composites by encapsulating phase change materials in graphene via emulsion polymerization (with no additional emulsifier) and chemical reduction. Multiple graphene sheets are connected to construct an efficient thermally and electrically conductive network. The composite microspheres exhibit no leakage and



superior phase transition behavior and sense external environments such as temperature changes and water drops falling, allowing them to be engineered into devices for temperature monitoring. In addition, it converts electrical energy into thermal energy to achieve rapid temperature increase. The incorporation of polydopamine improves the photothermal efficiency of the phase change microspheres and senses the light irradiation, offering a promising route to extend the single source of thermal energy. It is envisioned that the precise early warning of the operating environment and regulation of the release temperature based on the integration of electrothermal and photothermal, as well as self-sensing of temperature changes, water droplet falling, and light irradiation, provide insights into the intellectual development of multi-functional phase change materials.

Professor Jiao Weicheng from HIT is the corresponding author. This work was financially supported by the National Natural Science Foundation of China, the National Key Research and Development Program of China, and the Shenzhen Science and Technology Program.

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Hongyuan Guo, Weicheng Jiao, Haozheng Jin, Zijian Yuan, Xiaodong He. Microsphere structure composite phase change material with anti-leakage, self-sensing, and photothermal conversion properties for thermal energy harvesting and multi-functional sensor. Advanced Functional Materials, 2022. DOI: 10.1002/adfm.202209345

A NOVEL "INDUSTRIAL DOCTOR" FOR IN-SITU AND CONTACTLESS INSPECTION OF CFRP

Carbon fiber reinforced polymer (CFRP) composites with outstanding mechanical properties may possess barely visible defects (such as delamination, and disbonds) in sub-mm layers, which greatly effects safe use. Therefore, to ensure the reliability of CFRP in industrial applications, it is of importance to develop a non-destructive testing (NDT) approach for the subsurface defect detection. Up to now, several NDT techniques are employed for CFRP inspection, such as X-ray, acoustic emission, electrical resistivity measurement, eddy current, a variety of infrared thermography techniques, and ultrasonic techniques. However, precise and efficient inspection of defects in sub-mm layers of composite structures still poses a considerable challenge in the non-destructive and testing industry.

Recently, Professor Liu Junyan's group from the State Key Laboratory of Robotics and System, the School of Mechatronics Engineering at Harbin Institute of Technology, published a paper titled "Contactless Inspection of CFRP Artificial Disbonds Using Combined Laser Thermography and Laser Ultrasonics with Optical Microphone" in *Composite Structures*.

In this work, 16 artificial disbands (flat bottom holes) with different sizes and depths in CFRP composites were detected without contact, using combined laser thermography and laser ultrasonics with a novel kind of optical microphone. Employed a membrane free optical microphone, the presented laser ultrasonic technique is a contactless, all-optical and nondestructive technique and shows high detectability for flat bottom holes with deep depth in this preliminary investigation. Sizes and depths of the flat-bottom holes were determined by the presented laser ultrasonics technique. The results are in good agreements with the results using the traditional water immersion ultrasonic imaging method. Flat bottom

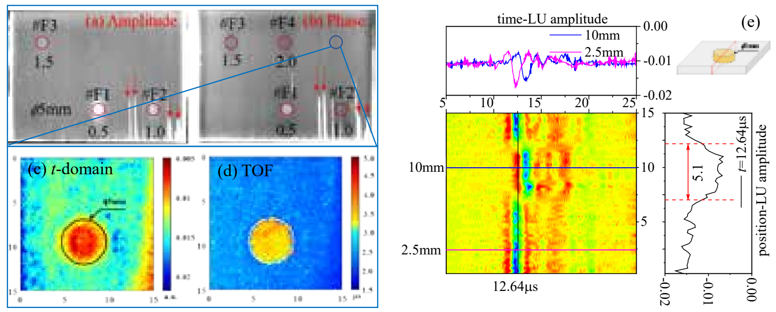

Figure 1 Laser thermography (LT) and laser ultrasonics (LU) results of CFRP
(a) LT amplitude, (b) LT phase, (c) time-domain of LU, (d) Time of Flight (TOF) of LU, (e) A-scan and B-scan LU results of (c). The red arrows in (a) and (b) are the fibers delaminated from the front surface when performing water immersion ultrasonic experiments.

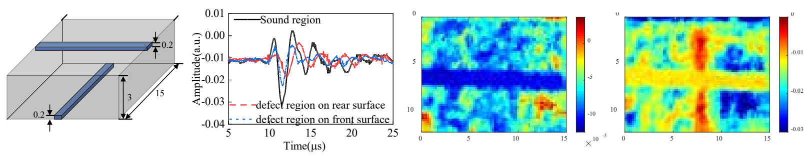

Figure 2 LU results at different time
(a) CFRP with artificial flat grooves at front and rear surfaces, (b) A-scan profiles of three regions, (c) amplitude image at t=10.76μs, (d) amplitude image at t=11.28 μs

holes with a diameter to depth ratio (D/d) over 2.5 can be effectively detected by the presented LIT method with the measurement time on the order of seconds. While flat bottom holes with D/d larger than 0.5 can be quantitively detected, and artificial grooves with a depth of 0.2 mm at both surfaces of the 3 mm-thick specimen can be distinguished using the presented LU technique, which LIT could not identify due to the artificial groove on the back surface.

Finally, it can be concluded that this investigation combines the high detection efficiency of laser thermography and high detection sensitivity of laser ultrasonics with the novel optical microphone together for the contactless and in-situ inspection of artificial disbands among the CFRP specimens. The presented method can be also used to identify flaws at different depths for thin samples and for tomography application in the future as well. This work paves a new and feasible way for solving the contradiction between high precision and efficiency in the NDT field.■

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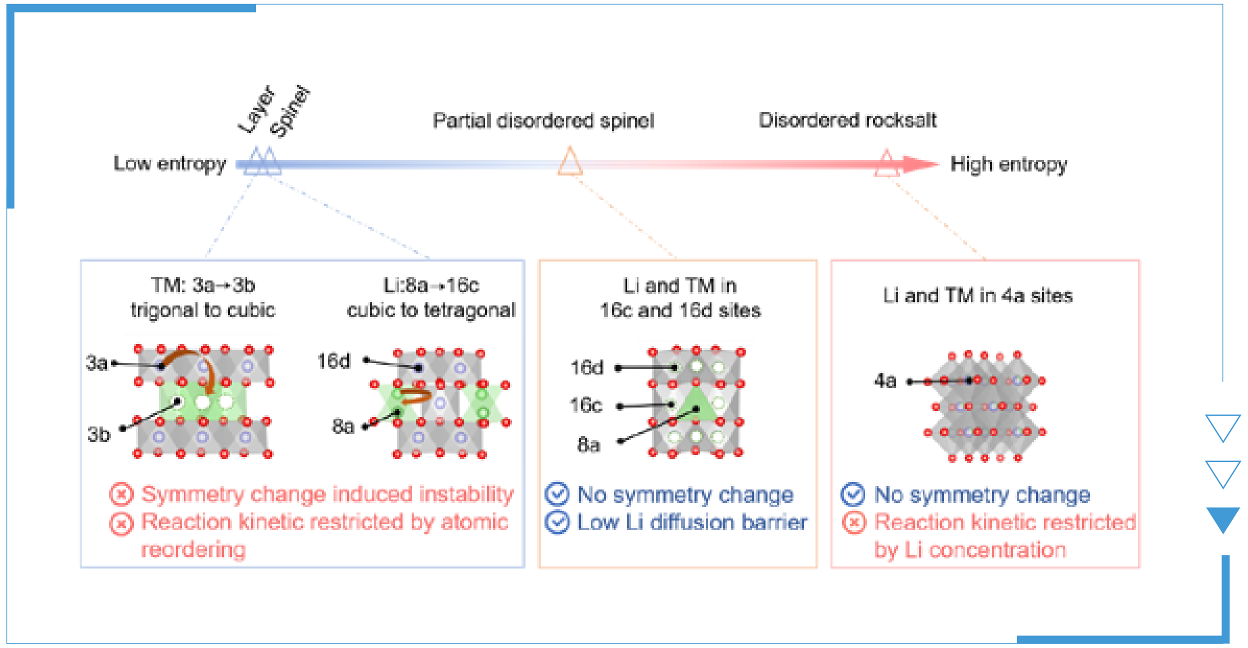
Song P., Liu JY., Liu LX., Wang F., Sun XG., Liu ZJ., Xu LX. Contactless inspection of CFRP artificial disbonds using combined laser thermography and laser ultrasonics with optical microphone. Composite Structures, 2022, 297: 115971.

ENTROPY, A THERMODYNAMIC QUANTITY, AS NEW METRIC OF CATHODE MATERIALS FOR LI-ION BATTERIES

In classical thermodynamics, entropy is a property of the thermodynamic system that expresses the direction or outcome of spontaneous changes in the system. Recently, Professor Xu Cheng-Yan and his colleagues from the School of Materials Science and Engineering at Harbin Institute of Technology, Shenzhen, reported their new finding that entropy, a well-established scientific concept in Second Law of Thermodynamics, serves as a new metric of lithium transition metal oxide cathode materials, $Li_xTM_yO_2$ (TM = Ni, Mn, Co, *etc.*), which hold great promise for high-energy-density Li-ion batteries (LIBs). The article titled "A Medium-Entropy Transition Metal Oxide Cathode for High-Capacity Lithium Metal Batteries" was published in *Nature Communications*, a prestigious multidisciplinary journal dedicated to publishing high-quality research in all areas of the biological, health, physical, chemical, and Earth sciences.

A central challenge in boosting the energy density of Li-ion batteries is to maximize the practical capacity of cathode materials. Although 3*d* TM-based lithium transition metal oxides ($Li_xTM_yO_2$, TM = Ni, Mn, Co, *etc.*) can deliver a theoretical capacity of >270 mA h g^{-1}, the high-capacity operation inevitably triggers the migration of TM or Li-ions and brings the symmetry changes. Therefore, the high-capacity operation of $Li_xTM_yO_2$ is always accompanied by continuous phase evolutions, such as layer to spinel, layer to rocksalt, or spinel to T1/T2 phase transitions in highly de/lithiated $LiCoO_2$, $LiNi_aMn_bCo_cO_2$ ($a+b+c=1$), $Li_{1+x}TM_{1-x}O_2$ and $LiNi_{0.5}Mn_{1.5}O_4$, resulting in the unsatisfied cyclic stability and rate performance in most high-capacity cathodes. Consequently, a critical direction in establishing a high energy density cathode is to prevent the continuous reordering of cation ions upon the high de/lithiation of $Li_xTM_yO_2$.

To resolve this, Professor Xu's group aims to overturn the thermodynamically structural evolution under the high-capacity operation of $Li_xTM_yO_2$ (TM=Ni, Mn) through entropy engineering. To break the thermodynamic-driven TM ions ordering, they



prepared a defective $Li_{1.46}Ni_{0.32}Mn_{1.2}O_{4-x}$ through proton substitution, further triggering the interlayer disordering of TM ions to form a partial cation-disordered spinel phase upon the initial delithiation process. This medium-entropy-state $Li_{1.46}Ni_{0.32}Mn_{1.2}O_{4-x}$ phase represents a distinctive electrochemical behavior with that of well-ordered or disordered phases, which is traced from the partial disordering of TM ions. Comprehensive experimental characterizations, including the synchrotron X-ray diffraction (SXRD), neutron diffraction (ND), scanning transmission electron microscopy (STEM), and theoretical calculations reveal the cation disordering in delithiated $Li_{1.46}Ni_{0.32}Mn_{1.2}O_{4-x}$ and the shuttling of Li ions from octahedral sites in this medium-entropy state phase, which bypasses the undesired cubic to tetragonal symmetry change in the conventional spinel structure. *Ex-situ* X-ray spectroscopy measurements reveal the charge compensation is dominated by Mn^{3+}/Mn^{4+} cationic redox and anionic redox, boosting the reversible capacity up to 314.1 mA h g^{-1} and specific energy up to 999.3 Wh kg^{-1}.

In this work, Professor Xu's group not only unearths a new type of high-capacity cathode but also shows that a proper entropy level could essentially alter the electrochemical properties of $Li_xTM_yO_2$ cathode materials. Looking forward, the entropy-manipulation strategy in this work is a potential direction to overcome the thermodynamically driven atomic evolution upon the insertion/extraction of Li ions, and the cation-disordered spinel structure opens up a large space for exploring the medium-entropy compounds. ■

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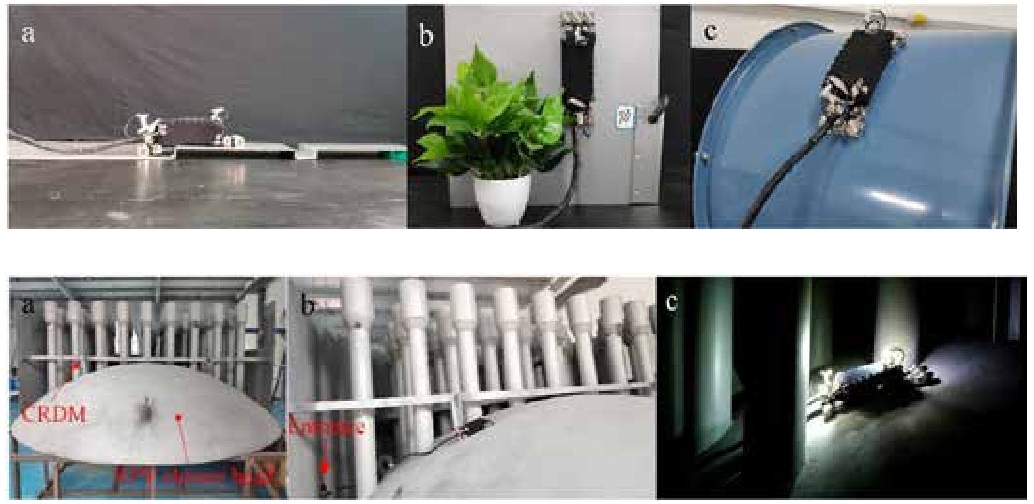
SPRINGWORM: A SOFT CRAWLING ROBOT WITH A LARGE-RANGE OMNIDIRECTIONAL DEFORMABLE RECTANGULAR SPRING FOR CRDM INSPECTION

Professor Zhao Jianwen and his colleagues from the State Key Laboratory of Robotics and System, Harbin Institute of Technology, published a paper titled "SpringWorm: A Soft Crawling Robot with a Large-Range Omnidirectional Deformable Rectangular Spring for CRDM Inspection" in *Soft Robotics*, the leading robotics journal publishing world-class peer-reviewed research on the emerging technologies and developments of soft and deformable robots. This research presents a cable-driven elastic backbone worm-like robot (named "SpringWorm") of decimeter-level size, which has high adaptability in crack inspection of the weld between reactor pressure vessel (RPV) and control rod drive mechanisms (CRDMs). The robot consists of a body that adopts a rectangular helix spring backbone driven by four cables and the flexible claws embedded with distributed electromagnets. Combining the omnidirectional deformation of the



backbone and the passive deformation adsorption of the claws, the robot can achieve a variety of gaits. Moreover, a mechanical model considering the friction between the cable and the backbone has been established.

SpringWorm is 670 g, measures 206 mm×65 mm×75 mm, and has a maximum payload of 1 kg. Compared to rigid robots with multiple DOFs for equipment detection, SpringWorm has safe interaction due to its flexibility; compared to the published flexible robots, SpringWorm has a greater load capacity due to its large local stiffness. Therefore, the proposed robot combines the compliance of soft robot with the large load capacity of rigid robot. The robot has successfully completed crack inspection for CRDMs with a 1:1 simulator. The robot can also work inside other equipment and implement complex actions.

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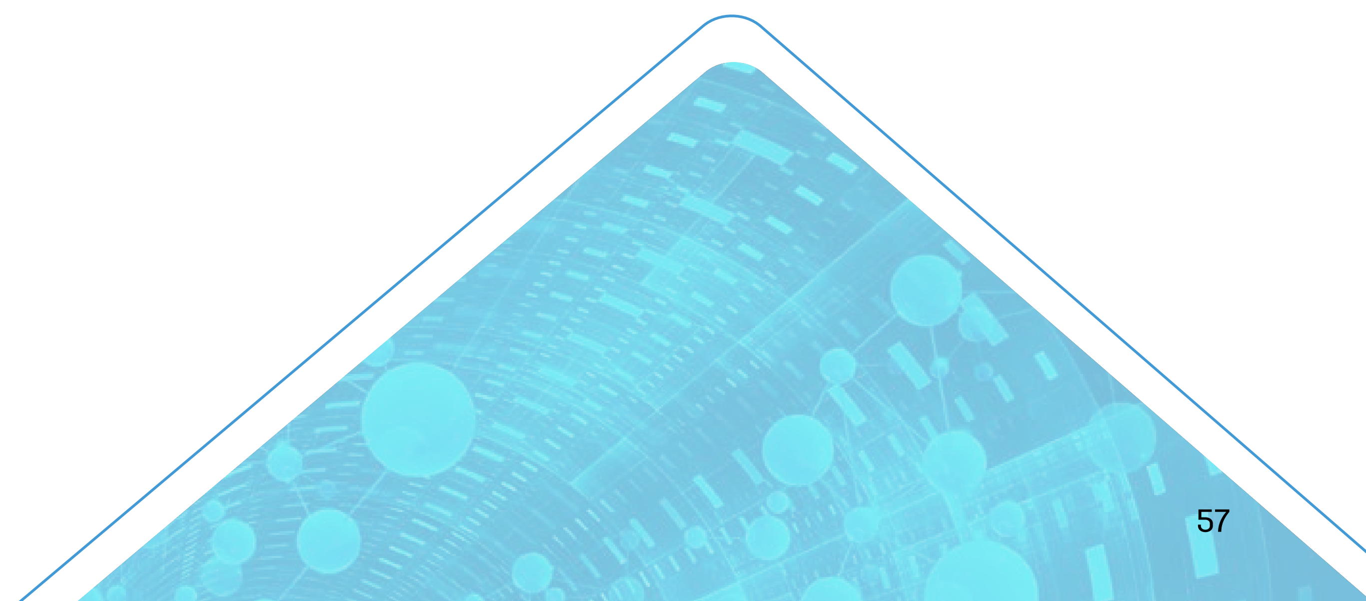
Pengpeng Yang, Bo Huang, David McCoul, Donghu Xie, Mingchao Li, Jianwen Zhao. SpringWorm: a soft crawling robot with a large-range omnidirectional deformable rectangular spring for control rod drive mechanism inspection. Soft Robotics, 2022. DOI: 10.1089/soro.2021.0127

MODULAR BIOINSPIRED HAND WITH MULTIJOINT RIGID-SOFT FINGER POSSESSING PROPRIOCEPTION

Robotic hands are usually rigid and complex in structure, making compliant grasp and manipulation tasks difficult. However, soft hands are intrinsically compliant but usually lack stiffness and proprioception.

Recently, a research group led by Professor Jiang Li, from the State Key Laboratory of Robotics and System, Harbin Institute of Technology, published their latest work on dexterous robotic hands, titled "Modular Bioinspired Hand with Multijoint Rigid-Soft Finger Possessing Proprioception" in the



Rigid-soft humanoid dexterous hand and 32 gasp types

international top journal *Soft Robotics*.

This work develops an advanced platform of humanoid compliant grasping and manipulation. Inspired by the anatomical structure of the human hand, Professor Jiang Li and his co-authors adopted the rigid and soft material combined strategy, developed a rigid-soft structure for the humanoid robotic hand, combining the rigid skeleton, flexible quasi-joint and soft outer skin, embedded with liquid metal sensors system. This 20-DoFs robotic hand can reproduce human behavior, achieve 32 types of grasping, and demonstrate its great potential on compliant grasps and manipulation tasks. This work provides a new idea to develop high-performance dexterous robotic hands.

Professor Jiang Li is the corresponding author. Ph.D. student, Zhen Ruichen is the first author. This work was financially supported by the National Natural Science Foundation of China.■

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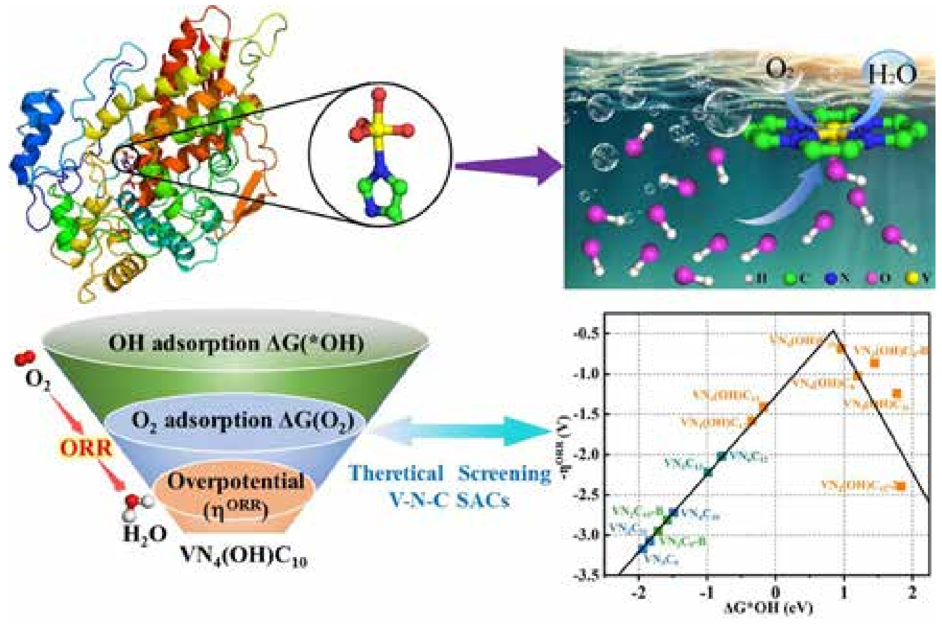
Zhen R., Jiang L., Li H., et al. Modular bioinspired hand with multijoint rigid-soft finger possessing proprioception. Soft Robotics, 2022. DOI: 10.1089/soro.2021.0197

DECRYPTING THE INFLUENCE OF AXIAL FIFTH COORDINATION ON VANADIUM SITES FOR ENHANCING ELECTROCATALYTIC OXYGEN REDUCTION

Recently, Associate Professor Liu Yang's group from the School of Chemistry and Chemical Engineering, Harbin Institute of Technology, reported the coordinatively saturated V-N-C single-atom catalyst (SAC) with spontaneous OH coordination in axial orientation to vanadium atom in alkaline solution for electrocatalytic oxygen reduction reaction (ORR). The research article titled "Atomically Dispersed V-N-C Catalyst with Saturated Coordination Effect for Boosting Electrochemical Oxygen Reduction" was published in *Chemical Engineering Journal*.

Single-atom catalysts (SACs) exhibit impressive catalytic activity for various reactions due to low coordination environment and tunable electronic structures, attracting increasing attention. Inspired by the structure and mechanism of vanadium-dependent haloperoxidase (V-HPO) in macroalgae with a penta-coordinated vanadium active site, penta-coordinated vanadium-based SAC with one OH ligand was designed by DFT method and synthesized by cage-encapsulated precursor pyrolysis strategy in this work. Furthermore, the SCN^- poisoning measurements and DFT calculations revealed the important role of axial coordinated OH ligand on ORR activity. Spontaneous axial OH coordination to V-N-C catalyst in alkaline electrolyte not only optimizes the adsorption interaction for key intermediates to boost ORR activity but also keeps vanadium atom at the highest valence against Fenton activity to improve the stability. This work provides a proof-of-concept design of SACs and broadens the horizon of its potential applications

Liu Yang's research group is engaged in the development



of functional electrocatalysts materials by combining theoretical calculations with experimentation. Recently, the papers "Trimetallic Single-Cluster Catalysts for Electrochemical Nitrogen Reduction Reaction: Activity Prediction, Mechanism, and Electronic Descriptor", "Building up Bimetallic Active Sites for Electrocatalyzing Hydrogen Evolution Reaction under Acidic and Alkaline Conditions", and "Vibronic Coupling of Adjacent Single-Atom Co and Zn Sites for Bifunctional Electrocatalysis of Oxygen Reduction and Evolution Reactions" were published in *Chemical Engineering Journal* and *The Journal of Physical Chemistry Letters*, respectively. These researches were financially supported by the National Natural Science Foundation of China.

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News & Events
HIT TIMES 2022

HIT HELD THE 3RD ANNUAL CONFERENCE OF CHINESE ROBOTICS SOCIETY

From August 3rd to 5th, the 3rd Annual Conference of Chinese Robotics Society was held in Harbin. More than 1,000 experts and scholars attended the conference. CAE Academician Lin Zhongqin (chairman of the Chinese Mechanical Engineering Society and president of Shanghai Jiao Tong University), CAS Academician Han Jiecai (president of Harbin Institute of Technology), and CAE Academician Liu Hong (co-chairman of the conference and vice president of Harbin Institute of Technology) attended the opening ceremony and delivered speeches.


HIT President Han Jiecai


HIT Vice President Liu Hong

This conference was co-sponsored by the Chinese Mechanical Engineering Society, the Chinese Association of Automation, the Chinese Society of Astronautics, the Chinese Association for Artificial Intelligence, and the China Computer Federation. The topic of this year was "Man-Robot Integration, Facing Challenges Together", which aims to further improve the academic research atmosphere in China and provide an important academic exchange platform for Chinese scholars in the field of robotics. There were seven keynote reports, one keynote forum, 12 theme reports, 48 invited reports at sub forums, 108 poster displays, etc. Academicians Wang Tianran, Li Peigen, Yang Wei, Jiang Zhuangde, Yang Huayong, Wang Yaonan, and Mao Ming respectively delivered keynote reports. Nearly 100 national high-level talents made special reports.

Academician Deng Zongquan from HIT served as the initiator of the keynote forum of "Building Equipments and Facilities with National Strategic Importance". Acadamicians Feng Xisheng, Ren Luquan, Tan Jianrong and Huang Qingxue were invited as the forum speakers. Acadamicians Cai Hegao, Ding Han, Qiao Hong, and other experts and scholars from different universities, research institutions, and enterprises across the country exchanged the latest research achievements in the field of robots and provided advice and suggestions for the development of China's robot industry.

HIT PRESIDENT HAN JIECAI ATTENDED THE GLOBAL UNIVERSITY PRESIDENTS' FORUM

On October 6th, the Global University Presidents' Forum was held online and offline at Huazhong University of Science and Technology (HUST). The topic was "Education for Sustainable Development: The Role of Higher Education"; as such the forum featured the presentation of presidents and senior leaders from twelve prestigious universities and organizations home and abroad, including Queensland University, University of California, Manchester University, ParisTech, University of Arizona, Nagoya University, Shanghai Jiao Tong University, Harbin Institute of Technology, Wuhan University, Chongqing University, Wuhan University of Technology, HUST, and APRU (the Association of Pacific Rim Universities). The leaders gave insightful speeches, discussed the opportunities and challenges for the sustainable development of higher education around the world in a new era, and shared cases and techniques to seek high-quality development together.

HIT President Han Jiecai attended and delivered a speech with the topic of "Expanding the Opening Up of Education in the New Era, Creating a Diversified Training Model for Top Talents". He pointed out that scientific and technological innovation has become an international core competitiveness and first-class universities should continuously cultivate first-class innovative talents to meet the challenges of the future world. Through introducing high-quality international education resources, Harbin Institute of Technology cooperates with Zurich University of the Arts, St. Petersburg State University, Bauman Moscow State Technical University, and Moscow Aviation Institute to establish cooperative education projects and explore new models of cooperative education to improve the quality of talent training. Through establishing the Association of Sino-Russian Technical Universities, the collaborative innovation of Chinese and foreign universities has achieved fruitful results and continued to promote the scientific and cultural exchanges between Chinese and Russian universities. Through international joint research centers/laboratories, we will continuously gather global innovation resources.

INTER-SCHOOL COLLABORATIONS

HIT and Emlyon Business School Promoted Further Cooperation

On July 19th, HIT Vice President Zhen Liang met with Wang Hua, vice president of Emlyon Business School, and his delegation in Conference Room 333 of the Administration Building. The two sides held a discussion and exchange on cooperative education projects.

Wang Hua said that he learned more about the history and culture of Harbin Institute of Technology through this visit and hoped that the two sides could share resources and complement each other's advantages through cooperative education projects, and jointly cultivate leading talents of "technology+management".

Zhen Liang said that HIT took the cooperation seriously, and he hoped that both sides can jointly promote high-level international exchanges.

The two sides had in-depth discussions and reached consensus on the training program, discipline construction, school system, personnel training, and other issues of the cooperative education projects.

HIT President Han Jiecai

President of the University of Macau Song Yonghua

HIT Signed Cooperation Agreements with the University of Macau

On August 9th, HIT President Han Jiecai and President of the University of Macau Song Yonghua held a video meeting and jointly signed cooperation agreements. Vice President Zhen Liang chaired the meeting. Ge Wei, vice president of the University of Macau, attended the meeting.

Song Yonghua said that Harbin Institute of Technology has always been an important partner of the University of Macau. Due to the efforts of the past decade, the two universities have achieved mutual benefits and many results through visits, academic exchanges, joint scientific researches, etc. During this opportunity to sign agreements, he hoped to further strengthen the cooperation between both sides in talent training and scientific research innovation, promote the establishment of a regular cooperation between the two universities, and work together to make greater contributions to the development of higher education.

Han Jiecai introduced the latest progress of exchanges with Hong Kong and Macau and other international cooperative education programs. He said that training young talents is important to the future of our nation and Macau. HIT will give full play to its advantages in scientific research and resources, strengthen strategic cooperation with the University of Macau in training top innovative talents, build high-level scientific research platforms, introduce talents, academic and cultural exchanges among young students, and jointly enhance the international influence of the two universities and accelerate the pace of building world-class universities.

At the meeting, they signed the “Strategic Cooperation Framework Agreement,” the “Cooperation Agreement of Recommended Exam-Exempted Projects,” and the “Student Exchange Agreement”.

HIT President Attended Sino-Russian University Alliances Presidents Forum

On December 8th, the first Sino-Russian University Alliances Presidents Forum was held online. HIT President Han Jiecai, the Chinese permanent chairman of the ASRTU, was invited to attend the forum and signed the “Memorandum of Understanding on Cooperation between the Sino-Russian University Alliances in the Fields of Education, Science and Innovation” on behalf of the ASRTU alongside the other 12 alliance units.

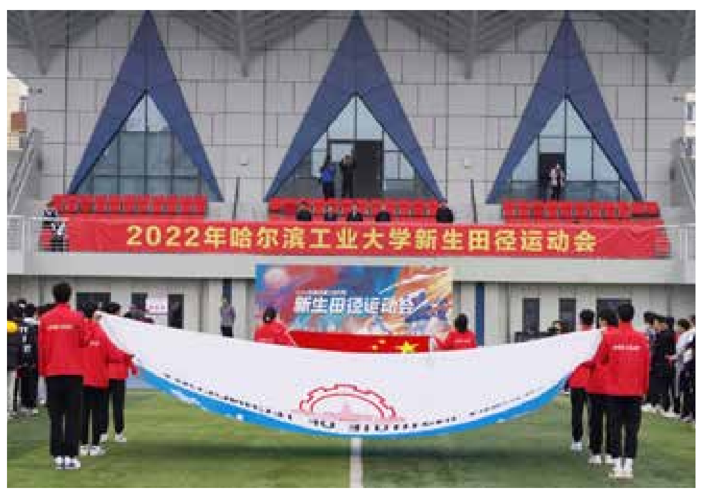
The Sino-Russian University Alliances is composed of the ASRTU and other 12 alliances divided by disciplines or regions and has become the largest bilateral university cooperation network in the world. It aims to strengthen exchanges in modern teaching methods, scientific research, innovation, cultural and social activities.

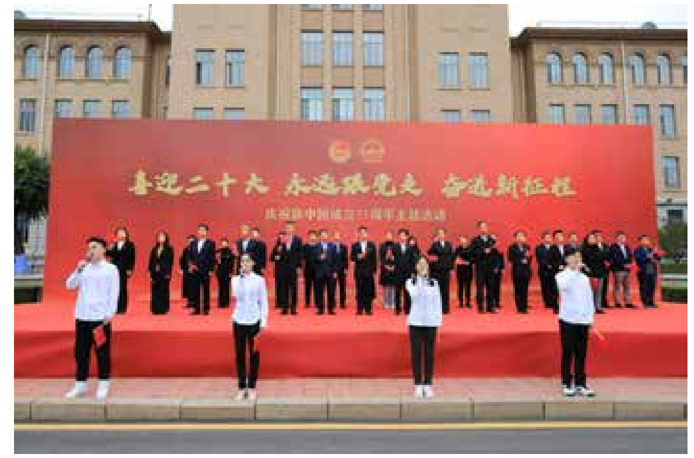
HIT CELEBRATING NATIONAL DAY

On the morning of October 1st, a flag raising ceremony was held at three campuses of Harbin Institute of Technology to celebrate the 73rd anniversary of the founding of new China. During the activity, teachers and students waved the national flag and sang "My Motherland and I" together to express their feelings of patriotism.

HIT also organized a series of activities to celebrate National Day: a carnival, a gala for new students, a drawing activity, a painting competition, marathon, and freshmen's track and field games.

HIT CELEBRATING NATIONAL DAY





HIT CELEBRATING NATIONAL DAY

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