香港科技大學
THE HONG KONG UNIVERSITY OF
SCIENCE AND TECHNOLOGY

香港科大能源研究院
The HKUST
Energy Institute

HKUST EI

ENERGY INSTITUTE NEWSLETTER

DECEMBER 2024

BUILDING A BRIGHTER FUTURE

Contents

December 2024

Published by:
The HKUST Energy Institute
The Hong Kong University of Science and Technology

Advisor:
Prof. Minhua Shao

Editor:
Ms. Hester Chau

EI Website:
ei.hkust.edu.hk

Message from the Director

Prof Minhua Shao
Director of the HKUST Energy Institute
Cheong Ying Chan Professor of Energy Engineering and Environment
Head and Chair Professor, Department of Chemical and Biological Engineering

Energy transition is a global and common challenge, but it also offers opportunities. Driving the energy transition forward in a sustainable way, it is imperative to accelerate innovative research, intensive dialogue and idea exchange among all involved stakeholders and the society. In this issue, I am pleased to present you some of the latest research findings of our members and activities.

I am thrilled to share with you that our faculty members have recently awarded a total of around HK$17.3 million from the Hong Kong Research Grants Council (RGC) for their team-based projects. Congratulations to Prof. Yoonseob KIM awarded the Collaborative Research Fund and Prof. ZHOU Yuanyuan the Young Collaborative Research Fund, and I received the Research Impact Fund. We delighted to welcome five new members.

To enhance cross-disciplinary collaboration and knowledge transfer, we are proud to announce our participation in the HKUST-CATL (Contemporary Amperex Technology) partnership to advance innovation and talent grooming in sustainable development and new energy technology. And more, established a Joint Laboratory for Hydrogen Energy with Changchun Institute of Applied Chemistry, CAS. We also signed two Memorandums of Understanding with Baima Lake Laboratory and Langya District, Chuzhou City. These collaborations underscore our dedication to bridging the gap between research and practice.

To connect the community, we co-organized the 22nd International Meeting on Lithium Batteries (IMLB) which was held in AsiaWorld-Expo in June. Hosted NSFC-BHKAEC Joint Symposium on Electrochemical Interfaces in Energy Conversion and Storage in November and the exhibition and sharing on “Energy in Transition - Powering Tomorrow” with Consulate General of the Federal Republic of Germany in Hong Kong in September.

We acknowledge the outstanding dedication and synchronized effort of our members! We value your staying connected to us!

Prof. SHAO Minhua and Prof. GAO Ping Awarded HK$6.9 million RGC Research Impact Fund

Prof. SHAO Minhua, Director of Energy Institute, Cheong Ying Chan Professor of Energy Engineering and Environment, and Head and Chair Professor of Chemical and Biological Engineering, and Prof. Ping GAO, Professor of Chemical and Biological Engineering, have been awarded the Research Impact Fund (RIF) of HKD6.9 million and a matching fund of ~HK$2.9 million from HKUST, for the project titled "Development of Solid State Lithium Batteries for Electric Vehicles".

Solid-state batteries (SSBs) have attracted great attention owing to their higher safety and energy densities than conventional Li-ion batteries. Thus, they are a better choice as the power source for electric vehicles. However, the lack of reliable and highly conductive solid electrolytes, high-energy cathodes, and stable Li metal anodes has hindered the development of SSBs.

Working together with local and international researchers, this study aims to develop solid-polymer-electrolyte (SPE)-based SSBs with unprecedented performance by tackling these issues. By integrating a high energy composite cathode, an SPE composite hybrid electrolyte, and a stable Li-metal anode, the team expects to achieve an SSB with an energy density exceeding 400 Wh kg-1. The outcomes of this project will advance the development of next-generation SSB technology and accelerate the widespread adoption of electric vehicles which can significantly reduce the dependence on fossil fuels. More advanced, zero-emission EVs will help to achieve a more sustainable world.

This project is collaborated with Southern University of Science and Technology, China; College de France, France; The Pennsylvania State University, USA; Argonne National Laboratory, USA; Contemporary Amperex Technology Co. Limited (CATL), China; and Shenzhen BAK Battery, China

The RIF encourages academics to harness the potential of their research to deliver benefits to the wider community, spurring impactful and translational research projects. The Fund also promotes collaboration between academia and government departments, the business sector, industry and research institutes. Successful projects are granted funding of up to HK$10 million per project for a three to five-year period.

Prof. Yoonseob KIM Awarded HK$5.5 Million RGC Collaborative Research Fund

Prof. Yoonseob KIM of Chemical & Biological Engineering has been awarded nearly HK$5.5 million by the Collaborative Research Fund (CRF) for the multidisciplinary research on "High-Energy-Density All-Solid-State Lithium-Metal Batteries".

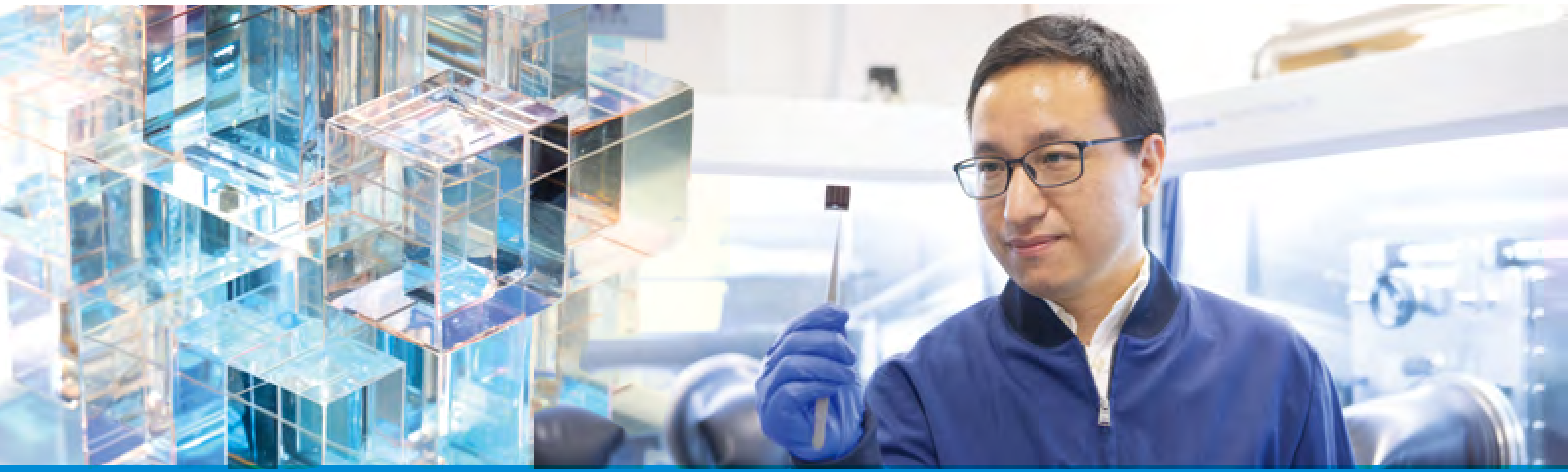
Lithium (Li)-metal batteries (LMBs), holding the highest energy density, have great potential in the energy storage market. However, safety issues related to unstable Li anode and high reactivity of Li in all types of liquid solvents have severely impeded LMB development. As a breakthrough, solid electrolytes have received significant attention. These are promising if they can conduct Li^+ rapidly in a reliable manner and can be integrated into full cells with minimum contact resistance.

Prof. Kim and his team set out to develop a new generation of solid electrolytes for LMBs. These solid electrolytes are called ionic covalent organic frameworks (iCOFs). iCOF solid electrolytes can transport Li^+ rapidly and reliably, while showing high electrochemical/mechanical/chemical stability for battery applications. Since these iCOFs are emerging materials, they will conduct a multi-scale modeling, e.g., density functional theory and molecular dynamic simulations, to understand Li^+ conduction pathways, etc. With these understandings, the research team will fabricate LMB full cells to show a high reversible capacity to operate stably up to 800 cycles. These findings demonstrate the great potential of iCOFs for electrochemical energy storage devices.

Working together with PolyU and HKU researchers, Prof. Kim has confidence that the successful completion of the proposed project will establish design guidelines for COF-based solid electrolytes for all-solid-state LMBs. Adopting all-solid-state rechargeable batteries will render electric vehicles more robust, safe, and affordable, ultimately leading to environmental and economic benefits both in Hong Kong and further afield.

The Collaborative Research Fund is one of the most competitive research grants in Hong Kong, administered by the Research Grants Council (RGC). The Fund aims at encouraging research groups in universities funded by the University Grants Committee to engage in collaborative research across disciplines and universities with a view to enhancing the research output in terms of the level of attainment, quantity, dimensions and speed.

Prof. ZHOU Yuanyuan Awarded HK$4.9 Million RGC Young Collaborative Research Grant



Prof. ZHOU Yuanyuan of Chemical and Biological Engineering and his collaborators from The University of Hong Kong (HKU) received a Young Collaborative Research Grant (YCRG) of around HK$4.9 million for their project on "Perovskite Opto-Ionics for In-Sensor Computing".

In-sensor computing has rapidly emerged as a promising avenue towards building next-generation intelligent systems that can find enormous uses in the sensor nodes in the future IoTs. But the fundamental device unit – (opto-) electronic memristors, being developed to date, is still limited in controllability and biomimicry. This collaborative project proposes to explore emerging (opto-)ionics in metal halide perovskites, and to exploit the uniqueness and versatility of these materials to develop memristors with low device-to-device and cycle-to-cycle variations for more reliable in-sensor computing.

Ordinary memristors face significant challenges for being applied to in-sensor computing due to programming stochasticity, unstable response to electrical stimulation, and insufficient response to light. These issues are rooted in the fact that memristive layers are metal oxides and chalcogenides in low-crystallinity states. They respond to electrical simulation with redox reactions and ion migrations in electrolytes with random or disorder structures, resulting in limited controllability and biomimicry. Perovskites are a new class of ionic semiconductors which exhibit a high-level coupling of photonic, electronic, and ionic processes, potentially delivering multilevel biomimetic behavior involving the interplay with light. Furthermore, the versatility of the perovskite family has set a foundation for achieving a wide range of controllable properties, which can be further exploited by forming perovskite composites between two or more distinct compositions to create new bulk properties. This unleashes the high potential of perovskite memristors.

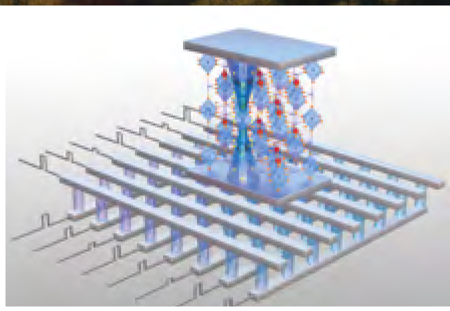
By assembling all key expertise of areas, this project aims to establish an interdisciplinary research program centered at the frontier science and engineering of perovskite memristors. A bottom-up approach will be adopted to reveal new sciences across the atomic to device/system scales. Highly interrelated tasks will be performed with the following three objectives: (i) fundamental investigation of emerging (opto-)ionics underpinning the memristive behavior in perovskites; (ii) nano-engineering of perovskite film structures for achieving high-performance memristors; (iii) development of a perovskite-based in-sensor reservoir computer to enable edge learning.

The outcome of this project will generate impacts not only for developing a new prototypical in-sensor computing technology that finds vital use in edge scenarios in the practical world, but more importantly for creating an uncharted territory of materials and device sciences with overarching impacts on the progress of various energy and electronic devices.

Established under the Collaborative Research Fund (CRF), YCRC aims to encourage young researchers to gain experience in leading and managing collaborative research at their early career stage so as to pave the way for seeking larger collaborative research funding in future.

HKUST Engineering Researchers Discover a "Secret" Hidden Structure that Paves New Way of Making More Efficient and Stable Perovskite Solar Cells

A research team led by Prof. Yuanyuan (Alvin) ZHOU of Chemical and Biological Engineering revealed the existence of surface concavities on individual crystal grains – which are the fundamental blocks – of perovskite thin films, and unravel their significant effects on the film properties and reliability. Based on this fundamental science discovery, the team pioneered a new way of making perovskite solar cells more efficient and stable via a chemo-elimination of these grain surface concavities.



A new-generation solar cells developed by Prof. YuanYuan ZHOU and his research group, known as perovskite solar cells.

Perovskite solar cells are a stellar solar-cell technology that has demonstrated potential to replace existing silicon solar cells in a wide range of application scenarios, for example grid electricity, portable power, and space photovoltaics. They not only attain higher power conversion efficiencies (PCEs) than commercial silicon cells, but also offer advantages in terms of low material costs, sustainable manufacturing, and high versatility in transparency and colors. However, the long-term stability of perovskite devices under light, humidity, and thermomechanical conditions remains a hurdle in the commercialization of this promising solar technology.

To address this issue, Prof. Yuanyuan ZHOU, Associate Professor of the Department of Chemical and Biological Engineering at HKUST, and his research group have conducted fundamental-oriented research from a unique perspective of materials' microstructure. They discovered a proliferation of surface concavities at the crystalline grains of the perovskite material. These concavities are shown to break the structural continuity at the perovskite film interface, serving as a hidden microstructure factor limiting the efficiency and stability of perovskite cells.

Then, the team took an innovative step to remove the grain surface concavities by using a surfactant molecule, tridecafluorohexane-1-sulfonic acid potassium, to manipulate the strain evolution and ion diffusion during the formation of perovskite films. Accordingly, their final perovskite cells demonstrated obvious improvements in efficiency retention under standardized thermal cycling, damp-heat, and maximum-power-point tracking tests.

"Structure and geometry of individual crystalline grains are the origin of the performance of perovskite semiconductors and solar cells. By unveiling the grain surface concavities, understanding their effects, and leveraging chemical engineering to tailor their geometry, we are pioneering a new way of making perovskite solar cells with efficiency and stability towards their limits," said Prof. Zhou, the corresponding author of this work.

"We were very intrigued by the surface concavities of perovskite grains when we were using atomic force microscopy to examine the structural details of perovskite films. These concavities are usually buried underneath the film bottom and easily be overlooked," said the first author of this work, XIAO Tong, a PhD student under the Hong Kong PhD Fellowship Scheme (HKPFS) in Prof. Zhou's research group.

"Microstructure is of vital importance for perovskite solar cells and other optoelectronic devices, and can be more complex than conventional materials owing to the hybrid organic-inorganic characteristics of perovskite materials. Under Prof. Zhou's guidance, we are able to develop various novel characterization and data-science approaches to gain insights into perovskite microstructure," said ZHANG Yalan, another PhD student and the co-author of this work.

The team's research work has now been published in the prestigious journals, titled "limination of grain surface concavities for improved perovskite thin-film interfaces", in Nature Energy and "Chiral-structured heterointerfaces enable durable perovskite solar cells" in Science. The work was collaborated with Hong Kong Baptist University and Yale University.

HKUST Engineering Researchers Develop Advanced Solid-State Electrolytes for High-Performance All-Solid-State Lithium Metal Batteries

(From left) Prof. Yoonseob Kim, Assistant Professor of the Department of Chemical and Biological Engineering at HKUST, and his PhD students: Huang Jun (the first author of the paper), Li Chen and Luo Hang

Researchers at the School of Engineering of the Hong Kong University of Science and Technology (HKUST) have recently developed a new generation of solid-state electrolytes (SSEs) for lithium-metal batteries (LMBs), that can greatly improve the safety and performance. This groundbreaking discovery can help advance the development of energy storage technologies for battery applications like electric vehicles, portable electronics, and power grids.

Compared to traditional liquid electrolyte LMBs, all-solid-state LMBs offer enhanced safety and higher energy density by replacing the flammable organic solvent electrolytes with solid electrolytes and suppressing a harmful phenomenon called dendrite growths. They present a promising future for developing energy storage technologies. However, their wider adoption has been limited by low ionic conductivity and Li+ transference number at room temperature.

To address this challenge, the research team led by Prof. Yoonseob KIM, Assistant Professor of the Department of Chemical and Biological Engineering at HKUST, has developed a novel strategy that combines a class of porous called ionic covalent organic frameworks (iCOFs) with a type of polymer called poly(ionic liquid) (PIL) for fabricating solvent- and plasticizer-free SSEs with high performance.

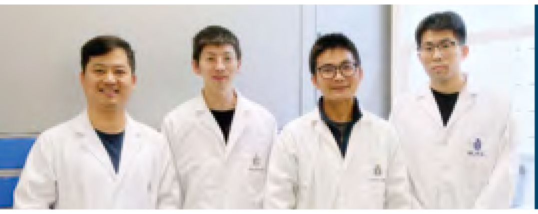
This new iCOF/PIL composite SSE achieved exceptional ionic conductivity (up to 1.50×10^{-3} S cm^{-1}) and lithium-ion transport capability (> 0.80) at room temperature. Through combined experimental and computational studies, the team revealed that the co-coordination and competitive coordination mechanisms established between the PIL, lithium bis(trifluoromethanesulfonyl)imide (LiTFSI) and iCOFs enable rapid Li^+ transport while restricting the movement of $TFSI^-$.

Using this advanced SSE, the team further fabricated a LMB full cell, made of composite SSEs and $LiFePO_4$ composite cathode, and found that it demonstrated an initial discharge capacity of 141.5 mAh g^{-1} at 1C and room temperature, with an impressive capacity retention of 87% over 800 cycles.

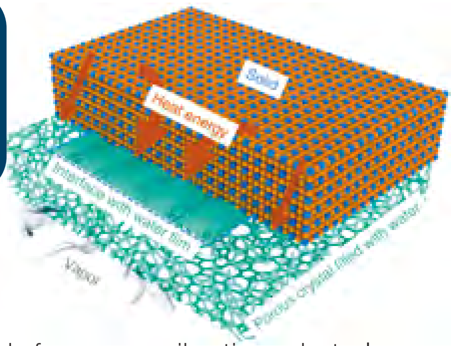
"Our breakthrough approach demonstrates stable cell operation and shows a high reversible capacity in all-solid-state LMBs for the first time. It unleashes great potential of iCOFs for electrochemical energy storage devices, opening up new paths forward for wider adoption of all-solid-state LMBs in a variety of applications, from electric vehicles to portable electronics and power grids," Prof. Kim said.

This study was a collaboration between researchers at HKUST, Shanghai Jiao Tong University and Zhejiang University in Mainland China and Hanyang University in South Korea. The research paper, titled "High-Performance All-Solid-State Lithium Metal Batteries Enabled by Ionic Covalent Organic Framework Composites", was recently published in *Advanced Energy Materials*, a prime applied energy journal for research providing solutions to today's global energy challenges.

HKUST Researchers Enhance Performance of Eco-Friendly Cooling Applications by Developing Sustainable Strategy to Manipulate Interfacial Heat Transfer



Prof. Zhou Yanguang (second right), Assistant Professor of Mechanical and Aerospace Engineering at HKUST, and his PhD students Fan Hongzhao (first left), Wang Guang (second left) and Li Jiawang (first right)



Heat transferred from the solid substrate to passive cooling porous crystals via water filled interfaces

The research team led by Prof. Simen Yanguang ZHOU, Assistant Professor of Mechanical and Aerospace Engineering, has developed a sustainable and controllable strategy to manipulate interfacial heat transfer, paving the way for improving the performance of eco-friendly cooling in various applications such as electronics, buildings and solar panels.

As demand for effective cooling solutions continues to grow due to the rising global temperature, scientists worldwide have been actively exploring energy-saving cooling technologies that are more effective. Compared to active cooling, which entirely depends on energy consumption to operate, passive cooling relies on natural processes and design principles to reduce heat and maintain a comfortable temperature with low or no energy consumption. This approach has therefore generated wide interest among researchers due to its eco-friendly nature and zero-electricity characteristic.

One emerging field of study is passive cooling using metal-organic frameworks (MOFs), which are porous materials that can capture water vapor from the air and be used to increase energy efficiency in room temperature space cooling applications. However, MOFs typically exhibit low thermal conductivity, making them poor thermal conductors. Moreover, the presence of adsorbed water molecules in MOFs further reduces their effective thermal conductivity. This limitation leaves little room for manipulating the intrinsic thermal transport properties of MOFs to enhance their cooling performance.

To address the issue, researchers worldwide have turned their attention to the interfacial heat dissipation between MOFs and the materials they come into contact with. Various approaches, including the use of adhesion layers, nanostructures, chemical modification, and self-assembled monolayers, have been employed to enhance the interfacial thermal conductance (ITC). However, synthesizing or fabricating buffer layers with precise atomic control is a challenging task, limiting the potential applications of these methods.

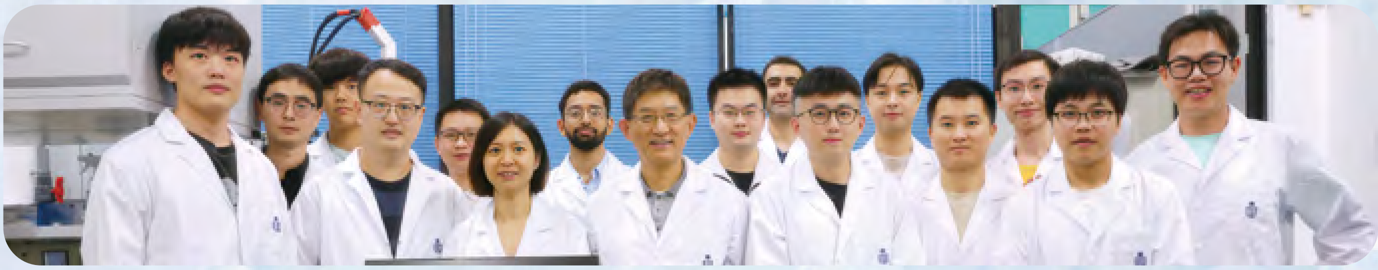
In their pioneering work, Prof. Zhou and his team introduced a sustainable and controllable strategy to manipulate interfacial heat transfer between the contacted substrate and typical MOFs by utilizing a water adsorption process. Through comprehensive frequency-domain thermoreflectance (FDTR) measurements and molecular dynamics (MD) simulations, they have demonstrated a remarkable improvement in ITC between the contacted substrate and MOFs. The ITC was increased from 5.3 MW/m2K to 37.5 MW/m2K, representing an enhancement of approximately 7.1 times. Effective enhancements are also observed in other Au/MOF systems.

The research team attributes this improvement to the formation of dense water channels facilitated by the adsorbed water molecules within MOFs. These channels serve as additional thermal pathways, significantly enhancing thermal energy transfer across the interfaces. Further analysis using the frequency domain direct decomposition method developed by the team found that the adsorbed water not only activates the high-frequency vibrations, but also increases the overlap of vibrational density of states between the substrate and MOF which enhances the thermal energy dissipation from the substrate to MOF, highlighting the bridge effect of the adsorbed water molecules.

"This innovative study not only provides new insights into thermal transport across MOFs and other materials, but also holds great promise for enhancing the performance of cooling applications involving MOFs. By leveraging the water adsorption process, our team has achieved a breakthrough in manipulating interfacial heat transfer, paving the way for more efficient cooling technologies," said Prof. Zhou.

Their research work, titled "Direct Observation of Tunable Thermal Conductance at Solid/Porous Cystalline Solid Interfaces Induced by Water Adsorbates", was recently published in first-rate multidisciplinary journal *Nature Communications*. The metal-organic findings of the team were also highlighted by the Croucher Foundation, a prestigious foundation promoting science in Hong Kong, in the Croucher News titled "Hong Kong researchers unlock key to boosting eco-friendly cooling" (publishing date: 3 Jun 2024). Led by Prof. Zhou, the team included his PhD students WANG Guang, FAN Hongzhao, and LI Jiawang, as well as Associate Head of the Department of Mechanical and Aerospace Engineering at HKUST Prof. LI Zhigang.

HKUST Engineering Researchers **Develop Eco-Friendly Cooling Device** with Record-Breaking Efficiency



Prof. Sun Qingping (front row, fourth left), Prof. Yao Shuhuai (front row, third left), both Professors of Department of Mechanical and Aerospace Engineering (MAE), MAE Postdoctoral Research Associate Dr. Zhou Guoan (front row, second left), MAE PhD student Li Zexi (front row, first left), and other members of the research team with their elastocaloric air conditioner.

Researchers at the School of Engineering of the Hong Kong University of Science and Technology (HKUST) have developed an eco-friendly refrigeration device with record-breaking cooling performance in the world, setting to transform industries reliant on cooling and reduce global energy use. With a boost in efficiency of over 48%, the new elastocaloric cooling technology opens a promising avenue for accelerating the commercialization of this disruptive technology and addressing the environmental challenges associated with traditional cooling systems.

Traditional vapor compression refrigeration technology relies on refrigerants of high global warming potential. Solid-state elastocaloric refrigeration based on latent heat in the cyclic phase transition of shape memory alloys (SMAs) provides an environmentally friendly alternative, with its characteristics of greenhouse gas-free, 100% recyclable and energy-efficient SMA refrigerants. But the relatively small temperature lift between 20 and 50 K, which is a critical performance indicator of the cooling device's ability to transfer heat from a low-temperature source to a high-temperature sink, has hindered the commercialization of this emerging technology.

To overcome the challenge, the research team led by Prof. SUN Qingping and Prof. YAO Shuhuai from the Department of Mechanical and Aerospace Engineering has developed a multi-material cascading elastocaloric cooling device made of nickel-titanium (NiTi) shape memory alloys and broke the world record in its cooling performance.

They selected three NiTi alloys with different phase transition temperatures to operate at the cold end, intermediate end, and hot end, respectively. By matching the working temperatures of each unit with the corresponding phase transition temperatures, the overall device's superelastic temperature window was expanded to over 100 K and each NiTi unit operated within its optimal temperature range, significantly enhancing the cooling efficiency. The built multi-material cascading elastocaloric cooling device achieved a temperature lift of 75 K on the water side, surpassing the previous world record of 50.6 K. Their research breakthrough, titled "A Multi-Material Cascade Elastocaloric Cooling Device for Large Temperature Lift", was recently published in *Nature Energy*, a top journal in the field.

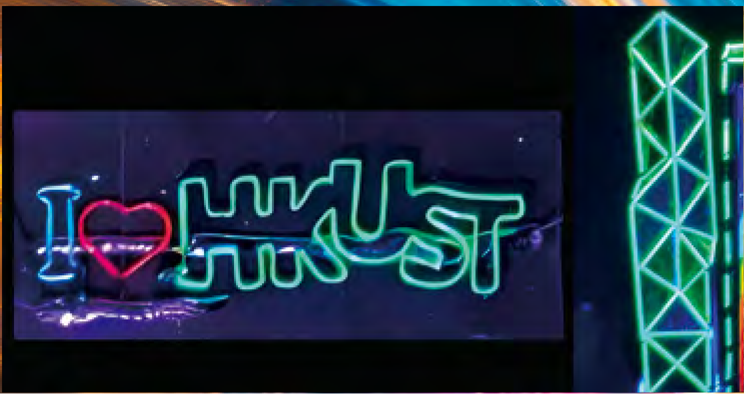
Building on the success in developing elastocaloric cooling materials and architectures with many patents and papers published in leading journals, the research team plans to further develop high-performance shape memory alloys and devices for sub-zero elastocaloric cooling and high-temperature heat pumping applications. They will continue to optimize material properties and develop high-energy efficient refrigeration systems to drive the commercialization of this innovative technology.

Space cooling and heating account for 20% of the world's total electricity consumption and, according to industry estimates, are projected to become the second-largest source of global electricity demand by 2050.

"In the future, with the continuous advancement of materials science and mechanical engineering, we are confident that elastocaloric refrigeration can provide next-generation green and energy-efficient cooling and heating solutions to feed the huge worldwide refrigeration market, addressing the urgent task of decarbonization and global warming mitigation," Prof. Sun said.

The research work was conducted by Prof. Sun and Prof. Yao (both corresponding authors), Postdoctoral Research Associate and PhD graduate Dr. ZHOU Guoan (first author), PhD student LI Zexi, PhD graduates ZHU Yuxiang and HUA Peng, as well as a collaborator from Wuhan University.

HKUST Engineering Researchers Develop Full-Color Fiber LEDs Based on Perovskite Quantum Wires




Photoluminescence of flexible full-color Fi-LEDs: I ♥ HKUST pattern (left) and "night scene" of Victoria Harbor showing color transition (right), built by mounting batches of fibers.

A research team led by Prof. FAN Zhiyong, Chair Professor of Electronic & Computer Engineering and Department of Chemical & Biological Engineering has developed full-color fiber light-emitting diodes utilizing perovskite quantum wires (PeQWs), paving the way for innovative wearable lighting and display devices.

Fiber light-emitting diodes (Fi-LEDs) stand out as a key component in the realm of flexible LEDs because of their compatibility with textile fabrication and excellent spatial luminance uniformity. Metal halide perovskites (MHPs) have emerged as promising light-emitting materials for next-generation LEDs due to their superior optoelectronic properties. Despite the potential, the fabrication of MHP-based Fi-LEDs has faced challenges such as gravity- and surface tension-induced nonuniform coating, low-quality crystallization, and complex electrode deposition processes, which all culminate in uneven and inefficient light emission.

To tackle these issues, the research team led by Prof. Fan employed a novel approach using porous alumina membrane (PAM) templates on thin aluminum fibers. The PAM, with an ultrasmall pore size of approximately 5 nm, was fabricated on aluminum fibers using a roll-to-roll solution-coating process. The MHP precursor solution was filled into the PAM channels, followed by a surrounding annealing procedure to ensure spatially uniform solvent vaporization and MHP crystallization. This method enables the uniform growth of PeQW arrays and minimizes the formation of unwanted thin-film structures on the PAM surface.

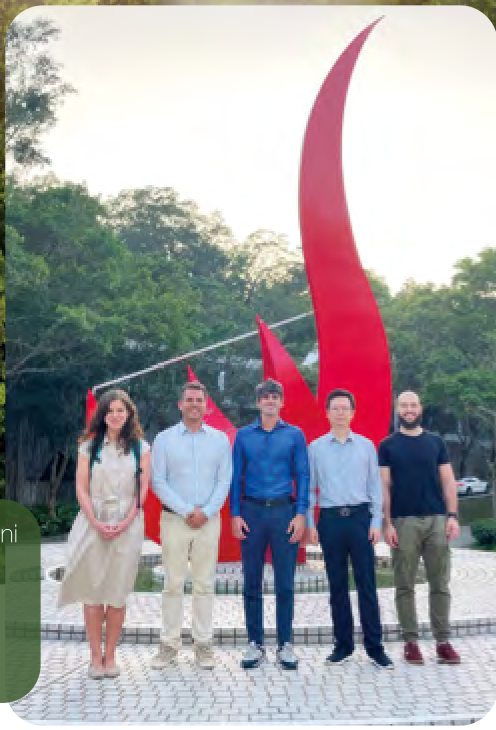
The research team successfully demonstrated the fabrication of full-color Fi-LEDs with emission peaks at 625 nm (red), 512 nm (green), and 490 nm (sky-blue). The fabricated fibers exhibited good bendability and stretchability, making them suitable for textile lighting applications. Various 2D and 3D architectures were showcased, including a 2D full-color string "I ♥ HKUST", all with excellent fluorescence uniformity. Additionally, a "night scene" of Victoria Harbor was created using PeQWs with halide gradient-induced color transitions, highlighting the versatility and aesthetic potential of the Fi-LEDs.

This work presents a significant advancement in the field of Fi-LEDs. Future developments could focus on enhancing the efficiency and stability of the Fi-LEDs, exploring new perovskite compositions for a broader range of emission colors, and integrating these devices into commercial textile products.

"The combination of quantum confinement effect and the passivation from the 3D porous alumina membrane structure has enabled us to achieve outstanding photoluminescence and electroluminescence efficacy. Our innovative approach for fiber LEDs opens up new possibilities for fabricating unconventional 3D-structured lighting sources, paving the way for advanced wearable display technologies," said Prof. Fan.

The research work was published in first-rate multidisciplinary journal *Science Advances* entitled "Full-Color Fiber Light-Emitting Diodes Based on Perovskite Quantum Wires". Electronic and Computer Engineering PhD student REN Beitao is the first author, and Prof. Fan is the corresponding author. Other co-authors include PhD students and postdoc researchers in Prof. Fan's group and collaborators in Sun Yat-sen University and Nanjing University of Science and Technology.

HKUST Researchers Find Strategic Emission Caps Key to Ammonia Industry Decarbonization



(From left) Prof. Magdalena KLEMUN, Assistant Professor of HKUST's PPOL; Prof. Giovanni SANSAVINI and Dr. Paolo GABRIELLI from ETH Zurich's Department of Mechanical and Process Engineering; Prof. LU Zhongming, Assistant Professor of HKUST's ENVR; and Dr. Stefano MINGOLLA, PhD Graduate of HKUST's ENVR and currently a postdoctoral researcher at Carnegie Science, Stanford University of the research team.

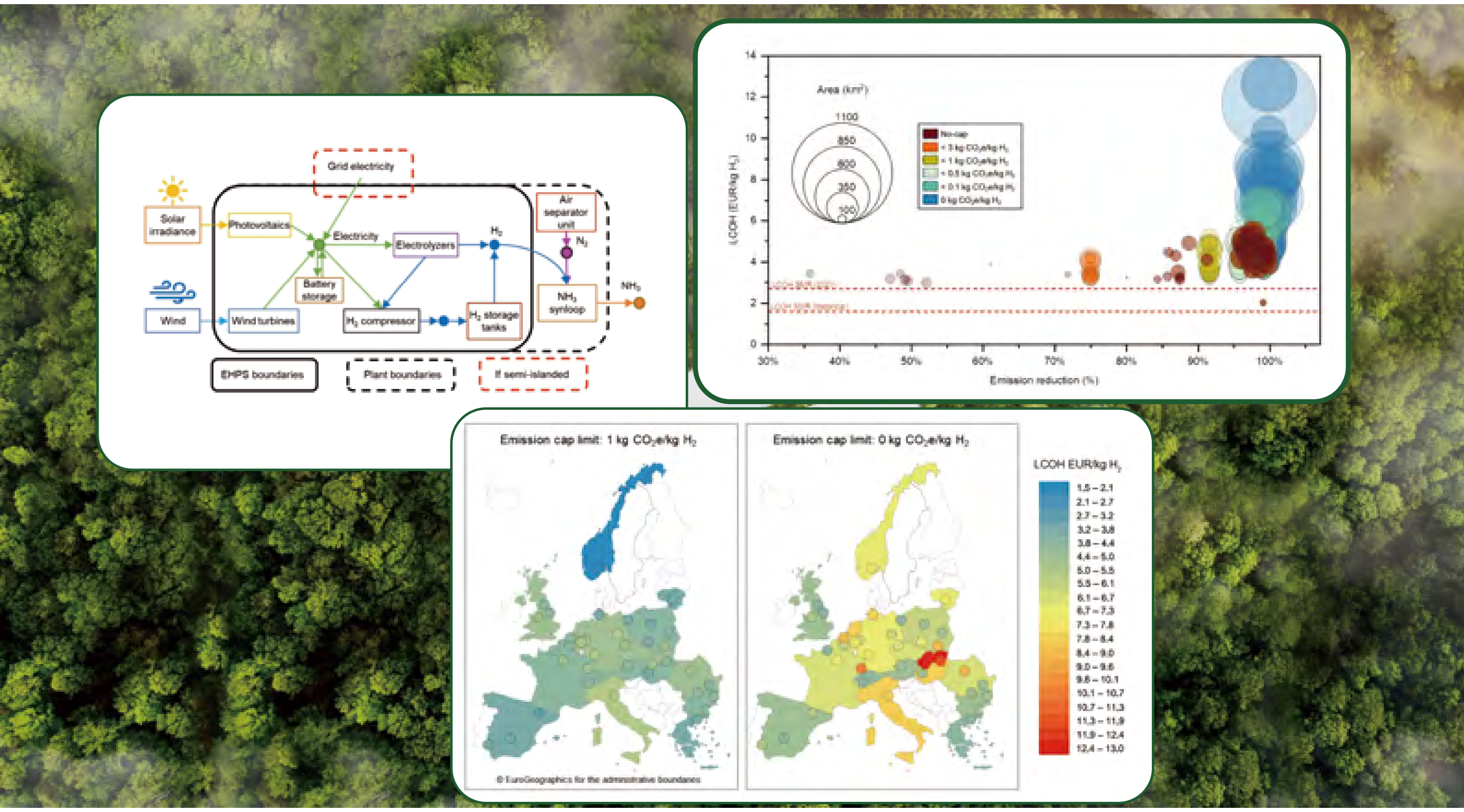
An international cross-disciplinary research team led by the Hong Kong University of Science and Technology (HKUST) has revealed critical insights into how strategic emission cap choices can lead to cost-effective, near-100% ammonia industry decarbonization while avoiding issues such as land use constraints and grid congestion. This groundbreaking study is the first to identify cost-optimal characteristics for ammonia production plants and emission reduction targets.

Ammonia production, which accounts for 36 million metric tons of carbon dioxide emissions annually in Europe, primarily relies on hydrogen derived from fossil fuels. These emissions could be drastically reduced by electrolytic hydrogen – producing hydrogen via water electrolysis – as it only requires electricity, which could be generated by renewable sources.

However, transiting to low-carbon alternatives, particularly electrolytic hydrogen using grid electricity, poses major economic and logistical challenges as the complex impact of regional factors – including the availability of renewable resources and the carbon intensity of local electricity production – on the relationship between emission standards and costs is not well understood.

To fill this gap, a study first-authored by Dr. Stefano MINGOLLA, PhD Graduate of HKUST's ENVR and now a post-doc at the Carnegie Institution for Science, and co-led by Prof. LU Zhongming, Assistant Professor of HKUST's Division of Environment and Sustainability (ENVR) and Prof. Magdalena KLEMUN, Assistant Professor of HKUST's Division of Public Policy (PPOL), has examined the impact of a range of emission caps on costs and the feasibility of transitioning to renewable-based electrolytic hydrogen production in Europe, leveraging high-resolution renewables data from 38 European locations and spanning the years 2024 to 2050. While the data inputs and results are EU-specific, the approach can be useful for other world regions and hard-to-abate sectors transitioning to low-carbon fuels. The research was conducted in collaboration with researchers at the Institute of Energy and Process Engineering at ETH Zurich and also involved students and scientists at HKUST's Department of Mechanical and Aerospace Engineering, the Ammonia Industry Association, and the University of Bayreuth.

They identified that achieving ambitious emission reduction targets, such as cutting emissions by 95% compared to current levels, is feasible with minimal cost escalation over less stringent targets



proposed by regulatory bodies like the European Commission. However, transitioning to 100% emission reduction – operating entirely off-grid with renewable energy sources – presents substantial cost and land use implications, particularly in regions with resource limitations.

“Strategic choices in setting emission caps are pivotal for the ammonia industry's transition to low-carbon technologies,” Prof. Lu said. ”This study provides vital insights for policymakers aiming to balance environmental goals, costs, and resource availability while ensuring the feasibility of industrial energy transitions.” The team highlights the need for strategic choices of emission caps, combined with investments in technology innovation, to enable continued cost reductions in plant components and improve the flexibility of plant designs. Because more flexible plants can better respond to varying renewable energy availability, they reduce the need for expensive backup infrastructure, thereby cutting the costs and land requirements of off-grid electrolytic hydrogen production.

Policymakers could set more stringent decarbonization targets for regions that present a combination of favorable conditions for the deployment of electrolytic hydrogen that can allow near-zero emissions while bearing minimal or no cost increases compared to fossil-based hydrogen production, while less stringent or delayed measures could apply to other regions.

“By adopting region-specific, phased strategies and prioritizing plant flexibility, the hard-to-abate industry can better manage its transition to low-carbon technologies while maintaining competitiveness,” Dr. Mingolla said.

The findings of their study were recently published in *Nature Communications*, by lead author Dr. Stefano MINGOLLA, co-leads Prof. LU Zhongming and Prof. Magdalena KLEMUN, and group members Prof. Francesco CIUCCI from HKUST’s Department of Mechanical and Aerospace Engineering, Prof. Giovanni SANSAVINI and Dr. Paolo GABRIELLI from the Department of Process Engineering at ETH Zurich, Alessandro MANZOTTI and Matthew ROBSON, and Dr. Kevin ROUWENHORST from the Ammonia Energy Association.

Why Soft Technology Matters for the Clean Energy Transition

Technologies like solar photovoltaic systems consist of more than hardware — however, system deployment processes have lagged behind physical equipment in their rate of improvement, a new study finds.

The decline in the price of solar photovoltaic (PV) systems over the past decades is often considered a success story for clean energy technology. But what drove this trend, and how much did improvements in hardware contribute compared to changes in installation processes?

Researchers at HKUST, MIT, and Harvard have identified the most influential sources of cost change and developed a framework that provides a glimpse into future cost drivers. “Improvements in ‘hardware features’ like material usage or device efficiencies not only caused hardware cost declines, but contributed nearly 80% of the total decline in deployment costs,” says Magdalena KLEMUN, the study’s lead author, Assistant Professor in the Division of Public Policy, and a faculty affiliate at the Energy Institute. “That is a lot, and it is counterintuitive, as we typically associate reductions in deployment or ‘soft’ costs with efficiency gains in processes, not with better hardware, at least not primarily.”

Hardware features not only caused the majority of past cost declines, Klemun adds. “Based on a new metric we developed, hardware features continue to influence a larger share of costs than soft features, although soft costs now exceed hardware costs in many PV markets.” This is another counterintuitive result generated using the new model, which allows separating the contributions of hardware and non-hardware improvements to cost change in technologies. The findings are reported in the journal Nature Energy in a paper by Klemun and colleagues at the Massachusetts Institute of Technology (MIT) and Harvard University. Co-authors include Goksin Kavlak, an associate at the Brattle Group and former MIT post-doc; James McNerney, a senior research fellow at the Harvard Kennedy School; and Jessika Trancik, a professor in MIT’s Institute for Data, Systems, and Society (IDSS), and the study’s senior author.

Overall, while solar PV systems now cost just 1% of what they cost in 1980, only 10 to 15 percent of this dramatic cost drop can be attributed to “soft technology” features. These features include durations of various tasks in system design, installation, and permitting, as well as wages—essentially any price-relevant feature of the services and processes needed to deploy a photovoltaic system. While these features have improved, for instance, through replacing manual design drawings with software, they have done so more slowly than hardware features, and the changes were much less influential for cost change.

These findings directly relate to current challenges in the transition to low- and zero-carbon energy technologies, as the upfront investment costs of many clean energy technologies are now dominated by ‘soft costs’. Extrapolating the study’s findings, these costs may need to be reduced through continued hardware innovations, leveraging the same channels that have been effective in the past, where hardware innovations drove soft cost declines without much contribution from soft improvements. Or, inefficient deployment processes and the associated ‘soft features’ could be tackled directly without changing hardware, trying to increase historically slow improvement rates.

“Being deliberate about soft technology is essential for making it more efficient and effective — to drive down costs, support a high-quality customer experience, and create jobs, among other objectives” says Trancik, “Soft technology will be instrumental for supporting a successful clean energy transition.‘‘ “However,” Klemun adds, “the kind of systematic thinking typically applied to hardware design doesn’t exist yet for soft technology. So there is a lot of work to do.”

Establishing a science of soft costs

Part of the motivation for the study was to improve traditional approaches to technology cost modeling. In the past, costs have often been modeled as sums of hardware and non-hardware cost components, and changes in costs have been associated with changes in hardware or non-hardware technology inputs. However, additive cost components are just the first layer in the new framework developed by the HKUST-MIT research team. ‘‘To really understand why rates of change in technology costs are rapid or slow, we need to go deeper than simply adding up the costs of inputs,” Trancik says. ‘’We need to consider the features of technology and how those features are changing and contributing to costs.”.

In the model underlying the new study, cost components are represented as products of functions of several cost variables, which capture individual hardware and soft technology features—a technology’s representative state at any given point in time and space. The model then splits out the contributions of changes in individual features to changes in cost components, given data on how these features changed over time in a given location.

Using this approach, the researchers were able to estimate how influential better PV hardware (e.g., lighter modules with higher rated capacity)

Prof. Magdalena Klemun

was for cheaper installation. For example, they computed how much the increase in module and inverter efficiency — both changes in hardware features, and the acceleration of mechanical installation tasks with time — a change in a soft feature — contributed to the total decline in installation costs. “Separating those contributions is important because hardware and soft features are encoded in technologies in different ways, which affects how innovations are typically shared across locations and influence costs”, Klemun says. Hardware features are embodied in the design of physical components, which can be mass-produced and shipped around the world, bringing much of the associated information with them. Soft features are encoded in people and institutions, which are typically less mobile. “Both feature types ultimately need to improve to optimize technology performance, but the underlying strategies may differ. That’s why separating the two is a good starting point to consider this difference carefully in engineering design, manufacturing, and policy”.

Interestingly, the researchers showed that the influence of some hardware features on costs was realized almost to the same degree through soft cost reductions as it was through hardware cost reductions. For example, photovoltaic modules were, on average, twice as efficient in 2017 compared to 1980, and that improvement reduced overall system costs by 17 percent. Yet 40 percent of that overall reduction, almost half, could be linked to soft cost reductions driven by higher module efficiency.

One of the reasons for this result is intuitively simple but challenging to formalize in a cost change model: When a technology’s hardware changes, e.g., when components become lighter or change shape due to design and manufacturing innovations, these changes also affect deployment processes and, thus, costs. However, when a process is altered at the permitting office or installation site, the hardware components stay the same, as their features have been “fixed” at the factory gate. Therefore, while most cost components are functions of hardware variables, only a few soft cost components show dependencies on soft variables or “features.” “You can spot this structural difference even before collecting data on how the technologies have evolved. That’s why first understanding and then visualizing a technology’s network of cost dependencies is a promising way to get at potential drivers of change, not just for solar PV but also for other technologies,” Klemun notes.

Looking across countries and to the future

The study also explored the drivers of cost differences across countries, which remain large. The paper shows that in no major PV market covered in their dataset, soft costs improved from a comparatively high level in the past (1980) to a comparatively low level in the present (2017). In other words, countries with robust ‘soft technology’ did not necessarily reach that performance level with time but already had lower soft costs to begin with. Countries with higher soft costs have tended to improve at a similar rate globally, driven by hardware innovations shared through integrated global supply chains. Soft technology innovations weren’t shared across borders to the same degree, or when they were, their influence on costs was smaller.

Going forward, Klemun is interested in exploring whether what they observed for PV — that improvements in soft features haven't been that influential for soft and overall cost reductions — also holds for other technologies. “Maybe there is a silver bullet for soft cost reductions that can be applied to PV. Or maybe not, in which case we would learn something about the importance of building the potential for hardware-driven soft cost reductions into technologies at the design stage.” One of Klemun’s current projects examines the cost evolution of advanced metering infrastructure. “Smart metering systems are similar to solar PV in that some components are standardized, easy to ship, and mass-manufactured, like the meter itself. But then integrating communication and data management systems can lead to high soft cost shares across sites, countries, and years.” These costs are often covered by the public sector through mandated smart meter roll-outs, she says, but the return in terms of cost improvement hasn’t been studied.

Another interesting topic, she says, is to critically examine the desirability of reducing different types of soft costs. “Not all soft costs represent inefficiencies; longer processes can make technologies more attractive to the consumer (due to customization or by enabling participatory processes) or safer. So there are trade-offs between deploying technologies very efficiently to speed up the clean energy transition and leaving enough room for temporary inefficiencies and things like creativity or building clean energy communities.”

This research is funded by the U.S. Department of Energy Solar Energy Technologies Office.

HKUST and CATL Forge Cross-disciplinary Partnership to Advance Innovation and Talent Grooming in Sustainable Development and New Energy Technology

The Hong Kong University of Science and Technology (HKUST) has recently entered a cross-disciplinary technological innovation partnership with Contemporary Amperex Technology (CATL) and became the first university in Hong Kong to collaborate with the tech giant. This partnership aims to promote research innovation and talent development in the areas of sustainable development and new energy.

Through this collaboration, CATL will provide funding to HKUST over five years. The parties will work together on collaborative research and knowledge transfer in areas such as advanced materials and zero-carbon technologies. A venture capital fund will be established to support technology start-ups with growth and market potential, while part of the contribution will also be allocated to recognize exceptional doctoral and master's students engaged in related research. Awardees may have priority for job opportunities at CATL after graduation. The HKUST Energy Institute will lead this collaboration.

In a ceremony witnessed by CATL Co-president for Research & Development Prof. OUYANG Chuying, also the Advisory Committee Member of the HKUST Energy Institute, HKUST Council Vice-Chairman Prof. Patrick YEUNG and President Prof. Nancy IP, CATL Vice President and Chief Technology Officer Dr. GONG Jiadong and HKUST Vice-President for Institutional Advancement Prof. WANG Yang signed the partnership agreement. Other senior management officials from both parties were also present.

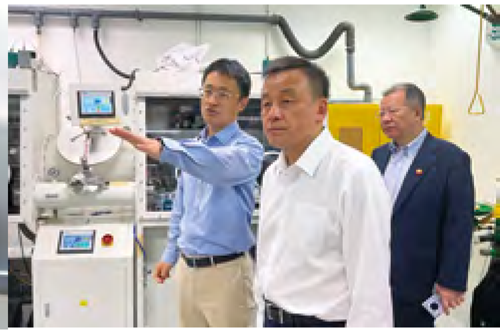
Prof. Ouyang Chuying said: "CATL is still a continuously developing and growing enterprise. Achieving high-quality technological innovation requires the industry's top resources to work in tandem with deep collaboration among industry, academia, and research institutions. This approach will jointly promote the steady advancement of new energy technologies."

Expressing her gratitude for CATL's unwavering support and trust, Prof. Nancy Ip said: "Innovation and technology are crucial engines for promoting sustainable development and enhancing quality of life. Advancing high-quality research in new energy technology will be a key driver of future global economic growth. As a research university, HKUST is committed to collaborating with various sectors of society, integrating academic achievements with practical applications to drive social progress through technological innovation. I believe that through

our collaboration with CATL, we can build a sustainable future with innovative technologies, fostering greater development for Hong Kong and the country."

As a globally leading research university, HKUST is dedicated to advancing fundamental research in frontier areas to tackle major global challenges through breakthrough discoveries. The University established the Energy Institute in 2014, creating an interdisciplinary platform for pioneering scientific research in energy. Meanwhile, CATL is a global leader in new energy technology and, at the invitation of the Hong Kong SAR Government at the end of last year, established its international headquarters and research center in Hong Kong. Both parties share a common vision of promoting global sustainable development through technological innovation.

HKUST and Changchun Institute of Applied Chemistry, CAS Collaborate on **Joint Laboratory for Hydrogen Energy to Foster Innovation in Clean Technologies**



HKUST and Changchun Institute of Applied Chemistry (CIAC) of the Chinese Academy of Sciences (CAS) have collaborated to establish a Joint Laboratory for Hydrogen Energy to foster innovation in clean technologies. Led by Energy Institute's Director Prof. SHAO Minhua, Cheong Ying Chan Professor of Energy Engineering and Environment, and Head and Chair Professor of the Department of Chemical and Biological Engineering, the newly accredited joint lab, was awarded HK$1.25 million for a period of five years under the Research Grants Council's (RGC) Co-funding Mechanism on Joint Laboratories with CAS.

Clean hydrogen technologies are becoming increasingly important in the world today as countries look for ways to reduce their carbon emissions and combat climate change. Hydrogen is a versatile and clean energy storage media that can be produced from renewable sources such as wind, solar, and hydropower. It can be used as a fuel in a variety of applications, including transportation, power generation, and industrial processes. Clean hydrogen technologies have the potential to help reduce greenhouse gas emissions, improve air quality, and increase energy security. As such, many countries including China are investing significant resources into developing and commercializing clean hydrogen technologies. The widespread adoption of these technologies could play a crucial role in achieving the carbon neutrality goal and creating a sustainable energy future.

Changchun Institute of Applied Chemistry has multiple platforms focusing on developing hydrogen related technologies. Prof. XING Wei is the Director of the Advanced Chemical Energy Technology Lab, Jilin Low Carbon Energy Technology Key Lab, and Jilin Chemical Energy Engineering Center. His group has made significant progresses on fuel cell and electrolyzer manufacturing and optimization. The SHAO group focuses on the development of key materials, components and stacks. Together, the two groups aspire to drive forward sustainable hydrogen energy solutions and promote technological breakthroughs.

A total of 14 joint labs across local universities were awarded funding this round, including four from HKUST.

HKUST and Baima Lake Laboratory signed a Memorandum of Understanding to Deepen Collaboration

The Hong Kong University of Science and Technology (HKUST) signed a Memorandum of understanding (MoU) with Baima Lake Laboratory to foster the partnership on green energy initiatives through research, technology and talent development in August 2024.

Through this alliance, the two parties joint hands on green energy research projects related to solar energy conversion, catalysis, and zero-carbon energy conversion and storage. Investigate energy low-carbon conversion and multi-energy coupling technologies to promote the synergistic use of different energy forms. This partnership can leverage HKUST's cutting-edge technologies and Baima Lake Laboratory's applied research to address major scientific challenges.

To promote technological breakthroughs, Baima Lake Laboratory and HKUST focus joint efforts on developing novel materials for improving energy conversion efficiency and storage capacity, and innovative solutions that advance clean energy technologies and applications. Leverage the industrial background of the Zhejiang Energy Group, and the expertise of leading academic institutions, to promote the green and low-carbon transformation of existing energy industries and explore paths for commercialization.

Baima Lake Laboratory, also known as the Zhejiang Laboratory of Energy and Carbon Neutrality, was announced as one of the third group of provincial laboratories in Zhejiang. It is a novel type of research institution co-founded by Zhejiang University, Westlake University, and the Energy Group.

HKUST Partners with Langya District, Chuzhou City to Establish Innovation Center

The Hong Kong University of Science and Technology (HKUST) signed a Memorandum of Understanding (MoU) with Langya District, Chuzhou City, a strategic partner, on 30 September 2024, outlying their plans to establish an Innovation Center, with an aim to driving the commercialization and application of cutting-edge technologies in key industries: energy generation, conversion and storage and new materials.

Under this partnership, both parties will deepen cooperation in innovative technology exploration; facilitating talent exchange, entrepreneurship, and technological collaboration between Hong Kong and Chuzhou, contributing to the development of the Greater Bay Area.

Chuzhou is the third largest city in Anhui province in terms of GDP and one of the central cities in Yangtze River Delta. It borders with two provincial capitals of Hefei and Nanjing. Langya District is the political, cultural, and economic center of Chuzhou. It is positioned as a leader in high-end manufacturing for solar panels, batteries, hydrogen technologies, new materials, food technologies, and biomaterials.

New Members

HKUST has a wealth of expertise in energy comprising top-notch scholars at the frontiers of energy-related research. As part of the university-wide initiative to promote energy research and education, the Energy Institute (EI) brings together innovative, world-class scientists from a wide range of disciplines. In the past year, 5 new members joined the EI family.

Fan SHI

Assistant Professor of Mechanical and Aerospace Engineering

Research Area
- Energy generation
- Energy storage and distribution

Research Interests
- Non-destructive devaluation
- Material characterization
- Ultrasonic array imaging and inversion
- Modelling of elastic wave propagation

Qiye ZHENG

Assistant Professor of Mechanical and Aerospace Engineering

Research Area
- Energy utilization and conservation

Research Interests
- Ultrafast and nanoscale thermal metrology
- Thermal energy metamaterials

Tianwei DUAN

Research Assistant Professor of Chemical and Biological Engineering

Research Area
- Energy generation
- Energy utilization and conservation

Research Interests
- Advanced chiral materials for energy-saving
- Chiral semiconductor synthesis and characterization
- Chiral semiconductors for optoelectronics

Fei XIAO

Research Assistant Professor of Energy Institute

Research Assistant Professor of Chemical and Biological Engineering

Research Area

- Energy generation
- Energy utilization and conservation

Research Interests

- Advanced materials
- Energy and Environmental Technologies
- Electrochemistry
- Electrocatalysis
- Fuel cell
- Electrolyzer

Jiawei LIU

Research Assistant Professor of Energy Institute

Research Assistant Professor of Chemical and Biological Engineering

Research Area

- Energy storage and distribution
- Energy utilization and conservation

Research Interests

- Advanced materials
- Colloid and surface chemistry
- Electrocatalysis
- Nanoparticles

Faculty Achievement

EI Professors achieved remarkable success at the 49th International Exhibition of Inventions Geneva

The Hong Kong University of Science and Technology (HKUST) has made remarkable progress at the 49th International Exhibition of Inventions Geneva, showcasing outstanding achievements and surpassing previous records with 36 teams winning a total of 36 awards. Many of the inventions have been developed through collaborative efforts with government and industry leaders, aiming to create a profound impact on society. Five members of Energy Institute awarded one Gold and four Silver Medals.

"I am so proud to witness a record-breaking number of HKUST winning teams at the International Exhibition of Inventions Geneva this year," HKUST Vice-President for Research and Development Prof. Tim CHENG said. "This is not only a testament to our research and innovation capabilities but also reinforces our solid track record in entrepreneurship and knowledge transfer. Building upon our strong network with governments, industry and academia, we are now planning an innovation park to bridge the gap between basic research and impactful outcomes, while strengthening our city's entrepreneurial ecosystem, so more innovative breakthroughs can be transformed into practical solutions and technologies that improve human life."

This remarkable achievement underscores the exceptional research performance and contributions of our faculty.

The 49th International Exhibition of Inventions Geneva is being held from April 17 to 21 in Switzerland with a record number of inventors, universities, institutes, and companies showcasing over 1,000 inventions from about 40 countries and regions. A total of 365 inventions from Hong Kong are participating in the show.

Congratulations to:

Prof. YANG Jinglei

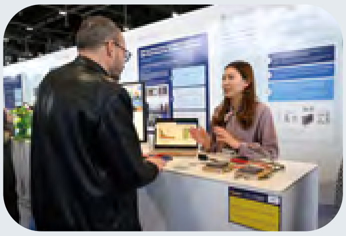
Gold Medal

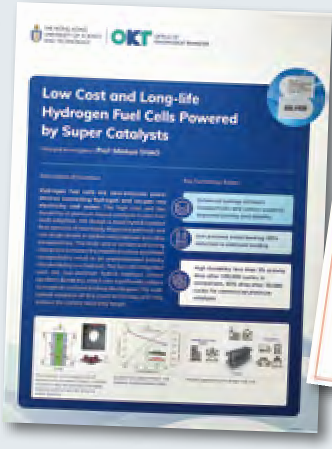
"Multi-functional Self-cleaning Nanocoating with Visible Light Photocatalysis for Phovoltaic (PV) Panel."

Silver Medal

Prof. SHAO Minhua

"Low Cost and Long-life Hydrogen Fuel Cells Powered by Super Catalysts."





Prof. YAO Shuhuai

"3Screen: Low cost and High throughput Viral Testing."

Prof. HUANG Baoling

"Bio-inspired Radio transparent Optical Metamaterial Films with Ultra broadband Spectrum Manipulation for Passive Space Cooling."

Prof. LI Mitch Guijun

"AI-generated Food with 3D Printing Solution and Simultaneous Infrared Heating."

EI faculty Showcased Innovations at **the WEF Summer Davos 2024**

The Hong Kong University of Science and Technology (HKUST) was honored to be invited to participate in the 15th Annual Meeting of the New Champions held by the World Economic Forum in Dalian, China. This prestigious event is also known as the Summer Davos Forum.

Prof. GUO Yike, HKUST Provost and world-renowned scholar on Artificial Intelligence (AI) and machine learning, who shared his thought leadership on the interplay of Generative AI and art. Joining Prof. Guo at the global event were EI Director Prof. SHAO Minhua, Cheong Ying Chan Professor of Energy Engineering and Environment, and Head and Chair Professor, Department of Chemical and Biological Engineering, and Prof. FAN Zhiyong, Chair Professor, Department of Electronic and Computer Engineering while Prof. HUI Pan, Chair Professor of Computational Media and Arts of HKUST (GZ), participated as a member of Global Future Council on the Future of Metaverse.

The "Frontiers of Innovation Expo", which showcased state-of-the-art inventions specially selected by WEF, was a highlight at Summer Davos 2024. Prof. Shao and Prof. Fan presented their groundbreaking inventions which enhance inclusivity and sustainability for a better world at this prestigious event.

Developed by Prof. SHAO, the hydrogen fuel cell directs participants' attention to the increasing use of hydrogen as a cleaner source of energy. Hydrogen fuel cell is a promising clean energy option as it generates power by converting hydrogen and oxygen into electricity, with zero emission of carbon dioxide, particulate matters and other air pollutants that may cause smog and other health problems. If hydrogen fuel cells are more cost-effective to produce, they could be deployed globally, furthering carbon neutrality goals. Boasting high durability, it stands as a testament to the University's commitment to sustainability.

The other exhibit, the world's first 3D artificial eye developed by Prof. FAN Zhiyong, has proved to outperform existing bionic eyes, igniting hopes for patients with visual impairment worldwide. The 3D artificial retina – made of an array of nanowire light sensors which mimic the photoreceptors in human retinas. The working principle of the artificial eye involves an electrochemical process which is adopted from a type of solar cell. In principle, each photo sensor on the artificial retina can serve as a nanoscale solar cell. With further modification, the EC-Eye can be a self-powered image sensor, so there is no need for external power source nor circuitry when used for ocular prosthesis, which will be much more user-friendly as compared with the current technology.

With the theme of "New Frontiers for Future Growth", this forum brought together more than 1,600 leaders and innovators from business, politics, social organizations and international organizations to discuss ways to achieve sustainable development of the global economy.

Congratulations to our faculty members who have received numerous honors and accolades!

(The list of awards below shows some of our faculty awards. It is not exhaustive.)

Prof. Minhua SHAO

Director of Energy Institute
Head and Chair Professor of Chemical and Biological Engineering

- 2024 Highly Cited Researchers by Clarivate
- Silver Medal, the 49th International Exhibition of Inventions Geneva

Prof. Baoling HUANG

Professor of Mechanical and Aerospace Engineering

- Silver Medal, the 49th International Exhibition of Inventions Geneva

Prof. Jinglei YANG

Professor of Mechanical and Aerospace Engineering

- Gold Medal, the 49th International Exhibition of Inventions Geneva

Prof. Masaru YARIME

Associate Professor of Public Policy

- Highly Ranked Scholar by ScholarGPS

Prof. Yuanyuan ZHOU

Associate Professor of Chemical and Biological Engineering

- selected as the Star Faculty by HKUST

Prof. Laurence DELINA

Assistant Professor of Environment and Sustainability

- AESS Early Career Award by the Association for Environmental Studies and Sciences (AESS)

Prof. Yoonseob KIM

Assistant Professor of Chemical and Biological Engineering

- 2023 Class of Influential Researchers in Asia and Pacific by Industrial & Engineering Chemistry Research (I&EC Research)
- 2024 Early Investigator by ACS PMSE (American Chemical Society, Polymeric Materials Science and Engineering)

Prof. Mitch Guijun LI

Assistant Professor of Integrative Systems and Design
Assistant Professor of Electronic and Computer Engineering

- Silver Medal, the 49th International Exhibition of Inventions Geneva

Prof. Zhongming LU

Assistant Professor of Environment and Sustainability

- Best Oral Presentation Award at the 5th IWA Resource Recovery Conference

Pursuing a Professorship

Academia can be very challenging and yet rewarding. Becoming a professor is a significant achievement that reflects years of hard work, dedication, and a deep commitment to the pursuit of knowledge. In this issue, some of the young researchers shared with you their passion to become a professor.

ZHU Shangqian

Professor of Chemistry and Chemical Engineering
Southeast University (SEU, Nanjing, China)

PhD, HKUST (2019)

Prof. ZHU Shangqian was born in Shaoxing, Zhejiang Province of China. He is currently a Professor of the School of Chemistry and Chemical Engineering at Southeast University (SEU, Nanjing, China). He got his bachelor's degree in chemical engineering and technology from the Beijing University of Chemical Technology (BUCT) in 2013, and MPhil and PhD degrees in chemical and biomolecular engineering from the Hong Kong University of Science and Technology (HKUST) in 2016 and 2020, respectively (under the supervision of Prof. SHAO Minhua). Between March 2020 and March 2023, he worked as a postdoctoral fellow at HKUST with Prof. Shao. Later, he received the National Natural Science Fund for Excellent Young Scientists (Overseas) in 2022 and joined SEU in March 2023.

During his 8.5-year postgraduate and postdoctoral training at HKUST, his research was focused on developing in situ spectroscopy to study interfacial phenomena in electrocatalysis and synthesis of advanced electrocatalysts for CO_2 reduction, fuel cell, and water splitting applications. Notably, he provided brand new insights into the role of electrolyte pH and bimetallic catalytic interfaces in hydrogen evolution/oxidation reactions through applying the advanced in situ infrared spectroscopy and partially ceased the long-lasting debates in the past few decades. In addition, his contribution to understanding the catalyst structure/composition-to-performance has accelerated the design of next-generation catalysts for CO_2 upgrading to value-added chemicals. At HKUST, he published over 20 papers as the first author/equal contribution in *Nature Catalysis, J. Am. Chem. Soc., Angew. Chem. Int. Ed., Adv. Mater.*, etc. He received several prestigious awards and honors from the university, industry, social media, and government, including the World's Top 2% Scientists by Stanford University, Hong Kong Research Grants Council Postdoctoral Fellowship Scheme, School of Engineering PhD Research Excellence Award and Best Postgraduate Student for Excellent Research in Department of Chemical and Biological Engineering at HKUST, HKJEBN Scholarship for Health and Quality Living from the HK JEBN Limited.

At SEU, his research group currently consists of 1 postdoctoral fellow, 9 postgraduates, and 2 undergraduates. The group is trying to tackling challenges and enigmas in electrochemical energy technologies/interfaces for building a more sustainable and carbon neutral world. Several related research projects from National Natural Science Fund of China and Natural Science Fund of Jiangsu Province are ongoing.

Dr. GE Jingjie

Assistant Professor
Department of Applied Biology and Chemical Technology
The Hong Kong Polytechnic University

Research Assistant Professor, HKUST (2023)

Dr. GE Jingjie is an Assistant Professor in the Department of Applied Biology and Chemical Technology at The Hong Kong Polytechnic University. She received her Ph.D. from the University of Science and Technology of China (USTC) in 2018 under the supervision of Prof. LI Yadong and Prof. HONG Xun. She then worked as a Postdoctoral Fellow and Research Assistant Professor at Nanyang Technological University and The Hong Kong University of Science and Technology, respectively. Her current research focuses on the atomic design and precise nanomaterials synthesis for green chemistry and sustainable energy applications. She has authored or co-authored over 30 SCI papers with a total citation of over 2,600 and an H-index of 23, including *Proc. Natl. Acad. Sci., J. Am. Chem. Soc., Angew. Chem. Int. Ed., Adv. Mater., Nat. Commun.*, etc. She is the Young Editorial Committee Member of Nano Research, MedMat, and Materials Reports: Energy.

What is it like to be a professor? Here, Dr. Ge shared her personal experience: "Becoming a professor has always been a long-term aspiration driven by my passion for knowledge creation and dissemination. I am motivated by the opportunity to contribute meaningfully to my research field on sustainable energy through innovative research on atomic design high-efficient catalysts, while also inspiring the next generation of scholars and professionals. I aim to bridge the gap between theoretical research and practical applications, ensuring my work has real-world application potentials. Furthermore, I see the role of a professor as a mentor and guide who can shape not only academic careers but also values like perseverance and intellectual curiosity in students. In the long term, I hope to contribute to a global academic community, fostering cross-disciplinary collaborations and addressing challenges with a holistic perspective."

Dr. Usman Bin SHAHID

Assistant Professor
Department of Chemistry and Chemical Engineering
Syed Babar Ali School of Science and Engineering (SBASSE)
Lahore University of Management Sciences (LUMS)

PHD, HKUST (2024)

Dr. Usman Bin SHAHID is an Assistant Professor in the Department of Chemistry and Chemical Engineering at the Syed Babar Ali School of Science and Engineering (SBASSE), Lahore University of Management Sciences (LUMS). Dr. Shahid completed his undergraduate studies in Chemical Engineering (with distinction) from McGill University, Canada and earned a Master's in Sustainable Environment from Hamad Bin Khalifa University, Qatar. His research focuses on addressing global sustainability challenges, with a particular emphasis on electrocatalytic pathways for sustainable ammonia synthesis, a key area of his PhD studies. Dr. Shahid obtained his PhD in Chemical and Biomolecular Engineering from the Hong Kong University of Science and Technology (HKUST) in 2024.

During his Ph.D. study at HKUST under the guidance of Prof. SHAO Minhua, he worked on developing a sustainable alternative to the Haber-Bosch process. More specifically, his research revolved around electrosynthesis of ammonia from nitrates in ultrahigh alkalinity systems at industrially relevant current densities. This research resulted in the discovery of a novel Fe-Cu-Ni catalyst that is capable of operation at industrially-relevant current densities with high faradaic efficiency and with a very promising technoeconomic prospectives.

At LUMS, he is building his research group to explore sustainable chemical processes (including Ammonia), with a focus on nitrogen cycle management and waste-to-resource technologies. He also engages in mentoring students and designing innovative courses to foster a hands-on learning environment.

What is it like to be a professor? Here, Dr. Shahid shared his personal views: "My vision is to advance sustainable technologies by bridging academic research and industrial applications. I aspire to create impactful solutions addressing global challenges in energy and resource sustainability while inspiring the next generation of engineers and scientists to innovate responsibly."

Dr. YAO Yao

Assistant Professor of Chemistry
School of Science
Great Bay University (GBU, Dongguan, China)

PhD, HKUST (2020)

Dr. YAO Yao obtained her PhD from the Department of Chemical and Biological Engineering (CBE) at HKUST in 2020. Following this, she conducted postdoctoral research at École Polytechnique +Fédérale de Lausanne (EPFL) in Switzerland before becoming an Assistant Professor at Great Bay University (GBU) in June 2023. Dr. Yao's research now focuses on studying electrode/electrolyte interfaces during electrochemical reactions, particularly electrochemical CO_2/N_2 reduction.

During her PhD studies in Prof. Minhua Shao's group at HKUST, she focused on N_2 electrochemical reduction; devoted most of her time to studying reaction intermediates using Surface Enhanced Infrared Absorption Spectroscopy and Differential Electrochemical Mass Spectrometry. The results confirmed the associated reaction pathway for N_2 reduction on noble metal surfaces, resulting in 5 first-author publications. Dr. Yao valued the professional training at HKUST, which was crucial for her research career. Beyond the research itself, she treasured many aspects of her time there: the weekly Friday afternoon departmental seminars for research communication, the opportunities to attend and present at international conferences, the chances to interact with leading researchers in the field, and the close friendships she has formed. "I am deeply grateful for these experiences," Dr. Yao said.

What is it like to be a professor? Here, Dr. Yao shared her personal experience: "As a young researcher at a newly established university, the Great Bay University (GBU), life is undoubtedly challenging. It's an unspoken truth that a scientist's life is becoming increasingly demanding. I spent several months in industry, which was definitely much easier. Yet, I chose to return to academia when given the chance, drawn by the pure joy I find in research—a feeling I believe many researchers share. Spending most of my time exploring meaningful and interesting topics, learning more about the physical chemistry of our complex world, is my primary motivation as an academic researcher. It's like being a pioneer, exploring the boundaries of knowledge while building upon existing foundations. Though I don't claim the academic path is the best choice for everyone, I believe in pursuing what truly brings you happiness. Life is too short, and I'm following my path."

Dr. WANG Yian

Assistant Professor
School of Physical Sciences
Great Bay University (GBU, Dongguan, China)

Postdoc (RGC Postdoctoral Fellowship 2024)
PhD, HKUST (2023)

Dr. WANG Yian received her B.Sc. degree in Chemistry from Wake Forest University in 2017, M.Sc. degree in Energy Science, Technology and Policy from Carnegie Mellon University in 2018, and Ph.D. degree in Chemical and Biomolecular Engineering from the Hong Kong University of Science and Technology (HKUST) in 2023. She worked as a postdoctoral fellow in the Department of Chemical and Biological Engineering at HKUST with Chair Professor SHAO Minhua, the Department Head and the Director of HKUST Energy Institute. Dr. Wang joins the Great Bay University (GBU) in Dongguan, China as an Assistant Professor in December 2024. Her research focuses on the theoretical modeling and computations of electrocatalytic materials, reactions, and systems, by using density functional theory and ab initio molecular dynamics. Her work aims to investigate reaction mechanisms and develop high-performance catalysts for electrochemical processes such as nitrate reduction, CO_2 reduction, urea synthesis, hydrogen evolution/oxidation and oxygen evolution/reduction. She has published over 20 papers in top-tier journals such as *Energy & Environmental Science, Journal of the American Chemical Society, Angewandte Chemie International Edition, Nano Letters and ACS Catalysis*. She has been recognized by multiple awards and honors, including the RedBird Academic Excellence Award from HKUST (2022), the RGC Postdoctoral Fellowship from the Research Grants Council (2024), and the Rising Stars Women in Engineering from the Asian Dean's Forum (2024).

What is it like to be a professor? Here, Dr. Wang shared her thoughts: "Pursuing a career in academia is challenging, which requires setting firm goals to keep track of progress, working persistently to build a strong resume, and properly managing stress to maintain mental and physical health. To me, strong support from my supervisor and colleagues at HKUST has genuinely helped me through the tough time. However, working in academia is also very rewarding, when research progress is made, projects are accomplished, and students are properly educated or mentored to achieve their goals. Thus, these rewarding moments have motivated me and will continue motivating me to contribute to research, education and society during my academic journey."

Student Achievement

Congratulations to our students who have received numerous awards and honors!

(The list of awards below shows some of our student awards. It is not exhaustive.)

Mr. Kaveh ALIZADEH

Gold Medal for the most novel and high-impact idea at the 2nd International Nanotechnology Olympiad (INo2024).

Mr. Mohammad FARHADPOUR

Gold Medal for the most novel and high-impact idea at the 2nd International Nanotechnology Olympiad (INo2024).

Mr. Hongzhao FAN (HKUST(GZ) SEE)

Best Poster Award in the International Symposium On Multiscale Simulations of Thermophysics-2024

Mr Yixin YU

Best Poster Award in the International Symposium On Multiscale Simulations of Thermophysics-2024

Mr. Wuke XU

Best Poster Award in the 22nd International Meeting on Lithium Batteries 2024

Mr. Hanchen SHEN

Selected for the 2024 CAS Future Leaders Program

NSFC-BHKAEC Joint Symposium on Electrochemical Interfaces in Energy Conversion and Storage

To deepen the scientific research collaboration between Hong Kong SAR and Mainland, NSFC-BHKAEC joint symposium on Electrochemical Interfaces in Energy Conversion and Storage was held at HKUST on 8-11 November 2024. The event was funded by the National Natural Science Foundation of China (NSFC) and the Beijing-Hong Kong Academic Exchange Centre (BHKAEC). Prof. LO Kam Hong, Dean of Engineering, and Prof. SHAO Minhua, Director of Energy Institute, welcomed more than 30 renowned speakers and over 100 participants at the opening ceremony.

Renewable energy is playing an increasingly vital role in the global energy transition. The importance of energy storage technology to enhance grid flexibility, support renewable integration, and promote industry decarbonization has become increasingly prominent. Throughout the Symposium, speakers presented their latest research findings and shared their perspectives on scientific challenges and potential solutions in the areas of “Advancements in Perovskite Solar Materials”, “Hydrogen Energy and Electrocatalysis”, “Battery Health Monitoring Technologies”, “Solid-State Battery”, and “Electrocatalytic Carbon Dioxide Reduction”.

The Symposium facilitated fruitful discussions among participants, emphasizing the importance of interdisciplinary approaches to address the challenges in energy conversion and storage. Future research directions were identified, focusing on enhancing material stability, optimizing catalytic processes, and improving battery technologies, all of which are crucial for advancing sustainable energy solutions. It not only provided a platform for scientists in Hong Kong and the Greater Bay Area to exchange scholarly ideas and to establish future collaborations, but also an excellent opportunity for the students and young researchers to widen their scientific horizon.

Energy in Transition - Powering Tomorrow

Energy Institute was thrilled to host Mr. Stefan BREDOHL, Consul General of Germany, in Hong Kong on Sep 17. During his visit, Consul General Bredohl gave a special sharing on the roadmap of energy transition in Germany, the challenges and the significant role of research and innovation. Following the warm welcome by Prof. WANG Yang, Vice President for Institutional Advancement and Prof. SHAO Minhua, Director of HKUST Energy Institute, CG Bredohl had an engaging discussion with over 60 students from different disciplines.

The event is organized as part of the "Energy in Transition - Powering Tomorrow" Exhibition on campus from Sep 16-19, co-organized by the Consulate General of the Federal Republic of Germany in Hong Kong and HKUST Energy Institute. The exhibition highlights the complex aspects, challenges and potentials of the global energy transition from the perspectives of society, politics, business and science and provides information on the importance and components of a sustainable and socially just global energy transition.

HKUST is dedicated to advancing research innovation and pushing forward impactful collaborations that supports sustainable development and enhances the living environment for future generations. We are honored to be the first university in Hong Kong hosting the Exhibition presented by the Consulate General of the Federal Republic of Germany in Hong Kong.

School of Engineering Distinguished Workshop: Electrochemical Energy Storage Technologies

Energy Institute hosted the School of Engineering Distinguished Workshop on “Electrochemical Energy Storage Technologies” from 17-18 June 2024.

Electrochemical energy storage (EES) technologies, particularly rechargeable batteries will play an important role in net-zero electricity generation and green transport, which are Hong Kong’s two major decarburization strategies. Hong Kong committed to achieve net-zero emissions by 2050 in response to the Paris Agreement. HKUST committed to achieve net-zero carbon emissions by 2045.

With the increasing maturity of large-scale new energy power generation and the shortage of energy storage resources brought about by the increase in the penetration rate of new energy in the future, the development of electrochemical energy storage technology and the construction of demonstration applications are imminent.

This distinguished workshop is another attempt made by School of Engineering to foster a critical academic exchange among international and local experts, and to strengthen international collaborations.

The workshop focused on the new frontiers in battery development, the opportunities and challenges. Seven renowned speakers from USA, Canada, Japan, Korea and Mainland China presented recent findings in two afternoons. IAS Distinguished Lecture by Dr. Akira YOSHINO, Nobel Prize Winner in Chemistry in 2019, gave an IAS Distinguished Lecture on “Future Society Engendered by Lithium Ion Battery” on 17 June. The other six renowned scientists presented at the lecture with the theme “Electrochemical Energy Storage Technologies” on 18 June. They are

Prof. Stacey BENT, Standford University, USA;

Prof. Jang Wook CHOI, Seoul National University, South Korea

Prof. Yunhui HUANG, Huazhong University of Science and Technology, China

Prof. Yoon Seok JUNG, Yonsei University, South Korea

Prof. Andy Xueliang SUN, University of Western Ontario, Canada

Prof. Eric D WACHSMAN, University of Maryland, USA

Energy Institute Co-organized IMLB 2024: Pioneering the Future of Batteries in Hong Kong

The 22nd International Meeting on Lithium Batteries (IMLB 2024) was held successfully from 16-21 June 2024 at the Asia International Expo in Hong Kong. Energy Institute (EI) was one of the co-organizers. EI Director Prof. SHAO Minhua was the Co-Chair and EI Associate Director Prof. CHEN Qing was the organizing committee member.

IMLB 2024 is the premier international conference on the state of lithium battery science and technology, as well as current and future applications in transportation, commercial, aerospace, biomedical sciences, and other promising sectors. Convening in Hong Kong, the conference drew around 1,500 experts, researchers, and company representatives involved in the lithium battery field from around the globe.

Aimed to reduce global carbon emissions and promote the development of lithium batteries, the conference served as a crucial platform for discussing recent advancements in lithium battery technology, focusing on both fundamental research and applied innovations that enhance energy storage and conversion capabilities. The conference featured 80 world renowned speakers who covered a wide array of topics, including but not limited to the development of advanced lithium battery materials, and insights into the electrochemical processes governing battery performance.

2019 Nobel Prize winner in Chemistry Akira Yoshino, one of the inventors of the lithium-ion battery, shared his latest research findings and illuminated in his discussion the futuristic society utilizing the Artificial Intelligence Enhanced Vehicles (AIEVs)

This conference not only facilitated scientific exchange but also provided industry professionals with valuable collaborative opportunities.

IAS-EI joint seminar Liquid Sunlight®, Made from CO_2

by YANG Peidong

Prof. YANG Peidong, Chemistry Chair Professor, S.K. and Angela Chan Distinguished Professor in Energy at the University of California, Berkeley, gave a distinguished lecture on “Liquid Sunlight®, Made from CO^2” in March 2024.

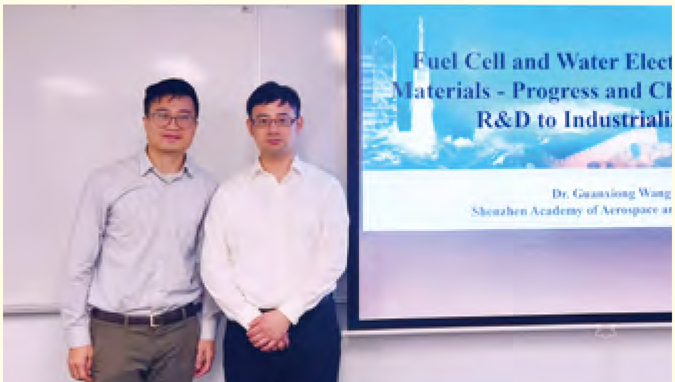
Liquid sunlight can be considered as a new form of chemical energy converted and stored in chemical bonds from solar energy. Efficient capture and storage of solar energy can provide unlimited renewable power sources and drive the capture and conversion of greenhouse gases such as CO_2 into valuable chemicals. Solar-to-chemical production using a fully integrated system is an attractive goal, but to-date there has yet to be a system that can demonstrate the required efficiency, durability, or be manufactured at a reasonable cost. In this lecture, Prof. Yang introduced introduce the original nanowire-based photochemical diode system design, and discuss the challenges associated with fixing CO_2 through traditional chemical catalytic means, contrasted with the advantages and strategies that biology employs through enzymatic catalysts to produce more complex molecules at higher selectivity and efficiency. Introducing microorganisms as whole-cell catalysts into the overall photochemical diode system led to the generation of powerful photosynthetic biohybrids capable of converting sunlight, H_2O and CO_2 into food, fuels, pharmaceuticals, and materials.

Fuel Cell and Water Electrolyzer Key Materials: Progress and Challenges from R&D to Industrialization

by Dr. WANG Guanxiong

Dr. WANG Guanxiong from Shenzhen Academy of Aerospace and Technology gave a presentation on "Fuel Cell and Water Electrolyzer Key Materials: Progress and Challenges from R&D to Industrialization" in Feburary 2024.

Hydrogen energy is an abundant, green, low-carbon, and widely used secondary energy source that is gradually becoming one of the crucial carriers for global energy transformation and development. To help achieve peak carbon emissions and carbon neutrality goals, it is imperative to accelerate breakthroughs in core hydrogen energy technologies and key material bottlenecks, speed up industrial upgrading and expansion, and realize a virtuous cycle and innovative development of the industrial chain. Dr. Wang shared with audience his views and discuss key materials' research and industrialization path for AEMWEs (anion exchange membrane water electrolysis) and analyze its technological advantages, challenges, and future development directions.



EI-CBE-CIAC-HKUST JLHE joint seminar Super Stable and Highly Active Pt and Pt Alloy Catalysts over Nanostructured Single-Pt-Atomic-Site for PEMFCs

by Prof. XIE Jian

On 22 May 2024, Prof. XIE Jian, Professor at the School of Mechanical Engineering, School of Materials Engineering, Purdue University, and Department of Mechanical and Energy Engineering at the Purdue School of Engineering and Technology, IUPUI visited HKUST. He gave a lecture on "Super Stable and Highly Active Pt and Pt Alloy Catalysts over Nanostructured Single-Pt-Atomic-Site for PEMFCs".

Polymer electrolyte membrane fuel cells (PEMFCs) for heavy-duty vehicle (HDV) applications require the membrane electrode assemblies (MEAs) with high durability and efficiency, which directly associate with the activity and stability of the cathode catalysts for the oxygen reduction reaction (ORR).

At the lecture, Prof. XIE Jian introduced his research group's latest development of the innovative single-Pt-atomic-site Pt-N-C supports and the new class of platinum group metal (PGM) catalysts over such supports to achieve the enhanced activity and super strong stability, in combination with an ingeniously designed ionomer/catalyst interface into an ideal nanostructured MEA for HDV applications.

This seminar was co-organized by Energy Institute, Department of Chemical and Biological Engineering, and CIAC-HKUST Joint Laboratory for Hydrogen Energy.

On 10 Janurary 2024, Korean Professors, Dr. Sang-Il CHOI, Associate Professor of Chemistry and Green-Nano Materials Research Center at the Kyungpook National University and Chang Hyuck CHOI, Associate Professor of Chemistry at Pohang University of Science and Technology (POSTECH) presented their findings to the audience at a networking seminar event.

Vertically aligned β-Ni oxyhydroxides as highly active and stable oxygen evolution reaction catalysts

by Prof. Sang-Il CHOI

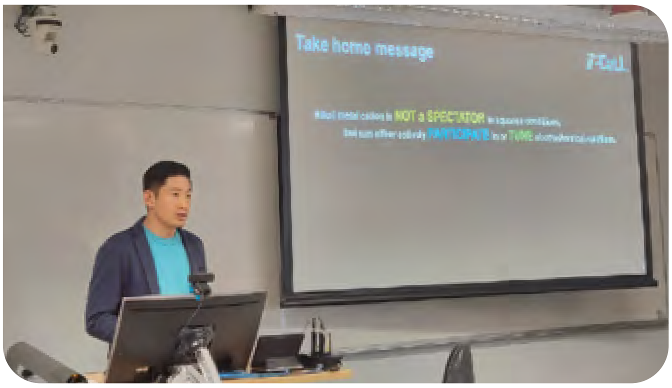
Nickel-based alkaline electrolyte membrane water electrolyzers (AEMWEs) have received much attention owing to the great potential for eco-friendly and massive hydrogen production. Based on the high intrinsic activity, 2-dimensional β-NiOOH has been considered one of the best candidates for anodic catalysts in AEMWEs. However, the β structure of NiOOH rapidly transforms into less active γ structure under electrocatalytic working conditions, which reduces the catalyst activity and stability and therefore limits practical application.

In this talk, Prof. Sang-Il CHOI introduced the vertical alignment of β-NiOOH on Ni(111) facet via ionic heteroepitaxy, in which the unique structure prevents phase transformation during the anodic reaction, resulting in exceptional catalytic activity and durability.

Cation Effects on Electrocatalysis

by Prof. Chang Hyuck CHOI

Electrocatalysis, whose reaction venue locates at the electrode-electrolyte interface, is controlled by electron transfer across the electric double layer, envisaging a mechanistic link between the electrocatalytic property and the EDL structure. One of the most intriguing questions is the mechanistic role of the alkali metal cation at the electrode-electrolyte interface, often referred to as the “cation effect”. In this presentation, Prof. Chang Hyuck CHOI showed that the identity and activity of the alkali metal cation not only influence catalytic performance and selectivity, but could also directly affect electrode stability. To understand the puzzling “cation effect”, various control experiments and computational studies were performed to explore potential scenarios such as the cation-coupled electron transfer, the field strength modification, and the ion paring effect. With a comprehensive understanding of alkali metal identity-dependent electrocatalysis, he proposed a conceptual strategy for better electrocatalysis.



EI - CIAC-HKUST JLHE joint seminars

Energy Institute (EI) and CIAC-HKUST Joint Laboratory for Hydrogen Energy co-organized two seminars on hydrogen-energy in November.

Electro-catalysis for Advanced Fuel Cells and Hydrogen Production from Seawater Electrolyser

by Prof. LIN Wen-Feng

On 18 November 2024, Prof. LIN Wen-Feng, University Special Envoy for East Asia, Professor of Chemical Engineering and Departmental Director of Research at Loughborough University, UK gave a seminar on "Electro-catalysis for Advanced Fuel Cells and Hydrogen Production from Seawater Electrolyser".

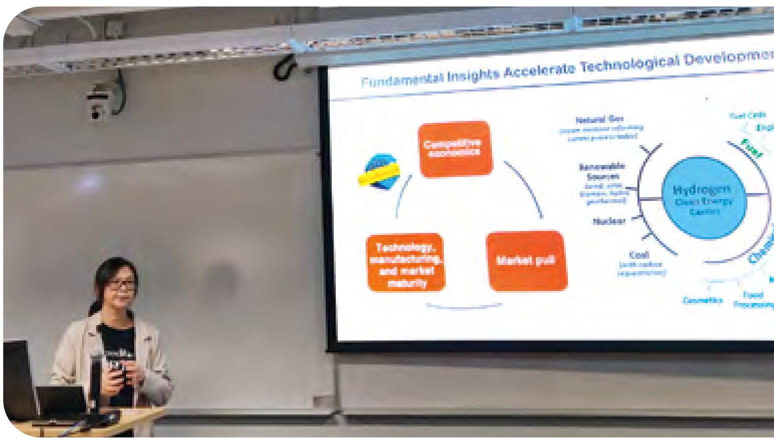
Electro-catalysis plays key roles in electrochemical energy conversion technologies such as fuel cells and seawater electrolysis for green hydrogen production. In this talk, Prof. Lin shared with participants the recent progress on the development of low-cost electrocatalysts for both advanced direct liquid fuel cells and seawater electrolysis for green hydrogen production. The effects of supports and electrode structures on catalyst layers towards liquid fuel oxidation and seawater splitting reactions (hydrogen evolution reaction and oxygen evolution reaction) have been demonstrated, and mechanisms understood.

Accelerated Catalyst Design for Hydrogen Economy

by Prof. HUANG Yu

On 27 November 2024, Prof. HUANG Yu, Traugott and Dorothea Frederking Endowed Chair in Engineering and Professor of the Department of Materials Science and Engineering at University of California Los Angeles, USA, talked about "Accelerated Catalyst Design for Hydrogen Economy".

Hydrogen, as a clean and versatile energy carrier, plays a crucial role in reducing greenhouse gas emissions and advancing the transition toward a more sustainable and environmentally friendly energy future. Electrocatalysis plays a central role in hydrogen energy technologies. This presentation delved into the development of experimentally attainable descriptors capable of predicting the catalytic activity and stability of catalysts, which facilitates the accelerated discovery of more efficient catalysts.



Visiting Scholars and Delegations

Energy Institute warmly welcome contacts and collaborations, from cutting-edge research projects to education, sharing and experience exchange, and more….

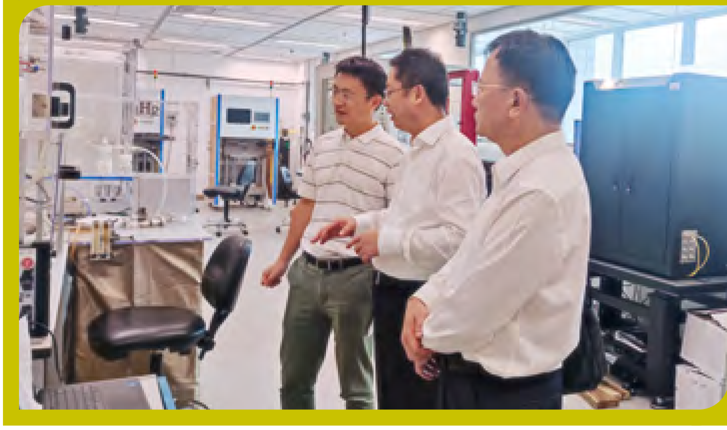
PetroChina Shenzhen New Energy Research Institute Co., Ltd. and
PetroChina International (Hong Kong) Corporation Limited

China Hydrogen Limited

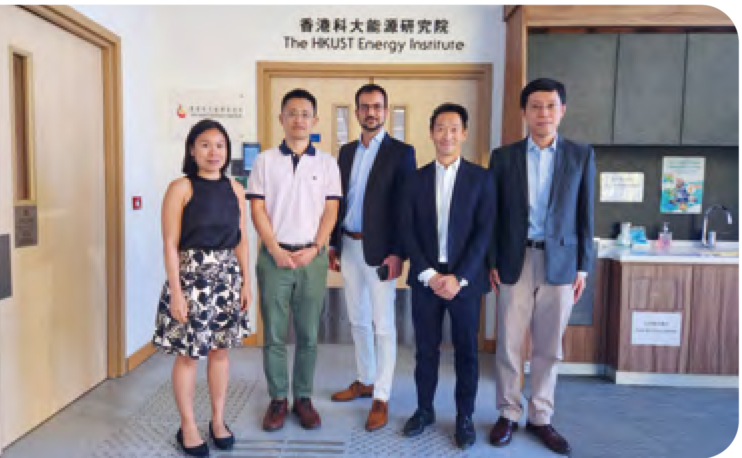
Petro China Co., Ltd.

Ministry of Science and Technology of the People's Republic of China and National Innovation Centers

Gdańsk University of Technology, Poland



Shaanxi Non-ferrous Metals Holding Group



CLP and E.ON Group

University of Strathclyde

Electrical & Mechanical Services Department (EMSD), and Construction Industry Council (CIC)

Committees

Advisory Committee

Chairman

Prof. Hong LO
Dean of Engineering, HKUST

Members

Ir Don H.K. CHENG
Head of Commercial – Hong Kong Utility,
Head of Sustainable Green Energy Hub
The Hong Kong and China Gas Co. Ltd.

Ir Prof Simon Kwok Chuen CHEUNG
Business Development Director (China Region)
QEV Technologies

Ir Harry Hon Chung LAI
Deputy Executive Director
Hong Kong Green Building Council Limited

Dr. Stephen Chuying OUYANG
Co-President of Research and Development
Executive Deputy Director of 21C LAB
Contemporary Amperex Technology Co., Limited (CATL)

Ir. Prof. Paul POON
Managing Director
Poon's Engineering Limited

Prof. Chao-Yang WANG
William E. Diefenderfer Chair Professor of Mechanical, Chemical Engineering, and Materials Science and Engineering
Pennsylvania State University

Prof. Minhua SHAO
Director of HKUST Energy Institute
Cheong Ying Chan Professor of Energy Engineering and Environment
Head and Chair Professor of Chemical and Biological Engineering, HKUST

Executive Committee

Chairman

Prof. Minhua SHAO
Director of HKUST Energy Institute
Cheong Ying Chan Professor of Energy Engineering and Environment
Head and Chair Professor of Chemical and Biological Engineering, HKUST

Members

Prof. Henry He YAN
Associate Director of HKUST Energy Institute
Chair Professor of Chemistry, HKUST

Prof. Qing CHEN
Associate Director of HKUST Energy Institute
Associate Professor of Mechanical and Aerospace Engineering
Associate Professor of Chemistry, HKUST

Prof. Jiannong WANG
Wu Chien-Shiung Professor of Science
Head and Chair Professor of Physics, HKUST

Prof. Zhiyong FAN
Chair Professor of Electronic and Computer Engineering
Chair Professor of Chemical and Biological Engineering, HKUST

Prof. Tianshou ZHAO
Founding Director of HKUST Energy Institute
Chair Professor of Mechanical and Aerospace Engineering, HKUST

Prof. Baoling HUANG
Professor of Mechanical and Aerospace Engineering, HKUST

Prof. Ding PAN
Associate Professor of Physics
Associate Professor of Chemistry, HKUST

香港科技大學
THE HONG KONG
UNIVERSITY OF SCIENCE
AND TECHNOLOGY

能源研究院
ENERGY INSTITUTE