

HKUST EI

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NET ZERO



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Message from the Director

Developing and implementing sustainable energy solutions is critical. The pursuit of net-zero emissions by 2050 is a pressing and highly challenging endeavor. In this newsletter, I want to share with you some of my viewpoints and how we work together to move the world toward a sustainable future.

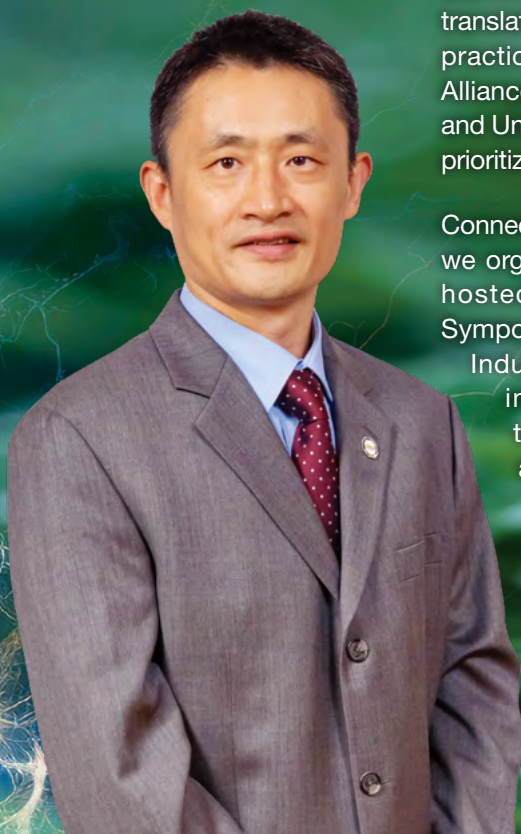
We shined a spotlight on the remarkable achievement of our faculty on awarded team-based funding. Congratulations to Prof. Baoling HUANG, Prof. Zhigang LI and Prof Mitch LI awarded grants in RGC Collaborative Research Fund; Prof Haipeng LU received the Notional Natural Science Foundation of China (NSFC) Young Scientists Fund and Prof. Yuanyuan ZHOU awarded by the NFSC-RGC Collaborative Research Scheme. And I received a major funding from the Department of Science and Technology of Guangdong Province. We welcomed four new members to join this research family.

Committed to developing cutting-edge research and translating developed ideas, techniques and knowledge into practical applications, we joined the Energy Engineering Alliance with Southern University of Science & Technology and University of Macau. We partner with COMKING AGGE to prioritize research cooperation in renewable energy solutions.

Connecting the community through knowledge and sharing, we organized a Technology Showcase in December 2022, hosted the 15th Global Chinese Chemical Engineers Symposium in August 2023 and co-organized the HKUST Industry Engagement Day Plus in December 2023 to introduce our latest energy-related findings and technology. A very good platform to meet our industrial and educational partners.

Our members' contribution and effort are a testament to the power of perseverance and dedication in the pursuit of innovation, knowledge transfer, and education. Thank you to our valued members' commitment!

Do enjoy reading this issue!



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

Meeting the Challenge of Net Zero Faster



The pursuit of net-zero emissions by 2050 is a pressing and highly challenging endeavor. As many people globally tread this path toward a sustainable future, what are the key factors that must come into play for the world to achieve this ambitious target?

Energy Institute Director, Prof. Minhua SHAO, Cheong Ying Chan Professor of Energy Engineering and Environment, Head of the Department of Chemical and Biological Engineering shared with readers his viewpoints. Prof Shao is a world-renowned electrochemist with a research focus on electrochemical energy conversion and storage.

First and foremost, a shift in energy sources is imperative. While we must embrace renewable energy on a grand scale, harnessing the power of the sun and wind to meet our growing energy needs, that alone is not enough. Societies must also focus on energy efficiency and conservation. It is up to people and companies alike to prioritize reducing their energy consumption by making conscious choices in their daily lives. Putting simple steps such as selecting energy-efficient appliances, insulating homes, and utilizing natural light at the heart of our decision-making are among the ways we can all make a difference to energy saving.

We must face the fact that the transportation sector, a significant contributor to greenhouse gas emissions, must undergo a transformative revolution. We need to transition faster from reliance on fossil fuel-powered vehicles to electric vehicles (EVs) powered by batteries and fuel cells and invest in a robust charging infrastructure. Some governments are already implementing policies such as tax incentives and subsidies to promote the adoption of EVs. Investing in public transportation systems to reduce

individual car usage is another avenue that needs to move up the to-do list.

Furthermore, we must rapidly address the role of corporations and industries in this journey. Companies need to be prepared to adopt sustainable practices throughout their operations, from their supply chains to their manufacturing processes. Embracing circular economy principles, where waste is minimized and resources are recycled or repurposed, can have a profound impact. Investing in clean technologies and promoting sustainable business models should be at the forefront of near-term corporate strategies.

As can be seen from the above, it is not one change that can meet the challenge. Reaching the net-zero emission target by 2050 – now just 27 years away – requires a multifaceted approach. From the shift toward renewable energy to energy efficiency, sustainable transportation, and corporate responsibility, it has to be a collective effort involving individuals, governments, and organizations.

To contribute to meeting the 2050 target, the HKUST Energy Institute (EI) is leveraging its wide-ranging expertise in research, collaboration, and education. Researchers at EI are working at full speed to develop innovative technologies on energy generation, storage, efficiency, and policy. In addition to research, the Institute is dedicated to undergraduate and postgraduate education on energy, with the hope of inspiring the next generation of leaders and innovators to become agents of change and move the world toward a sustainable future.

Working together is what will bring the seemingly unreachable within reach.

Prof. Baoling HUANG and Prof. Zhigang LI Together Awarded around HK\$8.9 Million RGC Collaborative Research Fund



The research team led by **Prof. Baoling HUANG** of Mechanical and Aerospace Engineering has been awarded a Collaborative Research Fund (CRF) of around HK\$4.78 million for the cross-institutional multidisciplinary project titled “High-Performance Ionic Thermoelectric Hydrogels for Multifunctional Smart Skin and Body Heat Harvesting”.

Ionic thermoelectric hydrogels show great potential in low-grade heat harvesting and thermal sensing owing to their ultrahigh thermopower, excellent flexibility/stretchability, low cost and eco-friendliness. Despite significant advance in this area in recent years, the fundamental understanding of ionic thermoelectric phenomena in hydrogels has yet to be developed, which seriously hinder the further development of high-performance ionic hydrogels. Particularly, n-type hydrogels with decent thermopower are quite scarce and the redox thermopowers in aqueous thermocells are quite limited. It is thus desirable to develop effective strategies for modulating the ionic thermoelectric properties of ionic hydrogel for practical applications.

Working together with CityU and CUHK researchers, the study aims to investigate the factors that influence the thermopower in polymer electrolytes and to develop different strategies for tuning the thermoelectric properties of ionic hydrogels. Ionic hydrogel-based multifunctional smart skin and hybrid body heat harvester will then be developed to explore the potential applications of high-performance ionic hydrogels in thermal sensing and low-grade heat harvesting.

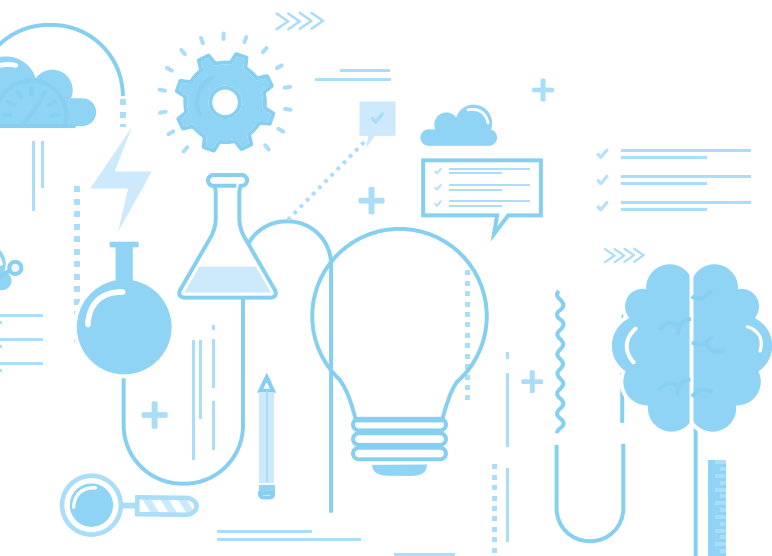


Prof. Zhigang LI of Mechanical and Aerospace Engineering has been awarded nearly HK\$4.16 million by the Collaborative Research Fund (CRF) to carry out a multidisciplinary research on “Shaping Gas Fuel Storage: Understanding the Thermal Properties of Porous Metal-Organic Frameworks”.

Energy consumption is experiencing a continuous rise. In terms of energy production, the growing worldwide demand on fossil fuels has brought significant environmental issues, especially the climate change caused by carbon emissions. Compared to liquid petroleum and solid coal, gas fuels such as hydrogen (H₂) or methane (CH₄) are more environmentally friendly owing to their low carbon emissions and higher gravimetric energy densities. The main challenge for gas fuels lies in the storage and transportation that usually require harsh conditions and consume massive amounts of energy, due to their extremely low boiling points, low densities, high critical pressures, and high diffusivities. Porous metal-organic frameworks (MOFs), owing to their ultrahigh porosity, high thermal and chemical stability, are regarded as a potential alternative for gas fuel storage or transportation under moderate conditions. However, in an actual gas storage system, the heat of adsorption (exothermic) and desorption (endothermic) will cause a large temperature change which has a negative impact on the usable gas capacity.

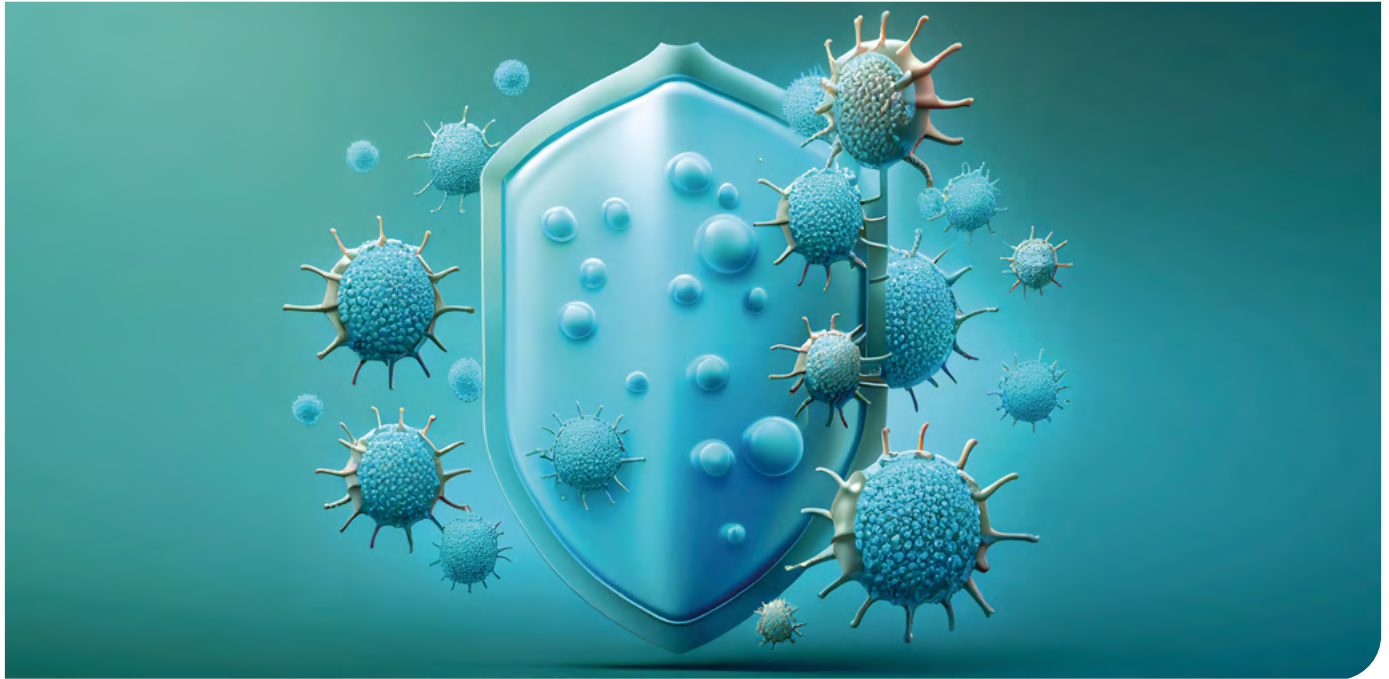
Prof Li and his team set out to advance the understanding and manipulate the physical and thermal properties of porous metal-organic frameworks, thereby providing design guidance for future gas fuel storage systems. Collaborators include CityU and HKU researchers.

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. Mitch LI Awarded the Young Collaborative Research Grant



Prof. Mitch LI of Integrative Systems & Design and Electronic & Computer Engineering, and his collaborators from The University of Hong Kong (HKU) received a Young Collaborative Research Grant (YCRG) of around HK\$4.17 million for their project on “Scalable Manufacturing of Antiviral Self-

Cleaning Surfaces Against Respiratory Infectious Diseases”. Team members also include EI faculty Prof. Zhiyong FAN of Electronic & Computer Engineering, and Chemical & Biological Engineering; and Prof. Shuhuai YAO of Mechanical & Aerospace Engineering, and Chemical & Biological Engineering.

Infectious respiratory diseases are severely affecting modern societies. There is a high risk of transmission

of respiratory infectious diseases in public places. This collaborative project aims to develop a scalable-manufacturable antiviral surface that can be easily deployed in public facilities to mitigate the spread of respiratory infectious diseases.

The work seeks to develop a smart manufacturing system to fabricate low-cost antiviral films for deploying on public surfaces against such diseases.

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.

Prof. Haipeng LU Received the 2022 National Natural Science Foundation of China (NSFC) Young Scientists Fund

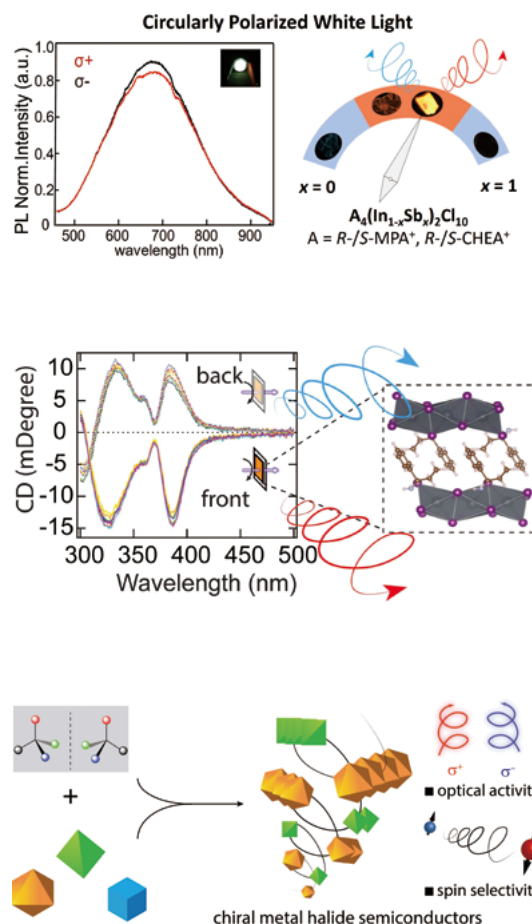


Prof. Haipeng LU (first from the right) and his group members

Prof. Haipeng LU, Assistant Professor in the Department of Chemistry, has been awarded the 2022 National Natural Science Foundation of China (NSFC) Young Scientists Fund.

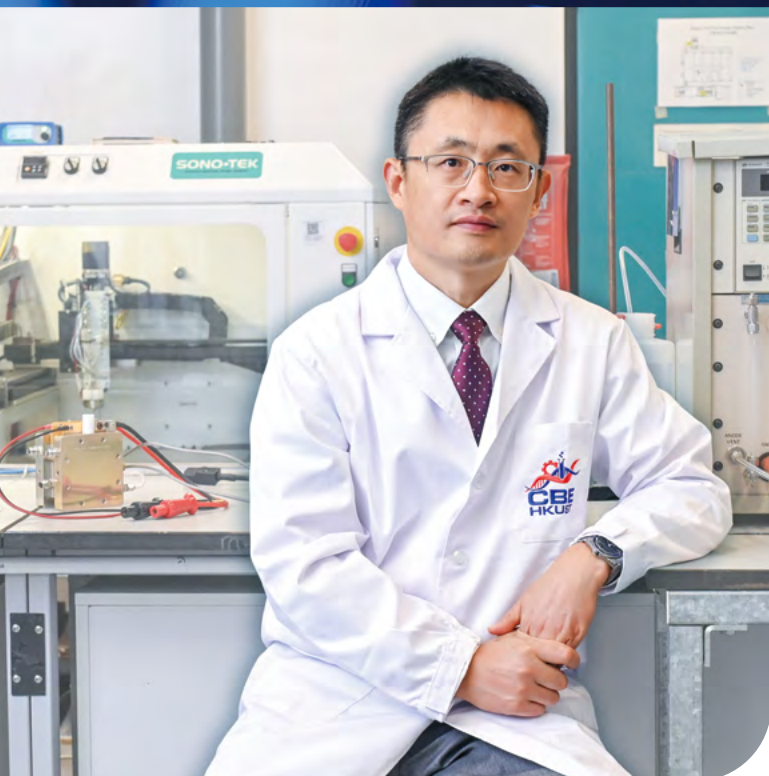
Prof. Haipeng Lu is awarded for his research project titled “Development of highly luminescent chiral hybrid semiconductors”. The development of polarized light sources plays an essential role in the modern display industry and future technologies including 3D display, quantum computing and sensing, and information processing. Current materials and approaches that generate polarized light have serious limitations including excessive cost, complex infrastructure, and low sensitivity and resolution. This project is focused on the development of an emerging family of hybrid semiconductors that break the time-reversal symmetry via structural chirality. These materials have the potential to emit high purity of circularly polarized luminescence with high efficiency. This project is to build such a synthetic roadmap for these fascinating materials.

This prestigious fund offers support to young academics and encourages them to focus on a self-chosen area for basic research. It helps foster the young scholars with outstanding achievement on the international science frontiers.



Prof. Minhua SHAO

Awarded CNY ¥20 Million Guangdong Province Key Areas R&D Plan Project Fund



El-led project has been awarded the Guangdong Province Key Areas R&D Plan Project Fund in the area “New energy vehicles and autonomous driving” with an overall grant of CNY ¥20 million. El Director **Prof. Minhua SHAO**, Cheong Ying Chan Professor of Energy Engineering and Environment, Head and Chair Professor of Chemical and Biological Engineering, is the principal investigator.

In this three-year awarded project “Development and industrialization of highly active and durable platinum-based hydrogen fuel cell catalysts”, Prof. Shao’s team aims to develop and commercialize the key materials and components of fuel cells, which are highly active and highly durable platinum-based hydrogen fuel cell catalysts, membrane electrode assemblies and achieve large-scale preparation. The purpose is to provide technical support for the development of fuel cell and new energy vehicle industries in Greater Bay Area and even the country.



By collaborating with South China University of Technology and two enterprises with advanced R&D conditions and industrialization foundation in key fuel cell materials and components from Greater Bay Area, the research team expects to address the problems of insufficient activity and durability of surface platinum-rich intermetallic catalyst, high cost of palladium-platinum-core-shell catalyst, as well as to accelerate membrane electrode assemblies batch preparation technology with high catalyst utilization. The industrialization of catalysts and membrane electrodes will surely drive the development of the entire industry chain of fuel cell new energy vehicles.

The Guangdong Province Key Areas R&D Plan Project Fund was set up by the Guangdong Provincial Government and Guangdong Provincial Department of Science and Technology to provide better and more focused funding support for research and development projects which can help Guangdong province and Greater Bay Area decarbonize and enhance environmental protection as China strives towards carbon neutrality by 2060.

Prof. Yuanyuan (Alvin) ZHOU

Awarded HK\$3.6 million
by NSFC-RGC Collaborative
Research Scheme



Prof. Yuanyuan (Alvin) ZHOU, Associate Professor of Chemical & Biological Engineering, was awarded HK\$3.6 million by NSFC-RGC Collaborative Research Scheme (CRS) for his project “Multi-elemental Lone-electron-pair Cations Based Pb-free Perovskite Optoelectronics: from Materials design, Synthesis to High-performance Devices”. Only three projects in the area of “New Materials Science” across the entire Hong Kong have been funded under this scheme. In this four-year project, Prof. Zhou’s team aims to combine the theoretical and experimental approaches and to artificial intelligence to develop new perovskite semiconductors without the involvement of toxic Pb for optoelectronic applications such as photovoltaics and light-emitting diodes.

Perovskite solar cells (PSCs) have emerged as a promising photovoltaic technology for integration into the future urban environment to power buildings and internet of things (IoT) devices. However, state-of-the-art PSCs contain toxic Pb, restricting the commercialization, while as-reported Pb-free PSCs suffer from the performance and stability issues due to the intrinsic materials shortcomings. This project proposes a multi-elemental strategy to design novel Pb-free perovskites based on lone-electron-pair cations for stable, efficient Pb-free PSCs and optoelectronics.

The field has been searching for Pb-free perovskite alternatives. As of now, potentially less toxic metal cations,

including Sn, Ge, Ti, Bi, Sb, etc., have been used as Pb substitutes in perovskites, respectively. Amongst these options, Sn perovskite demonstrates the highest promise, but it still suffers from the high sensitivity to oxygen. Vast efforts have been devoted to modifying Sn perovskites, and other single- or dual-cation Pb-free perovskites. But the advancements so far have not brought sufficient excitement, calling for the re-design, exploration, and discovery of a new Pb-free perovskite system from a different perspective.

Therefore, Prof. Zhou proposes to examine and discover new promising candidates amongst the multi-elemental Pb-free perovskites, because the multi-elemental strategy largely expands the chemical space for structural and property explorations, and meanwhile, the syngenetic effects of tailoring structural factors (tolerance factor, octahedral factor), alloying ratio, and electronic dimensionality can possibly create new materials states. Prof. Zhou expects, by leveraging the strong existing research and collaboration foundations, as well as considering the vast space amongst the proposed multi-elemental Pb-free perovskite system, these project outcomes will impart impacts not only for developing high-performance devices for real-world applications, but also for unravelling new semiconductor sciences.



HKUST Researchers Design Iron-Based Cathode to Achieve Record Performance for Protonic Ceramic Fuel Cells

Prof. Francesco Ciucci (second left), postdoctoral fellow Dr. Song Yufei (first left), PhD students Wang Yuhao (second right) and Matthew James Robson (first right) and other team members have identified an exceptionally promising cathode material for protonic ceramic fuel cells, marking a major step toward the commercialization of this renewable energy technology.




Researchers at the Hong Kong University of Science and Technology (HKUST) have designed an innovative iron-based cathode material to achieve record performance for protonic ceramic fuel cells, marking a significant step forward in the development and commercialization of this promising renewable energy technology.

Fuel cells, which use the chemical energy of hydrogen or other fuels to generate electricity efficiently and cleanly, are environmentally friendly power sources that have been under intensive development worldwide in an effort

to combat climate change and energy shortage. A new technology in the field, protonic ceramic fuel cells (PCFCs) are based on proton-conducting ceramic electrolytes and have the advantages of low pollutant emissions, high efficiency, and the flexibility of working well with not just hydrogen but also other gases like ammonia, biogas, and methane. They are generally used for distributed power generation, including off-grid power production.

However, the widespread commercialization of PCFCs has been hindered by the lack of high-performance and



low-cost cathode materials. Currently, cobalt-based perovskites are the most widely used cathode materials because cobalt can easily lower and raise its oxidation number, which results in superior oxygen reduction reaction activity that is vital to the performance of the cathode. Yet, these materials suffer from high costs, cause pollution in mining, and require complex preparation procedures incompatible with mass production. They are also in high demand in lithium-ion batteries, which are commonly used in electric vehicles.

Ideally, cobalt needs to be replaced by transition metals with lower costs but comparable reactivity. Iron lies close to cobalt in the periodic table, shares many similar chemical properties, but is much cheaper. Yet, iron-based materials are generally understood to be worse catalysts, leading to unsatisfactory performance. Therefore, the compositions of the materials must be fine-tuned to identify the best-performing material.

Working in this direction, a research team led by Prof. Francesco CIUCCI from the Department of Mechanical & Aerospace Engineering and Department of Chemical & Biological Engineering combined first-principle simulations, molecular orbital analysis, and experiments to design new, inexpensive ceramics that use cheap elements, such as barium (Ba), iron (Fe), and zirconium (Zr), leading to a PCFC with record performance.

The team designed the cathode materials from basic physical-chemical principles and density functional theory. Through computationally guided optimization,

Ba_{0.875}Fe_{0.875}Zr_{0.125}O_{3-δ} (D-BFZ) was identified as the most promising cathode material. Experiments showed that D-BFZ has an exceptional electrochemical activity to react with oxygen achieving a high peak power density, among the best in the field, and excellent operational stability. Moreover, D-BFZ can be produced using simple, mass-production-suitable synthesis techniques, which is a major step toward realizing commercially viable PCFCs.

“PCFC technology could be transformational and there are many exciting opportunities to develop it further. We will continue to leverage first-principle calculations and experiments to improve the performance of PCFCs. If used reversibly, PCFCs will have a tremendous impact on hard-to-decarbonize sectors, such as siderurgy, ammonia production, and heavy-duty transportation,” said Prof. Ciucci.

The team’s research work was recently published in *Nature Catalysis* and highlighted in *Nature Reviews Materials*.

Led by Prof. Ciucci, the team included PhD students WANG Yuhao, Matthew James ROBSON, and Alessio BELOTTI; postdoctoral fellow Dr. SONG Yufei; PhD graduates Dr. WANG Jian (Class of 2018) and Dr. LIU Jiapeng (Class of 2020); former postdoctoral fellows Dr. WANG Zheng and Dr. ZHANG Zhiqi; as well as collaborators from Ulsan National Institute of Science and Technology and Seoul National University in South Korea, Nanjing Tech University in China, and Curtin University in Australia.

Research Collaboration/ Knowledge Transfer

Establishment of SUSTech-HKUST-MU Energy Engineering Alliance

On May 2023, the signing ceremony of the Guangdong-Hong Kong-Macao University Alliance for Energy Science and Technology cum the Carbon Neutral Energy Forum was held at the University of Macau. The alliance was initiated by the Southern University of Science and Technology, the Hong Kong University of Science and Technology, the University of Macau, and Sun Yat-sen University. Its aim is to promote Guangdong-Hong Kong-Macao cooperation in the field of energy science and technology, integrate related research resources of the elite university alliance, and promote Guangdong-Hong Kong-Macao exchange, collaboration, and resource sharing in the field of energy science and technology.

The Carbon Neutral Energy Forum focused on areas such as energy science and technology, and carbon emissions reduction. In the forum, Energy Institute's faculty Tianshou ZHAO (Founding Director of Energy Institute and Chair Professor of Mechanical & Aerospace Engineering) and Furong GAO (Chair Professor of Chemical & Biological Engineering), and other experts and scholars from higher education institutions gave keynote speeches and led in-depth discussions.

Focusing on the bottleneck of large-scale energy storage in renewable energy utilization, Prof. ZHAO gave a keynote speech on 'Storing Solar Energy with E-fuels' to discuss efficient, safe, scalable renewable liquid fuel storage technologies and emphasize the importance of energy storage systems in the application of new energy power systems. Prof. Gao, with the topic of 'Introduction of Battery Management System Frontier Technologies', shared intelligent battery management technologies, such as battery charge status and health status estimation, and battery data compression and reconstruction.

During the forum, a number of researchers from the University of Macau, the Southern University of Science and Technology, the Hong Kong University of Science and Technology, and Sun Yat-sen University also gave presentations and shared their research achievements.



HKUST and COMKING AGGE signed Memorandum of Understanding to Prioritize Research Cooperation in Renewable Energy Solutions

On Oct 17 2023, the Hong Kong University of Science and Technology (HKUST) signed a memorandum of understanding (MOU) with Comking A-Grade Green Energy (HK) Innovation Centre on the application of flow batteries as renewable energy storage systems, contributing to the development of new energy solutions. Prof. Minhua SHAO, Director of Energy Institute, Head and Chair professor of Chemical and Biological Engineering, said cooperation between the two parties will cover joint research and development projects, technology commercialization, and exchanges of materials, equipment, and talent. "We are delighted to have the opportunity to commercialize the university's scientific achievements through this collaboration. We hope to engage in research that will have a long-term, transformative impact on Hong Kong and the nation's energy future," Shao said. Mr. Guocheng WU, Director of Zhuhai Comking Electric Co, said the company has always focused on new power distribution, electricity consumption and energy systems, aimed at providing comprehensive energy solutions. "We provide integrated solutions such as wind and solar energy storage, charging and inspection, and the development of flow batteries can adequately respond to the need to store renewable energy," Wu said. Jonathan Lamport, founder and CEO of A-Grade Energy, said, "Combined with the university's technological innovation capacity, we can jointly drive progress in renewable energy technologies and sustainable development."

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, 4 new members joined the EI family.



Kam Tim TSE

Professor of Civil and Environmental Engineering

Research Area

- Energy generation
- Energy utilization and conservation

Research Interests

- Wind energy harvesting
- Wind turbine efficiency



Yuanyuan (Alvin) ZHOU

Associate Professor of Chemical and Biological Engineering

Research Area

- Energy generation

Research Interests

- Advanced materials
- Energy and environment
- Data science and PSE



Zhongming LU

Assistant Professor of Environment and Sustainability

Research Area

- Energy storage and distribution
- Energy policy

Research Interests

- Sustainable and resilient urban infrastructures systems
- Emerging technology for cities
- Land use-water-energy-nutrient nexus analysis
- Cyber-enabled sustainable design and planning
- Sustainable engineering toolbox



Qinbai YUN

Research Assistant Professor of Energy Institute

Research Assistant Professor of Chemical and Biological Engineering

Research Area

- Energy generation
- Energy storage and distribution

Research Interests

- Nanomaterials
- Metallic materials
- Catalysis
- Batteries

Faculty Achievement

Prof. Minhua SHAO Named Cheong Ying Chan Professorship in Energy Engineering and Environment

As technology advances and concerns about sustainability become more pressing, researchers worldwide are seeking new ways to tackle the energy- and environment-related challenges facing modern society. Some of the most promising practical applications come from materials science and electrochemistry — the main fields of expertise of Professor Minhua SHAO, HKUST's appointed Cheong Ying Chan Professor of Energy Engineering and Environment, which was created to support the University's mission of fostering breakthroughs in science and engineering that ultimately lead to the betterment of humankind.

The Inauguration Ceremony of Named Professorships was held on 5 December 2023 at the Hong Kong University of Science and Technology.

HKUST Council Chairman Prof. Harry SHUM said, "The recipients of this year's Named Professorships have each made a significant impact on society through their research. They have contributed to HKUST's continuous strive for excellence to make positive impacts to mankind. Our ability to honor this year's inductees is founded



upon the limitless kindness of our donors. We express our deepest appreciation for their ongoing support for HKUST's mission, which allows us to provide an environment in which excellence can thrive."

HKUST President Prof. Nancy IP congratulated the appointed faculty members and thanked donors' generosity. "For the last decade, HKUST has proudly



bestowed the title of Named Professor on over 70 faculty whose teaching and research achievements are worthy of the highest commendation. These scholars have excelled in both academic and pedagogical pursuits, exerting significant influence on various fields of study worldwide while also dedicating themselves to nurturing the next generation. We sincerely thank our generous donors for their support, which enables us to commend, reward, and attract academic leaders from diverse fields, working together with the University to reach new heights and contribute to society,” she said.

Serving as Director of the HKUST Energy Institute and Head & Chair Professor of HKUST’s Department of Chemical and Biological Engineering, Prof. Shao is an internationally recognized scholar with a 20 years of track record in spearheading research on electrochemical systems, nanomaterials, and electric vehicles.

Electrochemical energy conversion and storage represent a major area of innovation by Professor Shao and his group. He is currently leading projects on the development of high-performance and long-life hydrogen fuel cells and high-energy density solid-state lithium batteries, among other innovative directions, which are supported by major local and national funding bodies. The research team led by Prof. Shao, found a new formula which not only could cut down the proportion of platinum used by

80%, but also set a record in terms of the cell’s durability level. Such research holds great promise for advanced sustainability applications, ushering in the next generation of environmentally friendly energy devices.

After graduating in 2006 from the State University of New York at Stony Brook with a Ph.D. in Materials Science and Engineering, Prof. Shao took up prominent industry positions, honing his applied skills in advanced nanomaterials and electric vehicle development at UTC Power and Ford Motor Company. He joined HKUST in 2014 as Associate Professor of Chemical and Biological Engineering, rising rapidly through the University’s ranks and taking over the directorship of the HKUST Energy Institute in 2021.

Prof. Shao has published over 240 peer-reviewed articles and filed over 30 patent applications (19 issued). As well as holding key editorial posts for prestigious journals, he has received myriad honors and awards in recognition of his achievements, including the International Outstanding Young Chemical Engineer Award (2022) and the Teaching Excellence Appreciation Award of the HKUST School of Engineering (2017). He is one of the founding members of the Hong Kong Young Academy of Sciences and was awarded the status of UTC Technical Fellow for his outstanding technical contributions and strategic leadership and mentoring skills.

Prof. Henry YAN and Prof. Zhiyong FAN were Conferred the Chair Professor Title

Prof. Henry Yan and Prof. Zhiyong Fan were promoted to Chair Professor in appreciation of their achievement of excellence and commitments in teaching and research.



Prof. Henry He YAN, Associate Director of Energy Institute and Chair Professor of Chemistry, is a world leading energy scholar. His research mainly focuses on the design and synthesis of organic/polymer materials for highly efficient organic solar cells.

After obtaining his doctor degree in 2004 at Northwestern University, Prof. Yan continued his research work at Polyera Corporation as a group leader and built up the organic solar cell research division of the company. In 2012, Prof. Yan returned to HKUST and continued his research on organic solar cells. In 2015, Prof. Yan's record efficiency cell was recorded in NREL chart. Prof. Yan is also one of first scholars reporting highly efficient non-fullerene organic solar cells with low voltage losses (Nature Energy, 2016, 1, 16089). Prof. Henry Yan has been identified as Highly Cited Researcher in the field of Materials Science and Environment and Ecology by Clarivate Analytics in 2023, the six consecutive year he has been selected in the list, which represents some of the world's most influential scientific minds.



Prof. Zhiyong FAN, Chair Professor of Electronic & Computer Engineering, and Chemical & Biological Engineering, joined the Hong Kong University of Science and Technology (HKUST) in 2010. His research interests include nanoelectronic design, nanofabrication and nanomaterials.

Currently, he is the founding Director of Center on Smart Sensors and Environmental Technologies, Co-director of the State Key Laboratory of Advanced Display and Optoelectronics Technologies at HKUST, Associate Director of Materials Fabrication and Preparation Facility of HKUST, and Associate Director of Guangdong-Hong Kong-Macao Joint Laboratory for Intelligent Micro-Nano Optoelectronic Technology.

He is a Fellow of the Royal Society of Chemistry, Fellow of Optica, Senior Member of IEEE, and Founding Member of the Young Academy of Sciences of Hong Kong. He has won a number of awards, including 2022 Tencent Xplorer Prize, 2022 HKBOC Science and Technology Innovation Prize, Shandong Natural Science Second Prize, 2022 and 2020 Top 10 Research Progress on Semiconductors in China, HKUST SENG Young Investigator Award, Outstanding Research Award, etc. His research interest is focused on functional nanomaterials and structures for electronic, optoelectronic and bionic electronic devices. Till date, he has published over 240 peer reviewed papers in Nature, Nature Photonics, Nature Electronics, etc., with citations ~28,000, H index 88. He also has 30 Chinese and US patents and one national high-tech company.

Congratulations to Prof. Henry Yan and Prof. Zhiyong Fan for the well-deserved title of Chair Professorship!

ASV17

Prof. Huihe QIU Won the Highest Award at the 17th Asian Symposium on Visualization



Prof. Huihe QIU, currently the Acting Director of Sustainable Energy and Environment Thrust at the Hong Kong University of Science and Technology (Guangzhou), won the highest award “Nakayama-Wei Award” at the 17th Asian Symposium on Visualization which was held in June 2023 in Japan.

Prof. Huihe QIU is the Head and Professor of Sustainable Energy and Environment Thrust at the Hong Kong University of Science and Technology (Guangzhou). He received his Ph.D. degree from Institute of Fluid Mechanics, LSTM, at the University of Erlangen, Germany. He joined The Hong Kong University of Science and Technology (HKUST) in 1994 and became the Head of Department of Mechanical and Aerospace Engineering in 2018. Prof Qiu's research has focused on fluid dynamics and heat transfer, bioinspired propulsion and flapping wing aerodynamics, transport phenomena in microscale multiphase flows. Prof. Qiu is the founding Editor-in-Chief of Case Studies in Thermal Engineering (Q1, Clarivate 2022) and Associate Editor of Aerospace Science and Technology (Q1, Clarivate 2022). He has been invited to give 35 plenary and keynote speeches at International Conferences. He is the Chairman of several International Conferences. Prof. Qiu is the recipient of the Best Paper Award of Measurement Science & Technology, Institute of Physics (IOP) in 1994, Philips Outstanding Paper Award (2012), ASME Best Poster Award (2010), Best Paper Award, 2nd World Congress on Mechanical, Chemical, Material Engineering (2016), Best Paper Award, 4th



International Conference on Heat Transfer and Fluid Flow (2017), Best Paper Award, 10th International Conference on Nanotechnology: Fundamentals and Applications (2019), Best Paper Award in 16th Asian Symposium on Visualization (ASV16), Nakayama-Wei Award (2023), The State Scientific and Technological Progress Award (SSTPA) and the Scientific and Technological Achievement Award from the State Education Commission.

The Asian Symposium on Visualization (ASV) is an international conference established by the Visualization Society of Japan, and is currently hosted by a committee of Asian countries on a rotating basis. It has been held for more than 30 consecutive years. The highest award awarded by the seminar, the "Nakayama-Wei Award", was established in memory of its founders, Professors Nakayama and Wei. Focusing on advances in visualization methods and their applications, especially in fluid dynamics, ASV is a platform for the exchange of visualization techniques in a wide range of fields.

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

- 2023 Fellow of the Electrochemical Society



Prof. Henry He YAN

Associate Director of Energy Institute
Chair Professor of Chemistry

- Chair Professor
- 2023 Highly Cited Researchers in the field of Materials Science and Environment and Ecology



Prof. Zhiyong FAN

Chair Professor of Electronic and Computer Engineering
Chair Professor of Chemical and Biological Engineering

- Chair Professor
- 2022 Bank of China (Hong Kong) Science & Tech Innovation Prize in the new materials category
- 2023 Fellow of Optica



Prof. Huihe QIU

Professor Emeritus of Mechanical and Aerospace Engineering

- 2023 The Nakayama-Wei Award
- 2023 Fellow of the International Association of Advanced Materials (IAAM)



Prof. Yi-Kuen LEE

Associate Professor of Mechanical and Aerospace Engineering
Associate Professor of Chemical and Biological Engineering

- 2023 Undergraduate Research Opportunities Program (UROP) Faculty Research Award



Prof. Stephane REDONNET

Assistant Professor of Mechanical and Aerospace Engineering

- 2022-23 SENG Teaching Excellence Appreciation Award
- 2023 Undergraduate Research Opportunities Program (UROP) Faculty Research Award 2023
- Fellow of the Royal Aeronautical Society

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.)

- | | |
|--|--|
| <ul style="list-style-type: none"> ▪ Bangyuan AN ▪ Hanz Charles Ponce ACOSTA ▪ Yijie ZHANG ▪ Yuqi LIU | <ul style="list-style-type: none"> • 2022 Tsinghua International Case Analysis Competition of Public Policy on Sustainable Development Goals, Second Prize |
| <ul style="list-style-type: none"> ▪ Man Ting CHUNG ▪ Chun Yi LEE ▪ Bryan Suryaraso GANI | <ul style="list-style-type: none"> • 2022 BSOMES (Building Services Operation and Maintenance Executives Society) Research Prize - Group Awards: 1st prize |
| <ul style="list-style-type: none"> ▪ Chi San Ivor LEUNG | <ul style="list-style-type: none"> • 2022 Paul and May Chu Undergraduate Research Award, Honorable Mention |
| <ul style="list-style-type: none"> ▪ Chi San Ivor LEUNG ▪ Ngai Nam CHAN | <ul style="list-style-type: none"> • 2023 Undergraduate Research Opportunities Program (UROP) Award |
| <ul style="list-style-type: none"> ▪ Usman Bin SHAHID | <ul style="list-style-type: none"> • Champion Award and the People's Choice Award in the 2023 HKUST 3MT Competition |
| <ul style="list-style-type: none"> ▪ Yan SHEN ▪ Sepideh Sadat HOSSEINI NOORABD ▪ Yapeng CHEN ▪ Zhenteng WU ▪ Dan LI (Advance Materials, HKUST(GZ) Function Hub) | <ul style="list-style-type: none"> • 2023 "Tong Fei Cup" Smart Technology for Composites Innovation Competition" co-organized by the COMAC and Tongji University, Merit Award |
| <ul style="list-style-type: none"> ▪ Yian WANG | <ul style="list-style-type: none"> • 2022 CBE Best Teaching Assistant Award |

Community Engagement

El Technology Showcase 2022



On 9 December 2022, Prof. Tim CHENG, Vice-President for Research and Development, Dr. Shin Cheul KIM, Associate Vice-President for Research and Development (Knowledge Transfer) and Prof. Minhua SHAO, Director of Energy Institute (EI), welcomed 150 more faculty, researchers, government officials and industry leaders who joined in person or online, at the HKUST Energy Institute Technology Showcase.

At the Technology showcase, the Institute demonstrated the University's commitment on green technologies and its response to China's mission on carbon neutrality and HK's commitment to achieve net-zero emissions. EI members have been investigating the next-generation green and energy-efficient technologies which aim to conserve, monitor or reduce the negative impact of technology on the environment and the consumption of resources. Some 13 faculty members presented the latest developments in the major fields of smart energy such as fuel cells, hydrogen production and storage; batteries, and energy-efficient technologies for green buildings. In parallel to the presentations, there were feature exhibits and interactive demonstrations to showcase innovative research on new energy technologies at HKUST. Some of them are ready for commercialization.

Investment environment is essential to enable innovative green technologies and make them market-ready. Public and private R&D support is equally important, not only funding but also co-work. Energy Institute values the opportunity to develop a durable partnership between



and work collaboratively with industry sector stakeholders to advance energy innovation. Technology Showcase 2022 provided a platform for participants to share mutual interest, synergies and complementary experience, and more, to forge collaborations. Through the collaborative research projects to enhance the knowledge transfer of research outcomes to society.

Many thanks to all participants who made the Technology Showcase possible. And, a big thank you to our speakers who enriched the event with interesting topics. Speakers included Prof. Tim Cheng; Dr. Shin Cheul Kim; Prof. Minhua Shao; Prof. Henry Yan; Prof. Zhiyong Fan; Prof. Ping Gao; Prof. Baoling Huang; Prof. Jianwei Sun; Prof. Jinglei Yang; Prof. Shuhuai Yao; Prof. Francesco Ciucci; Prof. Yi-Kuen Lee; Prof. Joanthan Halpert; Prof. Yoonseob Kim and Prof. Frank Lam.



Frontier in Chemical Engineering
15th Global Chinese Chemical Engineers Symposium (GCCES-2023)
 (15th Annual Conference of Global Academy of Chinese Chemical Engineers)

第十五屆全球華人化工學者研討會
 (全球華人化工學者學會第十五屆年會)

August 5 – 9, 2023 | 2023 年 8 月 5-9 日

Hong Kong, China 中國, 香港

承辦單位 | 香港科技大學 協辦單位 | 香港大學 香港中文大學 香港城市大學 香港理工大學



The 15th Global Chinese Chemical Engineering Symposium

The 15th Global Chinese Chemical Engineers Symposium (GCCES-2023) was held successfully at the Hong Kong University of Science and Technology from 5-9 August 2023. Profs. Minhua Shao (HKUST), Guohua Chen (City University of Hong Kong), and Jesse Zhu (Western University, Canada) co-chaired the conference.

The Symposium attracted more than 500 top-notch scientists and students from Mainland, Hong Kong, Macao and abroad gathered to discuss and share experience on the research challenges and trends of chemical science and engineering. The unique symposium offered a dynamic environment that fostered international collaborative innovation and interdisciplinary integration as well as industrial-academic co-operation.

A High-end Forum themed “Future Chemical Engineering Education and Research” was specially organized to celebrate the 30th Anniversary of HKUST Department of Chemical and Biological Engineering (CBE). The expertise offered valuable insights and new perspectives

on possible directions and approaches for advancing chemical engineering education and research.

At the other featured session “Innovation and Entrepreneurship Forum”, participants are encouraged to overcome the challenges and seize opportunities by turning their research breakthroughs into real-world impacts. The GCCES strongly promotes the professional development of young Chinese chemical engineers and scientists by organizing various forums included Doctoral Scholar, Women in Chemical Engineering and Future Chemical Engineering Scholars’ Forum.

The Global Chinese Chemical Engineering Symposium (GCCES) is a prestigious and world-wide platform for the communication and academic exchange of chemical science and engineering. The first session of the conference was held in Great Falls, Canada in 2009. Since then, it has been successfully held for 14 consecutive years using the mode of rotation in China and abroad.

HKUST Industry Engagement Day Plus: Enabling Technologies for Achieving Dual Carbon Target



Organized by the HKUST Office of Knowledge Transfer and co-organized by the HKUST Energy Institute, the Industry Engagement Day Plus is a transformative platform that unites key stakeholders from government, industry leaders, innovators, and entrepreneurs, fostering a collaborative environment for knowledge exchange and inspiring initiatives that have the potential to positively impact our society. With a central focus on addressing the pressing challenges posed by climate change, the event aims to explore the intersection of technology and policy in achieving the dual carbon target.

Through engaging panel discussions, keynote speeches, and interactive technology showcases, the event showcased 20 Technology showcases and attracted hundreds of participants, providing an effective platform for thought leaders to share their expertise and insights. By showcasing cutting-edge innovations, successful case studies, and best practices, the event encourages cross-sector collaboration and knowledge sharing, driving the development and adoption of sustainable solutions.



Cross-Campus Workshop on Bio, Ene and Mat

The first cross-campus workshop on biology, energy, and materials was successfully held at the Guangzhou campus of the Hong Kong University of Science and Technology (GZ) from November 10th to 12th, 2023. The workshop was jointly organized by the Advanced Materials Thrust of the Functional Hub of the Hong Kong University of Science and Technology (GZ), the Energy Institute and the Department of Chemical and Biological Engineering (CBE) and of the Hong Kong University of Science and Technology (CWB).

Prof. Minhua SHAO, Director of the Energy Institute and the Head of Chemical & Biological Engineering, led a group of over 20 faculty and research staff to attend the workshop. During the opening ceremony, he introduced the Institute and department and extended an invitation to colleagues from the Guangzhou Campus to visit the Clear Water Bay Campus for further communication and collaboration.

During his opening remarks, Prof. Jingshen WU, the Vice President for Teaching and Learning of HKUST (GZ), provided a review of the founding process of the Guangzhou campus, emphasizing the unique academic structure of "Hubs-Thrust" and the importance of interdisciplinary integration. He then proceeded to introduce the future development plan of the Guangzhou campus. Prof. Wu hoped that HKUST (GZ) would leverage the unique location advantages of Nansha to foster interdisciplinary collaboration and promote cross-campus cooperation.

EI Associate Director Prof. Qing CHEN, EI faculty Prof. Zhengtang LUO, Prof. Yuanyuan ZHOU, Prof. Yoonseob KIM and Prof. Frank LAM, experts and scholars from academia and industry, as well as outstanding research staff and students, were invited to give presentations, sharing their research progress in the fields of biology, energy, and materials science. They discussed cutting-edge scientific issues and promoted the development of interdisciplinary integration. The workshop was also available for online live streaming, which attracted more than 100 participants from various universities and research institutions in the Greater Bay Area to attend remotely.



EI-CBE Joint Workshop: Chemical Process and Conversion

In the EI-CBE joint workshop on “Chemical Process and Conversion” in February 2023, Prof Jesse Zhu of Western Ontario, Prof Huijun Zhao of Griffith University and Prof. Shi-Zhang Qiao of University of Adelaide discussed recent developments, current challenges, and perspectives in the chemical engineering processes and conversion, and its applications. Besides, they also shared with audience some tips on early research career development.



EI Young Investigator Symposium Series

Energy Institute (EI) was delighted to hold the Young Investigator Symposium (YIS) Series in 2023. The YIS aims to offer young faculty, postdocs, research staff and students an excellent platform to establish and expand their professional connections, career development and scientific exchange.

The 1st Symposium was taking place on 12 April 2023 with the theme on Carbon Dioxide Electrochemical Reduction. Speakers included Dr. Ernest Pahuyo DELMO, HKUST; Prof. Zhanxi FAN, City University of Hong Kong; Prof. Xue WANG, City University of Hong Kong; Prof. Ying WANG, Chinese University of Hong Kong; and Dr. Qinbai YUN, City University of Hong Kong.



The 2nd Symposium was held on 5 May 2023, featured on Perovskite Materials, Spectroscopy, and Devices. Presenters included Prof. Philip C. Y. CHOW, University of Hong Kong; Prof. Yen Hung LIN, HKUST; Prof. Lingling MAO, Southern University of Science and Technology; Prof. Yuanyuan ZHOU, Hong Kong Baptist University; and Prof. Zonglong ZHU, City University of Hong Kong.



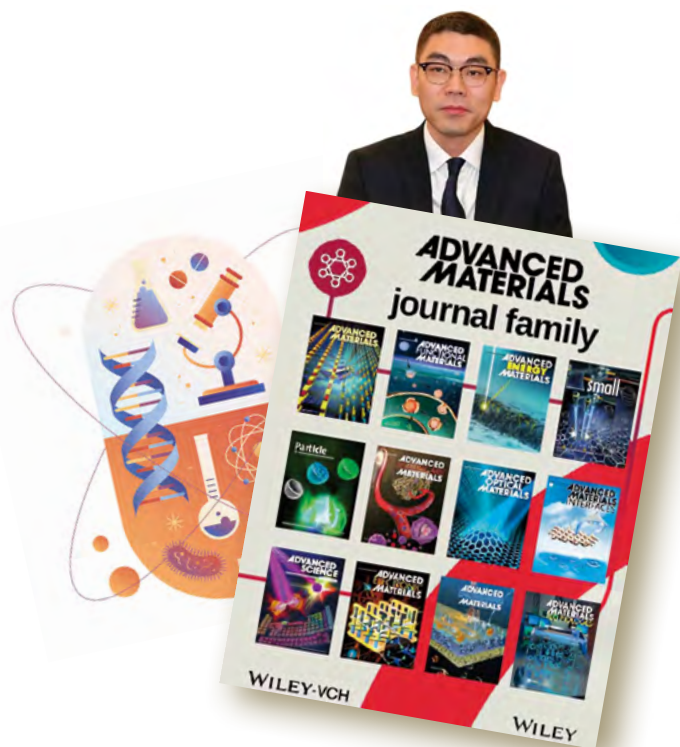
Meeting the Editors

In the highly competitive research environment, authors how to interact with publishers and how to select appropriate journal and meet the publishing criteria? Energy Institute invited editorial speakers to share with audience on tips and trends.

Publishing in Wiley Materials Science Journals

by Dr. Guangchen XU

On 16 May 2023, **Dr. Guangchen XU**, Director, Physical Sciences (Materials Science, Chemistry & Engineering), Wiley China, gave participants valuable tips on how to select an appropriate journal for their papers, what aspects of preparation and presentation to focus on from an editor's and referee's perspective, and hinted for increasing the discoverability of their papers after publication.



Make Your Research Matter: Tips from the Editor-in-Chief

by Dr. Steve CRANFORD

Matter is the third offering in the physical sciences from *Cell Press*. It's goal is to provide a high impact publication in the field on par with *Nature Materials*.

On 5 December 2023, **Dr. Steve CRANFORD**, Founding Editor-in-Chief of *Matter*, *Cell Press* outlined the aims and scope of *Matter*, introduced their internal scientific editorial team, and described their assessment process and outlined their framing of materials science.




High Impact Publishing in Joule

by Dr. Ruhui CHEN

Joule, a scale-spanning energy journal by *Cell Press*, is a home for outstanding and insightful research, analysis and ideas addressing a key global challenge: the need for more sustainable energy.

On 11 December 2023, **Dr. Ruhui CHEN**, Scientific Editor of *Joule*, *Cell Press*, introduced to the participants the publishing process of this high-impact energy journal from the perspective of a scientific editor. She shared the aim and scope of *Joule*, and their strong interest in serving the energy research community. She then shed audience light on the manuscript life cycle and review process, sharing editor considerations when evaluating manuscripts and providing advice for manuscript preparation.





Net-Zero

E1-ENVR Joint Seminar: Energy Transition from Diesel to Renewables in Off-Grid Islands: From Least Cost to a Net-Zero System by Prof. Joey D. OCON

On 9 Jan 2023, **Prof. Joey D. OCON**, Professor and Former Chair, Department of Chemical Engineering, College of Engineering, University of the Philippines Diliman at the lecture “Energy Transition from Diesel to Renewables in Off-Grid Islands: From Least Cost to a Net-Zero System” shared with audience the vision of how the hybrid systems utilizing renewable energy sources offer a cleaner and more sustainable way of powering 600+ off-grid islands, while at the same time, lowering the power generation cost.



Development and Application of Functional Materials for Next- Generation Electrochemical Energy Storage Technologies by Prof. Donghai WANG

Prof. Donghai WANG of The Pennsylvania State University gave a talk on “Development and Application of Functional Materials for Next-Generation Electrochemical Energy Storage Technologies” on 16 March 2023. In this lecture, Prof. Wang demonstrated the research effort aiming to build knowledge, expertise, and understanding of critical electrochemical processes and mechanisms to employ desired features in electrochemical energy storage systems to meet the requirement of new energy applications.



E1-CBE Joint Seminar: Challenges and Opportunities of All Solid-State Batteries by Dr. Xueliang Andy SUN

Dr. Xueliang Andy SUN Distinguished University Professor and Senior Canada Research Chair (Tier I) for the Development of Advanced Materials for Clean Energy, at the University of Western Ontario, Canada visited HKUST on 17 May 2023. He gave a presentation on “Challenges and Opportunities of All Solid-State Batteries”.

In All-state-state lithium batteries (ASSLBs), solid-state electrolyte is a key component and interface is a big challenge. Dr. Sun talked about halide-based electrolyte for ASSLBs and demonstrated to apply atomic layer deposition/molecular layer deposition (ALD/MLD) for interface design between sulfide-based electrolyte and cathode material.



Managing Barsebäck NPP during Early Closure – Lessons Learned by Mr. Per LINDELL

On 4 October, 2023, **Mr. Per LINDELL**, Senior Advisor Nuclear Power, gave a talk on “Managing Barsebäck NPP during Early Closure – Lessons Learned” at HKUST. Leadership, visibility and communication were essential for a CEO to manage the Nuclear Power Plant. At the seminar, Mr. Lindell talked about the management and leadership for safety in the Nuclear Energy Industry.



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A large, stylized graphic of the text '100%' in white. The numbers '100' are rendered in a bold, sans-serif font, and the percentage sign '%' is to the right. The interior of the numbers and the sign are filled with a detailed image of a bright blue sky with fluffy white clouds and several small black birds in flight. To the left of the '100' is a white flame icon, and to the right of the '%' is a white leaf icon. The entire graphic is set against a solid blue background.

100%

Carbon Neutrality

