The Hong Kong Polytechnic University 香港理工大學

University of Cambridge

Faculty of Science 理學院

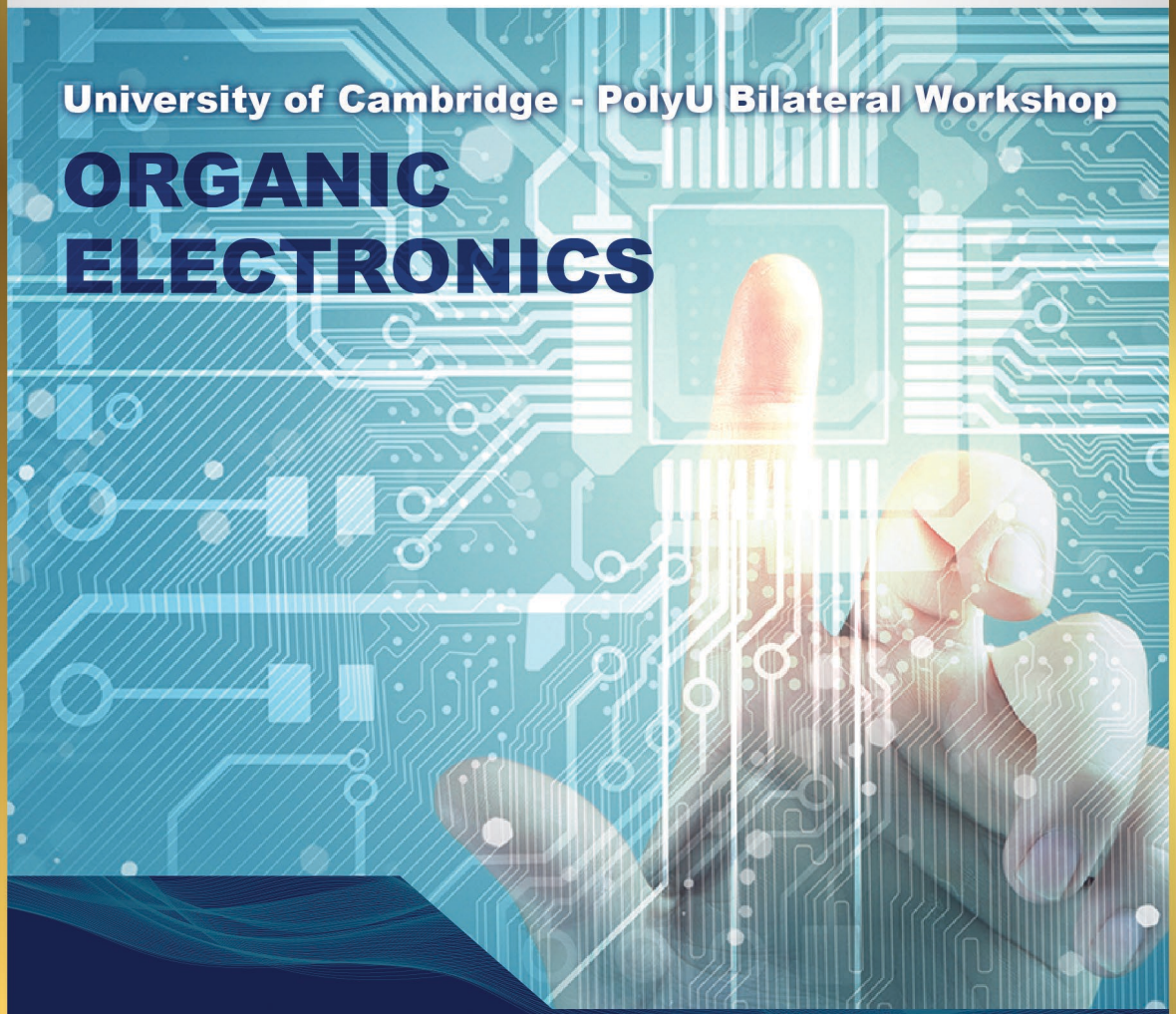
Department of Applied Physics 應用物理學系

Research Centre for Organic Electronics 有機電子學研究中心

iWEAR Research Institute for Intelligent Wearable Systems 智能可穿戴系統研究院

University of Cambridge - PolyU Bilateral Workshop

ORGANIC ELECTRONICS



Date: 3 October 2025 (Friday)

Time: 09:00 - 17:00

Venue: M1603, 16/F, Li Ka Shing Tower (Core M),
The Hong Kong Polytechnic University

PREFACE

We are delighted to announce that University of Cambridge - PolyU Bilateral Workshop on Organic Electronics will be held on 3 October 2025 at The Hong Kong Polytechnic University. This one-day workshop aims to explore the rapidly evolving field of organic electronics, which lies at the intersection of materials science, physics, chemistry, and engineering. It will bring together global experts to discuss breakthroughs in carbon-based semiconductors and their applications in next-generation electronic and optoelectronic devices.

The workshop will showcase innovative research in organic electronics, highlighting cutting-edge advancements in flexible displays, wearable sensors, organic photovoltaics, and bioelectronic interfaces. Through keynote lectures and technical presentations, the workshop will provide a platform for knowledge exchange and collaboration, addressing key challenges and opportunities in the field.

This interdisciplinary event is designed to foster partnerships between international and local researchers while encouraging practical applications of research that strengthen Hong Kong's role as a global hub for innovation. By bridging academia and industry, the workshop aims to inspire new ideas and collaborations that can shape the future of organic electronics.

Key Themes

- Advanced Organic Materials
- Flexible and Wearable Electronics
- Organic Photovoltaics and Energy Harvesting
- Bioelectronic Interfaces
- Device Engineering and Integration

We hope you will enjoy this workshop filled with insightful presentations and stimulating discussions. May this workshop serve as a catalyst for new ideas, foster collaborations, and inspire us all to continue advancing the field of organic electronics through shared knowledge and innovation.

Organizing Committee

Prof. Wai-Yeung WONG, Raymond
Dean of Faculty of Science
Chair Professor of Chemical Technology
Department of Applied Biology and Chemical Technology
The Hong Kong Polytechnic University

Prof. George MALLIARAS
Prince Philip Professor of Technology
Department of Engineering
University of Cambridge

Prof. Feng YAN
Director of RCOE
Chair Professor of Organic Electronics
Department of Applied Physics
The Hong Kong Polytechnic University

Programme Rundown

| 3 October 2025 (Friday)

Session 1 - Chaired by **Prof. Feng YAN**

09:00-09:05 Opening Address by **Prof. Zuankai WANG**

09:05-09:10 Welcome Speech by **Prof. Wai-Yeung WONG, Raymond**

09:10-09:45 **Prof. George MALLIARAS**
University of Cambridge
"New Materials and Architectures for Wearables"

09:45-10:10 **Prof. Zhiyong FAN**
The Hong Kong University of Science and Technology
"Large-scale and Flexible Light-emitting Diodes based on Halide Perovskite Quantum Materials"

10:10-10:30 **Prof. Jun YIN**
The Hong Kong Polytechnic University
"Machine Learning Potential-Driven Insights into Water-Induced Degradation and Structural Heterogeneity of Hybrid Perovskites"

10:30-10:50 Coffee Break

Session 2 - Chaired by **Prof. Ye ZHU**

10:50-11:25 **Prof. Iain MCCULLOCH**
Princeton University
"Design of Mixed Conducting Organic Semiconductors for Electrochemical Transistors"

11:25-11:50 **Prof. Qian MIAO**
The Chinese University of Hong Kong
"Enhancing and Correcting Field Effect Mobility in Organic Thin Film Transistors"

11:50-12:10 **Prof. Linli XU**
The Hong Kong Polytechnic University
"Two-Dimensional Metal-Acetylide Frameworks: Synthesis, Characterization, and Their Applications in Optoelectronics and Energy Science"

12:30-13:40 Lunch Break

Session 3 – Chaired by **Prof. Jun YIN**

14:00-14:35 **Prof. Oren A. SCHERMAN**
University of Cambridge
"Next Generation Dynamic Materials: Imparting Function Through Molecular Level Understanding"

14:35-15:00 **Prof. Qichun ZHANG**
City University of Hong Kong
"Covalent Organic Frameworks as Promising Platforms for Diverse Applications"

15:00-15:20 **Prof. Ye ZHU**
The Hong Kong Polytechnic University
"Probing Structure of Organic Materials Using 4D Scanning Transmission Electron Microscopy"

15:20-15:40 Coffee Break

Session 4 – Chaired by **Prof. Linli XU**

15:40-16:15 **Prof. Thomas D. ANTHOPOULOS**
The University of Manchester
"Organic Hydrogen Sensors for the Emerging Hydrogen Economy"

16:15-16:35 **Dr Miao ZHANG**
The Hong Kong Polytechnic University
"Functional Metal Complexes for Organic Photovoltaic Applications"

16:35-16:55 **Dr JiaJun SONG**
The Hong Kong Polytechnic University
"Organic Electrochemical Transistors for Wearable Physiological Monitoring"

16:55-17:00 Closing Remarks by **Prof. Feng YAN**

17:00 End of programme

Session 1

Chaired by Prof. Feng YAN

Prof. George MALLIARAS

Prince Philip Professor of Technology
Department of Engineering
University of Cambridge

Prof. MALLIARAS is the Prince Philip Professor of Technology at the University of Cambridge (UK). Before joining Cambridge, he was a faculty member at Cornell University (USA), and School of Mines of St. Etienne (France). George's research on bioelectronics has been recognized with awards from the European Academy of Sciences, the Materials Research Society, the New York Academy of Sciences, the US National Science Foundation, and DuPont. He received an Honorary Doctorate from the University of Linköping (Sweden) and is Fellow of the Royal Society, the Materials Research Society, Academia Europaea and the European Academy of Sciences.

New Materials and Architectures for Wearables

Wearable systems have been receiving a great deal of attention, as they promise to generate continuous baselines for health and performance markers, leading to a step change in the way we practice medicine and track human performance. Arguably, the field is limited by materials used at the biotic/abiotic interface to bidirectionally transduce information. Conducting polymer composites with biomaterials offer several advantages to this interface, including excellent mechanical and electrochemical properties and compatibility with additive manufacturing. Different device architectures that leverage these materials to achieve optimal performance and promote new applications for wearables will be discussed.

Prof. Zhiyong FAN

Chair Professor
Department of Electronic and Computer Engineering
Department of Chemical and Biological Engineering
The Hong Kong University of Science and Technology

Prof. FAN is a Chair Professor at the Department of Electronic and Computer Engineering and Department of Chemical and Biological Engineering. He received B.S. and M. S. degrees from Fudan University, PhD degree from University of California, Irvine then worked as a postdoctoral fellow at UC Berkeley (HKUST) in 2010. 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. He is a Fellow of the Royal Society of Chemistry, Fellow of Optica, Academician of Asia Pacific Academy of Materials, Fellow of Hong Kong Academy of Engineering and Lawrence Berkeley National Laboratory in 2007~2010. He joined Hong Kong University of Science and Technology 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, 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 270 peer reviewed papers in Nature, Nature Photonics, Nature Electronics, Nature Materials, Science Robotics, etc., with citations >34,000, H index 97.

Large-scale and Flexible Light-emitting Diodes based on Halide Perovskite Quantum Materials

Halide perovskites are enticing candidates for highly efficient light-emitting diodes (LEDs) with commercial potential in displays and lighting. However, it remains a challenge for conventional fabrication of perovskite thin films, namely solution spin coating, to achieve large-scale and efficient LEDs, limited by low light extraction efficiency, small substrate-size, in conjunction with intrinsic instability. Here, we have reported large-scale and efficient perovskite LEDs with the utilization of nanostructured perovskites, such as perovskites on nanophotonic substrates[1], nanowires (NWs)[2] and quantum wires (QWs) [3-5]. Specifically, the nanophotonic substrates resulted in a high light extraction efficiency of 73.6 % and hence a high device external quantum efficiency (EQE) of 17.5 %.[1] The perovskite NWs based LED device demonstrated 45 % improvement of EQE from 11 % to 16 %, compared with the planar control device.[2] When further reducing the NWs diameter to quantum regime, the quantum confinement effect and strong surface passivation significantly increased radiative recombination rate, and consequently a high photoluminescence quantum yield (PLQY) of up to 92 % and long PL lifetime (T_{PL50}) of 5,644 hours were achieved for $MAPbBr_3$ QWs in porous alumina membrane (PAM).[3] Consequently, blue, sky-blue, green and pure-red LED devices with spectrally stable electroluminescence (EL) and mechanical flexibility have been successfully fabricated, demonstrating EQE of 12.41%, 16.49%, 26.09% and 9.97%, respectively.[4] Excellent up-scalability of perovskite QWs LEDs is also demonstrated with the successful fabrication of four-inch wafer-scale LED devices with respectable EL uniformity.[3] Intriguingly, the conformal nature of CSVR QW growth enables the fabrication of a unique 3D spherical LED device, demonstrating excellent spatial EL luminance distribution. The results suggest that the large-scale and efficient LEDs based on nanostructured perovskites are highly promising for future large-area displays and lighting applications.

1. Q. P. Zhang, M. M. Tavakoli, L. L. Gu, D. Q. Zhang, L. Tang, Y. Gao, J. Guo, Y. J. Lin, S.-F. Leung, S. Poddar, Y. Fu, & Z. Y. Fan, *Nat. Commun.*, **2019**, *10*, 727.
2. Q. P. Zhang, D. Q. Zhang, L. L. Gu, K.-H. Tsui, S. Poddar, Y. Fu, L. Shu, & Z. Y. Fan, *ACS Nano*, **2020**, *14*, 1577.
3. D. Q. Zhang, Q. P. Zhang, B. T. Ren, Y. D. Zhu, M. Abdellah, Y. Fu, B. Cao, C. Wang, L. L. Gu, Y. C. Ding, K.-H. Tsui, S. F. Fan, S. Poddar, L. Shu, Y. T. Zhang, D.-B. Kuang, J.-F. Liao, Y. Lu, K. B. Zheng, Z. B. He, & Z. Y. Fan, *Nat. Photon.*, **2022**, *16*, 284.
4. Y. B. Cao, D. Q. Zhang, Q. P. Zhang, X. Qiu, Y. Zhou, S.Poddar, Y. Fu, Y. D. Zhu, J.-F. Liao, L. Shu, B. T. Ren, Y. C. Ding, B. Han, Z. B. He, D.-B. Kuang, K. F. Wang, H. B. Zeng, & Zhiyong Fan, *Nat. Commun.*, **2023**, *14*, 4611.
5. Y. Fu, S. Poddar, B. T. Ren, Y. Xie, Q. P. Zhang, D. Q. Zhang, B. Cao, Y. Q. Tang, Y. C. Ding, X. Qiu, L. Shu, J.-F. Liao, D.-B. Kuang, & Z. Y. Fan, *ACS Nano*, **2022**, *16*, 8388.

Prof. Jun YIN

Assistant Professor
Department of Applied Physics
The Hong Kong Polytechnic University

Prof. YIN is an Assistant Professor in the Department of Applied Physics at The Hong Kong Polytechnic University and holds the conferred title of Presidential Young Scholar since 2022. He received his Ph.D. degree in Physics from Nanyang Technology University (NTU). He then joined King Abdullah University of Science and Technology (KAUST) as a Postdoctoral Fellow and was promoted to Research Scientist before joining PolyU. He has published over 250 research papers with h-index of 78, including publications in *Science*, *Nature*, *Nature Energy*, *Nature Photonics*, and *Nature Synthesis*. He is a recipient of the Excellent Young Scientists Fund from NSFC and has been recognized among the world's top 2% most-cited scientists by Stanford University from 2022 to 2024. His research focuses on leveraging machine learning to bridge theoretical insights with practical device applications, aiming to accelerate the development of next-generation materials for energy conversion and quantum technologies.

Machine Learning Potential-Driven Insights into Water-Induced Degradation and Structural Heterogeneity of Hybrid Perovskites

I will present our recent progress in developing machine learning potentials (MLPs) to investigate hybrid perovskite materials, with a focus on how surface orientation and chemical composition govern surface and phase stability. By integrating MLP-accelerated molecular dynamics simulations, we enable large-scale and long-timescale modeling of the $FAPbI_3$/water interface. These simulations reconcile previously conflicting experimental findings and provide quantitative insights into the degradation mechanisms of hybrid perovskites. Beyond interfacial stability, we explore structural heterogeneity arising from mixed A-site cation distributions. To capture this effect, we introduce a heterogeneity coefficient that quantitatively describes cation spatial distribution. This descriptor effectively predicts organic cation rotation and octahedral distortion, both of which critically influence the electronic properties of heterogeneous perovskites. Our findings establish key structure-stability relationships and deliver a predictive framework for guiding the rational design of more robust hybrid perovskite materials for next-generation photovoltaic application.

Session 2

Chaired by Prof. Ye ZHU

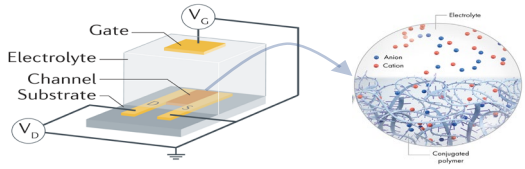
Prof. Iain MCCULLOCH

Director of Andlinger Center for Energy and the Environment
Professor of Electrical and Computer Engineering
Department of Electrical and Computer Engineering
Princeton University

Prof. MCCULLOCH is the Director of the Andlinger Center for Energy and the Environment and a Professor of Electrical and Computer Engineering at Princeton University, as well as holding a Visiting Professor position in the Department of Chemistry at the University of Oxford. He previously held joint appointments as Professor of Chemical Science and Director of KAUST Solar Center at KAUST, as well as a Chair in Polymer Materials in the Chemistry Department at Imperial College. Before joining academia, he spent 18 years managing industrial research groups at Hoechst in the US and Merck in the UK. He is a Fellow of the Royal Society, the Royal Society of Chemistry, the European Academy of Sciences and a Member of Academia Europaea. He is the recipient of the 2022 Royal Society Armourers and Brasiers Prize, the 2020 Blaise Pascal Medal for Materials Science, the Royal Society of Chemistry 2020 Interdisciplinary Prize, 2014 Tilden Medal for Advances in Chemistry and the 2009 Creativity in Industry Prize. His interests are in the design and investigation of organic semiconducting materials.

Design of Mixed Conducting Organic Semiconductors for Electrochemical Transistors

Organic electrochemical transistors (OECTs) are promising bioelectronic devices for transduction of biological signals through electrical amplification, enabling selective sensing of ions and metabolites. The sensitivity and selectivity of the response of this device is determined by the organic semiconducting polymer employed as the active layer. This presentation will discuss the role of semiconductor molecular structure on optimizing the apparent trade-off between ion uptake and morphological order within the bulk of the active layer. A range of molecular design concepts will be shown, which limit the impact of in-operando disorder, including two dimensional COF structures, polymers with well-defined porosity, and polymers with controlled hydrophobic-hydrophilic balance. These new materials demonstrate good OECT performance, through operation in accumulation mode, with high transconductance and low operating voltage.



a) Schematic representation of an OECT with source (S), drain (D) and gate (G) electrodes (top), b) ionic charge movement into open microstructure of an OECT

Prof. Qian MIAO

Professor
Department of Chemistry
The Chinese University of Hong Kong

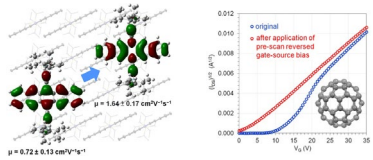
Prof. MIAO graduated from the University of Science and Technology of China with a B.S. in 2000. He received his Ph.D. from Columbia University in 2005 under the direction of Prof. Colin Nuckolls and was a postdoctoral scholar with Prof. Fred Wudl at University of California, Los Angeles. He joined the Chinese University of Hong Kong (CUHK) as an Assistant Professor in 2006, was promoted to Associate Professor in 2012, and became a Full Professor in 2016. His research interests include the design and synthesis of novel polycyclic aromatic molecules with interesting structures and useful applications, exploring novel molecular nanocarbons and developing high-performance organic semiconductor materials and devices using tools from organic synthesis, and supramolecular and surface chemistry. He is a Croucher Senior Research Fellow (2019) and an Outstanding Fellow of the Faculty of Science, CUHK.

Enhancing and Correcting Field Effect Mobility in Organic Thin Film Transistors

Field-effect mobility of charge carriers is a critical parameter for organic thin film transistor (OTFT) performance, determining how quickly charges move through the device under a given electric field. This lecture will present our recent research on enhancing field effect mobility of holes through molecular orbital engineering and correcting overestimated field effect mobility of electrons by elimination of double-slope nonideality.

Molecular orbital engineering refers to modification of the frontier molecular orbitals of an organic semiconductor without altering its shape and molecular packing in the crystal structure by substituting atoms in its π-backbone. This strategy can change the charge transfer integral, leading to an increase in the rate of charge transport in organic semiconductors. We have recently demonstrated the concept of molecular orbital engineering for organic semiconductors through the use of *N,N*'-diethynylated derivatives of 6,13-dihydro-6,13-diazapentacene, which exhibit field effect mobilities more than twice of those of their parent pentacene derivatives in OTFTs.[1]

Double-slope nonideality, widely observed in OTFTs, leads to inaccurate extraction of field-effect mobility, hindering the evaluation of new organic semiconductors and limiting OTFT applications. The second part of this lecture presents a solution to this issue in n-type OFETs based on C_{60}, demonstrating that applying a pre-scan reversed gate-source bias eliminates the double-slope nonideality.[2]



1. Zhang, L.; Zhao, Y.; Li, J.; Fu, Y.; Peng, B.; Yang, J.; Lu, X.; Miao, Q. *J. Am. Chem. Soc.*, **2025**, 147, 3459–3467.
2. Zeng, X.; Zhao, X.; Xu, J.; Miao, Q. *Adv. Electron. Mater.*, **2025**, *11*, 2500101.

Prof. Linli XU

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

Prof. XU is an Assistant Professor in the Department of Applied Biology and Chemical Technology at The Hong Kong Polytechnic University (PolyU). She earned her PhD in 2010 from the Chinese Academy of Sciences (CAS) and subsequently served as an Assistant Researcher at the Technical Institute of Physics and Chemistry, CAS, from 2010 to 2017. Her research interests encompass the design and synthesis of two-dimensional carbon and carbon-rich materials, with a focus on their applications in optoelectronics, energy conversion and storage, and thermal management. To date, she has authored over 60 peer-reviewed publications in leading journals, including *Chem. Soc. Rev., J. Am. Chem. Soc., Agnew. Chem. Int. Ed., Adv. Mater.*

Two-Dimensional Metal-Acetylide Frameworks: Synthesis, Characterization, and Their Applications in Optoelectronics and Energy Science

Transition metal elements as new functional units can be introduced into the frameworks of graphdiyines *via* metal-alkyne bonds to afford metal-acetylide frameworks (MAFs). However, related research work is still in its infancy and their large-area and free-standing nanosheets were first isolated for use in the optical devices and catalysis by us in 2021. The novel MAFs has been designed and synthesized with homo- or hetero-metallic skeleton via the facile bottom-up method, which integrates the advantages of both metal centers and graphyne frameworks. The propensity of d_{10} Hg(II)-, d_8 Ni(II)-, Pd(II)- and Pt(II)-$(PR_3)_2$ (R = alkyl chain) units to form a moiety with alkynyl units makes them attractive building blocks for two-dimensional (2D) organometallic functional materials. Both few-layer and multi-layer 2D nanosheets can be generated depending on the types of interface-assisted (i.e. liquid/liquid and gas/liquid) approaches and their bulks can be prepared by the one-pot method. The ligand structures and electronic properties can be easily adjusted in terms of the spacer length between the ethynyl unit and central core, central chromophore as well as the number of coordination sites. Therefore, the 2D nanosheets with different topological structures, pore sizes, surface areas and advanced functionalities can be prepared by using different monomers with diverse electronic, optical and catalytic properties. The relationship between the performance of MAFs and their well-defined nanostructures will be elucidated, with a major focus on studying the effects of transition metals and ligands in activating their optical and catalytic properties. The properties and catalytic performance can be fine-tuned through chemical modification of the chromophores. The proposed work can produce a new class of 2D carbon-rich materials and provide a design concept for developing efficient nonlinear optical materials and photo-/electro-catalysts.

Session 3

Chaired by Prof. Jun YIN

Prof. Oren A. SCHERMAN

Director of the Melville Laboratory for Polymer Synthesis
Professor of Supramolecular & Polymer Chemistry
Yusuf Hamied Department of Chemistry
University of Cambridge

Prof. SCHERMAN (h-index 86, >28,000 cites, >2500 citations/yr) is the Director of the Melville Laboratory for Polymer Synthesis and Professor of supramolecular and polymer chemistry in the Department of Chemistry at the University of Cambridge. He completed his PhD in the group of Professor Robert H. Grubbs (Caltech, USA) focused on the use of controlled-polymer architectures for materials science via Ring-Opening Metathesis Polymerization (ROMP). He then moved to Europe for a post-doctoral stay in the group of Professor E.W. (Bert) Meijer (TU/e, Netherlands) where he worked on the recognition and engineering of supramolecular polymers, exploiting multiple hydrogen bonding motifs.

Following this he began his academic career in 2006, at the University of Cambridge where he set out to address one of the fundamental issues limiting the widespread application of supramolecular polymers in materials, their recognition and self-assembly in aqueous environments. He pioneered the use of cucurbit[n]uril (CB[n]) macrocycles as molecular “handcuffs” for assembling macromolecular architectures in water. In 2013, he was appointed Director of the Melville and in 2015, he became a full professor.

Currently his research group utilizes the powerful recognition properties of CB[n]s to direct and control interfacial assembly, harness interactions at interfaces and bring together a variety of chemical motifs.

He has won several awards of note, the 2022 3M Lectureship, 2018 Corday Morgan Prize, 2014 Cram Lehn Pedersen International Prize in Supramolecular Chemistry, 2014 Bob Hay Lectureship, 2013 Hickinbottom Award and 2013 McBain Medal, 2010 Macro Group UK Young Researchers Medal, and 2009 Harrison-Meldola Prize and Medal. Additionally, he sits on the advisory boards for ChemComm and the ICCB conference series and on the scientific advisory boards for SABIC IP and the spin-out Aqdot and is the CSO of the recent spin-out Kodiaq Technologies, both of which he is a co-founder.

In 2013, Professor Scherman was named the Xuetang Visiting Professor of Chemistry at Tsinghua University (Beijing, China) where he spent a year sabbatical. To date, he has supervised >50 PhD students, 45 Postdocs, and 18 MPhil students, his current group comprises ~15 - 20 researchers.

Next Generation Dynamic Materials: Imparting Function Through Molecular Level Understanding

Supramolecular host–guest interactions offer a powerful molecular design strategy to control structure and function across length scales. The Scherman group has pioneered the use of cucurbit[n]urils (CB[n]) - and in particular, CB[8]-mediated ternary complexes - as dynamic, programmable motifs for engineering supramolecular materials. By leveraging the rich host- guest chemistry of CB[8], we have developed a versatile toolbox of orthogonal complexes with tunable binding affinities, association/dissociation kinetics, and interaction modes (π–π, polar–π, charge-transfer). This toolbox allows precise molecular control over dynamic crosslinking events in supramolecular polymer networks (SPNs), enabling bulk properties to be encoded through molecular recognition.

Through systematic study of CB[8]-mediated crosslinks and their dynamics, we have demonstrated how subtle modifications in guest structure and interaction type can profoundly influence viscoelastic behaviour, toughness, and self-healing. For example, slow- dissociating CB[8] polar–π complexes enabled the fabrication of glass-like SPNs with high compressive strength and rapid self-recovery (Nat. Mater., 2022), while strong yet dynamic π–π complexes formed the basis of highly stretchable, tough elastomers for strain sensing (Adv. Mater., 2017). Most recently, we have introduced conductive SPNs with simultaneous ionic and electronic transport, paired with tissue-like mechanical properties, enabling seamless integration with the human body (Adv. Mater., 2023).

Our ongoing efforts focus on the molecular engineering of CB[n]-based host–guest complexes to program and augment bulk material behaviour. This molecular-level control over dissociation dynamics, network architecture, and reversible binding continues to unlock new functionalities in soft robotics, multilayer electronics (Sci. Adv., 2024), wearable electronics, and biomedical interfaces (Adv. Mater., 2025). We anticipate that further exploration of these supramolecular structure–property relationships will provide a blueprint for designing responsive, high-performance materials from the molecular scale upward.

Prof. Qichun ZHANG

Professor
Department of Chemistry
Department of Materials Science and Engineering
City University of Hong Kong

Prof. ZHANG received his B.S. at Nanjing University in China in 1992, MS in physical organic chemistry (organic solid lab) at Institute of Chemistry, Chinese Academy of Sciences in 1998, MS in organic chemistry at University of California, Los Angeles (USA, 2003), and completed his Ph.D. in chemistry at University of California Riverside in 2007. Then, he worked as a Postdoctoral Fellow at Northwestern University (Oct. 2007 –Dec. 2008). Since Jan. 2009, he joined School of Materials Science and Engineering at Nanyang Technological University (NTU, Singapore) as an Assistant Professor. On Mar 1st, 2014, he has promoted to Associate Professor with tenure. On Sep 1st 2020, he moved to Department of Materials Science and Engineering at City University of Hong Kong as a full professor. Currently, he is an associate editor of J. Solid State Chemistry & Susmat, the International Advisory Board member of Chemistry – An Asian Journal, the Advisory board member of Journal of Materials Chemistry C, the Advisory board member of Materials Chemistry Frontiers, the Advisory board member of Inorganic Chemistry Frontiers, the Advisory board member of Aggerate, the Advisory board member of Materials Advances, and the Advisory board member of Science Chinese Materials and small structures. Also, he is Guest Editors of CCS Chemistry (2020-2021), Advanced Materials (2020-2021), J Mater Chem C (2020-2021, 2017-2018), Mater. Chem Front (2019-2020), Inorganic Chemistry Frontiers (2016-2017, 2017-2018). From 2018 to 2024, he has been recognized as one of highly-cited researchers (top 1%) in Clarivate Analytics. He is a fellow of the Royal Society of Chemistry. Currently, his research focuses on carbon-rich conjugated materials and their applications. Till now, he has published $>$620 papers and 25 patents (H-index: 120).

Covalent Organic Frameworks as Promising Platforms for Diverse Applications

Since Yaghi et al. reported the first covalent organic frameworks (COFs) in 2005, COFs have caused many scientists' interest in both fundamental research (synthesis, properties, theoretical simulation, etc.) and possible applications (gas absorption/separation, catalysis, energy-related devices, sensing, imaging, and so on). In this talk, I will present our recent progress on the preparation of novel COFs as well as their diverse applications in optoelectrical devices.

1. Lizhong He+, Tuoya Naren+, Lei Zhang, Fangyuan Kang, Jinglun Yang, Zihao Chen, Aimin Yu, Dong-Sheng Li, Libao Chen*, Qichun Zhang*, "Interweaving Covalent Organic Polymer Chains into Two-Dimensional Networks: Synthesis, Single Crystal Structure and Application for Stabilizing Lithium Metal Anode", Angew. Chem. Int. Ed. 2025, 64, e202506036.
2. Miaomiao Xue, Lei Zhang, Xin Meng, Jinglun Yang, Yanping He, Chun-Sing Lee, Jian Zhang,* Qichun Zhang*, "Ultraviolet Nonlinear Optical Single Crystals of A Three-Dimensional Chiral Covalent Framework Containing Te-O-B-O Bonds", Angew Chem Int Ed. 2024, 63, e202412289. 10.1002/anie.202412289.
3. Lei Zhang,+ Zihao Chen,+ Xiao-Xin Li,+ Xiang Wang, Qianfeng Gu, Xin Wang, Chun-Sing Lee,* Ya-Qian Lan,* Qichun Zhang*, "A Covalent Organic Nanoribbon: Preparation, Single Crystal Structure with Chinese Luban Lock Configuration, and Photocatalytic Behavior", Angew Chem Int Ed. 2024, 63, e202411018. 10.1002/anie.202411018.
4. Qiang Dong,+ Tuoya Naren,+ Lei Zhang, Weixuan Jiang, Miaomiao Xue, Xiang Wang, Libao Chen,* Chun-Sing Lee, Qichun Zhang* "A Naphthalenetetracarboxdiimide-Containing Covalent Organic Polymer: Preparation, Single Crystal Structure and Battery Application", Angew Chem Int Ed. 2024, 63(26), e202405426. 10.1002/anie.202405426.
5. Miaomiao Xue, Lei Zhang, Xiang Wang, Qiang Dong, Zengkui Zhu, Xin Wang, Qianfeng Gu, Fangyuan Kang, Xin-Xiong Li*, Qichun Zhang,* "A Metal-Free Helical Covalent Inorganic Polymer: Preparation, Crystal Structure and Optical Properties", Angew Chem Int Ed. 2024, 63, e202315338. 10.1002/anie.202315338.
6. Miaomiao Xue‡, Lei Zhang‡, Xiao-Xin Li, Fangyuan Kang, Xiang Wang, Qiang Dong, Xin Wang, Chun-Sing Lee, Ya-Qian Lan*, Qichun Zhang,* "Growing large single crystals of covalent organic frameworks through unconventional Te-O-P linkages", Nature Communications, 2024, 10.1038/s41467-024-54235-9.
7. Lizhong He, Lei Zhang, Jinglun Yang, Fangyuan Kang, Xiang Wang, Qianfeng Gu, Lang Jiang,* Qichun Zhang*, "A Covalent Organic Polymer Containing Dative Nitrogen→Boron Bonds: Preparation, Single-Crystal Structure and Photo-Response/Photocatalytic Performance", Small structure, 2024, 10.1002/sstr.202400492 .
8. Xin Wang,† Lei Zhang,† Xiang Wang, Tianqi Cheng, Miaomiao Xue, Qiang Dong, Yungkang Peng, Qichun Zhang*, "Constructing Covalent Organic Polymers Through Dative B-N Bonds: Synthesis, Single Crystal Structures, and Physical Properties", Advanced Functional Materials, 2024, 10.1002/adfm.202401362.

Prof. Ye ZHU

Associate Professor
Department of Applied Physics
The Hong Kong Polytechnic University

Prof. ZHU is currently an associate professor in the Department of Applied Physics, The Hong Kong Polytechnic University. He received his Ph.D. from the University of Wisconsin-Madison, and worked as a postdoctoral researcher at Cornell University and Monash University. Prof. Zhu is dedicated to developing cutting-edge transimission electron microscopy (TEM) techniques, with one of his research foci being in situ TEM on chemical reactions under liquid and gas environments. Applying these techniques, his team has made numerous discoveries, including the direct nanoscale observation of oxygen-evolution reaction in liquid.

Probing Structure of Organic Materials Using 4D Scanning Transmission Electron Microscopy

The fascinating properties of organic materials are underpinned by their complex and intricate structures, which are extremely difficult to probe especially down to nanoscale. The recent advent of four-dimensional (4D) scanning transmission electron microscopy (STEM) technique offers a powerful tool to tackle this challenge. In this work we demonstrate the application of low-dose cryogenic 4D-STEM in probing manifold hierarchical structure of polymer spherulites. Combining the ultrafast ultrasensitive electron detector with the quantitative data analysis, we have unveiled unprecedented multiscale information including: (1) Individual lamella morphology and orientation in the pristine state without staining or chemical etching; (2) Molecular chain tilt within individual lamellae; (3) Lamella configurations at spherulite boundaries; (4) Detailed lamella twisting structure, pathway, and rates; (5) Crystallinity distribution. All above information can be achieved down to nanoscale. It further sheds light on the crystallization mechanism of polymer spherulites, such as the nucleation as the sheaf-like structure, as well as a remarkable spiral crystallization pattern in banded spherulites. Our work establishes low-dose cryo-4D-STEM as a powerful tool to explore the intricate structure of soft materials. Further application on 4D-STEM on organic electronic materials and hybrid perovskites will also be presented.

Session 4

Chaired by Prof. Linli XU

Prof. Thomas D. ANTHOPOULOS

Professor of Emerging Optoelectronics
Department of Electrical and Electronic Engineering
The University of Manchester

Prof. ANTHOPOULOS is a Professor of Emerging Optoelectronics at the University of Manchester, UK, and the Acting Department Head of Research. Following the award of his BEng. and PhD degrees, he spent two years at the University of St. Andrews (UK), where he worked on organic semiconductors for light-emitting diodes before joining Philips Research Laboratories (Netherlands) to focus on organic transistors. From 2006 to 2017, he held faculty positions at Imperial College London, first as an Advanced Fellow and later as a Reader and Professor of Experimental Physics. From 2017 to 2023, he was a Professor of Material Science at King Abdullah University of Science and Technology in Saudi Arabia. His research interests are diverse and cover the development and application of novel processing paradigms and the physics, chemistry, and application of functional materials.

Organic Hydrogen Sensors for the Emerging Hydrogen Economy

Hydrogen is an abundant and clean energy source that can help to decarbonize difficult-to-electrify sectors of the global economy. However, its safe widespread deployment depends heavily on the availability of reliable and cost-effective hydrogen sensors. The vast majority of commercial hydrogen detectors are expensive and consume high power, limiting their broader use in key emerging applications. In this talk, I will discuss the recent development of a novel hydrogen detector based on solution-processable organic semiconductors as the active material that can operate across wide temperature and humidity ranges. I will describe the inner working of the novel sensing mechanism and the prospects for further developments through new materials and advanced device engineering. Compared to commercial detector technologies, the organic hydrogen sensor offers superior operating characteristics under different real-world sensing scenarios, making the technology a strong candidate for use in distributed sensing networks for the early warning of hydrogen leaks as well as in medical applications.

Dr Miao ZHANG

Research Assistant Professor
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Dr ZHANG received her Ph.D. degree from Beijing Jiaotong University. She then carried out postdoctoral research through the Hong Kong Scholars Program from 2019 to 2021 in the Department of Applied Biology and Chemical Technology at the Hong Kong Polytechnic University. Since 2022, she has served as a Research Assistant Professor in the same department. Her research interests focus on organic/organometallic materials and device engineering for sustainable energy development.

Functional Metal Complexes for Organic Photovoltaic Applications

Solar energy technologies have gained significant global attention as crucial facilitators for the green and sustainable development of human society and the economy. Organic materials hold great potential in solar energy conversion due to their advantages, such as diverse molecular modification, pollution-free nature, low cost, solution processing, and flexible device fabrication. Our research focuses on developing functional metal complexes and investigating their performance in organic photovoltaics. We designed and synthesized a series of organometallic terpolymers by incorporating varying ratios of an iridium complex into the backbone of the commercial polymer PM6. The power conversion efficiencies (PCEs) of both single-junction and ternary polymer solar cells were significantly enhanced when the terpolymer containing 1% iridium complex was utilized. Additionally, iridium(III)- and platinum(II)-based molecules with high singlet-to-triplet conversion efficiencies were, for the first time, employed as solid additives. These additives served to extend exciton lifetime and diffusion length, while also optimizing the active layer morphology, thereby further improving the PCE of layer-by-layer polymer solar cells. Overall, our results demonstrate that the development of novel metal complexes opens a meaningful pathway from molecular design to improve solar energy utilization in photo-to-electric conversion.

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Dr SONG is currently a Research Assistant Professor in the Department of Applied Biology and Chemical Technology at The Hong Kong Polytechnic University (PolyU), specializing in organic bioelectronics. He began working on organic electrochemical transistor (OECT) in 2014 during his master's studies at Shenzhen University. Then, he pursued a Ph.D. in the Department of Applied Physics at PolyU under the supervision of Prof. Feng Yan, focusing on flexible OECTs for bioelectronic applications, and continued in the same group as a postdoctoral fellow. His current research focuses on developing emerging mixed ionic–electronic conductors, such as 2D metal–organic frameworks and covalent organic frameworks, for high-performance organic transistors aimed at bioelectronic applications.

Organic Electrochemical Transistors for Wearable Physiological Monitoring

Wearable sensors offer conformal, high-fidelity interfaces with the human body, enabling continuous physiological monitoring for proactive wellness and improved clinical care. Organic electrochemical transistors (OECTs) are a compelling platform for such devices owing to their mechanical softness, intrinsic signal amplification, biocompatibility, facile functionalization, and low cost. Their ion-permeable channels support volumetric doping, yielding high transconductance at low operating voltages-ideal for high-performance, body-compatible sensing. This presentation will introduce our recent advances in functional OECTs for wearable physiological monitoring: (1) Perovskite solar cell-gated OECTs for photonic health monitoring. We realize a flexible photodetector with ultrahigh sensitivity and rapid response by gating an OECT with a perovskite solar cell. The device enables photoplethysmography and peripheral oxygen saturation measurements under ambient illumination, and further supports contactless remote sensing. (2) Metal–organic framework–based electrochemical transistors (MOFECTs) for electrocardiogram mapping. We prepare highly oriented 2D MOF films as OECT channels, where vertically aligned, ion-conductive nanopores facilitate rapid ion transport and high volumetric capacitance, yielding high transconductance and fast temporal response in the devices. Ultra-flexible MOFECT arrays with uniform and stable performance are fabricated, allowing for electrocardiogram mapping on the skin in multiple directions. These wearable sensors combine high sensitivity, low-voltage operation, and mechanical compliance, underscoring their potential for proactive and efficient healthcare.

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