THE HONG KONG POLYTECHNIC UNIVERSITY
香港理工大學

FACULTY OF 理學院 SCIENCE

Seoul National University-PolyU Bilateral Workshop

Flexible Organic and Perovskite Electronics

Date: 19-20 July 2024

Time: Day 1: 14:00-17:30

Day 2: 09:00-17:00 (HKT)

Venue: Room AG710, Chung Sze Yuen Building (Core A)

The Hong Kong Polytechnic University

PREFACE

We are pleased to welcome you to the Seoul National University (SNU) - PolyU Bilateral Workshop on Flexible Organic and Perovskite Electronics, hosted by the Faculty of Science (FS) of The Hong Kong Polytechnic University (PolyU).

This is the third bilateral workshop between SNU and PolyU. Organic semiconductors have been studied for over 50 years. Unlike conventional semiconductor materials, organic semiconductors can be easily produced through solution-based processes at low cost, making them compatible with printing technologies. Other unique properties, such as mechanical flexibility and tunable band structures through molecular design, have also generated significant research interest. Organic-inorganic metal halide perovskites are another emerging class of functional materials that can be used in devices similar to organic semiconductors, including solar cells, light-emitting diodes, sensors, and field-effect transistors. Both organic semiconductors and perovskites have demonstrated great potential for practical applications, particularly in the field of flexible electronics. Researchers at SNU and PolyU have been actively working on various aspects of these materials, including fundamental chemistry and physics, electronic devices and applications.

This bilateral workshop brings together 20 speakers, both senior and junior, from SNU, Hanyang University, Yonsei University, Korea Advanced Institute of Science and Technology (KAIST), PolyU and Hong Kong Baptist University (HKBU). They will share their insights and valuable experiences during this knowledge-sharing platform. The workshop series also aims to promote inter-institutional collaborations on important scientific topics and explore opportunities for further commercializing the latest research findings.

We hope you will enjoy the programme over the next one and a half days. May this symposium serve as a catalyst for new ideas, foster collaborations and inspire us all to strive for innovative technology through the study of organic and perovskite electronics.

FACULTY OF 理學院 SCIENCE

Organizing Committee

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

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Prof. Tae-Woo LEE
Professor,
Department of Materials Science and Engineering,
Seoul National University

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

Members *(in alphabetical order of surnames)*

Dr Linli XU
Assistant Professor,
Department of Applied Biology and Chemical Technology,
The Hong Kong Polytechnic University

Dr Jun YIN
Assistant Professor,
Department of Applied Physics,
The Hong Kong Polytechnic University

Dr Miao ZHANG
Research Assistant Professor,
Department of Applied Biology and Chemical Technology,
The Hong Kong Polytechnic University

Programme Rundown

Day 1 | 19 July 2024 (Friday)

Start Time *(HK Time)*	Particular
13:45	Reception
14:00-14:05	Welcome and Opening Address by **Prof. Raymond Wai-Yeung WONG**
Session 1 - Chaired by **Prof. Feng YAN**	
14:05-14:30	**Prof. Tae-Woo LEE** Seoul National University *"Metal Halide Perovskite Nanocrystals for Next-Generation Displays"*
14:30-14:55	**Prof. Kian Ping LOH** The Hong Kong Polytechnic University *"Synthesis of New Phase 2D All Organic Perovskites plus Spin-optoelectronics on 2D Hybrid Organic-inorganic Perovskites"*
14:55-15:20	**Dr Jeonghun KWAK** Seoul National University *"Quantum Dot Light-Emitting Diodes for Future Displays"*
15:20-15:40	Coffee Break
Session 2 - Chaired by **Prof. Tae-Woo LEE**	
15:40-16:05	**Prof. Takhee LEE** Seoul National University *"Photo-Response Characteristics of Molecular Junctions"*
16:05-16:30	**Prof. Gang LI** The Hong Kong Polytechnic University *"Efficient and Scalable Perovskite Photovoltaics"*
16:30-16:55	**Prof. Cheolmin PARK** Yonsei University *"Self-assembled Halide Perovskites for Emerging Photoelectronics"*
16:55-17:20	**Dr Jun YIN** The Hong Kong Polytechnic University *"Computational Insights into Photophysics of Hybrid Perovskites"*
17:20	End of Day 1

Day 2 | 20 July 2024 (Saturday)

Start Time *(HK Time)*	Particular
08:45	Reception
Session 3 - Chaired by **Prof. Joon Hak OH**	
09:00-09:25	**Prof. Yongtaek HONG** Seoul National University *"Stretchable Hybrid Electronics (SHE) for Body-Attachable Display, Sensor, Thermoelectric Applications"*
09:25-09:50	**Prof. Tom WU** The Hong Kong Polytechnic University *"Heterostructure Engineering and Machine Learning in Advancing the Perovskite Electronics"*
09:50-10:15	**Dr Peng TAO** The Hong Kong Polytechnic University *"Triplet Excited State-Utilizable Emitters for Optoelectronic Applications"*
10:15-10:45	Coffee Break
Session 4 - Chaired by **Prof. Tom WU**	
10:45-11:10	**Prof. Joon Hak OH** Seoul National University *"Harnessing Multiscale Chirality in Organic Semiconductors for Advanced Optoelectronics"*
11:10-11:35	**Dr Yang WANG** The Hong Kong Polytechnic University *"Artificial Photosynthesis via Covalent Organic Frameworks: A Tale of Charge and Mass Transport"*
11:35-12:00	**Dr Keehoon KANG** Seoul National University *"Overcoming Doping Challenges in Emerging Semiconductors"*
12:00-12:25	**Dr Miao ZHANG** The Hong Kong Polytechnic University *"Organometallic Materials and Their Application in Solar Energy Conversion"*
12:25	Lunch Break

Session 5 – Chaired by **Prof. Takhee LEE**	
14:00-14:25	**Prof. Sang Ouk KIM** Korea Advanced Institute of Science and Technology (KAIST) *"From Graphene Oxide Liquid Crystal to Artificial Muscle"*
14:25-14:50	**Dr Xunjin ZHU** Hong Kong Baptist University *"In Situ Electropolymerizing toward Porous Nanofilms of Cobalt Porphyrin for Electrochemical CO_2 Reduction"*
14:50-15:15	**Prof. Jeong-Yun SUN** Seoul National University *"Glass Transition Temperature as a Unified Parameter to Design Self-Healable"*
15:15-15:40	**Dr Linli XU** The Hong Kong Polytechnic University *"Metallated Graphynes: Synthesis, Characterization and their Application"*
15:40-16:10	Coffee Break
Session 6 - Chaired by **Dr Xunjin ZHU**	
16:10-16:35	**Prof. Do Hwan KIM** Hanyang University *"A Monolithic Artificial Tactile Organic Synapse Using Piezo-ionics for Neuro-robotics"*
16:35-17:00	**Prof. Feng YAN** The Hong Kong Polytechnic University *"Flexible Organic Electrochemical Transistors for Sensing Applications"*
17:00-17:05	Closing Remarks by **Prof. Feng YAN**
17:05	End of Day 2

DAY 1

19 July 2024
Sessions 1 - 2

Prof. Tae-Woo LEE

Professor and Research Director
Department of Materials Science and Engineering
Seoul National University

Prof. LEE is a professor in the Department of Materials Science and Engineering at Seoul National University, Korea. He received his Ph.D. in Chemical Engineering from Korea Advanced Institute of Science and Technology (KAIST), Korea, in 2002. He joined Bell Laboratories, Lucent Technologies, USA, as a postdoctoral researcher in 2002 and then worked at Samsung Advanced Institute of Technology as a member of the research staff (2003–2008). He was an assistant and associate professor in the Department of Materials Science and Engineering at Pohang University of Science and Technology (POSTECH), Korea, until August 2016. His research interest spans organic, organic–inorganic hybrid perovskite, and carbon materials, and their applications to flexible electronics, printed electronics, displays, solid-state lightings, solar energy conversion devices, and bio-inspired neuromorphic devices. He was appointed as a regular member of Korea Academy of Science and Technology in 2021. He was honored as 2020 Materials Research Society (MRS) Fellow and 2024 SPIE Fellow. To date, he is the author and co-author of 289 papers in high-impact journals including Science, Nature, and their distinguished sister journals.

Metal Halide Perovskite Nanocrystals for Next-Generation Displays

Metal halide perovskites (MHPs) have emerged as promising candidates for future display technologies, primarily due to their superior high color purity. This talk will delve into the unique advantages and strategies of utilizing MHPs for display technologies, focusing on innovative nanostructures and material design approaches in precisely tailored colloidal perovskite nanocrystals (PNCs) to maximize luminous efficiency of perovskite light-emitting diodes (PeLEDs). First, we will introduce comprehensive material strategies aimed at suppressing defect generation, leading to the enhancement of the luminescent efficiency of PNCs. More specially, we incorporated zero-dipole guanidinium cation into formamidinium lead bromide ($FAPbBr_3$) PNCs and utilized interlayer based on bromide-incorporated molecules. We also developed a modified bar-coating technique capable of producing large-area PeLEDs that match the efficiency of the PeLEDs with a small emission area. Additionally, we'll present an advanced core/shell PNC synthesis method, enabling to demonstration of simultaneously bright, efficient, and stable PeLEDs. Moreover, we will explore a novel hybrid tandem PeLEDs with an ideal optical structure that emits light more efficiently with a narrow bandwidth. Finally, we incorporated conjugated molecular multipods that reduce the dynamic disorder of perovskite, resulting in significantly improved luminescent efficiency of PeLEDs. These advancements highlight the potential of MHPs as promising materials for next-generation vivid displays.

Prof. Kian Ping LOH

Chair Professor of Materials Physics and Chemistry
Department of Applied Physics
The Hong Kong Polytechnic University

Prof. LOH obtained his Bachelor degree (Hons) from the National University of Singapore, Chemistry department in 1994, and his Ph.D. from the Physical and Theoretical Chemistry Laboratory, University of Oxford in 1996.

He is currently director of Jockey Club STEM laboratory on Quantum Materials and Physics as Chair Professor of Materials Chemistry and Physics in Hong Kong Polytechnic University. Loh's recent research focuses on the growth, molecular chemistry, electronic material science and devices of 2D materials, which include 2D covalent organic framework, 2D hybrid perovskites and 2D Topological Quantum materials. He is on the Clavirate's list of highly cited scientist from 2018-2023. He is Academician of Asia Pacific Academy of Materials (2015). He is the winner of Singapore's President's Science Award in 2014 and American Chemical Society Nano lectureship award in 2013.

Synthesis of New Phase 2D All Organic Perovskites Plus Spin-optoelectronics on 2D Hybrid Organic-inorganic Perovskites

The perovskite materials, consisting traditionally of inorganic compounds, and more recently also the organic-inorganic hybrids, enjoy enduring interests from researchers owing to their impact on wide ranging fields, which include ferroelectrics, piezoelectrics and photovoltaics. Metal-free or all-organic perovskites are the newest addition to this family, but the synthetic methodology to make these are relatively undeveloped. Herein, we report the synthesis of metal-free 2D layered perovskite with the formula of A2B2X4, which we christened as Choi-Loh van der Waals phase (CL–v phase). CL-v phase is reminiscent of Ruddlesden–Popper phase in terms of having a van der Waals gap mediated by interlayer hydrogen bonding, and can be grown or exfoliated into 2D organic sheets. As a hallmark of layered materials with van der Waals gap, changes in interlayer sliding enables polymorphs to be synthesized.

Two-dimensional hybrid organic-inorganic perovskites with chiral spin texture are emergent spin-optoelectronic materials. Despite the wealth of chiro-optical studies on these materials, their charge-to-spin conversion efficiency is unknown. Here we demonstrate highly efficient electrically driven charge-to-spin conversion in enantiopure chiral perovskites (R/S-MB)2(MA)3Pb4I13 (⟨n⟩ = 4). Using scanning photovoltage microscopy, we measured a spin Hall angle θ_shof 5% and a spin lifetime of ~95 ps at room temperature in ⟨n⟩ = 4 chiral perovskites, which is much larger than its racemic counterpart as well as the lower ⟨n⟩ homologues. In addition to current-induced transverse spin current, the presence of a co-existing out-of-plane spin current confirms that both conventional and collinear spin Hall conductivities exist in these low-dimensional crystals.

References

1 **Molecularly thin, two-dimensional all-organic perovskites**
HS Choi, J Lin, G Wang, WPD Wong, IH Park, F Lin, J Yin, K Leng*, J Lin*, **Kian Ping Loh*** Science 384 (6691), 60-66 (**2024**)

2 **Two-Dimensional Chiral Perovskites with Large Spin Hall Angle and Collinear Spin Hall Conductivity**, Ibrahim Abdelwahab, Jun Yin*, Hyun Soo Yang* and **Kian Ping Loh*** et. al. Science, accepted **June 2024**.

Dr Jeonghun KWAK

Associate Professor
Department of Electrical and Computer Engineering
Seoul National University

Dr KWAK received his B.S. (2005) and Ph.D. (2010) degrees in Electrical Engineering from Seoul National University (SNU), Korea. After working as a postdoctoral researcher at SNU for one year, he worked as an assistant/associate professor at Dong-A University, Korea (2011–2015) and at the University of Seoul, Korea (2015–2019). Since March 2019, he has been an associate professor at the Department of Electrical and Computer Engineering, SNU. His current research interests focus on opto- and nano-electronic devices, such as QLEDs, organic thermoelectric devices, and neuromorphic devices based on organic molecules and low-dimensional materials.

Quantum Dot Light-Emitting Diodes for Future Displays

Colloidal quantum dots (QDs) have attracted great interest due to their unique optical and electrical properties, such as size-dependent bandgap tunability, broad absorption and narrow emission spectra, and controllable surface properties. Recently, several types of devices using QDs have been reported for future optoelectronics. The QD-based light-emitting diodes, QLEDs, are one of the most promising devices for future full-color displays and novel light sources. However, fundamental mechanisms such as charge injection into QDs, exciton recombination, and operational stability should be better understood and improved to commercialize the QLED displays. In this talk, I will mainly present our recent research progress on QLEDs, from fundamental understanding to practical applications.

Prof. Takhee LEE

Professor
Department of Physics and Astronomy
Seoul National University

Prof. LEE is a professor in Department of Physics and Astronomy, Seoul National University (SNU), Korea. He received his B.S. and M.S. degree in physics at SNU in 1992 and 1994, respectively, and he received his Ph.D. degree in physics at Purdue University, USA in 2000. He was a postdoctor at Yale University, USA until 2004. His current researches at SNU are characterization of the electrical properties of structures involving single molecules, self-assembled monolayers, polymers, perovskites, semiconductor nanomaterials, and their assembly into electronic devices. He has edited 2 books, written 11 book chapters, 23 review articles, and more than 300 journal articles. He was awarded with Korea Science Award (2018), Korean Physical Society Research Award (2016), Outstanding Research Award in SNU (2014), Korean Scientist of the Month Award (2010), Prime Minister Award (2010), and Minister of Education, Science and Technology Award (2008, 2010). He is a member of Korean Academy of Science and Technology (since 2022).

Photo-Response Characteristics of Molecular Junctions

Photoresponsivity is a fundamental process that constitutes optoelectronic devices. In molecular junction devices, one of the most adopted strategies is to employ photoactive molecules that can undergo conformational change upon light illumination. In this talk, I first briefly summarize my group's research work on the electrical transport properties of molecular-scale electronic junctions. Then, I will explain a series of research work on the photoswitching characteristics of diarylethene molecular junction devices that were made in three types of top electrodes (specifically, PEDOT:PSS, reduced graphene oxide, and graphene film top electrode) in the vertical junction structure [1]. Also, I present a recent research work of photoswitching junctions made with molecules that have intrinsically little photoresponse and organohalide perovskite/graphene heterojunction as a photoactive electrode [2].

References

1 D. Kim et al., Adv. Mater. 26, 3968 (**2014**); D. Kim et al., Adv. Funct. Mater. 25, 5918 (**2015**); J. Koo et al., ACS Appl. Mater. Inter. 11, 11645 (**2019**).

2 C. Lee et al., Adv. Opt. Mater. 10, 2200049 (**2022**).

Prof. Gang LI

Sir Sze-yuen Chung Endowed Professor in Renewable Energy
Chair Professor of Energy Conversion Technology
Department of Electrical and Electronic Engineering
The Hong Kong Polytechnic University

Prof. LI obtained his BS degree in Space Physics from Wuhan University (1994), MS in Electrical Engineering and PhD in Condensed Matter Physics from Iowa State University, U.S.A. (2003). His postdoctoral research in University of California Los Angeles (UCLA) from 2004 to 2007 was on polymer solar cells and LEDs. From 2007 to 2011, he led the printable polymer solar cell R&D in Los Angeles based Solarmer Energy Inc. Prof. LI has a good mix of academic and industrial experience. He was a Research Associate Professor in UCLA before he joins PolyU in August 2016. In 2019, he was promoted to Professor, and now is Sir Sze-Yuen Chung Endowed Professor in Renewable Energy.

Prof. LI's research interests are organic semiconductor, and organo-metal halide hybrid perovskite based thin-film optoelectronic devices. He has done seminal contributions to Printable Solar cells with global reputation. He has published ~140 papers in peer review journals including Nature Materials, nature Photonics, Science, Nature Review Materials etc. His papers have been cited over 59000 times according to Google Scholar, in which 17 papers have over 1000 citations. He is recognized as a Highly Cited Researcher (Materials Science 2014 – 2019; Physics 2017-2018, Chemistry 2018) by Thomson Reuter / Clarivate Analytic, with a H-Index of 71. He is Fellow of Royal Society of Chemistry, UK, and Fellow of The International Society for Optics and Photonics (SPIE).

Efficient and Scalable Perovskite Photovoltaics

Solar photovoltaic (PV) energy has been playing an increasingly important role in the world's energy portfolio. It is becoming a key contributor in the global transition to decarbonized electricity generation. Lead (Pb) halide perovskites have attracted great attention in PV due to their outstanding optoelectronic and defect properties. The research of halide perovskite solar cells continues to boom with device energy conversion efficiency approaching that of single crystal silicon solar cells The discovery of the extraordinary properties enables its application in efficient single-junction and multi-junction solar cells. In this talk, I will present the advance in understanding the optoelectronic properties of halide perovskites. One of the most promising, yet not heavily researched approaches is to make tandem solar cells using materials that function well even when they are polycrystalline and defective. Recent advances with hybrid perovskite semiconductors and their potential use in tandems will be emphasized. The progress of low-voltage deficit in wide bandgap perovskite and its application in high-performance perovskite-silicon tandem solar cells will be discussed. Besides, scaling up for perovskite-silicon tandem solar cells will also be briefed.

Prof. Cheolmin PARK

Professor
Department of Materials Science and Engineering
Yonsei University

Prof. PARK is a professor of the Department of Materials Science and Engineering at Yonsei University. He received his B.S. and M.S. degrees in the Department of Polymer and Fiber Engineering from Seoul National University in 1992 and 1995, respectively, and a Ph.D. degree in the Department of Materials Science and Engineering from Massachusetts Institute of Technology in 2001. After a postdoctoral fellowship at Harvard University in the Department of Chemistry and Chemical Biology, he joined at Yonsei University in 2002.

He is a fellow of Korea Academy of Science and Technology (KAST) and a member of the National Academy of Engineering of Korea (NAEK). He was selected as an Underwood Distinguished Professor at Yonsei University in 2014 for his excellent academic achievement. He is the Director of the BK21 Education and Research Division for Futuristic Human-centric Materials and the Director of the Center for Artificial Synesthesia Materials Discovery. He has been elected to the Board of Directors of the Materials Research Society (MRS).

Self-assembled Halide Perovskites for Emerging Photoelectronics

Halide perovskites (HPs) self-assembled into micro- or nanopatterns have attracted significant interest due to their potential to not only improve the efficiency of an individual device via the controlled arrangement of HP crystals, but also to develop multi-functional materials by facilitating unique photoelectric properties of a self-assembled host template. This presentation provides a comprehensive overview of the state-of-art bottom-up technologies used to develop micro- and nanometer scale HP patterns, and their potential for applications. Emphasis will be made on development of HPs self-assembled with block copolymers which exhibit excellent environmental stability, phase purity, and photoluminescence. Moreover, self-assembled dual-light-emitting materials are demonstrated for high-performance optical pattern encryption in which fluorescent HPs are stabilized and embedded in metal–organic frameworks (MOFs) designed for phosphorescent host–guest interactions. The presentation shows that self-assembled HPs reveal the unprecedented functionality of HPs, leading to new research areas that utilize their novel photophysical properties.

Dr Jun YIN

Assistant Professor
Department of Applied Physics
The Hong Kong Polytechnic University

Dr YIN is an Assistant Professor in the Department of Applied Physics at The Hong Kong Polytechnic University (PolyU) since 2022. He received his Ph.D. degree in Physics from Nanyang Technology University (NTU) in 2016. He then joined King Abdullah University of Science and Technology (KAUST) as a Postdoctoral Fellow and was promoted to Research Scientist in 2019. Dr Yin has published over 200 papers with h-index of 64, including articles in the journals such as *Science*, *Nature Energy*, and *Nature Photonics*. His research focuses on developing theoretical models and computational strategies to understand photophysical properties of perovskite materials.

Computational Insights into Photophysics of Hybrid Perovskites

Computational materials science has evolved beyond elucidating material properties to include sophisticated theoretical frameworks that predict new materials and phenomena and describe photophysical processes across various simulation scales. This progress has led to diverse computational tools such as density functional theory (DFT), many-body perturbation theory (MBPT), and nonadiabatic molecular dynamics (NAMD). These methodologies often intersect, enriching interdisciplinary theoretical and computational materials research. With these advanced methodologies, we investigate hybrid perovskite materials, focusing on how dimensionality, crystal structure, and chemical composition influence their photophysical properties. We also highlight recent advancements in studying hot carrier cooling processes and manipulating organic spacers to enhance spin splitting in these materials. Our work demonstrates the potential of computational insights to drive the discovery and understanding of hybrid perovskites.

DAY 2

20 July 2024
Sessions 3 - 6

Prof. Yongtaek HONG

Professor
Department of Electrical and Computer Engineering
Seoul National University

Prof. HONG received B.S. and M.S. in Electronics Engineering, from Seoul Nat'l Univ., Seoul, Korea, and Ph.D. in Electrical Engineering from Univ. of Mich., Ann Arbor, MI, USA. From 2003 to 2006, he was a senior research scientist at Display Science & Technology Center, Eastman Kodak Company, Rochester, NY, USA. Since 2006, he has worked for Dept. Elec. & Comp. Eng., Seoul Nat'l Univ., now is a full professor, Department Chair. He was a visiting professor of Dept. Chem. Eng., Stanford University, from 2012 to 2013. His research interests are printed/flexible/stretchable thin-film devices, display and sensors for wearable and electronic skin applications. Prof. Hong received IEEE EDS "2005 George E. Smith Award", IEEE/IEEK "Young IT Engineer of The Year Award" in 2010, IEC "1906 Award" in 2012, SNU CoE Shin Yang Engineering Award in 2015, Best Academic Development in Printed & Flexible Electronics Award from IDTechEX Show Printed Electronics USA and 100 Technology Lighting-up Korea in 2025 Award, both in 2017, "Display Day" Korea MOTIE Minister Award in 2018, "Scientist of The Month" Korea MSIT Minster Award in 2019, Merck Award in 2020, Korea National R&D Project 100 Best Achievement Award in 2021, Fellow, The Korean Academy of Science and Technology in 2023, and Fellow, The Society for Information Display (SID) in 2024. He is a convenor of IEC TC110 WG8 (Flexible Displays), an executive board member of KIDS and SID, and SID Chapter Formation Chair.

Stretchable Hybrid Electronics (SHE) for Body-Attachable Display, Sensor, Thermoelectric Applications

With significant research in molecular electronics, new platform technology based on flexible and stretchable substrate, has gained a lot of attention in wearable fields. However, since there are still limitations in implementing high-performance wearable electronic system using novel materials and devices only, hybrid combiation of both novel and conventional technologies, so called, hybrid stretchable electronics (SHE) technology has been considered a near-term solution. In this talk, my group's effort in SHE technology will be described. By isolating highly functional, typically rigid and brittle conventional components, from any external deformation stress, with stretchable spring-like interconnect conductors in between, we transforms conventional printed circuit boards (PCBs) and thermoelectric (TE) batteries into stretchable ones. Key enabling technology of SHE includes strain-engineering, stretchable interconnect, bonding of surface mount devices (SMDs), stretchable via and crossover. [1]. A new strategy based on soft modular block assembly is introduced to demonstrate fully customized wearable MP joint flexion monitoring system and robotic fingers [2]. For a long-term solution toward low-cost and potentially disposable wearable devices, stretchable printed electronics technology can be used [3]. SHE and printingtechnology would make paradigm shift of wearable electronic devices and help electronic skins and stretchable patch devices emerging in market as early as possible.

References

1 Y. Hong* et al., Nature Communications, 11, 5948 (**2020**); Science Robotics, 3, eaaas9020 (**2018**); Scientific Reports, 7, 45328 (**2017**); ACS Applied Electronic Materials, 5, 2769 (**2023**); ACS Energy Letters, 8, 2585 (**2023**); Nature Electronics, 7, 383 (**2024**)

2 Y. Hong* et al., Advanced Science, 6, 1801682 (**2019**); Advanced Intelligent Systems, 5 (8), 2300013 (**2023**).

3 Y. Hong* et al., Nature Communications, 11, 663 (**2020**); Nanoscale, 7, 6208 (**2015**); Advanced Electronic Materials, 3, 1600455 (**2017**); Smart Materials and Structure, 28, 025008 (**2018**); PloS one, 14, e0225164 (**2019**)

Prof. Tom WU

Chair Professor of Frontier Materials
Department of Applied Physics
The Hong Kong Polytechnic University

Prof. WU is Chair Professor of Frontier Materials in the Department of Applied Physics at The Hong Kong Polytechnic University (PolyU). He received his B.S. degree from Zhejiang University and his Ph.D. from the University of Maryland, College Park. Before joining PolyU as a STEM scholar, Dr. Wu worked at Argonne National Laboratory in Chicago, Nanyang Technological University (NTU) in Singapore, King Abdullah University of Science and Technology (KAUST) in Saudi Arabia, and the University of New South Wales (UNSW) in Sydney. Dr. Wu has authored nearly 400 peer-reviewed papers with citations of over 34,000 and a H-index of 98 (Google Scholar), and he has been among the Clarivate List of Highly Cited Researchers since 2019. In the past two decades, his research group has explored perovskite materials including oxide thin films, nanomaterials, and hybrid compounds, focusing on their electronic, magnetic, and optical functionalities. He also serves as an Associate Editor for ACS Applied Materials & Interfaces.

Heterostructure Engineering and Machine Learning in Advancing the Perovskite Electronics

As an emerging class of light-responsive semiconductors, hybrid organo-metal perovskites seamlessly marry the characteristics of organic and inorganic materials, offering a new fertile playground to explore light-matter interaction. Perovskites have been the subject of scrutiny by materials scientists for over a hundred years, but the past decade has seen a surge in interest due to their remarkable photovoltaic properties, promising a breakthrough in solar energy. The hybrid characteristics and the strong correlation of composition/structure/function in these frontier materials bring new opportunities and challenges. Here, I will highlight our latest endeavors in engineering heterostructures with judiciously chosen semiconductor materials, particularly low-dimensional materials, which offer the promise of going beyond the limit of individual perovskite materials. Also, I will discuss using high-throughput calculation and machine learning to achieve precise control of the energy band structure to accelerate the discovery and design of new hybrid perovskite materials.

Dr Peng TAO

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

Dr PENG obtained his B.Sc. and Ph.D. degrees from Taiyuan University of Technology, with the Ph.D. study supervised by Prof. Wei Huang, the academician of the Chinese Academy of Sciences. After postdoctoral work with Prof. Wai-Yeung Wong at The Hong Kong Polytechnic University (PolyU), he was appointed as a Research Assistant Professor at PolyU from Jul 2020. His current research interest focuses on the design and synthesis of advanced functional molecules and polymers including luminescent transition-metal complexes and π-conjugated compounds for multifunctional applications.

Triplet Excited State-Utilizable Emitters for Optoelectronic Applications

Triplet excited state-utilizable emitters including phosphorescent transition-metal complexes (PTMCs) and thermally activated delayed fluorescence (TADF) materials have been attracting significant attention because of their excellent luminescent properties and promising optoelectronic applications. Different from conventional fluorescent materials, the triplet excited state-utilizable emitters can effectively utilize the triplet excited states by strong spin-orbit coupling effect, efficient reverse intersystem crossing process, etc. Manipulating the excited states of these emitters could endow them with appealing photophysical properties, which play vital roles in triplet state-related photofunctional applications. In this talk, I will introduce my recent progress on the molecular design, synthesis and optoelectronic applications of triplet excited state-utilizable emitters. The following topics will be covered: 1) Molecular engineering of iridium(III) complexes for highly efficient organic light-emitting devices (OLEDs); 2) Rational design of narrowband emissive thermally activated delayed fluorescence emitters for OLEDs; 3) Triplet-triplet annihilation/hybridized local and charge transfer-based emitters for OLEDs; 4) Molecular engineering of phosphorescent manganese(II) complexes for X-ray scintillator

Prof. Joon Hak OH

Professor
Department of Chemical and Biological Engineering
Seoul National University

Prof. OH is a professor of School of Chemical and Biological Engineering at Seoul National University, Korea. He received his B.S, M.S, Ph.D degrees from Seoul National University. He worked as a senior engineer at Samsung Electronics. He then continued his postdoctoral research at Stanford University. He was a faculty at Ulsan National Institute of Science and Technology (UNIST, 2010-2014) and Pohang University of Science and Technology (POSTECH, 2014-2018), before moving to Seoul National University in 2018. His research focuses on synthesis of organic and polymeric materials, enhancement of their electrical and optical functions by controlling the physical and chemical features, and their applications to flexible electronic devices and energy devices, such as organic field-effect transistors, chemical/bio/physical sensors, and organic solar cells.

Harnessing Multiscale Chirality in Organic Semiconductors for Advanced Optoelectronics

Harnessing multiscale chirality in chiral organic semiconductors ranging from molecular to supramolecular chirality will open new opportunities for next-generation optoelectronics and spintronics. I will present synthesis of chiral organic semiconductors, fabrication of supramolecular semiconducting materials, structure-property relationships, and their applications in various physicochemical sensors. In addition, a simple yet powerful method to fabricate chiroptical flexible layers via supramolecular helical ordering of conjugated polymer chains will be introduced. These findings provide guidelines for enhancing chiroptical properties using multiscale chirality and rational molecular design of organic semiconductors toward high-performance chiral optoelectronics. In addition, these results demonstrate an effective strategy to realize on-chip detection of the spin degree of freedom of photons necessary for encoded quantum information processing and high-resolution polarization imaging.

Dr Yang WANG

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

Dr WANG obtained his BS degree from Anhui University in 2014 and his PhD degree at Technical Institute of Physics and Chemistry of Chinese Academy of Sciences (TIPC, CAS) in 2020. Then, he continued his research work in Prof. Wai-Yeung Wong's group as a research assistant professor at the Hong Kong Polytechnic University. His research interests mainly focus on artificial photosynthesis, including water splitting, carbon dioxide reduction, and redox organic transformation.

Artificial Photosynthesis via Covalent Organic Frameworks: A Tale of Charge and Mass Transport

As the "holy grail" of modern chemistry, artificial photosynthesis is one of the most attractive and promising technologies and methods to solve the problems of energy shortage and environmental degradation. Covalent organic frameworks (COFs), which are covalently linked skeletons with high crystallinity and precise chemical structures, have exhibited great potential in the field of artificial photosynthesis. However, their structure-property-activity relationship, which should be beneficial for the structural design, is still far away explored. Here, we introduce different metal sites in COFs and ab initio construct a novel symmetry-breaking coordination environment, to regulate the photogenerated carrier migration and CO_2 activation process from a molecular level, thereby effectively improving the performance of photocatalytic hydrogen production from water and aqueous CO_2-to-CO conversion.

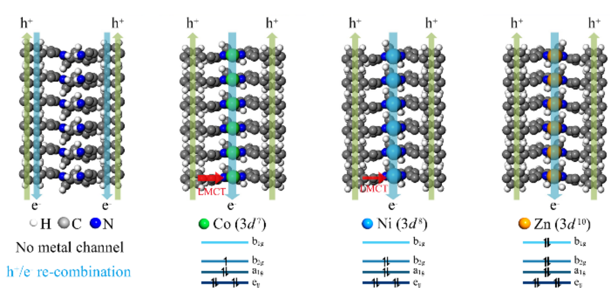

Fig. 1 Controlling mechanism of carrier dynamics in COFs with different metal sites.[1,2]

Keywords: *covalent organic frameworks, artificial photosynthesis, water splitting, aqueous CO_2 reduction, charge migration thermodynamics*

References

1 Chen, R.; Wang, Y.; Ma, Y.; Mal, A.; Gao, X.-Y.; Gao, L.; Qiao, L.; Li, X.-B.; Wu, L.-Z.; Wang, C. *Nat. Commun.* **2021**, **12**: 1354.

2 Zhong, Y.-H.; Wang, Y.; Zhao, S.-Y.; Xie, Z.-X.; Chung, L.-H.; Liao, W.-M.; Yu, L.; Wong, W.-Y.; He, J., *Adv. Funct. Mater.* **2024**, 2316199.

Dr Keehoon KANG

Assistant Professor
Department of Materials Science and Engineering
Seoul National University

Dr KANG is currently an assistant professor at Department of Materials Science and Engineering at Seoul National University, South Korea. He is an alumnus of the University of Cambridge, where he obtained his BA & MSci (combined) and PhD degrees in Physics in 2012 and 2017, respectively. After completing his postdoctoral research in the Department of Physics at Seoul National University, which also served as his military service substitution, he transitioned to a faculty position in the Department of Materials Science and Engineering at Yonsei University from 2021 to 2022. Currently, at Seoul National University, he is leading ONELab (Organic Next-gen Electronics) and is actively focused on the cutting-edge fields of mixed-ionic-electronic conducting organic semiconductors and metal-halide perovskites. His work is dedicated to exploring the fundamentals and developing new methods for controlling electrical properties of these novel materials for next-generation electronic and optoelectronic devices. He has been awarded numerous awards such as POSCO Science Fellowship (2019), Young Physicist Prize (2017) and he has served as a Young Advisory Board Member of InfoMat and InfoScience since 2023.

Overcoming Doping Challenges in Emerging Semiconductors

Doping has been one of the most essential methods to control charge carrier concentration in semiconductors. Excess generation of charge carriers is a key route for controlling electrical properties of semiconducting materials and typically accompanies alteration of electronic structure by the introduction of dopant impurities, both of which have played pivotal roles in making breakthroughs in inorganic microelectronic and optoelectronic devices both at research and industrial levels, especially for Si-based technology. Molecular doping is a facile and effective doping method for various semiconducting materials since it is relatively non-invasive compared to high-energy implantation of ionic impurities used in Si. However, there are main challenges remaining in fully utilising molecular doping in emerging semiconducting materials such as π-conjugated polymer semiconductors, two-dimensional materials and metal-halide perovskites due to the difficulties in preventing dopant-induced disorder effects while maintaining a high carrier mobility. This talk will introduce concepts that we have developed to minimizing the dopant-induced disorder [1, 2, 3] while mitigating current injection and doping stability issues in electronic devices [4, 5], and finally outline the future challenges remaining in the field to fully uncover the potentials.

References

1 K. Kang, et. al., “2D Coherent Charge Transport in Highly Ordered Conducting Polymers Doped by Solid State Diffusion”, *Nat. Mater*., Vol. 15, p. 896, **2016**.

2 J. Jang, et. al., “Reduced dopant-induced scattering in remote charge-transfer-doped MoS2 field-effect transistors”, *Sci. Adv.,* Vol. 8, No. 38, p. eabn3181, **2022**.

3 J. Lee, et. al., “Bulk Incorporation of Molecular Dopants into Ruddlesden–Popper Organic Metal–Halide Perovskites for Charge Transfer Doping”, *Adv. Funct. Mater.*, 33, 38, 2302048, **2023**.

4 Y. Kim, et. al., “Enhanced Charge Injection Properties of Organic Field-Effect Transistor by Molecular Implantation Doping”, *Adv. Mater.*, Vol. 31, p. 1806697, **2019**.

5 Y. Kim, et. al., “Highly Stable Contact Doping in Organic Field Effect Transistors by Dopant-Blockade Method” *Adv. Funct. Mater.* (**2020**) Vo. 30, p. 2000058

Dr Miao ZHANG

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

Dr ZHANG is currently a research assistant professor at The Hong Kong Polytechnic University (PolyU). She obtained her PhD degree in 2019 from Beijing Jiaotong University in China. Subsequently, she was selected as a postdoctoral fellow at PolyU through the Hong Kong Scholars Program (2019) under the supervision of Prof. Wai-Yeung Wong, Raymond. Her research interests mainly focus on the development of novel organic/organometallic materials and devices for solar energy conversion. To date, she has published more than 60 SCI-indexed papers with 20 publications as the first or corresponding author. These works have collectively garnered over 4000 citations.

Organometallic Materials and Their Application in Solar Energy Conversion

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 novel organometallic materials and investigating their performance in solar cells and solar evaporators. The iridium and platinum-based molecules with high singlet-to-triplet conversion would be explored to improve the exciton lifetime and diffusion length, while also optimizing the active layer morphology to enhance the efficiency of organic solar cells. Additionally, a new strategy is proposed that integrates multiple charge transfer mechanisms, including metal-to-ligand, ligand-to-metal, ligand-to-ligand, and intermolecular charge transfers, into an organometallic polymer. This approach aims to design highly efficient photothermal materials for solar evaporation applications. The development of novel organometallic materials opens a meaningful pathway from molecular design to improving the solar energy conversion efficiency of both photo-to-electric and photo-to-thermal processes.

Keywords: *Organometallic materials; Photo-to-electric; Photo-to-thermal; Organic solar cells; Solar evaporator*

Prof. Sang Ouk KIM

Professor
Department of Materials Science and Engineering,
Korea Advanced Institute of Science and Technology (KAIST)

Prof. KIM is a Professor in the Department of Materials Science & Engineering at KAIST, and currently serving as the director for the KAIST Institute for Nanocentury. His main research interest is the directed nanoscale assembly of soft materials towards novel materials discovery, including block copolymers and low-dimensional materials for a broad range of advanced applications. His scientific contribution has been recognized by prestigious honours, including Highly Cited Researcher from Clarivate Analytics (2018), KAIST Grand Prize for Academic Excellence (2015) and Presidential Young Scientist Award (2013). He is currently serving as an associate editor of *Energy Storage Materials* (Elsevier) as well as editorial board members for many scientific journals. To date, he has published more than 290 scientific journal papers relevant to the nanomaterials science.

From Graphene Oxide Liquid Crystal to Artificial Muscle

Graphene Oxide Liquid Crystal (GOLC) is an intriguing 2D carbon based soft material, which exhibits nematic type colloidal discotic liquid crystallinity with the orientational ordering of graphene oxide flakes in good solvents, including water. Since our first discovery of GOLC in aqueous dispersion at 2009, this interesting mesophase has been utilized over world-wide for many different application fields, such as liquid crystalline graphene fiber spinning, highly ordered graphene membrane/film production for water treatment, nanoporous graphene assembly for energy/environmental applications and so on. Interestingly, GOLC also allow us a valuable opportunity for the highly ordered molecular scale assembly of functional nanoscale structures. This presentation will introduce our current status of GOLC and other 2D material research particularly focusing on the nanoscale assembly of functional nanostructures, including highly oriented 1D fibers, 2D films and 3D nanoporous structures. In particular, human muscle inspired graphene based nanocomposite fiber actuators will be highlighted along with its interesting demonstration for biomimetic behaviors. Besides, relevant research works associated to the nanoscale assembly and chemical modification of various low dimensional materials, including 2D TMDs and MXene, will be presented particularly aiming at energy and environmental applications. In the last part of presentation, our first discovery of single atom catalyst will be introduced, including other relevant research efforts exploiting the customized heteroelement doping of graphene based structures.

Dr Xunjin ZHU

Associate Professor
Department of Chemistry
Hong Kong Baptist University

Dr ZHU, a Chemical Engineering graduate from Wuhan Institute of Technology, holds a PhD in Chemistry from Hong Kong Baptist University. He conducted post-doctoral research at the University of Texas at Austin and Georgia Institute of Technology. Dr. Zhu is now an Associate Professor at Hong Kong Baptist University, specializing in porphyrin material design for applications like organic solar cells and electrocatalysis. With 6321 total citations and an h-index of 46, his work has made a significant impact in the scientific community.

In Situ Electropolymerizing toward Porous Nanofilms of Cobalt Porphyrin for Electrochemical CO_2 Reduction

Electrocatalytic CO_2 reduction using cobalt porphyrin molecular catalysts shows promise in advancing the carbon cycle and combating climate change. Challenges persist in optimizing performance and evaluations due to low loading and utilization of electroactive sites. This study introduces a novel approach by synthesizing a monomer, CoP, and electropolymerizing it onto CNT networks to create a 3D microporous nanofilm (EP-CoP). EP-CoP enhances electron transfer, redox kinetics, and durability in CO_2RR processes with a utilization rate of 13.1% and durability exceeding 40 hours. In a commercial flow cell, EP-CoP achieves a high FE_{CO} of 98.6% at 620 mV overpotential. Another study integrates EP-CoP onto a copper electrode to create an EP-CoP/Cu tandem catalyst for efficient C_2 product formation. The electrode shows a high current density of 726 mA/cm^2 at -0.9 V vs. RHE with remarkable stability in flow cells, marking a significant advancement in electrochemical CO_2 reduction catalysts.

Reference

1 C. Wang, Y. Chen, D. Su, W. L. Man, K. C. La, L. Han, L. Zhao, D. Zhan, X. J. Zhu, *Adv. Mater.* **2023**, 2303179.

Prof. Jeong-Yun SUN

Professor
Department of Materials Science and Engineering
Seoul National University

Prof. SUN is currently a professor in the Department of Materials Science and Engineering at Seoul National University (SNU), Republic of Korea. He got his B.S. (2005), M.S. (2007) and Ph.D. (2012) in Materials Science and Engineering at Seoul National University. During his Ph.D., he had stayed at Harvard University for 4 years as a visiting student. After getting Ph.D. (2012), he started to work as a postdoctoral fellow in School of Engineering and Applied Sciences at Harvard University. After his Post-Doc., he came back to SNU and worked as an assistant professor and an associate professor. His research was focused on developing soft and ionic materials. Based on the materials, he is developing many ionic devices such as sensors, actuators, energy harvesters etc. Dr. Sun has published many high impact peer-reviewed journal papers including Nature, Science, and Advanced Materials and so on. He became a member of the Young Korean Academy of Science and Technology (YKAST) in 2021. He has received honorable awards including "S-Oil Young Scientist Fellowship Award" from S-OIL Science and Culture Foundation (2023). "Top 100 National R&D Outstanding Achievements." from Korean Ministry of Science and ICT (2020), "Top 10 Nanotechnologies" from Korean Ministry of Science and ICT (2019), "Scientist in this Month" from Korean Ministry of Science (2018), "Young Scientist Award" from The Polymer Society of Korea (2017) and "Young Scientist Award" from Korean Materials Research Society (2016).

Glass Transition Temperature as a Unified Parameter to Design Self-Healable

Self–healing ability of materials, particularly polymers, improves their functional stabilities and lifespan. To date, the designs for self–healable polymers have relied on specific intermolecular interactions or chemistries. We report a design methodology for self–healable polymers based on glass transition. Statistical copolymer series of two monomers with different glass transition temperature (T_g) were synthesized, and their self–healing tendency depends on the T_g of the copolymers and the constituents. Self–healing occurs more efficiently when the difference in T_g between two monomer units is larger, within a narrow T_g range of the copolymers, regardless of their functional groups. The self–healable copolymers are elastomeric and nonpolar. The strategy to graft glass transition onto self–healing would expand the scope of polymer design.

Dr Linli XU

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

Dr XU is currently an assistant professor in the Department of Applied Biology and Chemical Technology at the Hong Kong Polytechnic University. Mainly focus on 2D carbon and carbon rich materials and their applications in the fields of optoelectronics, energy science, memory storage, and thermal management. She has published over 40 papers in important academic journals such as Chem. Soc. Rev., J. Am. Chem. Soc., Angew. Chem. Int. Ed., Nano Today, Coord. Chem. Rev., led 10 projects, participated in 9 funding projects, wrote 3 monographs, and authorized 8 national invention patents.

Metallated Graphynes: Synthesis, Characterization and Their Application

Transition metal ions as new functional units are introduced into the graphdiyne frameworks through metal-carbon linkages to form a novel kind of metallated graphyne *via* the matching effect of transition metal d orbitals and alkyne-based carbon p orbitals. This type of material will combine the dual advantages of both graphyne and transition metal ions to study its optoelectronic and catalytic properties. By constructing diverse molecular frameworks and transition metal types, the energy levels of molecular orbitals can be finely adjusted, as well as their photoelectric properties, catalytic performance. These 2D metallated graphynes not only exhibit excellent nonlinear optical properties, achieving short pulse laser output in laser devices. They also present high catalytic performance for O_2 reduction to generate H_2O_2 and CO_2 reduction reaction. The work can produce a new class of 2D carbon-rich materials and provide a design concept for developing efficient nonlinear optical materials and catalysts.

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Prof. Do Hwan KIM

Professor
Department of Chemical Engineering
Hanyang University

Prof. KIM is currently a Distinguished Professor in the Department of Chemical Engineering at Hanyang University, South Korea. He received his PhD in Chemical Engineering from Pohang University of Science and Technology in 2005. From 2006 to 2010, he worked at the Samsung Advanced Institute of Technology as a senior researcher. He also worked at Stanford University, United States, as a postdoctoral fellow in the Department of Chemical Engineering (2011–2012) and worked as an Assistant Professor at Soongsil University, South Korea (2012–2017). His research interests are in the field of organic optoelectronics, electronic skins, and multimodal synaptic devices.

A Monolithic Artificial Tactile Organic Synapse Using Piezo-ionics for Neuro-robotics

An iontronic-based artificial tactile nerve is a promising technology for emulating the tactile recognition and learning of human skin with low power consumption. However, its weak tactile memory and complex integration structure remain challenging. We present an ion trap and release dynamics (iTRD)-driven, neuro-inspired monolithic artificial tactile neuron (NeuroMAT) that can achieve tactile perception and memory consolidation in a single device. Through tactile-driven release of ions initially trapped within iTRD-iongel, NeuroMAT only generates non-intrusive synaptic memory signals when mechanical stress is applied under voltage stimulation. The induced tactile memory is augmented by auxiliary voltage pulses independent of tactile sensing signals. We integrate NeuroMAT with an anthropomorphic robotic hand system to imitate memory-based human motion; the robust tactile memory of NeuroMAT enables the hand to consistently perform reliable gripping motion.

***Keywords**: Real Metaverse, monolithic artificial tactile neuron, piezo-ionics, ion trap and release dynamics, neuro-robotics*

Prof. Feng YAN

Chair Professor of Organic Electronics
Department of Applied Physics
The Hong Kong Polytechnic University

Prof. YAN is a Chair Professor at The Hong Kong Polytechnic University. He is an Optica Fellow and a Fellow of the Royal Society of Chemistry (FRSC). He received his Ph.D. degree in Physics from Nanjing University. He joined the Engineering Department of Cambridge University in 2001 as a Research Associate and then became an Assistant Professor at the Department of Applied Physics of The Hong Kong Polytechnic University in 2006. He is a Highly Cited Researcher identified by Clarivate in 2021-2023. He has research interests in organic electronics, thin-film transistors, biosensors, solar cells, 2D materials, and smart materials.

Flexible Organic Electrochemical Transistors for Sensing Applications

Organic electrochemical transistors (OECTs) have been successfully used in numerous sensing applications, such as biosensors, photodetectors and chemical sensors. Our group have been working on OECT–based sensors for many years. In this talk, I will introduce the following applications: (1) High-performance biosensors based on OECTs. By modifying the gate electrodes of OECTs, we have realized the detection of various type of biomolecules, such as IgG antibody, protein biomarkers and RNA. (2) OECTs based on highly oriented 2-dimensional conjugated metal-organic frameworks (2D c-MOFs) ($Cu_3(HHTP)_2$). The ion-conductive vertical nanopores formed within the 2D c-MOFs films lead to the most convenient ion transfer in the bulk and high volumetric capacitance, endowing the devices with fast speeds and ultrahigh transconductance. (3) Highly sensitive photodetectors based on perovskite solar cell-gated OECTs. The devices show ultrahigh sensitivity and fast response speeds. (4) Flexible phototransistors based on 2D c-MOFs ($Cu_3(HHTT)_2$) thin films.

Keywords: *Organic electrochemical transistors, Flexible electronics, Biosensors*

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Room TU502, Yip Kit Chuen Building,
The Hong Kong Polytechnic University,
Hung Hom, Kowloon, Hong Kong

2766 5057 - 5059
2362 2578
fs.info@polyu.edu.hk
www.polyu.edu.hk/fs

polyuscience
polyuscience
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