

# 3<sup>rd</sup> Materials Chemistry Frontiers International Symposium

5 November 2018, National University of Singapore,  
Singapore



# Program

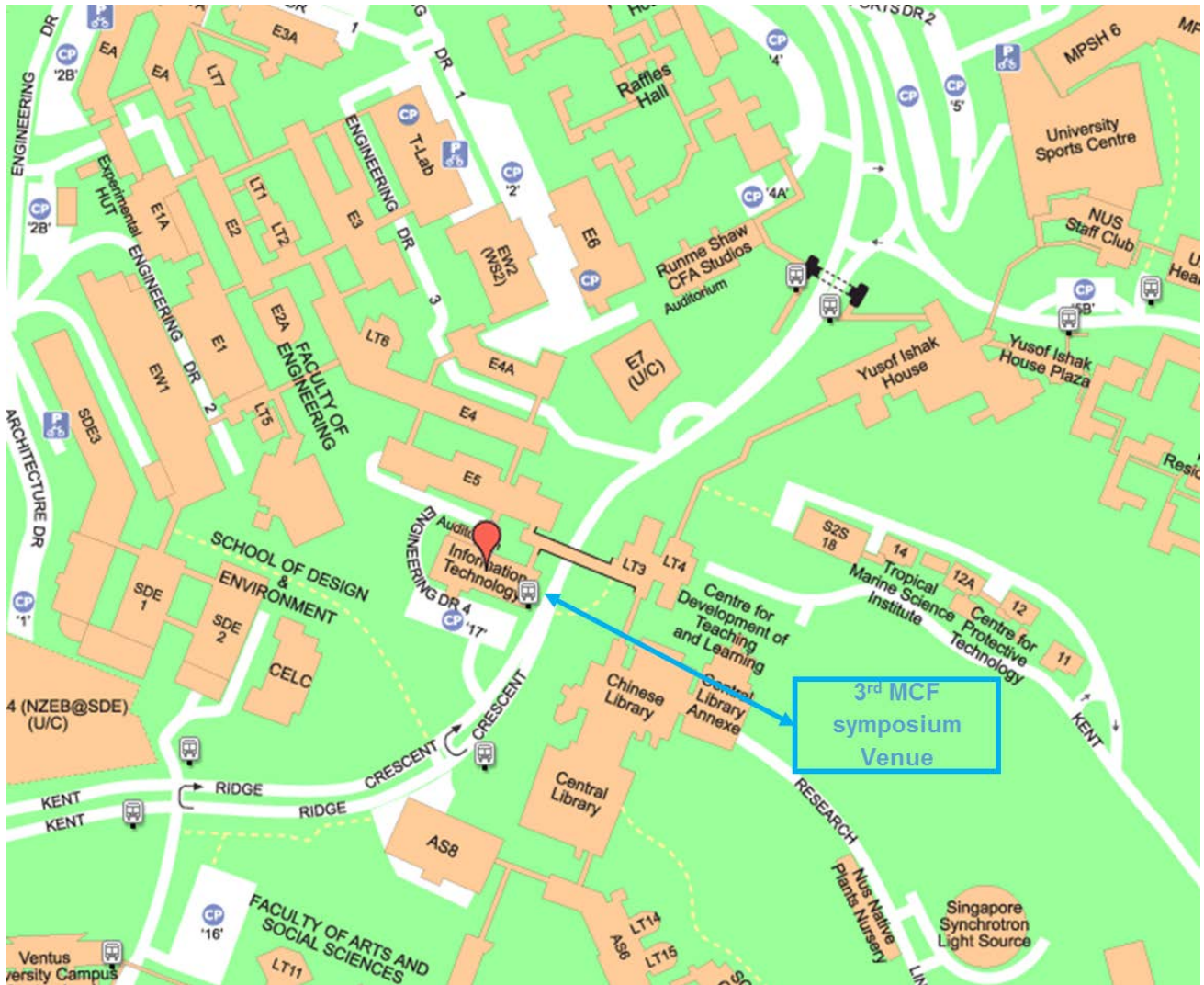
Thank you for attending the [3<sup>rd</sup> Materials Chemistry Frontiers International Symposium](#) in Singapore on 5<sup>th</sup> November!

Time	Event	Session Chair
8:50-9:00	Opening Remarks Bin Liu, National University of Singapore Wenjun Liu, Royal Society of Chemistry	
9:00-9:30	Chen-Ho Tung, Technical Institute of Physics and Chemistry, Chinese Academy of Sciences Photocatalytic Splitting of Water Based on Semiconducting QDs	Chair of Session 1  Zhen Li Wuhan University
9:30-10:00	Hua Zhang, Nanyang Technological University Phase Engineering of Novel Nanomaterials	
10:00-10:30	John Wang, National University of Singapore Transition Metal Carbides and Nitrides Nanoflakes for Electrocatalytic Energy Conversion	
10:30-10:50	Coffee & Tea (20 min)	
10:50-11:20	Pooi See Lee, Nanyang Technological University Stretchable electronics and energy conversion materials and devices	Chair of Session 2  Xiaogang Liu National University of Singapore
11:20-11:50	Shu Seki, Kyoto University Organic Functional Nanomaterials by Single Particle Triggered Linear Polymerization	
11:50-12:20	Feihe Huang, Zhejiang University Nonporous Adaptive Crystals (NACs) for Separation and Adsorption	
12:20-14:00	Lunch (100 min)	
14:00-14:30	Ling-Dong Sun, Peking University TBC	Chair of Session 3  Shu Seki Kyoto University
14:30-15:00	Xiaogang Liu, National University of Singapore Photon Upconversion in Lanthanide-doped Nanocrystals	
15:00-15:30	Xian Jun Loh, A*STAR Thermogelling Polymers – An Emerging Biomaterial for Biomedical Applications	
15:30-15:50	Coffee & Tea (20 min)	
15:50-16:20	Zhen Li, Wuhan University The Modification of the Functionality of $\pi$ -Molecules through the Structural Adjustment	Chair of Session 4  Xian Jun Loh A*STAR
16:20-16:50	Kazuo Tanaka, Kyoto University Unique Solid-State Luminescent Properties of “Flexible” Boron “Element-Blocks”	
16:50-17:20	Ben Zhong Tang, Hong Kong University of Science and Technology Clusteroluminogens: Common Materials for Uncommon Luminescence	
17:20-17:30	Closing Remarks Ben Zhong Tang, Hong Kong University of Science and Technology	

# General Information

## Meeting Venue

NUS Information Technology Computer Centre Auditorium, Level 2  
2 Engineering Drive 4, Computer Centre, Singapore 117584



## Travel

Changi airport to National University of Singapore will take about 30 min by taxi, or 100-120 min by public transportation. The nearest subway station is "Kent Ridge MRT Station", **Circle Line**

## Registration

The registration desk will open from 8:20 on 5 November.

## Program & Abstract Book

Event Program and E-Abstracts Book are available on the website (<http://rsc.li/mcfis18>) with PDF copy to download, also attached as a separate file.

**There will be printed one-page programmes available at the registration desk. Hard copy abstract books will NOT be provided on site.**

## Insurance

We advise that delegates ensure that they have adequate travel insurance arranged for their trip prior to the conference.

If you have any questions about any aspect of the event, please do not hesitate to contact us.

We look forward to welcoming you to the 3<sup>rd</sup> Materials Chemistry Frontiers International Symposium in Singapore!

*Materials Chemistry Frontiers Team*  
([MaterChemFrontiersED@rsc.org](mailto:MaterChemFrontiersED@rsc.org))





### **Chen-Ho Tung 佟振合**

*Technical Institute of Physics and Chemistry, CAS, China*

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Chen-Ho Tung is a full Professor and Member of the Chinese Academy of Sciences. He graduated from the Department of Polymer Chemistry of University of Science and Technology of China in 1963 and received his Ph.D from the Department of Chemistry of Columbia University in 1983. He is chiefly engaged in the research on organic photochemistry, particularly on photoinduced electron transfer, energy transfer and photochemical conversion in supramolecular assemblies. By using molecular aggregates, cavities and surfaces of microporous solids as “microreactors”, he successfully synthesized large-ring compounds in high yields even at high substrate concentrations. He could direct the photosensitized oxidation of alkenes selectively toward either the singlet oxygen mediated or the superoxide anion mediated products by controlling the status and location of the substrate and sensitizer molecules in the reaction media. He could photocatalyze hydrogen production from organic and inorganic protic solutions. He is the Board Member of *Photochem. and Photobiol.*, *J. Photochem. Photobiol. C: Photochem. Rev.*, and *J. Phys. Org. Chem.*. In 1992, he won a second prize of the CAS Natural Science Award. In 2003, he was granted the award of Ho Leung Ho Lee Foundation for Scientific and Technological Progress. In 2005, he received the second Prize of the National Natural Science Award. In 2008, he was granted the Asian and Oceanian Photochemistry Association Award. In 2010, he won Chinese Chemical Society - China Petroleum Chemical Co Chemical Contribution Award.



### **Hua Zhang 张华**

*Nanyang Technological University, Singapore*

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Dr. Hua Zhang obtained his B.S. and M.S. degrees at Nanjing University in China in 1992 and 1995, respectively, and completed his Ph.D. with Prof. Zhongfan Liu at Peking University in China in July 1998. He joined Prof. Frans C. De Schryver's group at Katholieke Universiteit Leuven (KULeuven) in Belgium as a Research Associate in January 1999. Then he moved to Prof. Chad A. Mirkin's group at Northwestern University as a Postdoctoral Fellow in July 2001. He started to work at Nanolnk Inc. (USA) as a Research Scientist/Chemist in August 2003. After that, he worked as a Senior Research Scientist at

## Invited Speakers

Institute of Bioengineering and Nanotechnology in Singapore from November 2005 to July 2006. Then he joined the School of Materials Science and Engineering in Nanyang Technological University (NTU) as an Assistant Professor. He was promoted to a tenured Associate Professor on March 1, 2011, and Full Professor on Sept. 1, 2013. Dr. Zhang's current research interests focus on the (crystal-)phase engineering of nanomaterials and controlled epitaxial growth of heterostructures, including the synthesis of ultrathin two-dimensional nanomaterials (e.g. metal nanosheets, graphene, metal dichalcogenides, metal-organic frameworks, covalent organic frameworks, etc.), novel metallic and semiconducting nanomaterials, novel amorphous nanomaterials and their hybrid composites, for various applications such as catalysis, clean energy, (opto-)electronic devices, nano- and biosensors, and water remediation.



**John Wang**

*National University of Singapore, Singapore*

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Professor John Wang is Professor and Head of Department of Materials Science and Engineering, National University of Singapore. He has more than 30 years of experience in education and research of functional materials and materials chemistry. His current research focuses include: energy materials and devices, 2D materials chemistry, and nanostructured materials for sustainable energy. Professor John Wang has published >400 papers in prestigious, top international refereed journals.



**Pooi See Lee**

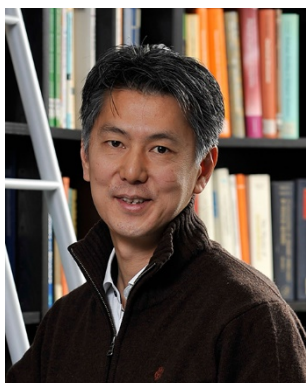
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Pooi See Lee is a full professor in the Nanyang Technological University, Singapore. She received B. Sc.(Hons) and Ph.D. degrees from the National University of Singapore. She joined the School of Materials Science and Engineering, NTU, in 2004. She was awarded the Nanyang Research Award in 2015 and National Research Foundation Investigatorship Award in 2016. Her research interests include nanomaterials for energy and

## Invited Speakers

electronics, energy conversion and storage, flexible and stretchable devices for human-machine interface.



**Shu Seki**

*Kyoto University, Japan*

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Shu Seki graduated from the University of Tokyo in 1993, and received his PhD degree in 2001 from Osaka University. He joined Argonne National Laboratory, USA in 1993, and Delft University of Technology in 2001. He was appointed as Professor of Applied Chemistry, Graduate School of Engineering, Osaka University in 2009. He was appointed as Professor of Molecular Engineering, Graduate School of Engineering, Kyoto University in 2015. His research is primarily focused on the physical chemistry of condensed matters, functional organic materials, and nanomaterials.

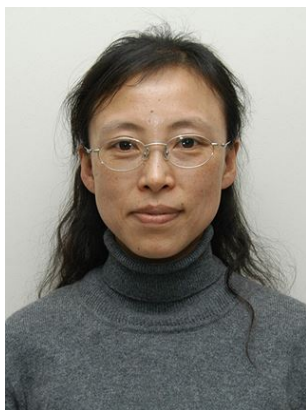


**Feihe Huang 黄飞鹤**

*Zhejiang University, China*

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Feihe Huang, born in 1973, obtained his PhD from Virginia Tech under the guidance of Professor Harry W Gibson in March 2005. Then he joined Professor Peter J Stang's group at University of Utah as a postdoctor. He is currently Qiushi Chair Professor of Zhejiang University. Awards and honors he has received include: Fellow of the Royal Society of Chemistry, Chinese Chemical Society AkzoNobel Chemical Sciences Award and Cram Lehn Pedersen Prize in Supramolecular Chemistry. His publications have been cited 10724 times with an h-index of 56. His current research interests are supramolecular polymers and pillararene supramolecular chemistry.



**Ling-Dong Sun 孙聆东**

*Peking University, China*

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Ling-Dong Sun, Professor of Chemistry, obtained her PhD from Changchun Institute of Physics, Chinese Academy of Sciences, in 1996. Following a postdoctoral fellowship at Peking University, she joined the faculty at the College of Molecular Science and Engineering, Peking University, in 1998. She worked as a visiting professor at Keio University (2001) and Kyoto University (2007). Her current research focuses on the materials chemistry and light-matter interaction studies of rare earth nanomaterials, plasmonic nanostructures, and the applications in bio-detection and imaging. Ling-Dong Sun was awarded a Research Prize for Youth Scientists, and the 10th National Award for Youth in Science and Technology, and the 2nd Grade National Award of Natural Science. And she was supported by the Distinguished Youth Funds to carry out research on lanthanide luminescent nanomaterials.



**Xiaogang Liu 刘小钢**

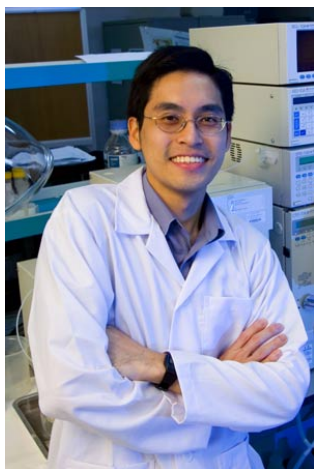
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Xiaogang Liu earned his B.E. degree (1996) in Chemical Engineering from Beijing Technology and Business University, P. R. China. He received his M. S. degree (1999) in Chemistry from East Carolina University under the direction of Prof. John Sibert and completed his PhD (2004) at Northwestern University under the supervision of Prof. Chad Mirkin. He then became a postdoctoral fellow in the group of Prof. Francesco Stellacci at MIT. He joined the faculty of the National University of Singapore in 2006. He holds a joint appointment with the Institute of Materials Research and Engineering, Agency for Science, Technology and Research. Currently, he sits as an Associate Editor for Nanoscale and serves on the editorial boards of Chemistry - An Asian Journal, Advanced Optical Materials, and Journal of Luminescence. His research encompasses optical nanomaterials and energy transfer and explores the use of luminescent nanocrystals for photocatalysis, sensing and biomedical applications.



## Invited Speakers



### **Xian Jun Loh 罗贤俊**

*Institute of Materials Research and Engineering, Singapore*

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Xian Jun Loh is a polymer chemist working in the inter-disciplinary field of biomaterials. He is the Head of the Soft Materials Department at the Agency for Science, Technology and Research's Institute of Materials Research and Engineering (A\*STAR's IMRE). He has published more than 190 papers and has been highly cited with a total of over 9800 citations, h-index of 59, and i-10 index of 139. He has over 20 patents and 6 books and has given numerous keynote and plenary lectures globally. He has received various awards including the Materials Science and Engineering C Young Researcher Award, Public Service Manager of the Year Award, Outstanding Mentor Award, Young Inventor Award, GSK Gold Medal, Lijen Industry Medal. He sits on the editorial board of numerous editorial boards of journals. His primary research interest is in applying thermogelling polymers for clinical applications.



### **Zhen Li 李振**

*Wuhan University, China*

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Zhen Li received his BSc and PhD degrees from Wuhan University (WHU) in China in 1997 and 2002, respectively, under the supervision of Professor Jingui Qin. In 2003-2004, he worked in the Hongkong University of Science and Technology as Research Associate in the group of Professor Ben Zhong Tang. In 2010, he worked in Georgia Institute of Technology in the group of Professor Seth Marder. He is currently a Full Professor at Wuhan University. He has published more than 230 papers, with an h-index of 50. His research interests are in the development of organic molecules and polymers with new structure and new functions for organic electronics and photonics.

## Invited Speakers



**Kazuo Tanaka**

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Kazuo Tanaka received his PhD degree in 2004 from Kyoto University, and worked at Stanford University, Kyoto University, and RIKEN as a postdoctoral fellow. In 2007, he moved to the Department of Polymer Chemistry, Graduate School of Engineering, Kyoto University, and in 2018, he was promoted to a Professor. His research projects especially focus on design of new functional materials based on the heteroatom-containing polymers and organic-inorganic polymer hybrids for developing optoelectronic devices and bio-related materials.



**Ben Zhong Tang 唐本忠**

*Hong Kong University of Science and Technology, China*

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Ben Zhong Tang is Stephen K C Cheong Professor of Science at the Hong Kong University of Science and Technology (HKUST). He received BS and PhD degrees from South China University of Technology and Kyoto University, respectively, and conducted postdoctoral research at University of Toronto. He joined the Department of Chemistry at HKUST in 1994. He was elected to the Chinese Academy of Sciences and the Royal Society of Chemistry in 2009 and 2013, respectively. He has been listed by Thomson Reuters as a Highly Cited Researcher in two disciplines: Chemistry and Materials Science. He received a Natural Science Award from the Chinese Government and a Senior Research Fellowship from the Croucher Foundation in 2007. His research interests include materials science, polymer chemistry and biomedical engineering.

## Photocatalytic Splitting of Water Based on Semiconducting Quantum Dots

Chen-Ho Tung,\* Li-Zhu Wu, Bin Chen

*Key Laboratory of Photochemical Conversion and Optoelectronic Materials, Technical Institute of Physics and Chemistry, the Chinese Academy of Sciences, Beijing 100190, P. R. China*

One of the best solutions for meeting future energy demands is the conversion of water into hydrogen fuel using solar energy. The splitting of water into molecular hydrogen ( $H_2$ ) and oxygen ( $O_2$ ) using light involves two half-reactions: the oxidation of water to  $O_2$  and the reduction of protons to  $H_2$ . To take advantage of the full range of the solar spectrum, researchers have extensively investigated artificial photosynthesis systems consisting of two photosensitizers and two catalysts with a Z-configuration: one photosensitizer-catalyst pair for  $H_2$  evolution and the other for  $O_2$  evolution. To achieve practical application of this strategy, the development of low-cost and robust photocatalysis systems is of great necessity. Colloidal quantum dots (QDs) of IIB-VIA semiconductors have recently appeared as an ideal choice for constructing highly efficient photocatalysts for splitting of water. This report reviews the advances our laboratory has made in the development of new systems for photocatalytic splitting of water. We constructed several assemblies of CdTe or CdSe QDs as photosensitizers with [FeFe]- $H_2$ ase mimics or transition-metal clusters as catalysts. These assemblies produced  $H_2$  in aqueous solutions photocatalytically and showed excellent activity and impressive durability in the photocatalytic reaction, suggesting that they can serve as a valuable part of an overall water splitting system. We also constructed several systems for photocatalytic oxidation of water to  $O_2$ . By assembling the above two half-reaction catalysis systems, we could carry out overall water splitting.

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## Phase Engineering of Novel Nanomaterials

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Hua Zhang

*Center for Programmable Materials, School of Materials Science and Engineering, Nanyang Technological University, 50 Nanyang Avenue, Singapore 639798, Singapore*

In this talk, I will summarize the recent research on the (crystal-)phase engineering of nanomaterials in my group. It includes the first-time synthesis of hexagonal-close packed (*hcp*) Au nanosheets (AuSSs) on graphene oxide, the first-time synthesis of 4H hexagonal phase Au nanoribbons (NRBs), the synthesis of crystal-phase heterostructured 4H/*fcc* Au nanorods, and the epitaxial growth of metals with novel phases on the aforementioned Au nanostructures. In addition, the first-time synthesis of 1T'-MoS<sub>2</sub> and 1T'-MoSe<sub>2</sub> crystals have been achieved. Moreover, the phase transformation of transition metal dichalcogenide nanomaterials during our developed electrochemical Li-intercalation method will also be introduced. Interestingly, the lithiation-induced amorphization of Pd<sub>3</sub>P<sub>2</sub>S<sub>8</sub> is also achieved. Currently, my group focuses on studies of (crystal) phase-based properties and applications in catalysis, surface enhanced Raman scattering, waveguide, photothermal therapy, chemical and biosensing, clean energy etc., which we believe are unique and very important not only in fundamental studies, but also in practical applications. Importantly, the concepts crystal phase heterostructures and hetero-phase nanomaterials are proposed.



## Transition Metal Carbides and Nitrides Nanoflakes for Electrocatalytic Energy Conversion

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John Wang\*, Zongkui Kou

*Department of Materials Science and Engineering,  
National University of Singapore 117574, Singapore.*

2D transition metal carbides and nitrides in nanoflake forms are offering exponentially increasing opportunities for both fundamental science and diverse technological applications, because of their unique physicochemical and catalytic properties, which are absent in their bulk counterparts and other dimensional nanostructures. Specially, 2D layered transition metal carbides and nitrides have been widely studied recently as a group of fascinating candidates for energy storage and conversion, owing to their versatile chemistry that allows for tuning of various electrochemical properties. We have been working on 2D transition metal carbides and nitrides ranging from 2D nanocrystals into 2D nanoflakes, which offer highly active and stable electrocatalysis for energy conversion due to the mixed advantages of nano-morphologies and layered structures. We have developed a general and facile bottom-up strategy for controlled fabrication of these 2D transition metal carbides and nitrides, where the large group of 2D nanoflakes thus synthesized are of particular interest and they are demonstrated to be among the outstanding materials for efficient energy conversion. In this talk, we will discuss the rapid and fascinating advances of 2D nanoflakes of transition metal carbides and nitrides that have been successfully developed in our lab.

## **Stretchable Electronics and Energy Conversion Materials and Devices**

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Pooi See Lee

*School of Materials Science and Engineering, Nanyang Technological University, Singapore*

The emergence of stretchable and deformable devices is driven by the need of free-form properties for conformable and wearable applications. To realize these needs, approaches to fabricate flexible and stretchable devices have embraced extensive exploitation of materials for active responsive coatings and structural modifications of the conventional rigid substrates. In this talk, I will discuss our recent progress in creating free-form, shapeable, flexible wearable electronics and energy devices. We have fabricated wearable energy harvestors using textiles with coatings that control surface properties to convert mechanical energy into power output. The wearable textile energy scavengers could harvest energy from contact mode based on triboelectric. Stretchable and transparent energy harvestors have been attained using elastomeric composites and hydrogel, allowing them to be mounted onto skin or machine. In addition, extremely stretchable and self-healable strain sensors that could monitor strain, flexion and twist deformations are also realized. Progresses on stretchable energy storage and stretchable electrochromics will also be discussed.

## Organic Functional Nanomaterials by Single Particle Triggered Linear Polymerization

Shu Seki

*Department of Molecular Engineering, Kyoto University, Nishikyo-ku, Kyoto 615-8510, Japan*

Low dimensional nanomaterials with precisely controlled sizes (0D nanoparticles, 1D nanowires, nanorods, nanoribbons, etc.) have been demanded highly in recent years particularly in nanoelectronics, nanomechanics, and biomedical fields. Although notable methods to grow nanowires by self-assembly are beautiful, there is an indispensable drawback to struggle and find out specific conditions appropriate for each system. In this sense, universal techniques to fabricate such nanowires from various organic materials have been thirsted for the further progress of the related research field. Here we report one of the promising and facile methodologies to give quantitatively the nanowires with controlled geometrical parameters. In this method, referred to as “Single Particle Nanofabrication Technique (SPNT)” and/or “Single Particle-Triggered Linear Polymerization (STLiP)”, organic thin films on a supporting substrate were irradiated with high-energy charged particles accelerated by particle accelerators. Each particle penetrates from the top of the films to substrate with gradually releasing the kinetic energy along its trajectory (ion track), generating reactive intermediates such as radical species that eventually induces propagation reactions. The resulting polymerized products were integrated into nanowires having uniform diameter and length that can be isolated via development with appropriate organic solvents. The widely applicable nature of SPNT/STLiP have been demonstrated to provide electronic conductive materials,<sup>1</sup> biological sensing materials,<sup>2,3</sup> drug delivery platforms,<sup>4</sup> nano-actuators,<sup>5,6</sup> catalysts,<sup>7</sup> etc., thus SPNT/STLiP opens a new door to access a number of functional nanowires and their assembly.

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## Nonporous Adaptive Crystals (NACs) for Separation and Adsorption

Feihe Huang

Department of Chemistry, Zhejiang University, Hangzhou 310027, P. R. China

In the chemical industry, distillation is a very important method to purify chemicals. In fact, distillation takes about 10-15% of global energy consumption. This is equal to 100 million tons of carbon dioxide emissions and 4 billion dollars in energy costs annually. Therefore, it is necessary to develop energy-saving approaches to purifying chemicals. For this purpose, adsorption and separation based on porous materials have been widely investigated. There are two main types of porous materials. At macromolecular level, we have zeolites, MOFs, and COFs. They are crosslinked organic and inorganic polymer networks. At molecular level, we have porous organic cages or POCs. In this talk, I will introduce a novel kind of solid materials for adsorption and separation, nonporous adaptive crystals (NACs), which function at the supramolecular level.<sup>1</sup> They are nonporous in the initial crystalline state, but the intrinsic or extrinsic porosity of the crystals along with a crystal structure transformation is induced by preferable guest molecules. Unlike solvent-induced crystal polymorphism phenomena of common organic crystals that occur at the solid-liquid phase, NACs capture vaporized guests at the solid-gas phase. Upon removal of guest molecules, the crystal structure transforms back to the original nonporous structure. I will focus on the discussion of pillararene-based NACs for adsorption and separation and the crystal structure transformations from the initial nonporous crystalline state to new guest-loaded structures during the adsorption and separation processes. Compared with traditional porous materials, NACs of pillararenes have several advantages. First, their preparation is simple and cheap and they can be synthesized in large-scale to meet practical demands. Second, pillararenes have better chemical, humid and thermal stability than crystalline MOFs, COFs and POCs, which are usually constructed based on reversible chemical bonds. Third, pillararenes are soluble in many common organic solvents, which means that they can be easily processed in solution. Fourth, their regeneration is simple and they can be reused many times with no decrease in performance. It is expected that this kind of materials will not only exert significant influence on scientific research, but also show practical applications in the chemical industry.

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## A Multi-shell Game to Enrich the Luminescence of Lanthanide Nanocrystals

Ling-Dong Sun,\* Hao Dong, Chun-Hua Yan

*Beijing National Laboratory for Molecular Sciences, State Key Laboratory of Rare Earth Materials Chemistry and Applications, College of Chemistry and Molecular Engineering, Peking University, Beijing 100871, China*

Light emission from lanthanide nanocrystals, ranged from ultraviolet to visible and even the near infrared, are attractive for a broad field of photon conversion applications. Efficient tailoring of the lanthanide emissions, *i.e.* intensity, selectivity and lifetime, is of great significance for extended applications. We presented facile and effective strategies to enrich the upconversion emission by engineering core/shell structures with precisely tuning the composition and thickness of the shell. And energy transfer localized in nanodomain benefits to tailor the emission of each shell part without cross interference, and orthogonal excitation and emission was demonstrated. The nanocrystals show great promise for displays, multiplex labels and *in vivo* bioimaging applications.

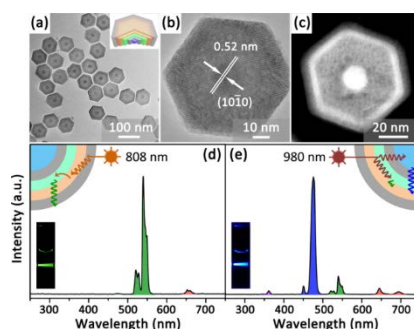


Figure 1. Orthogonal excitation and emission from lanthanide nanocrystals.

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## Photon Upconversion in Lanthanide-doped Nanocrystals

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Lanthanide-doped nanoparticles exhibit unique luminescent properties, including a large Stokes shift, a sharp bandwidth of emission, high resistance to optical blinking, and photobleaching. Uniquely, they can also convert long-wavelength stimulation into short-wavelength emission. These attributes offer the opportunity to develop alternative luminescent labels to organic fluorophores and quantum dots. In recent years, researchers have taken advantage of spectral-conversion nanocrystals in many important biological applications, such as highly sensitive molecular detection and autofluorescence-free cell imaging. With significant progress made over the past several years, we can now design and fabricate nanoparticles that display tailorable optical properties. In particular, we can generate a wealth of color output under single-wavelength excitation by rational control of different combinations of dopants and dopant concentration. By incorporating a set of lanthanide ions at defined concentrations into different layers of a core-shell structure, we have expanded the emission spectra of the particles to cover almost the entire visible region, a feat barely accessible by conventional bulk phosphors. In this talk, I will highlight recent advances in the broad utility of upconversion nanocrystals for multimodal imaging, bio-detection, display and photonics.

## **Thermogelling Polymers – An Emerging Biomaterial for Biomedical Applications**

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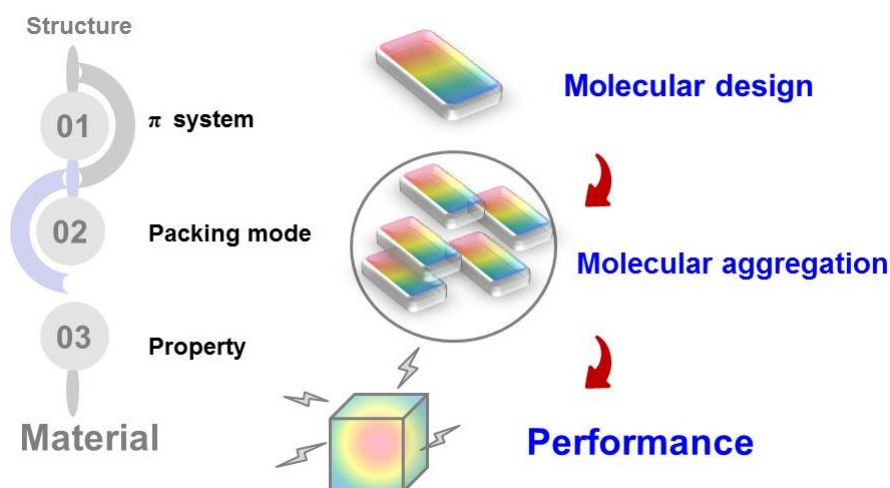
Thermogelling polymers are a unique class of materials that have the ability to undergo a sol-to-gel transition when the temperature of the solution is raised. This change is reversible and has been the subject of intense research in the last decade. These materials have been used for drug delivery, gene delivery and tissue engineering. New design strategies for thermogelling polymers have emerged in recent years. The properties of these materials are vastly different from their covalent counterparts and the exciting developments are summarized in this talk. I will also provide updates on new thermogels as well as new in vivo results on drug delivery and tissue engineering using these thermogels.

## The Modification of the Functionality of $\pi$ -Molecules through the Structural Adjustment

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To construct  $\pi$ -molecules with different structures is one of the key points in the research field of opto-electronic materials. In many cases, the molecular structure not only affects the intramolecular  $\pi$ -conjugation, but also the intermolecular  $\pi$ - $\pi$  stacking, to result in the different functionalities. In this talk, some typical examples will be presented to partially demonstrate the interesting different properties with minor or even ignorable structural difference.



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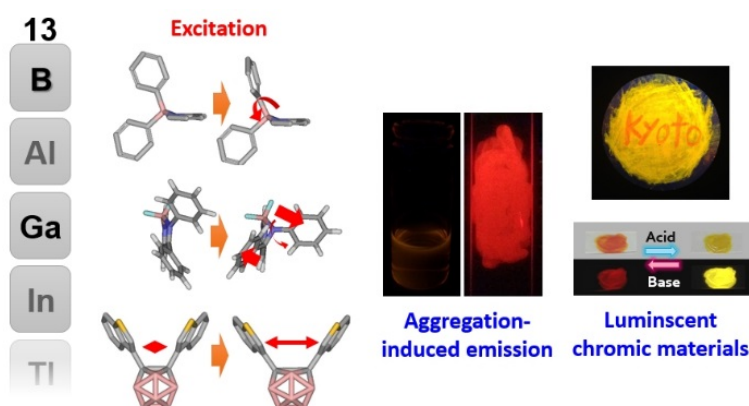


## Unique Solid-State Luminescent Properties of “Flexible” Boron “Element-Blocks”

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Organoboron complexes are a versatile “element-block”, which is defined as a minimum functional unit composed of heteroatoms, for developing advanced opto-electronic devices because of their superior properties such as light absorption property, emission, and electron-carrier ability.<sup>1</sup> However, their emissions in the solid states were usually spoiled by undesired intermolecular  $\pi$ - $\pi$  stacking interaction, called as aggregation-caused quenching (ACQ) effects. Therefore, applications of organoboron complexes in the solid state are still limited by the ACQ effects. Especially, in order to improve conversion efficiencies in the EL devices, ACQ is one of critical problems to be solved. Aggregation-induced emission (AIE) is a key phenomenon for overcoming the ACQ effect and obtaining highly-efficient light-emitting solid materials. We have found that ACQ-presenting organoboron dyes composed of the  $\beta$ -diketonate structure can be transformed to the AIE-active dyes by replacing the oxygen atoms in the  $\beta$ -diketonate ligand to nitrogen to form the ketoiminate or diiminate structures. According to quantum calculation, it was proposed that the nitrogen-replaced complexes should potentially show large degree of structural relaxation in the excited state. Based on this fact, the series of AIE-active conjugated polymers were able to be obtained. From these results, we regarded as these flexible organoboron complexes as an AIE-inducible “element-block”.<sup>2</sup> In this presentation, development of the AIE-active conjugated materials including multi-component molecules and polymers based on AIE-inducible “element-blocks” will be demonstrated. Moreover, we also mention the regulation of AIE properties by the external stimulus. It was found that AIE-active boron complexes often showed luminescent chromism triggered by temperature changes, mechanical stresses and vapor fuming. The mechanisms and design strategies for obtaining AIE-active molecules having various types of luminescent chromic properties will be explained in the presentation.



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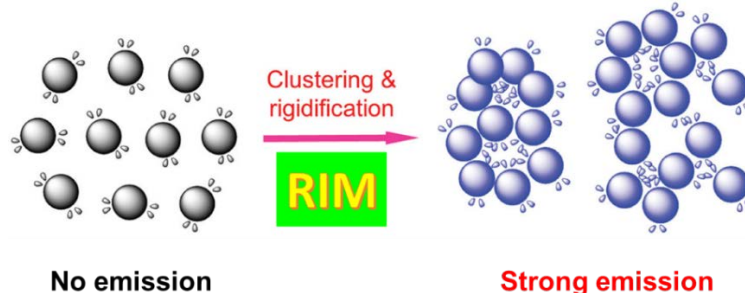
## Clusteroluminogens: Common Materials for Uncommon Luminescence

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Fluorescence, as a gift from nature, it plays an important role in our colourful world. So far, it is believed that the development of highly efficient fluorophores relies largely on the high electronic conjugation. However, some common materials, such as peptide, polysaccharide and some artificial polymers, can emit visible and bright emission but without any aromatic conjugation. Although this phenomenon has been observed for a long time, it has not attracted much attention as the underlying mechanisms were still unclear and this kind of materials was hard to be utilized as fluorescent materials. Recently, our group has developed several non-conjugated systems, such as poly(maleic anhydride) and polypeptides, which show bright and longer-wavelength emission. In order to eliminate the interference of impurities from these polymers, small molecules of oligopeptides, amino acid and tetraphenylethane have been designed and synthesized. The resultant pure molecules still exhibited strong and visible emission. We termed this kind of materials as “clusteroluminogens” and the unconventional emission as “clusteroluminescence”. Then, further experiments and theoretical calculation suggested that the through-space conjugation played an important role in the clusteroluminescence. Meanwhile, hydrophobic effect and dipolar interaction serve as the influential force to facilitate the formation of cluster in the process of aggregation. We believe some other effects also make contributions to the clusteroluminescence, and these potential mechanisms deserve our further exploration. In terms of application, the clusteroluminogens always show excellent biocompatibility, which may find applications as bioimaging or tracking probes. Meanwhile, as the inter- or intramolecular distance is sensitive to the mechanical force, so smart mechanically responsive materials can be developed in the future study.<sup>1-5</sup>



**Figure 1.** Schematic illustration of the working mechanism of clusteroluminescence.

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