香港中文大學理學院
Faculty of Science, The Chinese University of Hong Kong

SCIENCE FACULTY
Research Day 2015

Date: 3 June 2015 (Wednesday)
Time: 9:00a.m. - 12:35p.m.
Venue: L2, Science Centre, CUHK

Event Programme

09:00 - 09:15 Opening Ceremony

09:15 - 10:15 **Aggregation-Induced Emission: Together We Shine, United We Soar!**

Professor Tang Ben Zhong

Chair Professor, Department of Chemistry,
Division of Life Science,
The Hong Kong University of Science and Technology

10:15 - 10:30 Tea Break

10:30 - 11:30 **Redox Processes & Design Considerations for Li-Oxygen and Li-Sulfur Batteries**

Professor Lu Yi-Chun

Assistant Professor
Department of Mechanical and Automation Engineering
The Chinese University of Hong Kong

11:30 - 12:30 **Copper-Based Chalcogenide Compound Semiconductors for Photovoltaic Applications**

Professor Xiao Xudong

Professor, Department of Physics
Institute of Environment, Energy and Sustainability
The Chinese University of Hong Kong
Shenzhen Institute of Advanced Technology, CAS

12:30 - 12:35 Event Closing

卓越研究

Excellence in Research

The Faculty of Science is proud to be the home of more than a hundred dedicated scientists conducting cutting-edge research in various areas of science. Our staff and students remain committed to our Faculty's Mission in expanding the frontiers of human knowledge, aiming to build a better world for the future.

理學院擁有一支充滿熱誠的科研隊伍，逾百名科學家在多個領域進行尖端研究。我們的教職員與學生將秉承一貫的宗旨，擴展人類知識領域，為未來建立一個更美好的世界。

Message from the Dean of Science

Welcome to the Science Faculty Research Day 2015. The highlight of this year's Research Day is interdisciplinary collaboration within energy-related research. The Faculty's Research Day is certainly an exquisite occasion for stimulating discussions and sharing expertise. We see an incredible opportunity for assembling researchers, who are passionate about discovering collaborative and innovative solutions in response to uprising global energy and sustainability challenges.

Solving interdisciplinary challenges is our life-long mission, and the ability to take vibrant roles to explore new solutions to solve daily problems brings huge advancement to society. In the spirit of the Faculty's mission to encourage collaboration in interdisciplinary energy research, it gives us great honour to present to you three researchers who are experts in the field of energy and environmental conservation. First of all, Professor Tang Ben Zhong, Chair Professor, Department of Chemistry, Division of Life Science of the Hong Kong University of Science and Technology, is a world-renowned chemist, who was elected to the Chinese Academy of Sciences in 2009. Professor Tang has been listed by Thomson Reuters as a Highly Cited Researcher in both the categories of Chemistry and Materials Science (2014). Secondly, the Faculty has invited Professor Lu Yi-Chun, Assistant Professor, Department of Mechanical and Automation Engineering of The Chinese University of Hong Kong. Professor Lu was the recipient of the HKSAR Research Grants Council Early Career Award (2014). Her research interest centers on developing fundamental understanding and materials design principles for clean energy storage and conversion. Last but not the least, we have invited Professor Xiao Xu-Dong, Department of Physics and Institute of Environment, Energy and Sustainability of The Chinese University of Hong Kong and Shenzhen Institute of Advanced Technology, CAS. Professor Xiao is a recipient of the Outstanding Young Scientist Fund, Chinese National Science Foundation (2014). His expertise in photovoltaic solar energy has contributed a lot to surface science, nano-science and renewable energy science and engineering.

It is our pleasure to have a panel of three distinguished speakers with us today. I hope this event will provide you with a platform to exchange scientific ideas and inspire new research collaboration.

Yours sincerely,

Henry N.C. Wong

Presentation Abstracts and Speaker Introductions

Professor Tang Ben Zhong

Chair Professor, Department of Chemistry
Division of Life Science
The Hong Kong University of Science and Technology

Professor Tang Ben Zhong (唐本忠) received BS and PhD degrees from South China University of Technology and Kyoto University, respectively. He conducted postdoctoral research at University of Toronto. He joined Department of Chemistry at the Hong Kong University of Science and Technology as an assistant professor in 1994 and was promoted to chair professor in 2008. He was elected to the Chinese Academy of Sciences in 2009.

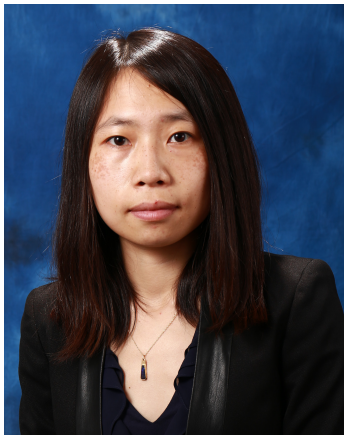
He has published more than 700 papers. His work has been cited over 20,000 times, with an h-index of 86. He has been listed by Thomson Reuters as a Highly Cited Researcher in the categories of Chemistry and Materials Science. He has opened up a new area of research on aggregation-induced emission, which was ranked as one of the Top 100 Research Fronts by Thomson Reuters in 2013. He received a State Natural Science Award from Chinese Government in 2007. He is serving as Editor of *Advances in Polymer Science* (Springer) and Associate Editor of *Polymer Chemistry* (RSC).

Aggregation-Induced Emission: Together We Shine, United We Soar!

Aggregation-induced emission (AIE) refers to a photophysical phenomenon shown by a class of luminogenic materials that are non-emissive when they are genuinely dissolved in good solvents as molecules but become highly luminescent when they are clustered in poor solvents or solid state as aggregates. In this talk, I will present a brief summary on the recent progresses in the area of AIE research. We have conducted mechanistic analyses of AIE processes and unified the restriction of intramolecular motions (RIM) as the main cause for the AIE effects. We have derived RIM-based molecular engineering strategies for the design of new AIE luminogen (AIEgen) systems. Typical examples of the newly developed AIEgen systems and their high-tech applications as optoelectronic materials, chemical sensors and biomedical probes will be presented and discussed.

Professor Lu Yi-Chun

Assistant Professor
Department of Mechanical and Automation Engineering
The Chinese University of Hong Kong

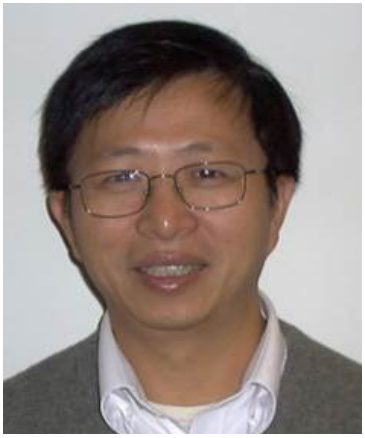


Dr. Lu Yi-Chun (盧怡君) received her B.S. degree in Materials Science & Engineering from the National Tsing Hua University, Taiwan, in 2007. She received her Ph.D. degree in Materials Science & Engineering from the Massachusetts Institute of Technology, Cambridge, USA in 2012. After her graduate study, she worked as a Postdoctoral Fellow in the Department of Chemistry at the Technische Universität München, Germany. She was the recipient of the Hong Kong SAR Research Grants Council Early Career Award (2014), European Materials Research Society Graduate Student Award (2011) and Electrochemical Society Battery Division Student Research Award (2010). She is currently an Assistant Professor in the Department of Mechanical and Automation Engineering at The Chinese University of Hong Kong. Dr. Lu's research interest centers on developing fundamental understandings and material design principles for clean energy storage and conversion.

Redox Processes & Design Considerations for Li-Oxygen and Li-Sulfur Batteries

Lithium-oxygen ($Li\text{-}O_2$) and lithium-sulfur (Li-S) batteries have received extraordinary research attention owing to high gravimetric energy density and element abundance. Fundamental understanding of the electrochemical redox processes in nonaqueous $Li\text{-}O_2$ and Li-S batteries is critical for developing rational designs of electrode materials and battery devices. We exploit various spectroscopic techniques (*in situ* and *ex situ*) coupled with single-cell electrochemical characterizations to probe the $Li\text{-}O_2$ and Li-S reaction mechanism and reaction kinetics. The chemical natures of the reaction products and the correlation between reaction processes and reaction potentials will be discussed. In addition, we will discuss the $Li\text{-}O_2$ recharge mechanisms, address major discrepancies regarding $Li\text{-}O_2$ charge kinetics and discuss the role of catalyst. In light of these findings, we will summarize common mechanistic aspects in $Li\text{-}O_2$ and Li-S redox processes and implications for $Li\text{-}O_2$ and Li-S batteries.

Professor Xiao Xudong



Professor, Department of Physics
Institute of Environment, Energy and Sustainability
The Chinese University of Hong Kong
Shenzhen Institute of Advanced Technology, CAS

Professor Xiao Xudong (肖旭東) received his Ph. D. degree in physics at the University of California at Berkeley in 1992. After his further training in the Lawrence Berkeley National Laboratory as a post doctorate fellow, he joined the Department of Physics at the Hong Kong University of Science and Technology in 1994, where he directed his research in surface science and nano science with both optical techniques and scanning probe microscopies. In 2007, Prof. Xiao moved to the Chinese University of Hong Kong and branched his research to photovoltaic solar energy. He is a recipient of the Outstanding Young Scientist Fund, Chinese National Science Foundation, 2004 and an awardee of "Thousand Talents Scheme", China, 2010. Prof. Xiao has made various contribution to surface science, nano science and renewable energy science and engineering, including inventing linear optical diffraction method for detecting submonolayer surface diffusion, discovery of room temperature "ice-like" water structure, developing quantitative tribology at nanoscales, experimentally demonstrating quantum capacitance of nano-junctions, discovery of pseudogap state in the nano-island of conventional superconductors, and successful fabrication of the best efficiency Cu(InGa)Se_2 solar cell in Great China Region. In addition to the lab device fabrication and physics study of various thin film solar cells, Prof. Xiao is also leading a team to develop instrumentation and production lines for manufacture Cu(InGa)Se_2 thin film solar panels in China.

Copper-Based Chalcogenide Compound Semiconductors for Photovoltaic Applications

In the 21st century, we are facing increasingly serious challenges in energy and environment. As a mature technology photovoltaic solar electricity is a perfect solution to meet these challenges. The successful deployment of solar electricity will not only overcome the energy and environment crisis but also sustain a healthy economic and civilizational development.

In photovoltaic technology, production cost is the one of the most important issues that impedes its global-scale application today. In this talk, I will present two copper-based chalcogenide compound semiconductors, the well-known $CuInGaSe_2$ (CIGS) and the emerging Cu_2ZnSnS_4 (CZTS), as photovoltaic absorber materials that can reduce production cost. Through the discussion on their crystal structures, electronic properties of grain and grain boundary, and device structure and fabrication, I will demonstrate the advantages for their adaption in photovoltaic application. While already successful, the current challenges faced by the CIGS technology and its large-scale application will be addressed. The present status and the challenges for the emerging CZTS will also be presented. In the end, the possibility to hybrid CIGS with the emerging perovskite solar cell technology will also be discussed.

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