THE HONG KONG POLYTECHNIC UNIVERSITY 香港理工大學

INSTITUTE OF TEXTILES & CLOTHING 紡織及製衣學系

DEPARTMENT OF APPLIED PHYSICS 應用物理學系

# Inorganic Nanoparticles for Organic Solar Cells


## Julia W. P. Hsu

*University of Texas at Dallas*


**Date:** 26 January, 2017
**Time:** 10:00 a.m. - 11:00 a.m.
**Venue:** ST 602 (4D Theatre), POLYU


**Abstract:**

Organic solar cells represent promising technology for low cost, lightweight solar energy harvesting. The inexpensive, large-area manufacturing methods, e.g. roll-to-roll printing, favor solution deposition techniques. Due to the blended nature of the organic active layer in an OPV device, carrier transport layers at the active layer/electrode interface are necessary to set up the electric field across the device to extract electrons and holes. In addition to appropriate work function, ideal transport layer materials should also have a large bandgap, be reasonably conductive and carrier selective. Furthermore, to facilitate forming a uniform film on top of the organic active layer, solvent compatibility and low (room)-temperature post processing requirements need to be considered. Metal oxides offer a wide range of electrical and optoelectronic properties and can be synthesized in nanoparticles for solution processing. Using nanoparticle suspensions to form films enable us to separate synthesis and processing requirements, resulting in optimized properties. I will discuss solution synthesis of ZnO, MoOx, WOx, NiOx, CoOx, CuGaO2 and CuCrO2 nanoparticles for charge transport layer applications in OPVs. I will also discuss recent results of CuCrO2 sol gel films made from combustion synthesis at low temperature and their performance as HTLs in OPVs.


**Biography:**

Julia W. P. Hsu is a Professor of Materials Science and Engineering in the Erik Jonsson School of Engineering and Computer Science of the University of Texas at Dallas (UT Dallas) and holds a Texas Instruments Distinguished Chair in Nanoelectronics. She received her BSE degree from Princeton University and M.S. and Ph.D. degrees from Stanford University. Prior to UT Dallas, she was Assistant and Associate Professor at the University of Virginia Physics Department (1993-1999), Member of Technical Staff at Bell Labs (1999-2003), and Principal Member of Technical Staff at Sandia National Laboratory (2003-2010). Hsu is a winner of a Hertz Foundation Fellowship (1985), the American Physical Society (APS) Apker Award (1986), a National Science Foundation Young Investigator Award (1993), and a Sloan Foundation Research Fellowship (1994). She was elected to Fellow of APS in 2001, American Association for the Advancement of Science (AAAS) in 2007, and Materials Research Society (MRS) in 2011. She was a co-chair for the Fall 2004 MRS meeting. She served as a Member-at-Large on the APS Division of Materials Physics Executive Committee (2004-2007), on the MRS Board of Directors (2005-2007), the Treasurer and Chair of Operation Oversight Committee for the MRS (2006-2007), chaired the MRS International Relations Committee from 2010-2011, and was on the Editorial Board of Solid State Communications. She currently serves on MRS Meeting Assessment Subcommittee. She has served on many external advisory committees, including Princeton University Center for Complex Materials, University of Massachusetts Energy Frontier Research Center, and Department of Energy Experimental Program to Stimulate Competitive Research (EPSCoR) at Idaho State University. She has published approximately 180 peer-reviewed journal papers and holds 5 patents.

# Low Dimensional Metal Chalcogenide Semiconductors: Design, Synthesis and Applications


## Jun He

*Chinese Academy of Sciences*


**Date:** 26 January, 2017
**Time:** 11:00 a.m. - 12:00 p.m.
**Venue:** ST 602 (4D Theatre), POLYU


**Abstract:**

While scaling the dimension(s) of semiconductors down to nanoscale, novel properties, such as ultrahigh specific surfaces and strong electrostatic tunability, will show up. Among the various low dimensional structures, two-dimensional (2D) semiconductors may lead the next generation of electronics and optoelectronics due to their compatibility with traditional micro-fabrication techniques and flexible substrates. Up to now, both layered and non-layered materials have been demonstrated to present in 2D configuration. For the former, even though big breakthroughs, especially on transition metal dichalcogenides (TMDCs), have been made, more systematical and deeper studies are needed. In addition, inspired by the success of 2D layered materials and the fact that many materials with significant functions have non-layered crystal structures, 2D non-layered materials have attracted increasing attentions. Based on above challenges and motivations, our research focuses on the design, synthesis and applications of low dimensional metal chalcogenides semiconductors. In this talk, I will present our recent progress on the following two aspects:

(1) 2D layered metal chalcogenide semiconductors: controllable synthesis, properties, electronic and optoelectronic applications. [1-10]

(2) Van der Waals epitaxial growth, electronic and optoelectronic properties of 2D non-layered materials, such as Te, Pb1-xSnxSe, and PbS nanosheets. [11-21]


**Biography:**

Prof. Jun He received his PhD in Semiconductor Physics from the Institute of Semiconductors, Chinese Academy of Sciences (CAS), in 2003. Then he joined Applied Physics Department of Technische Universiteit Eindhoven, Netherlands, as a postdoctoral fellow. From 2005 to 2007, he worked as a postdoctoral fellow at Material Department of University of California, Santa Babara, USA. From 2007 to 2010, he worked at California NanoSystem Insitute (CNSI), University of California, Los Angeles, USA, as a research scientist. He joined the "100-Talents" Program of CAS in Nov. 2010 and became a Full Professor of NCNST. Prof. He got the award of the National Science Fund for Distinguished Young Scholar in 2016.

***ALL ARE WELCOME !***