The Hong Kong Optical Engineering Society 香港光學工程學會

香港中文大學 The Chinese University of Hong Kong

HKOES 2015 Quarter 2 - COLLOQUIUM ON

Optoelectronics in Organic and Metallic Nanostructures

Date : *Saturday 13th June, 2015*	**Time :** *2:00 pm to 5:00 pm*
Address :	*Room WMY-501, Wu Ho Man Yuen (WMY) Building, The Chinese University of Hong Kong, Shatin, New Territories, Hong Kong*
Fee :	*Free of charge for HKOES members. For non-members, please reserve a seat in advance by emailing HKOES_EVENTS@YAHOO.COM*
Seats :	*25 seats (advance reservation is required on a first-come-first-serve basis)*
Language :	*Mainly in English*

Introduction:

The primary objective of these HKOES colloquiums is to provide an informal platform for scholars and industrial experts to present their ideas, papers; and have discussion on specific topics related to Optical Engineering.

This Q2 colloquium focuses on recent advances in nano-structured materials that have been shown to be extremely useful for solar energy harvesting, organic electronics and optofluidics. With the contents covering properties of nano-materials as well as latest research results, the talks are highly informative to optics professionals who are exploring opportunities in new interdisciplinary areas.

All ARE WELCOME

Agenda:

2:00 – 2:10 pm	***Opening Remarks***	***Dr. Jeremy Chang*** *Chairman, HKOES* *Managing Director, Edmund Optics China*
2:10 – 2:45 pm	***The Path to High Efficiency Perovskite-based Photovoltaic Cells***	***Dr. Charles Surya*** *Clarea Au Endowed Professorship in Energy, Microelectronics, Optoelectronics, Department of Electronic and Information Engineering, Polytechnic University of Hong Kong*
2:45 – 3:20 pm	***Organic and Nanostructured Optoelectronic Devices***	***Dr. Ni Zhou*** *Assistant Professor, Department of Electronic Engineering, Chinese University of Hong Kong*
3:20 – 3:40 pm	***Coffee Break***	
3:40 – 4:15 pm	***Photovoltage Loss in Excitonic Solar Cells***	***Dr. Stephen Sai-Wing Tsang*** *Assistant Professor, Department of Applied Physics & Materials Science, City University of Hong Kong*
4:15 – 4:50 pm	***Plasmonics of Random Metallic Nano-islands - Nano-optical-trapping and Optofluidics***	***Dr. Aaron Ho-Pui Ho*** *Vice Chairman, HKOES* *Professor, Department of Electronic Engineering, Chinese University of Hong Kong.*
4:50 – 5:00 pm	***Closing Remarks***	***Dr. Jeremy Chang*** *Chairman, HKOES* *Managing Director, Edmund Optics China*

1. ***Becoming a HKOES Member*** *: To join our future HKOES activities, please email directly to JCHANG@EDMUNDOPTICS.CN*

Organizers :

Supporting Organizations :

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SPEAKERS & ABSTRACTS

"The Path to High Efficiency Perovskite-based Photovoltaic Cells"

Dr. Charles Surya
Clarea Au Endowed Professorship in Energy, Microelectronics, Optoelectronics
Department of Electronic and Information Engineering
Polytechnic University of Hong Kong

Abstract
A major scientific breakthrough has been made, over the past several years, in the field of photovoltaics with the emergence of organo-metallic perovskite as the absorber material. The superior physical properties of this class of materials such as the strong light harvesting capability over a broad region of visible light spectrum, extremely long carrier diffusion lengths, broadly tunable bandgaps, good crystallinity and high carrier mobility have satisfied most of the requirements for fabricating high performance solar cells. It is widely acclaimed that the perovskite-based photovoltaic cells (PVCs) offer the promise of a breakthrough for the next-generation solar devices and thereby challenges the continued dominance of the field by silicon-based PVCs. In this tutorial an overview of the state-of-the-art perovskite-based solar cells will be presented followed by a discussion of recent investigations by our group on defect engineering in the perovskite materials. In particular, we will present experimental results on post-deposition treatment of the device in oxygen ambient on the material properties as well as the photovoltaic performances of the devices. Our results demonstrate substantial reduction in the trap density in the material resulting in significant enhancement of in the power conversion efficiency of the devices.

Biography
Charles Surya received his PhD in Electrical Engineering from the University of Rochester. His main research interests includes growth and characterization of semiconductor materials and devices; investigation of optoelectronic devices including photovoltaic devices and photodetectors; and the study of fluctuation phenomena in semiconductor devices. From 2007 to 2010 he served as the Associate Dean of the Faculty of Engineering. From 2010 to 2012 he served as the Acting Dean of the Faculty of Engineering. Since 2013 he was appointed Clarea Au Endowed Professor in Energy at the Department of Electronic and Information Engineering and Leader of the Thin-Film Optoelectronics Research Group. Dr. Surya served as the Chairman of the IEEE Electron Devices Society, Hong Kong Chapter, in 1997 and 2013. He is currently serving as the Chair of the Optoelectronic Devices Technical Committee of IEEE Electron Devices Society and an editor of the Journal Electron Devices Society.

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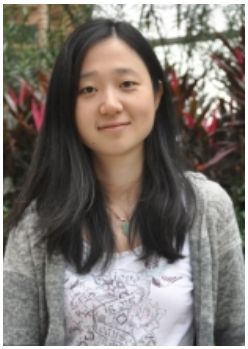

"Organic and Nanostructured Optoelectronic Devices"

Ni Zhao

Assistant Professor

Department of Electronic Engineering

Chinese University of Hong Kong

Abstract

Over the past several decades, intensive research efforts have been undertaken to develop optoelectronic devices through the use of nanostructured materials including small molecules, conjugated polymers and colloidal nanocrystal quantum dots. Unlike conventional semiconductors such as Si and GaAs, nanostructured materials are compatible with low-cost, large area roll-to-roll processing, needing lower energy intensity material processing; at the same time nanostructuring of solids enables tunability over electronic and optical properties. In this talk, I will discuss the design, fabrication and characterization of optoelectronic devices based on nanostructured materials. In the first part of the talk, I will address some of the key issues for realizing high-performance organic and nanocrystal based infrared photodetectors. In the second part of the talk, I will focus on spectroscopy studies on semiconducting conjugated copolymers. Specifically, the relationship between the molecular structure, morphology, and electronic properties will be described.

Biography

Ni Zhao received her Ph.D degree in Physics from the University of Cambridge (UK) in 2008. From 2008-2010 she worked as a postdoctoral research fellow at the Massachusetts Institute of Technology (USA). Her work at MIT involved developing novel hybrid solar cell structures that incorporate colloidal nanocrystal quantum dots with organic and inorganic materials, and using these structures to study electronic processes in solar cells. Prior to MIT she worked in the Optoelectronic Group at the Cavendish Laboratory in Cambridge, UK. Her PhD dissertation was focused on device physics of polymer based field-effect transistors, charge transport mechanism at organic semiconductor/ dielectric interface and nanoscale patterning using inkjet-printing technique. During her M.S Degree, Zhao worked in the Xerox Research Center of Canada on novel semiconducting polymers and their applications in field-effect transistors.

Ni Zhao joined the Department of Electronic Engineering at the Chinese University of Hong Kong (CUHK) in December 2010.

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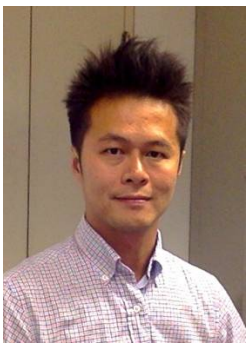

"Photovoltage Loss in Excitonic Solar Cells"

Dr. Stephen Sai-Wing Tsang
Assistant Professor
Department of Applied Physics & Materials Science
City University of Hong Kong

Abstract

Polymer solar cells with power conversion efficiencies (PCEs) over 8% have been demonstrated in laboratories with advances of novel materials, device processing, and device architectures. However, some critical physical properties of the polymer:fullerene bulk heterojunctions (BHJs) such as the donor-acceptor interface energetics which controls the charge transfer process are not well understood. In a BHJ photovoltaic cell, the open-circuit voltage (VOC) is determined by the energy level difference of the highest-occupied-molecular-orbital (HOMO) of the donor and the lowest-unoccupied-molecular orbital (LUMO) of the acceptor. However, there is lack of experimental approach to directly probe such alignment in a working device.

In this presentation, we will demonstrate a technique—charge modulated electroabsorption spectroscopy (CMEAS) to directly determine the effective bandgap and the interface effective force in a polymer:fullerene BHJ system.[1,2] By measuring the electroabsorption (EA) signal due to charge-modulation (CM) in the polymer, we are able to observe a clear sub-bandgap signal through direct excitation of excitons to the charge transfer states. Such a differential spectrum measured by CMEAS has a much higher signal-to-noise ratio than that measured by linear optical absorption techniques. Compared to the conventional electrochemical method, CMEAS can probe the energy level alignment at the electron donor-acceptor interface in a working BHJ photovoltaic cell. Using CMEAS, for the first time we are able to directly probe the effective bandgap in polymer:fullerene systems. The results also bring insight into the details of the charge transfer states and the origin of VOC in polymer photovoltaic cells.

[1] S.-W. Tsang, S. Chen, and F. So, Adv. Mater. ***25****, 2434 (2013)*

[2] S. Chen, S.-W. Tsang, T.-H. Lai, J. R. Reynolds, and F. So, Adv. Mater. ***26****,61125 (2014)*

Biography

Dr Stephen Sai-Wing Tsang is an assistant professor in the department of Physics and Materials Science at the City University of Hong Kong. Dr Tsang received his PhD in 2009 in the Materials Science and Engineering Department at the University of Toronto, Canada. His PhD was focused on developing experimental approaches and models to investigate the charge carrier transport across organic heterojunction, under the supervision of Prof. Zheng-Hong Lu. After his PhD, he joined the National Research Council (NRC) Canada as an Assistant Research Officer to develop solution processed quantum dots for photovoltaic applications. At 2011, he joined Prof. Franky So's group at the University of Florida as a Postdoc Fellow to develop high efficiency polymer solar cells and investigate the corresponding device physics. Before joining CityU, he joined the Nano and Advanced Materials Institute (NAMI) in Hong Kong as an Assistant Technical Manager in the Energy division to develop CIGS and a-Si photovoltaic cells.

Dr Tsang has published over 30 peer-review papers in prestigious journals including Nature Photonics, Adv. Mater., Adv. Energy Mater., Adv. Funct. Mater., Phys. Rev. B, and Appl. Phys. Lett. etc.

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"The Use of Quantum Mechanics in Photonic Devices"

Dr. Aaron Ho-Pui Ho
Professor
Department of Electronic Engineering
Chinese University of Hong Kong

Abstract

Typical plasmonic nano-structures are fabricated with high precision tools such as e-beam lithography or focused ion beam. The manufacturing process is time-consuming as well as expensive. Although the as-fabricated devices may have good predictability in terms of performance characteristics, quite often one only requires the nano-structure to exhibit strong plasmonic absorption within a given spectral band. Users then use localized heating to deliver the desired functionality. In this presentation, we experimentally demonstrate several useful applications of random gold plasmonic nano-islands in optofluidics, including (i) optical trapping and assembling of particles and live cells into highly organized pattern with low power density and (ii) optically actuated microfluidic flow guiding and valves. The observed trapping effect is attributed to optical forces from localized surface plasmons combined with thermal convection that pushes the target objects into the trapping zone. We have analyzed the forces in the system in detail. It was found that thermophoresis plays a critical role in the system. Our work provides a simple platform for on-chip optical manipulation of nano- and micro-sized objects, and may find applications in physical and life sciences.

Biography

Dr Ho received his BEng and PhD in Electrical and Electronic Engineering from the University of Nottingham in 1986 and 1990 respectively. Currently a professor in the Department of Electronic Engineering, The Chinese University of Hong Kong (CUHK), he has held positions as Associate Dean of Engineering, CUHK, Assistant Professor in the Department of Physics and Materials Science, City University of Hong Kong, and Senior Process Engineer for semiconductor laser fabrication in Hewlett-Packard. Started as a compound semiconductor materials scientist, his current academic interests cover a range of topics including nano-sized semiconductor materials for photonic and sensor applications, optical instrumentation, surface plasmon resonance biosensors, lab-on-a-chip and biophotonics. He has published over 270 peer-reviewed articles, 15 Chinese and 5 US patents. He is a Fellow of SPIE and HKIE, and a senior member of IEEE.