



NIM Guest Lecture

“Solution synthesis of metal oxide nanoparticles for interfacial contact layers in organic and perovskite solar cells”

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Chair Of Nanoelectronics
Theresienstrasse 90, Bldg. N8
Seminar Room N1812

Abstract: Organic and recently organic-inorganic hybrid perovskite solar cells represent promising technology for low cost, lightweight solar energy harvesting.

Due to the isotropic nature of active layer in these devices, 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 binary oxide nanoparticles, e.g. ZnO, MoO_x, NiO_x, and WO_x, for both electron and hole transport layers.

Additionally, solution-synthesized p-type delafossite CuGaO₂ and CuCrO₂ nanoparticles have been shown to be efficient transport layer in both organic and perovskite solar cells.

Curriculum of Professor Julia W. P. Hsu

Professor 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 Ph.D. degrees in Physics from Stanford University in 1991. After a two-year postdoc at Bell Labs, she joined the faculty at the University of Virginia as an Assistant Professor of Physics, earning tenure there in 1997. In 1999, she returned to Bell Labs as a Member of Technical Staff.

Prior to coming to UT Dallas, she was a Principal Member of Technical Staff at Sandia National Laboratories in Albuquerque NM from 2003 to 2010.

Hsu's research is in the area of nanoscale materials physics. She has done extensive work on local characterization of electronic and photonic materials and devices using scanning probe techniques. The material systems she has studied include metals and alloys, group IV, III-V and II-VI semiconductors, polymers, nanocomposites, and oxides. In wide bandgap nitride semiconductors, her work lead to a better understanding of dislocation electrical activity and interfacial electronic properties, and their relationship to device performance. She is an expert in sub-wavelength optical properties of materials and guided light in photonic structures.

Most recently, her research focuses on nanomaterials for optoelectronic and energy applications, including organic photovoltaics, nanomaterial synthesis, solution processing of inorganic nanocrystals and thin films, synthesis and processing of few-layer transition metal dichalcogenides, electrical and optoelectronic studies of solar cells and transistors, nanocomposites for dielectric waveguides, and Earth-abundant oxides for toxic NO_x abatement.

Hsu has published over 200 journal papers with an h-index of 51, has been granted 5 patents, and has given over 160 invited talks.

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, Materials Research Society (MRS) in 2011.

She has been an organizer of the TMS Electronic Materials Conference since 1997 and 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 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.