American Chemical Society, Orange County Section

Join us as we celebrate

THE INTERNATIONAL YEAR OF CHEMISTRY

SEPTEMBER DINNER MEETING

Thursday, October 20, 2011

The DoubleTree Club Hotel

7 Hutton Centre Drive, Santa Ana
Phone: 714-751-2400

Social: 6:00 PM ~ Dinner: 6:30 PM ~ Program & Presentation: 7:00 PM

Inorganic Solar Cells made from Solution

Dr Matt Law
Assistant Professor of Chemistry, University of California, Irvine

Abstract: Colloidal semiconductor nanocrystals (NCs) are attractive building blocks for solar photovoltaics (PV) for at least two reasons. First, some NCs offer the potential for ultra-high power conversion efficiency by, for example, the process of multiple exciton generation (the production of several electron-hole pairs per absorbed photon) in PbS or PbSe NCs. Multi-exciton generation may result in larger currents and higher efficiencies than traditional PV. Second, NCs are amenable to low-cost, roll-to-roll processing from NC inks, which ideally contain only nontoxic, earth-abundant materials. This talk highlights projects that target both approaches. I describe NC solar cells based on thin films of electronically-coupled PbS or PbSe NCs in Schottky and p-n heterojunction configurations. Variable-temperature electron and hole field-effect mobility measurements of alkanedithiol-treated PbSe NC films as a function of NC size, ligand length, and illumination are used to probe the mechanism of charge transport in these materials and to test strategies for boosting carrier diffusion lengths. These results establish a baseline for mobility trends in PbSe NC solids and have implications for fabricating high-mobility NC-based optoelectronic devices. I show that oxidation and photothermal degradation of NC films can be prevented by using low-temperature atomic layer deposition (ALD) to fill the pores of these films with various inorganic matrices to produce inorganic nanocomposites in which the NCs are locked in place and protected against oxidative and photothermal damage. ALD-infilling of PbSe NC field-effect transistors and solar cells yields devices that operate with enhanced and stable performance for at least months in air. I also discuss a major effort at UCI to make efficient PV from solution-deposited, earth-abundant iron pyrite (FeS2). Phase-pure, stable pyrite NC inks have been synthesized and used to make polycrystalline pyrite thin films. The optical and electronic properties of these films are described, along with strategies for fixing the historically low photovoltage of pyrite PV.

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Biography: Matt Law has been Assistant Professor of Chemistry at the University of California, Irvine since 2008. Matt received a Ph.D. in chemistry with Peidong Yang at U.C. Berkeley in 2005 and was a postdoctoral fellow with Arthur Nozik at the National Renewable Energy Laboratory (NREL) in Golden, CO until the summer of 2008. He was an ACS Division of Inorganic Chemistry Young Investigator in 2005 and won the IUPAC Prize for Young Chemists in 2006 and the DOE Early Career Award in 2010. His research interests include the development of new materials and devices for 3rd generation photovoltaics, earth-abundant solar energy conversion, and photoelectrochemical solar fuels production. Currently his group is preoccupied with, e.g., charge transport through nanoscale semiconductors, environmental stability of nanomaterials for optoelectronics, scalable syntheses of high-performance metal sulfide thin films, and practical electrodes for water oxidation.

All Reservations: Please contact us no later than 12 noon on Monday, October 17, 2011 at OCACS@sbcglobal.net, and indicate if you will be attending the dinner or the program only. Please list the names of all attendees.

Dinner Cost: $25 for members; $25 for member's significant other; $30 for non-members or those without reservations. **Note:** OCACS pays the hotel on the basis of the number of dinner reservations made. Your RSVP for dinner is a commitment to pay for dinner.

Program: Members and guests are invited to attend the program at 7:00PM. There is no charge for the program but reservations are requested. Space may be limited.

Directions: Take the Costa Mesa Freeway (55), exit at MacArthur Blvd. and go west (towards South Coast Plaza). Take the first left at MacArthur Place. The DoubleTree Club Hotel is straight ahead on the left. Do not turn right at MacArthur Place to the DoubleTree Hotel, which is not the same as the DoubleTree *Club* Hotel.