

Addressing the scale and complexity of the global energy challenge.



TACKLING THE CHALLENGE OF TRULY LARGE SCALE PHOTOVOLTAICS: THE INDUSTRIAL AND THERMODYNAMIC POTENTIALS OF ORGANIC SOLAR CELLS

Condensed Matter Physics Seminar Series

Sean Shaheen, Associate Professor of Physics and Astronomy at the University of Denver and subcontractor to the National Renewable Energy Laboratory

Thursday, November 3, 2011

12:00 p.m., Physics Building (Gamow Tower), 11th Floor

Summary: In order for photovoltaic systems to ultimately provide a considerable fraction of the world's energy needs they will need to meet a number of stringent performance metrics regarding their cost, efficiency, and robustness. In addition, they will need to be manufactured with very high throughput methods in order to realize the enormous production scales required. A simple calculation yields that for solar cells with 20% efficiency and 30 year lifetime, a global production rate of 8 billion square meters per year will be required to supply 33% of our future energy needs. This equates to a global production rate of 1 million square meters per hour. After analyzing global photovoltaic statistics and trends and the above calculation in a little more detail, I will discuss the prospects for printed organic photovoltaic (OPV) devices to meet this daunting challenge. I will overview the printing methods and production rates possible for organic photovoltaic modules, motivated by the already existing roll-to-roll fabrication lines at several companies and institutions around the world. I will then delve into the thermodynamic principles and materials physics issues that are fundamentally responsible for the power conversion efficiencies of 8-10% that are presently attainable in OPV. Lastly, I will discuss several pathways to substantially higher efficiencies being proposed by my colleagues and I based on detailed control of the molecular orientations, the free energy losses in the excitonic pathways, and the dielectric properties of the devices.

Co-authors: Dana Olson, Nikos Kopidakis, Jao van de Lagemaat, Garry Rumbles, David Ginley, Christoph Brabec, Kees Hummelen

Sean Shaheen, Ph.D.

Sean Shaheen is an Associate Professor in the Department of Physics and Astronomy at the University Denver and a contractor to NREL. He obtained his B.S. in physics at Carnegie Mellon University and Ph.D. in physics at the University of Arizona and was a Lise Meitner Postdoctoral Fellow at the University of Linz, Austria. Prior to joining the faculty at the University of Denver he worked full time in the National Center for Photovoltaics at NREL for 5 years. He has worked in the field of organic electronics for over 15 years and made early contributions to the advancement of their device efficiencies. He was recently named a Research Corporation Scialog Fellow and was awarded an NSF Solar project in collaboration with several PI's at CU and NREL (Park, Walba, Ablowitz, van de Lagemaat, and Rumbles). He gave a plenary talk on organic photovoltaics at the 2011 SPIE Optics + Photonics conference and will be giving an invited talk at the Abdus Salaam International Centre for Theoretical Physics in Trieste this spring. Beyond organic photovoltaics, he is also interested in topics of complex systems in biology, engineering, and society.

Campus Map for Gamow Tower (Physics): <http://www.colorado.edu/campusmap/map.html?bldg=W-GT>

Recommended Parking: Euclid Avenue AutoPark