Solar Cell Analysis with Optical Spectroscopy and Microscopy

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Colorado State University
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Refreshments at 3:45 PM
Location: 120 Engineering (Hammond Auditorium)

Abstract

Ultimately, solar cells could perform at the thermodynamic limit, but this is not yet achieved. Defects in the space charge region, bulk, or near interfaces could have different impact, and characterization of the charge carrier transport and recombination in devices or model systems contributes to increasing solar cell efficiency. Because optical excitation could be similar to solar radiation, electro-optical properties could be relatively simply correlated to solar cell characteristics. Depending on the research goals, this could allow rapid analysis or detailed understanding of device physics.

Our approach to identifying efficiency-limiting recombination or transport mechanisms is to precisely target excitation/carrier generation locations and to time- and spatially-resolve optoelectronic properties. This is especially informative for devices where carriers are generated/incur losses in semiconductor regions that differ in composition, band gap, and other properties. I will describe spectroscopic and microscopic optical measurements of charge carrier lifetimes, doping, defects, interface and bulk recombination, charge carrier transport, space charge fields, and metastability of electronic properties. Examples will be given from our recent research on single crystal, epitaxial, and polycrystalline materials and solar cells.

Biographical Sketch

Darius Kuciauskas has studied Physics (Diploma, Vilnius University, Lithuania) and Chemistry (Ph.D., Arizona State University). Since 2010, he is a senior scientist at NREL where he works on thin film photovoltaics, electro optical characterization, and defect spectroscopy. At NREL, he has developed and applied a number of spectroscopic techniques that help improve CdTe, CIGS, and other solar cells. He has published over 80 journal and 40 conference papers in physical chemistry, applied physics, and photovoltaics.