Designing and Probing Photovoltaic Materials

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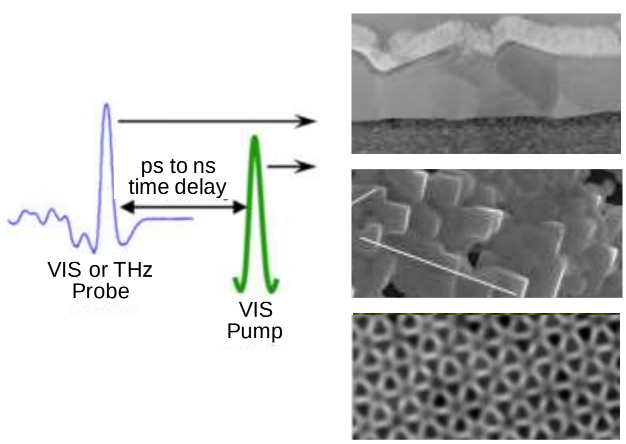
Reception 3:30-4:00 p.m. | NANOENGINEERING 181
Lecture 4:00-5:00 p.m. | NANOENGINEERING 181

Abstract

Photovoltaics have the potential to convert sunlight into electricity at very large scales and at low cost. However, many constraints on materials and interfaces must be simultaneously satisfied to achieve high efficiency. For example, light absorption by photovoltaic absorber materials generates electron-hole pairs that must be separated and collected before they recombine. For many materials, recombination lifetimes are on the order of picoseconds to nanoseconds. This talk will highlight our group's use of ultrafast spectroscopy to provide a link between processing, structure, and device performance that can help direct the design of more efficient solar cells. Specifically, we have combined time resolved terahertz spectroscopy and transient absorption spectroscopy with modeling of the semiconductor transport equations to extract carrier lifetimes and mobilities and to determine dominant



$Cu_2ZnSn(S,Se)_4$ thin films and single crystals

$CsPbI_3$ perovskite films

PbSe nanocrystal films

recombination mechanisms. I will discuss our application of this method to understand: (1) the dependence of dynamics on composition and surface treatments in $Cu_2ZnSn(S,Se)_4$ (CZTSSe) thin films and single crystals; (2) long and similar radiative lifetimes in organic and inorganic lead halide perovskites; and (3) the role of ligand chemistry in interfacial charge transfer and long range charge transport in PbSe nanocrystal films and binary nanocrystal superlattices.

Bio

Jason Baxter is a Professor in the Department of Chemical and Biological Engineering at Drexel University, where he began in 2007. His research group focuses on solar energy conversion, including materials chemistry and processing of thin films and nanostructures, fabrication and characterization of photovoltaic and photoelectrochemical cells, and ultrafast photophysics of solar energy materials. He is a recipient of the NSF CAREER Award and Drexel's College of Engineering Outstanding Teacher Award. He received his BS at University of Delaware and PhD at University of California Santa Barbara, both in chemical engineering, and was a postdoctoral fellow in physical chemistry at Yale University.