DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Nanoscale Investigations on the Bulk Photovoltaic Effect in Complex Oxide Systems

Ph.D. Thesis Proposal

June 3rd, 2019, 3:00-5:00 PM
Location: Curtis 162

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Advisor: Dr. Jonathan Spanier

Abstract: The bulk photovoltaic effect (BPVE) is an interesting and unique light to energy conversion mechanism compared to the more widely known junction based mechanism found in *p-n* junction diodes. The BPVE photo-generated carriers are formed within the bulk of the material and only a single layer is needed (the single layer acts as both the light absorber and the carrier separation layer) to generate power. While originally discovered in the 1960's, renewed interest in this effect has gained the attention of the photovoltaic and piezoelectric materials research communities, prompted by studies involving ferroelectric thin films, doped materials, 2-D materials, topological surfaces, and organic-inorganic hybrid materials. The BPVE is governed by the breaking of inversion symmetry at the microscopic level to generate a macroscopic photo-current. My thesis aims to advance understanding of photo-initiated ballistic carrier transport via BPVE, through the study of temperature, photo-excitation energy dependence, and ferroelectric domain structure.

Recent research has also revealed how nanoscale electrodes (tips) on non-centrosymmetric (lacking a center of symmetry) materials can be used to collect unexpectedly large photocurrents-current, as compared with macroscopically large planar electrodes. My thesis aims to study, parametrically, how electrode size, geometry, spacing, material conductivity, and optical transparency influence the tip enhanced response. By investigating the thermalization length, electron mobility, and aspects of photo-generated carrier collection, I seek to advance understanding of design principles and characteristics of photovoltaic devices based on the BPVE.