Materials Science & Engineering Seminar Series

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Adventures at the Atomic Scale: Diffusion and Defect Chemistry using Atom Probe Tomography

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Developing materials for optical and electrical applications often requires an understanding of the relationships between processing and point defects. Atomic scale relationships such as these are frequently elusive to understand due to a lack of characterization techniques. In this work, I will show examples of nanoscale and atomic scale characterization of oxide and semiconductor point defects determined through atom probe tomography (APT). Specifically, the relationship between ordered defect pair point defect chemistries and the resulting optoelectronic properties in Cu(In,Ga)Se2 thin film photovoltaic absorber layers will be illustrated. Similarly, oxygen stoichiometries in oxygen and proton conducting oxides can be directly related to the electrical conductivities where grain boundaries dominate transport. Laser assisted APT also allows for unique opportunities for measuring atomic diffusion where thermal transport can assist transformations from metastable states. Using a "Dynamic" atom probe, atomic scale diffusion can be quantified at the atomic scale in 3-dimensions using a combination of APT and in-situ electron diffraction with a temporal resolution of better than 1 ns.

Dr. Brian Gorman earned his PhD in Ceramic Engineering from the University of Missouri-Rolla under the guidance of Dr. Harlan U. Anderson. His PhD focused on the processing – structure – property relationships in thin film electrolyte solid oxide fuel cells. Following his PhD work, Dr. Gorman was employed at Texas Instruments where he developed processing and characterization techniques for low-k dielectrics for CMOS and ferroelectic RAM devices. He was also employed at Los Alamos National Laboratory where he worked on radiation tolerant ceramics for nuclear waste disposal. He subsequently joined the academic life full time at the University of North Texas where he founded the Center for Advanced Research and Technology and honed his skills in atomic scale materials characterization. In 2009, he joined the faculty at the Colorado School of Mines, the Colorado Center for Advanced Ceramics, and the National Renewable Energy Laboratory. His research interests are currently focused on atomic processing – structure – electronic property relationships in ceramics and semiconductor devices.

Doherty Hall 2210, 11:30AM
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