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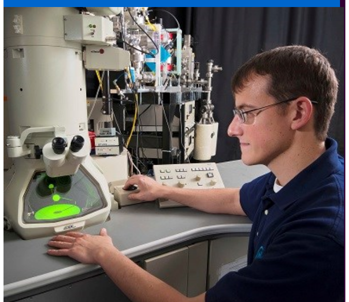

Dr. Khalid Hattar

Co-sponsored with Department of Mechanical & Materials Engineering

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Sandia National Laboratories

Nanoscale Observation of Ion Beam Tailoring via In-situ TEM

Understanding the relationship between processing, structure, and properties of materials has been core to humanity's progress since the Stone Age. Recent advancements in nanoscale modification and characterization tools along with exponential growth in computational capabilities have greatly expanded our ability to understand and control the properties of materials down to the nanoscale. Ion beam tailoring of materials has become essential to most nanoscale processes to control the structure and subsequent properties of materials. Similarly transmission electron microscopy (TEM) has become linked with nanoscale characterization.

This presentation will highlight recent capabilities developed at Sandia National Laboratories' *In situ* Ion Irradiation TEM (I^3TEM) facility. These capabilities currently permit real time nanoscale observation, while the electron transparent sample is exposed to MeV ion irradiation, keV gas implantation, quantitative mechanical loading, thermal annealing, gas or liquid environments, or various combinations thereof. These capabilities will be highlighted through a set of three experimental examples.

In the first set, both the detrimental and beneficial effects of ion irradiation in high-purity gold will be shown through a detail comparison of displacement damage and He bubble evolution in gold electrical contacts. This will also highlight the added advantage of combining *in situ* TEM techniques with nanoscale orientation image mapping to associate the dynamic evolution with the initial and final microstructures formed. Then this presentation will highlight the ability of *in situ* ion irradiation studies to investigate the structural evolution of advanced nanoscale detectors under controlled radiation environments. In the third set, advancements in *in situ* TEM stages permit studies in gas and liquid environments, as well as quantitative mechanical deformation will be briefly highlighted. To demonstrate the potential of these stages, recent work done at Sandia to understand: the uptake and release of hydrogen in nanoporous palladium nanoparticles, the nanoscale mechanisms of corrosion in high purity iron, the formation of nanoscale lanthanides, and the response of nanocrystalline metals to cyclic loading.

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Khalid Hattar is a Principal Member of the Technical Staff of Sandia National Laboratories. He received a B.S. in Chemical Engineering from University of California, Santa Barbara in 2003, and a Ph.D. in Materials Science and Engineering from University of Illinois, Urbana-Champaign in 2009. He joined the Radiation-Solids Interaction group at Sandia in 2008. He specializes in determining the property-microstructure relationship for a variety of structural, electrical, and optical materials through *in situ* TEM in various extreme environments, as well as tailoring local properties of materials through ion beam modification.

Tuesday, September 8, 3:30 pm
110 Jorgensen Hall

Host:
Dr. Bai Cui

Department of Mechanical & Materials Engineering

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