2007-2008

Graduate Seminar Series

The Department of Mechanical Engineering – Engineering Mechanics

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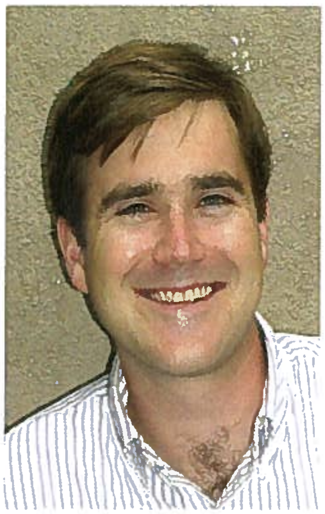
Professor Eric Stach
Purdue University



Dr. Eric Stach is an Associate Professor of Materials Engineering at Purdue University and directs the electron microscopy center at Purdue's Birck Nanotechnology Center. He received his B. S. M. E. from Duke University in 1992, his M.S.M.S.E from the University of Washington in 1994, and his Ph.D. from the University of Virginia in 1998. Prior to his recent appointment to Purdue, he was Principal Investigator and Program Leader within the Materials Science Division and the National Center for Electron Microscopy at the Lawrence Berkeley National Laboratory. Professor Stach's research focuses on the development and application of advanced electron microscopy techniques for the real time observation of nanostructured crystal growth and nanomaterials reliability.

Thursday, Feb. 28, 2008 3:00 – 4:00 p.m. Room 112, ME-EM Bldg.

Understanding the Onset of Plasticity in Materials Using Quantitative In-Situ Nanoindentation

Nanoindentation is widely accepted as the preferred technique to study localized mechanical deformation phenomena in materials. However, the mechanisms of deformation can only be inferred from the load-displacement data obtained during a typical instrumented nanoindentation test. In order to elucidate the underlying physics of these process, we have developed and exploited a new technique, that of in-situ nanoindentation in a transmission electron microscope (TEM). In this technique, a voltage-actuated piezoceramic tube is used to position a sharp diamond in plane with the edge of an electron transparent sample. The tip is driven into the material in order to induce deformation and the corresponding deformation is observed in real time and at high spatial resolution. In this talk, I will review the details of our experimental technique, as well as summarize our results from selected materials systems. In particular, we have studied thin films of aluminum deposited on top of microfabricated wedges of silicon, allowing us to observe such effects as initial deformation modes, size effects on hardening, grain boundary motion and dislocation nucleation, as well as the effects of solute additions on both dislocation propagation and grain boundary movement.

Additionally, experiments on harder materials have permitted the observation of unexpected deformation modes. In the case of single crystal silicon, we have found a size-dependent transition from pressure-induced phase transformation to room temperature deformation by dislocation nucleation and propagation.

Funding for the ME-EM Graduate Seminar Series is provided by Professional Plating, Inc. of Anoka, MN www.proplate.com
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