

The AAE Fall 2012 Colloquium Series

**Merging High Energy Diffraction Microscopy and
Materials Modeling**

Dr. Jay C. Schuren

AFRL

Materials and Manufacturing Directorate

Thursday, November 1, 2012

3:00 P.M.

ARMS 1109

Abstract

The strategic development of new engineering materials with improved performance rests on establishing computational models that link materials processing, microstructure, and properties/performance. Researchers within the greater scientific community have long sought these linkages, but without access to experimental data at the relevant length scales, validated models capable of predicting complex phenomena such as fatigue initiation and small-crack propagation have remained elusive. Without validated models, adoption of advanced computational methods will remain at the mercy of traditional large-scale testing programs which inherently limit the adoption of new materials or innovative design due to fiscal and time constraints. Emerging experimental techniques such as High Energy x-ray Diffraction Microscopy (HEDM) address a critical need with respect to validation experiments for models focused on the prediction of mechanical properties below the continuum-scale, where the response of grains and similar microstructural features are explicitly tracked (e.g., Crystal Plasticity Finite Element Model, Field Dislocation Mechanics, etc.). These experiments consist of in situ loading at ambient and elevated temperatures, where synchrotron x-rays are used to quantify the average elastic strain and stress tensor for each grain, map both the morphology and local crystallographic orientation within and between grains, and track the formation and propagation of voids/cracks in the sample. The presentation will provide an overview of HEDM techniques, a detailed discussion of the type of data produced, and a discussion of how the data can be used for the development/validation of models and insight into deformation processes below the continuum length scale.

Bio

Dr. Jay C. Schuren has worked at the Air Force Research Laboratory since he received his Ph.D. in Mechanical Engineering from the Cornell University in 2011. He currently is leading a collaborative effort with researchers from the Advanced Photon Source, Lawrence Livermore National Laboratory, Carnegie Mellon University, Cornell University, Purdue University, and Petra III focused on the integration of three high energy x-ray techniques to provide insight into the deformation of materials.

An informal coffee & cookie reception will be held prior to the lecture at 2:30 p.m. in the AAE/ARMS undergraduate lounge (directly in front of ARMS 3rd floor elevators).

COLLOQUIUM