

MSE 676 Advanced Topics in MSE

Section 1: Computational Micro-Plasticity

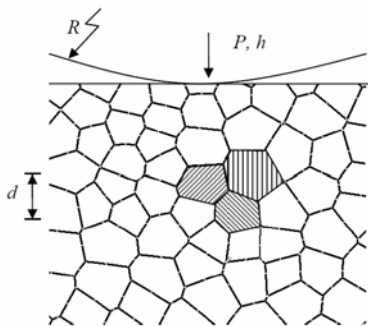
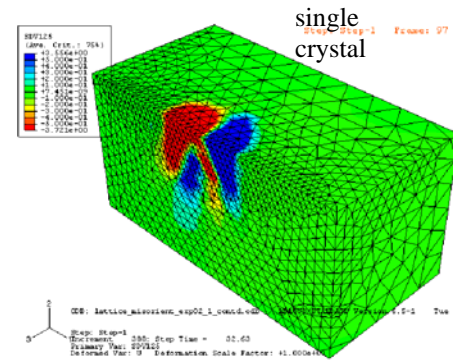
Instructor: Dr. Yanfei Gao (ygao7@utk.edu, 323B Dougherty)
Time: Fall 2007

Objectives

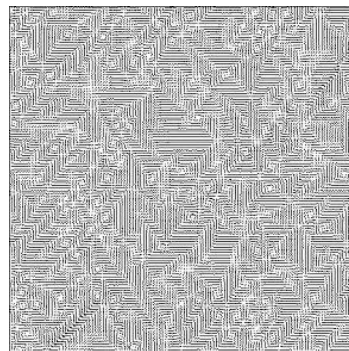
This course is intended to enhance the synergistic research efforts on plasticity and failure mechanisms of advanced materials in MSE and other departments. Of particular interest, the graduate students will work on project(s) based on their research topics, including shear-banding behavior in bulk metallic glass, polycrystal and single-crystal plasticity, fracture, fatigue crack growth, nanoindentation, dislocation dynamics, microstructural evolution, to name a few. The students will be provided with templates of user defined element and material subroutines for the use of ABAQUS, and will also be asked to do simple programming. The focus is on material behavior and hand-on practice, not on algorithm development.

Content

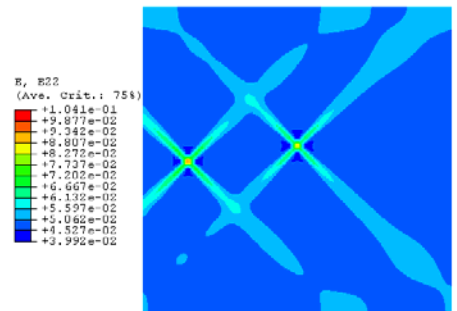
1. Introduction
 - (1) Review of continuum mechanics
 - (2) Review of the principle of virtual work and finite element formulation
 - (3) Overview of ABAQUS
2. Constitutive Behavior
 - (1) Continuum plasticity (J2 theory, rate-dependent theory)
 - (2) Internal state variable approach
 - (3) Crystal plasticity
 - (4) Gradient plasticity
 - (5) Cohesion and friction
3. Advanced Topics
 - (1) Integration scheme for non-linear problems
 - (2) Material instability (Hill-Hutchinson-Rice theory)
 - (3) Multiscale plasticity (dislocation dynamics, molecular simulation, etc)
4. Special Topics (potential projects)
 - (1) Fracture nucleation and propagation
 - (2) Fatigue (with overload effects)
 - (3) Slip, grain boundary deformation, and texture evolution
 - (4) Evolving microstructure (diffusion and migration)
 - (5) Shear bands in bulk metallic glass composites
 - (6) Adhesive contact
 - (7) Dislocation nucleation during nanoindentation
 - (8) Your own interest...



slip vs fracture in polycrystal



domain switching (ferroelectric materials) and toughening



amorphous alloy