



MMAE SEMINAR

**Monday, April 26, 2010
E-1 BUILDING – CRAWFORD AUDITORIUM
3:30 – 4:30 PM**

Multiscale Modeling of Fracture in Metals

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Abstract

Fracture in non-brittle crystalline materials involves material separation at the atomistic scale and dislocation plasticity, with its associated dissipation, occurring over much larger scales. The breakdown of conventional continuum plasticity around the crack tip compounds the problem of fracture prediction. After generally examining the multiscale aspects of fracture, we focus on the use of a discrete dislocation plasticity model to understand the origin of size effects in fracture. We demonstrate that the fracture toughness can be controlled by the spacing of the internal obstacles impeding dislocation motion in a material. The trends in toughness are qualitatively similar to predictions of a strain-gradient plasticity model, and thus provide an unambiguous physical interpretation of the gradient length scale parameter in the higher-scale theory. Analysis of the behavior of a dislocation pile-up in a stress gradient further reveals the importance of stress gradients in controlling the size effects in our fracture model. We then present implications of such a "stress gradient plasticity" model in other situations where size-dependent plasticity is observed.