Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Interface Mediated Nucleation and Growth of Dislocations in fcc-bcc nanocomposite RUIFENG ZHANG, JIAN WANG, IRENE J. BEYERLEIN, TIMOTHY C. GERMANN, Los Alamos National Laboratory — Heterophase interfaces play a crucial role in determining material strength for nanostructured materials because they can block, store, nucleate, and remove dislocations, the essential defects that enable plastic deformation. Much recent theoretical and experimental effort has been conducted on nanostructured Cu-Nb multilayer composites that exhibited extraordinarily high strength, ductility, and resistance to radiation and mechanical loading. In decreasing layer thicknesses to the order of a few tens of nanometers or less, the deformation behavior of such composites is mainly controlled by the Cu/Nb interface. In this work, we focus on the cooperative mechanisms of dislocation nucleation and growth from Cu/Nb interfaces, and their interaction with interface. Two types of experimentally observed Cu/Nb incoherent interfaces are comparatively studied. We found that the preferred dislocation nucleation sites are closely related to atomic interface structure, which in turn, depend on the orientation relationship. The activation stress and energies for an isolated Shockley dislocation loop of different sizes from specific interface sites depend strongly on dislocation size, atomic interface pattern, and loading conditions. Such findings provide important insight into the mechanical response of a wide range of fcc/bcc metallic nanocomposites via atomic interface design.

Ruifeng Zhang
Los Alamos National Laboratory

Date submitted: 23 Nov 2010 Electronic form version 1.4