Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

High Strain Rate Deformation of BCC Materials: Molecular Dynamics Simulations CON HEALY, GRAEME ACKLAND, University of Edinburgh — To improve machining processes, a good understanding of plasticity of bulk metals and at high strain rates is required. During machining processes, it is thought that strain rates of $\sim 10^6 s^{-1}$ are reached. These strain rates are currently not achievable in experimental high strain rate testing techniques. Here we investigate high strain rate deformation of bcc Fe using Molecular Dynamics simulations. Simulations include those of nano-scale single crystal pillars and of a nano-crystalline sample. We show that bcc materials may exhibit different deformation behavior at high strain rates. Under compression at strain rates of $\sim 10^8 s^{-1}$, nano-scale single crystal pillars may exhibit slip on atypical planes if the direction of maximum resolved shear stress points along that plane. The stress-strain behavior of these pillars is characterized by sudden strain bursts due to slip events. The yield stress required for these slip events can be as high as 2 GPa, much higher than the Peierls stress which is around 25 MPa for an edge dislocation in Fe. The nano-crystalline sample showed stress-strain behavior closer to that of a bulk metal. At high temperatures, pillars exhibit surface premelting. A large portion of the pillar turns amorphous when strained.

Con Healy
University of Edinburgh

Date submitted: 21 Nov 2011 Electronic form version 1.4