Abstract for an Invited Paper
for the SHOCK09 Meeting of
The American Physical Society

Laser Compression of Nanocrystalline Metals[1]

MARC MEYERS, U C San Diego

Laser compression carried out at the Omega and Janus yields new information on the deformation mechanisms of nanocrystalline Ni. Although conventional deformation does not produce hardening, the extreme regime imparted by laser compression generates an increase in hardness, attributed to the residual dislocations observed in the structure by TEM. An analytical model is applied to predict the critical pressures for the cell-stacking-faults transition in single-crystalline nickel and the onset twinning in nanocrystalline nickel. The slip-twinning transition pressure is shifted from 20 GPa, for polycrystalline Ni, to 80 GPa, for Ni with g. s. of 10 nm. Contributions to the net strain from the mechanisms of plastic deformation (partials, perfect dislocations, twinning, and gb shear) were quantified in the nanocrystalline samples through MD calculations. The effect of release, a phenomenon often neglected in MD simulations, on dislocation behavior was established. A large fraction of the dislocations generated at the front are annihilated.

In collaboration with Hussam Jarmakani, University of California, San Diego; Eduardo Bringa, U. Nacional de Cuyo; Bruce Remington, Lawrence Livermore National Laboratory; V. Nhon, University of Illinois; P. Earhart and Morris Wang, Lawrence Livermore National Laboratory.

[1]Support: ILSA contract No. W-7405-Eng-48.