Abstract Submitted
for the SHOCK11 Meeting of
The American Physical Society

Laser Compression of Monocrystalline Tantalum MARC MEYERS, CHIA-HUI LU, UCSD, BRUCE REMINGTON, BRIAN MADDOX, HYE-SOOK PARK, SHON PRIESBREY, LLNL, BIMAL KAD, UCSD, RAIN LUO, General Atomics — Monocrystalline tantalum with orientations [100] and [111] was subjected to laser driven compression at laser energies of 350 to 685 J, generating shock amplitudes varying from 15 to 100 GPa. The laser beam, with a beam spot diameter of $\sim$1 mm, created a crater of significant depth ($\sim$ 80 to $\sim$ 200 μm). Twins were observed just below the crater surface ($\sim$ 42 μm) by back-scattered SEM. Transmission electron microscopy (TEM) revealed profuse mechanical twinning within a distance from the energy deposition surface of about 1.5 mm ($\sim$ 1.3 mm from residual crater vertex) at 684 J compression power, corresponding to an approximate pressure of 35 GPa. The decay of the pulse through the specimens was accompanied by an attendant decrease in the density of shock-generated dislocations. Dislocation densities as a function of pressure were calculated for the case of homogeneous nucleation and for Orowan hardening. The observed results are compared with predictions. Microhardness measurements were conducted on the recovered samples. The experimentally measured threshold stress for twinning is compared with predictions using an analysis based on the constitutive response and the similarities and differences are discussed.

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Date submitted: 23 Feb 2011 Electronic form version 1.4