Abstract Submitted
for the SHOCK15 Meeting of
The American Physical Society

Multiscale modeling of high-rate plastic deformation of polycrystalline bcc metals[1] ROBERT E. RUDD, A. ARSENLIS, N.R. BARTON, R.M. CAVALLO, D.A. ORLIKOWSKI, H.S. PARK, S.T. PRISBREY, C.E. WEHRENBERG, B.A. REMINGTON, Lawrence Livermore National Laboratory — Multiscale strength models for high-rate deformation have been developed for tantalum and vanadium starting with atomic bonding and extending up through the mobility of individual dislocations, the evolution of dislocation networks and so on until the ultimate material response at the scale of an experiment. [1] High energy laser platforms such as the National Ignition Facility offer the possibility to study plasticity at extremely high rates in ramp-compression waves [2], for validation of strength models. Experiments have been conducted on tantalum and vanadium at pressures of 100 GPa and strain rates of 10^7/s. [3,4] Remarkably, the predictions of the multiscale model agree well with the 1 Mbar experiments without adjustable parameters. We discuss the role of polycrystalline microstructure on the deformation of tantalum at these extreme conditions. We also consider the role of homogeneous nucleation of crystal defects in ramp compression experiments at 5 Mbar. [5] [1] R.E. Rudd et al., MRS Bulletin 35, 999 (2010). [2] N.R. Barton et al., J. Appl. Phys. 109, 073501 (2011). [3] H.-S. Park et al., Phys. Rev. Lett. 104, 135504 (2010). [4] H.-S. Park et al., Phys. Rev. Lett., to appear (2015). [5] R.E. Rudd et al., AIP Conf. Proc. 1426, 1379 (2012)

[1]This work was performed under the auspices of the U.S. Dept. of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344.

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Date submitted: 30 Jan 2015 Electronic form version 1.4