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Using NIF to Test Theories of High-Pressure, High-Rate Plastic Flow in Metals[1] ROBERT E RUDD, A. ARSENLIS, R. M. CAVALLO, C. M. HUNTINGTON, J. M. MCNANEY, H. S. PARK, P. POWELL, S. T. PRISBREY, B. A. REMINGTON, D. SWIFT, C. E. WEHRENBERG, L. YANG, Lawrence Livermore National Lab — Precisely controlled plasmas are playing key roles both as pump and probe in experiments to understand the strength of solid metals at high energy density (HED) conditions. In concert with theoretical advances, these experiments have enabled a predictive capability to model material strength at Mbar pressures and high strain rates [1]. Here we describe multiscale strength models developed for tantalum 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 [2]. Experiments at the National Ignition Facility (NIF) probe strength in metals ramp compressed to 1-8 Mbar [3]. The model is able to predict 1 Mbar experiments without adjustable parameters [3]. The combination of experiment and theory has shown that solid metals can behave significantly differently at HED conditions [3]. We also describe recent studies of lead compressed to 3-5 Mbar. [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. 114, 065502 (2015).

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