Abstract Submitted
for the SHOCK15 Meeting of
The American Physical Society

Enhanced densification, strength and molecular mechanisms in shock compressed porous silicon J. MATTHEW D. LANE, TRACY J. VOGLER, Sandia National Labs — In most porous materials, void collapse during shock compression couples mechanical energy to thermal energy. Increased temperature drives up pressures and lowers densities in the final Hugoniot states as compared to full-density samples. Some materials, however, exhibit an anomalous enhanced densification in their Hugoniot states when porosity is introduced. We have recently shown that silicon is such a material, and demonstrated a molecular mechanism for the effect using molecular simulation. We will review results from large-scale non-equilibrium molecular dynamics (NEMD) and Hugoniotstat simulations of shock compressed porous silicon, highlighting the mechanism by which porosity produces local shear which nucleate partial phase transition and localized melting at shock pressures below typical thresholds in these materials. Further, we will characterize the stress states and strength of the material as a function of porosity from 5 to 50 percent and with various porosity microstructures. Sandia National Laboratories is a multi program laboratory managed and operated by Sandia Corporation, a wholly owned subsidiary of Lockheed Martin Corporation, for the U.S. Department of Energy's National Nuclear Security Administration under contract DE-AC04-94AL85000.

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Date submitted: 30 Jan 2015 Electronic form version 1.4