Abstract Submitted
for the MAR07 Meeting of
The American Physical Society

Anomalous elastic response of diamond single crystals to shock compression KEITH MCLAUGHLIN, MIKHAIL LADANOV, IVAN OLEYNIK, University of South Florida, SERGEY ZYBIN, California Institute of Technology, MARK ELERT, C.T. WHITE, US Naval Academy — We have performed large-scale molecular-dynamics simulations of shock-wave propagation in single-crystal diamond and observed an anomalous elastic response of the material in the intermediate range of shock-wave intensities between the elastic-plastic split shock-wave regime and the graphitization regime of shock compression. The anomalous elastic response is characterized by the absence of plastic deformations in highly uniaxially compressed material. The unusual materials response in shock-compressed diamond is attributed to unique and complex constitutive relationships: both shear and longitudinal stresses are non-monotonic functions of compression. This example clearly demonstrates the necessity of generalization of the notion of the Hugoniot elastic limit (HEL) to include critical shear stresses in a criterion of materials yielding upon shock compression.

Ivan Oleynik
University of South Florida

Date submitted: 03 Jan 2007 Electronic form version 1.4