SHOCK07-2007-000582

Abstract for an Invited Paper
for the SHOCK07 Meeting of
the American Physical Society

Making and Characterizing Off-Hugoniot States in Gas Gun Experiments[1]

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Understanding the high-pressure, high-temperature behavior of materials subjected to dynamic loading requires knowledge beyond typical Hugoniot EOS and sound speed experiments. Recent advances in the fabrication of Graded Density Impactors (GDIs) have enabled us to produce both smooth, continuous quasi-isentropes and complex tailored compression paths. In addition we have developed ellipsometry as an *in-situ* real-time diagnostic capable of measuring optical constants during gas gun experiments. Since measured optical constants can be related to crystal structures as well as emissivities, coupling ellipsometry with GDIs provides a means to create and characterize a wide region of thermodynamic space previously inaccessible in standard shock experiments. We present quasi-isentropic compression of Ta to over 1 Mbar, and ellipsometry measurements of solid-solid and solid-liquid phase transitions as well as pressure-induced solidification of water.

[1]This work was performed under the auspices of the U.S. Department of Energy by University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.