Reference-free EOS measurements from laser-accelerated flyer-plate impact

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The measurement of materials' equations of state (EOS) is relevant to a variety of applications, ranging from material science to geophysics and planetary science. EOS measurements along a shocked state (Hugoniot) are particularly useful for developing and benchmarking models because they yield data from well-defined thermodynamic states. Impedance-matching (IM) techniques, which are most often used to determine the shock state at multi-megabar pressure, rely on the accurate knowledge of the impedance matching standard EOS and behavior upon release, which are respectively limited in pressure or difficult to measure. Here we present the concept and initial results of absolute (reference-free) equation of state measurements, using symmetric impact of laser-accelerated flyer-plates. Experiments on diamond and molybdenum at multi-megabar pressures were performed at the Omega laser. VISAR (Velocity Interferometer for Any Reflector) measurements allowed us to monitor the flyer acceleration prior to impact and the shock state generated upon impact on the target, thus providing simultaneous measurement of the particle and shock velocity from which pressure and density can be obtained using the Rankine-Hugoniot relations.

This work was performed under the auspices of the US Department of Energy by Lawrence Livermore National Laboratory under Contract No. DE-AC52-07NA27344

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