Absolute Hugoniot measurements of CH foams in the 2-9 mbar range and future plans*

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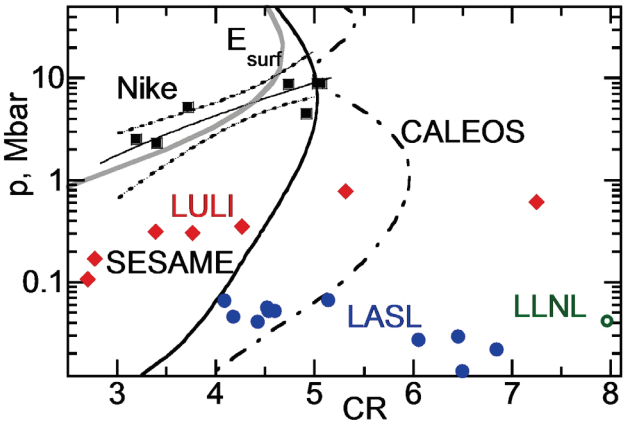
Foams can be used in ICF and HEDP as low-density, high-adiabat ablators; as wetted foam liquid fuel layers; as radiating sources to heat and backlight materials in z-pinch dynamic hohlraums for opacity measurements; and many other ways. There is, however, a long history of surprises with the Hugoniot curves of porous materials. This paper will report on absolute Hugoniot measurements for empty plastic foams at~10% of solid polystyrene density and supporting rad-hydro simulation results. Planar foam slabs, ~400 μm thick and ~500 μm wide, some of which were covered with a 10 μm solid plastic ablator, were directly driven with 4 ns long Nike krypton-fluoride 248 nm wavelength laser pulses that produced strong shock waves in the foam. The shock and mass velocities in our experiments were up to 104 km/s and 84 km/s, respectively, and the shock pressures up to ~9 Mbar. The motion of the shock and ablation fronts was recorded using side-on monochromatic x-ray imaging radiography. The steadiness of the observed shock and ablation fronts within ~1% has been verified. The shocked foam plasma is strongly coupled, with plasma parameter $\Gamma \approx 1$. The Hugoniot data inferred from our velocity measurements agree with the predictions of the SESAME and CALEOS equation-of-state models near the highest pressure ~9 Mbar and density compression ratio ~5. In the lower pressure range 2 to 5 Mbar, a lower shock density compression is observed than that predicted by the models, see the Figure. Possible causes for this discrepancy are discussed. We will also report on planned experiments on lower density foams, such as those relevant to dynamic hohlraum systems, as well as the design of spectroscopic measurements to determine temperature for further comparisons of thermodynamic properties with various EOS models.



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