

Abstract for an Invited Paper  
for the SHOCK11 Meeting of  
The American Physical Society

**Time resolved small angle x-ray scattering measurements in foams and metals loaded in high rate compression**

JAMES M. MCNANEY, Lawrence Livermore National Laboratory

Nanofoams are valuable for high energy density physics experiments because they provide a convenient method to vary density without changing atomic number. Characterizing the performance of low-density materials under extreme conditions provides crucial feedback concerning the reliability of existing models and insight to develop materials with optimal properties. The significant momentum present in these dynamic compaction events make it difficult to study the evolution of such systems ex-situ and experimental information is lacking. Likewise, the early stages of void formation in dynamically driven spall are difficult to observe experimentally. We have developed the capability to measure small angle x-ray scattering using a single x-ray pulse at the Advanced Photon Source. Two areas of keen interest, considered in this work, are the shock-induced collapse of the void structure in highly porous solids and shock-induced nucleation and growth of microvoids in metals. In solid density metal foils we have seen changes in scattering corresponding to the passage of the compression wave, subsequent formation of a tensile region in the material and eventual return to the uncompressed lattice. The small induced scattering signals seen indicate that, for the low compressive stresses and pure foils investigated here, few voids nucleate. The data support the notion that the void formation and growth is rapid. In contrast, carbon based foam materials begin with significant levels of scattering and, during compression, a decrease in the total scattering intensity and the average pore diameter are observed which is consistent with a collapse of the pore structure in the nanoporous carbon. Evolution of the foam structure continues during release of the compression wave due to the break up of the nanoporous carbon.