Abstract Submitted
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Direct comparison of computations and experiments on void collapse in PMMA over a range of loading conditions.[1] NIRMAL RAI, University of Iowa, EMILIO ESCUARIZA, DAN EAKINS, The University of Oxford, H.S. UDAYKUMAR, The University of Iowa — Pore collapse in energetic materials under shock loading leads to hotspot formation and reaction initiation. Depending on the strength of the shock, the collapse mode can vary from weak to strong jet formation. For shock strengths comparable to the yield stress of the material, the strength of the material (strain rate dependency, anisotropy etc.) affects the collapse mode and energy localization collocates with adiabatic shear bands. For high strength shocks, the collapse proceeds with a strong material jet formation. In the previous work, this shift in collapse mechanism has been studied in HMX using meso-scale simulations. However, this transition in collapse modes has not been analyzed/observed using physical experiments. In the present work, a coupled simulation and experiment approach has been pursued to explain the transition in collapse mechanisms in PMMA that exhibits rate dependent strength behavior similar to energetic crystals. It is observed that PMMA shows similar transition behavior as HMX, varying from a shear-band localized collapse mode to jet collapse with increasing shock strength. Using scaling analysis, the effect of various collapse modes on the hotspot shape and temperature is quantified. Direct, head-to-head comparison of pore collapse characteristics are demonstrated across a wide range of loading conditions. This work therefore provides crucial insights for modelers of energetic material response to shock/impact loading.

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Nirmal Rai
University of Iowa

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