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Novel PBX formulations containing thermally-expandable microspheres for on-demand control of explosive behavior[1] AMANDA DUQUE, BRIAN PATTERSON, LINDSEY KUETTNER, WILLIAM PERRY, JOSEPH MANG, Los Alamos National Laboratory — Here, we present the formulation and analysis of inert Plastic-Bonded eXplosive (PBX)-surrogates loaded with thermally expandable microspheres (TEMs). TEMs consist of a thermoplastic acrylonitrile shell (10-50 microns) encapsulating a low boiling hydrocarbon. Upon heating, the TEMs expand as the shell softens while the hydrocarbon gasifies, increasing the internal pressure and expanding the particle by as much as 120 vol%. We hypothesize that TEM expansion within a PBX will introduce tunable changes in local density and porosity, and ultimately the shock sensitivity. This paper focuses on microstructural details of surrogate PBX-TEM formulations, both before and after thermally-induced TEM expansion. The formulations were analyzed by scanning electron microscopy (SEM), ultra-small angle neutron scattering (USANS), and X-ray Computed Tomography (x-ray CT) under various thermal conditions. In parallel, the overall design is guided by πSURF, a recently developed hydrodynamic burn model that provides predictive capability for shock initiation response, based partly on a statistical characterization of the microstructure. Both experimental and numerical analysis suggests that TEM expansion within a PBX is a viable method to impart microstructural changes that are predicted to have a measurable, on-demand effect on the initiation sensitivity. Future work includes development of PBX-TEM formulations with HMX and shock initiation experiments.

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