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Investigating Deformation and Mesoscale Void Creation in HMX Based Composites using Tomography Based Grain Scale Finite Element Modeling DAVID J. WALTERS, DARBY J. LUSCHER, VIRGINIA MANNER, JOHN D. YEAGER, BRIAN M. PATTERSON, Los Alamos National Laboratory — The microstructure of plastic bonded explosives (PBXs) significantly affects their macroscale mechanical characteristics. Imaging and modeling of the mesoscale constituents allows for a detailed examination of the deformation of mechanically loaded PBXs. In this study, explosive composites, formulated with HMX crystals and various HTPB based polymer binders have been imaged using micro Computed Tomography (μCT). Cohesive parameters for simulation of the crystal/binder interface are determined by comparing numerical and experimental results of the delamination of a polymer bound bi-crystal system. Similarly, polycrystalline samples are discretized into a finite element mesh using the mesoscale geometry captured by in-situ μCT imaging. Experimentally, increasing the stiffness of the HTPB binder in the polycrystalline system resulted in a transition from ductile flow with little crystal/binder delamination to brittle behavior with increased void creation along the interfaces. Simulating the macroscale compression of these samples demonstrates the effects that the mesoscale geometry, cohesive properties, and binder stiffness have on the creation and distribution of interfacial voids. Understanding void nucleation is critical for modeling damage in these complex materials.

David Walters
Los Alamos National Laboratory

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