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Relative importance of plasticity and fracture/friction in ignition of polymer-bonded explosives (PBXs) AMIRREZA KEYHANI, The George W. Woodruff School of Mechanical Engineering,Georgia Institute of Technology, YASUYUKI HORIE, (ret.) Air Force Research Lab, Munitions Directorate, MIN ZHOU, The George W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology — The ignition of energetic materials (EM) under dynamic loading is mainly controlled by localized temperature spikes known as hotspots. Hotspots occur due to several dissipation mechanisms, including viscoplasticity, viscoelasticity, and internal friction along interfaces and crack surfaces. To analyze the contributions of these mechanisms, we carry out a computational study of the damage evolution, energy dissipation, and ignition behavior polymer-bonded explosives (PBXs) with different levels of plasticity in their energetic grains. The analysis uses a Lagrangian cohesive finite element framework (CFEM) that explicitly accounts for finite-strain elastic-viscoplasticity, viscoelasticity, crack initiation and propagation, contact, friction, heat generation, and heat conduction. To determine the ignition, a criterion based on a hotspot size-temperature criticality threshold obtained from chemical kinetics calculations is used. It is found that samples with higher levels of plasticity (lower yield strengths) are less likely to ignite due to interplays among the dissipation mechanisms. In particular, calculations show that plastic deformation reduces fracture and subsequent heating caused by friction along crack faces, leading to lower temperature in hotspots.

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