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Heating in Microstructures of HMX/Estane PBX during Dynamic Deformation[1] ANANDA BARUA, MIN ZHOU, Georgia Institute of Technology — The thermomechanical response of HMX/Estane over a range of initial temperatures (210 - 300 K) and strain rates (10^4 - 10^5 s^{-1}) is analyzed using a Lagrangian cohesive finite element method (CFEM) framework. The analysis focuses on the correlation between grain-level failure mechanisms and the overall response. Digitized micrographs of actual PBX materials are used. Calculated results show a transition in failure mode from brittle fracture at temperatures below the glass transition temperature (T_g) of the binder to shear band formation at temperatures above T_g. At the same level of overall deformation, earlier fracture and more severe temperature rises are observed in the grains for lower initial temperatures due to more brittle responses of the binder. Enhanced frictional heating along crack surfaces resulting from the failure contributes to the more severe heating. On the other hand, transgranular fracture is pronounced at higher strain rates, owing to the viscoelastic nature of the binder. The size and distribution of hot spots are quantified over the ranges of initial temperature and strain rate considered. The results are useful in establishing microstructure-performance relations of advanced energetic materials.

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