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An anisotropic thermodynamically consistent elastoviscoplastic model of HMX under quasi-isentropic compression.[1] XINJIE WANG, YANQING WU, FENGLEI HUANG, WEIJIA HU, Beijing Institute of Technology — An anisotropic thermodynamically consistent elastoviscoplastic model for β-HMX is developed to analyze the anisotropic thermomechanical responses under isentropic compression loading. The model considers anisotropy, nonlinear elasticity, and dislocation-based plasticity. The calculated results agree well with isentropic compression experimental wave profiles of (011) and (010) oriented HMX single crystals at pressures up to 12 GPa. The model can well capture the isentropic elastic limit, stress relaxation and steeper plastic wave speed in thick samples. Nonlinear elasticity by both pressure-dependent elasticity tensor and the complete equation of state is responsible for the transition from isentropic wave to shock wave. Pure isentrope is decoupled from quasi-isentrope which is commonly measured by isentropic compression experiments. Distinct detailed mesoscale dislocation activities on seven slip systems were analyzed. Anisotropic temperature rises contributed by pressure-volume work and dislocation based plasticity work were obtained and the effect of heat conduction was analyzed. Results provide insights into understanding the shock formation and predicting ignition sensitivity of explosives at the mesoscale.

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