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Shock Compression and Release of a-axis Magnesium Single Crystals: Anisotropy and Time-Dependent Elastic-Inelastic Response[1] P. RENGANATHAN, J. M. WINEY, Y. M. GUPTA, Washington State University — To understand the role of crystal anisotropy on shock-induced inelastic deformation in hexagonal close-packed metals, magnesium (Mg) single crystals were subjected to shock compression and release along c- and a-axes to 3.0 and 4.8 GPa elastic impact stresses. Wave profiles, measured using laser interferometry, showed a sharply peaked elastic wave followed by a plastic wave and time-dependent response. Compared with c-axis Mg, the elastic wave amplitudes for a-axis Mg were lower and less attenuation of the elastic wave amplitude was observed. The featureless release wave for a-axis Mg was in marked contrast to the structured features observed for c-axis Mg. Numerical simulations, using a time-dependent anisotropic modeling framework, showed that the wave profiles calculated using either prismatic slip or $(10\bar{1}2)$ twinning, individually, do not match the measured a-axis compression profiles but a good match is obtained when both are incorporated together. In contrast, prismatic slip alone provides a reasonable match to the measured release wave profiles. The experimental results and the corresponding simulations for c- and a-axis Mg demonstrate the important role of crystal anisotropy on the time-dependent inelastic deformation response of shocked and released Mg single crystals.

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