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Deformation twinning in a polycrystalline magnesium alloy during dynamic compression CALEB HUSTEDT, Johns Hopkins University, JEFFREY LLOYD, Army Research Laboratory, PAUL LAMBERT, VIGNESH KANNAN, Johns Hopkins University, DANIEL CASEM, Army Research Laboratory, K.T. RAMESH, Johns Hopkins University, NICHOLAS SINCLAIR, Washington State University, RICHARD BECKER, Army Research Laboratory, TODD HUFNAGEL, Johns Hopkins University — We report the results of combined in situ x-ray diffraction studies and crystal plasticity modeling of deformation twinning in polycrystalline magnesium during dynamic compression. Diffraction experiments were conducted at the Dynamic Compression Sector (DCS) of the Advanced Photon Source, on magnesium alloy (AZ31B) specimens (with various crystallographic textures) loaded at strain rates of ˜1000 s^{-1} in a compression Kolsky bar. The diffraction patterns, recorded with temporal resolution of 5-10 microseconds, provide information about the evolution of crystallographic texture during deformation, which we interpret in terms of the twinning mechanism (so-called "extension" or "tensile" twinning). We compare our observations quantitatively with predictions of the evolution of crystallographic texture from an efficient reduced crystal plasticity model. This model explicitly accounts for basal slip and extension twinning on a rate-independent basis, but treats other mechanisms (pyramidal and prismatic slip) as isotropic, rate-dependent functions. This combination yields substantial improvements in efficiency over full crystal-plasticity models while retaining key aspects of the most important deformation mechanisms.

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