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## Kinetics of twinning in magnesium under dynamic loading

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### ABSTRACT

Twinning is an important mode of deformation in many HCP materials including magnesium (Mg) and its alloys. Twinning in this material leads to important effects such as mechanical anisotropy, texture evolution, tension–compression asymmetry, and sometimes non-Schmid effects. Dynamic loading can introduce further complexity in the deformation behavior. The growth of twins takes place by the motion of the twin boundary (TB). Tension twins in Mg can accommodate considerable amounts of plastic deformation as they grow, and this affects the overall rate of plastic deformation. Detailed understanding of the kinetics of TB motion will enable us to work towards achieving the overarching goal of microstructural design of materials for performance. We undertake an experimental approach to gain insight into the kinetics of TB migration under dynamic loading. To achieve this goal we performed normal plate impact recovery experiments with microsecond pulse durations on pure polycrystalline Mg specimens. Estimates of average TB velocity under the known impact stress are obtained by characterization of twin sizes and aspect ratios developed within the target during the loading pulse. The measured average TB velocities in our experiments are of the order of several meter per second. These velocities are several orders of magnitude higher than those measured in Mg under quasi-static loading conditions. Further, twin nucleation and growth processes are investigated by conducting experiments with different durations of the loading pulse. This is achieved by using Mg specimens of different thicknesses. Electron back scattered diffraction is used to characterize the nature of the twins, microstructure, and twin fraction evolution. Detailed crystallographic analysis of the twins enables us to correlate the TB velocities to the twin variants.