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Real-time observation of twinning in shocked and released c-axis Mg single crystals using synchrotron x-ray diffraction[1] Y. M. GUPTA, STEFAN TURNEAURE, P. RENGANATHAN, J. M. WINEY, Washington State University — Recent wave profile measurements on shocked and released c-axis Mg crystals exhibited an unusual feature during unloading; the complete loading/unloading wave profiles were matched using a phenomenological model with dislocation slip during compression and twinning during unloading [Winey et al., JAP 117, 105903 (2015)]. In this work, multi-frame Laue x-ray diffraction measurements were performed on shocked and released c-axis Mg crystals at the Dynamic Compression Sector to directly examine twinning in real-time. Pulsed broadband x-rays (153.4 ns between pulses) passed through a polycarbonate impactor and a c-axis Mg crystal. For x-ray diffraction images obtained during plastic shock wave propagation through the Mg crystal, the same Laue spots seen at ambient conditions were observed, but with significant broadening consistent with dislocation slip during shock compression. For x-ray diffraction images obtained after unloading onset, a number of new Laue spots were observed which are consistent with the expected twin variants for shocked/released c-axis Mg. Although crystal twinning has long been considered as a likely stress relaxation mechanism competing with dislocation slip in some classes of materials, direct real-time observation of twinning has been lacking. This work demonstrates that the new capabilities at the Dynamic Compression Sector provide direct observations of twinning evolution in dynamically compressed crystals.

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