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Grain-level microstructural changes in shock-compressed polycrystalline Al: use of multi-frame synchrotron x-ray diffraction[1] STEFAN TURNEAURE, Y. M. GUPTA, Washington State University — Grain-level microstructural changes were examined in shock-compressed polycrystalline Al samples using multi-frame x-ray diffraction measurements at the Dynamic Compression Sector (Advanced Photon Source, Argonne). Polycrystalline Al samples with different grain sizes were impacted with LiF(100) impactors resulting in impact stresses from 5.5-12.7 GPa. Pulsed x-rays (153.4 ns between pulses) passed through the LiF impactor, the polycrystalline Al sample, and an Al(100) single crystal x-ray window bonded to the rear surface of the polycrystalline Al sample. The x-rays were incident on the target at an angle of 30 degrees to the impact surface. Four x-ray diffraction images were obtained during shock-compression and unloading. Fine grained polycrystalline Al samples (<5 micrometer grains) were initially textured and no changes to the initial texture were observed either during compression or during unloading. For larger grained samples (˜34 micrometer grain size), x-ray diffraction spots from individual grains were observed in unshocked samples. In shock-compressed Al, the diffraction spots from the individual grains grew in size such that they were largely overlapping indicating grain substructure development during shock compression. These experiments demonstrate the ability to examine the time-evolution of grain-level microstructural changes (texture and substructure evolution) in shock compressed polycrystalline materials at the Dynamic Compression Sector.

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