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Dislocation Compression and Recovery Mechanisms in Shock-Recovered Al Single Crystals from White Beam Diffraction* R. BARABASH, G. ICE, ORNL, J. BELAK, M. KUMAR, LLNL, J. ILLLAVSKY, APS — A spatially resolved diffraction method with a sub-micron beam is applied to characterize both the dislocation structure and strain gradients in shock-recovered samples of Al (123) single crystal. Complementary OIM and SEM analysis were performed. The microbeam-Laue diffraction reveals several distinct zones located at different depths under the shock front. Pronounced streaking of Laue images are observed in the zones close to the front and back surface, consistent with a single slip mode. The portion of geometrically necessary dislocations reduces with depth while the portion of statistically stored dislocations increases. The Al sample was shocked to incipient spallation fracture and the Laue diffraction in the region of void formation shows a peculiarly complicated shape. To get a better understanding of the reasons for such a complex shape, 3D depth resolved measurements were performed. These measurements showed that in the central region alternating local lattice rotation takes place. This is due to the inhomogeneous plastic deformation surrounding each void. The density and organization of dislocations is presented as a function of depth under the shock front as well as comparison to SEM on the same samples. * This work was performed by DOE, at LLNL under Contract W-7405-Eng-48, at ORNL under the Contract DE-AC05-00OR22725 and at APS under Contract No. W-31-109-ENG-38.

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