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Dislocation Mechanics Under Extreme Pressures RONALD ARMSTRONG, University of Maryland, WERNER ARNOLD, TDW-MBDA Systems, Germany, FRANK ZERILLI, NSWC IHD, Maryland — The shock-induced plasticity of copper, Armco iron, and tantalum materials is attributed to strain rate control by a substantial dislocation density being generated at the shock front. A thermal activation type constitutive equation is employed for the dislocation generation based on achievement of a limiting small activation volume for the process. A linear dependence of the equivalent compressive stress on logarithm of the plastic strain rate is predicted. The prediction compares favorably with Swegle-Grady and Meyers measurements previously fitted to a power law relationship. For Armco iron and tantalum, control is matched with a dislocation description of deformation twinning at the shock front. By comparison, the uniform shock-less loading in an isentropic compression experiment (ICE) provides for plastic strain rate control by the drag-resisted movement of mobile dislocations within the resident dislocation density.

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