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Strain Rate Effects in Shock and Quasi-Isentropic Compression of Solids[1] R. RAVELO, University of Texas- El Paso, B.L. HOLIAN, T.C. GERMANN, Los Alamos National Laboratory — We report on large-scale non-equilibrium molecular dynamics (NEMD) simulations of shock and quasi-isentropic compression (QIC) in defective copper crystals. The atomic interactions were modeled employing a well-tested embedded-atom method (EAM) potential for Cu. We examined the deformation mechanisms and material strength for strain rates in the range of 10^9 - 10^{12} s^{-1}, a regime relevant to the validation of material strength models. For samples with a relatively low density of pre-existing defects, the strain rate dependence of the flow stress follows a power law with an exponent of 0.40. On the other hand, for samples with a higher density of pre-existing defects, the flow stress exhibits a narrow linear regime at strain rates above 10^9 s^{-1} and then bends over at higher strain rates in a manner reminiscent of shear thinning in fluids. Both the NEMD shocks and QIC show behavior similar to sheared fluids, which can be described by the Ree-Eyring theory of non-Newtonian viscous flow.

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