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Modeling the Plastic Response of Single Crystals to High Strain Rate Deformation CURT BRONKHORST, Los Alamos National Laboratory, BENJAMIN HANSEN, University of New Mexico, IRENE BEYERLEIN, ELLEN CERRETA, DARCIE DENNIS-KOLLER, Los Alamos National Laboratory — A new metallic single crystal model based upon statistical average dislocation interactions is presented. This model includes motion of dislocations becoming drag-limited rather than thermally activated, requiring a physical transition in the average dislocation motion with strain-rate. Based upon the dislocation dynamics work of Wang, Beyerlein, and Lesar, plastic deformation evolution is based on statistical dislocation populations and the evolution of those populations. Three main dislocation populations are considered: 1) glissile dislocations (ρ_{M}); 2) glissile dislocations, which currently do not move referred to as "pile up" (ρ_{P}), and 3) sessile dislocations (ρ_{D}). Mobile dislocations (ρ_{M}) move through the crystal and are blocked by obstacles, react and annihilate, react and become sessile, or exit the region. The motivation to model the distribution of dislocation velocities is used to create the simplest distribution of two populations moving at two velocities. Results of single-crystal tensile simulations using the new model at various rates are compared to copper experiments. The key findings are: 1) a single-crystal model capable of transitioning from low to high strain rates, and 2) prediction of the transition from thermally activated to drag-dominated strain rates. Further investigation is easily adaptable in the model.

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