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MESOSCALE MODELING OF BACK STRESS, DYNAMIC RECOVERY, AND GRAIN SIZE EFFECTS

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ABSTRACT.
Metallic materials under plastic deformation produce abundant defects that localize in patterns of high and low densities. These mesoscale structures promote internal stresses known as back stresses that are heterogeneous and long-range in nature and have a significant effect on the macroscopic response under monotonic and cyclic loading. The magnitude and direction of the back stresses depend on the spatial characteristics of the structure and evolve according to dynamic recovery processes that control dislocation density localization. This talk will present a physic-based back stress formulation that depends on mesoscale structures and Eshelby inclusion formalism. The formulation has been linked to phenomenological hardening-recovery back stress formulations, and it can explain the dependence of flow stress on grain size.