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Modeling the Evolution of Subsurface Microstructures During Wear of Metal Single Crystals[1] CORBETT BATTAILE, SOMURI PRASAD, JOSEPH MICHAEL, Sandia National Laboratories — Friction can lead to complex mechanical and microstructural evolution near the worn surface, and these changes can impact the properties of the material. Recent results from tribological experiments on nickel single crystals reveal the formation of microstructural features ranging from nanometers (very near the surface) to microns in size. The formation and mechanical response of these zones is sensitive to crystallography, and can dramatically alter the frictional properties of the material itself. We have modeled these phenomena using a combination of dislocation plasticity, microstructure formation, and grain boundary sliding. The loading conditions are adopted from an analysis of static frictional contact. A phenomenological treatment of wear debris and asperity-mediated contact is included to appropriately describe the mechanical mixing that occurs very near the contact interface. We will provide an overview of the experimental evidence, discuss the wear model in detail, and present results for kilocycle wear on nickel single crystals in different crystallographic orientations.

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