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Decomposition of Dislocation Densities at Grain Boundary in a Finite-Deformation Gradient Crystal-Plasticity Framework

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Keywords: Grain Boundary; Gradient Crystal Plasticity; Finite Deformation; Dislocation Transmission

Abstract

The microscopically powerless boundaries are studied based on a finite-deformation gradient crystal-plasticity model which comprises energetic and dissipative governing components. The innovative feature in the present study includes a decomposition of dislocation densities at the boundary which provides a distinct observation of dislocation transmission through the boundary. Here, the relative orientation of the grain boundary to the grains is taken to account. Moreover, a misconception in the literature which renders micro-free GB as a GNDs-free interface is addressed. In addition, a boundary layer is employed and enforces the dislocations to flux only in the tangential direction at the micro-hard boundary as observed in experiments. Numerical results show the effect of powerless boundary conditions, transmission of plastic flows and accumulation of GNDs in polycrystals.

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