

FTMP-based Modeling and Simulation of Magnesium

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The present study proposes a constitutive model for deformation twinning which taking account of the twin degrees of freedom via incompatibility tensor model based on Field Theory of Multiscale Plasticity (FTMP). The model is introduced in the hardening law in the FTMP-based crystalline plasticity framework, which is further implemented into a finite element code. Deformation analyses are made for pure single crystal magnesium with HCP structure, and the descriptive capabilities of the proposed model are confirmed based on critical comparisons with experimental data under plain-strain compression in multiple orientations, available in the literature. The simulated results are demonstrated to successfully reproduce the unique stress-strain responses induced by twinning. The evolution of the relative activities of the various slips, and twin mechanisms for each orientation are extensively examined.

Keywords: Deformation twinning, Crystalline plasticity, Multiscale modeling, Field theory, Magnesium