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Abstract

One of the most critical issues in development of micromechanics models for TWIP steel is to establish the continuum constitutive model which can accurately represent and model the characteristic plastic deformation at macro level. However, the uncertainty in describing the evolution of state variables based on crystal plasticity theory poses a great challenge in handling the complex plastic deformation with different deformation mechanisms and their complicated interactions and interplays at microscopic scale and thus becomes a non-trivial issue. Many attempts to address this issue by coupling slip and twinning or slip and transformation have been proven to be efficient via comparing and corroborating the predicted texture evolution using crystal plasticity theory with experiment. An accurate constitutive model, however, needs to be established to articulate and model the interactions of slip, twinning and transformation, which have been observed in experiment. In this paper, a micromechanics model for modeling of slip, twinning and transformation induced plasticity of twinning-induced plasticity (TWIP) steel is proposed by using the crystal plasticity approach. The model serves as a feasible approach to reflecting the micro deformation mechanisms during the plastic deformation process of TWIP crystals. The phase transformation is introduced and represented by the rate-dependent constitutive model. The algorithms for realization of the developed model are implemented in ABAQUS/Standard