Study of twinning behaviour in titanium under different loading paths

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Abstract

The deformation behavior of commercially pure titanium under different loading paths was studied experimentally and theoretically using the crystal plasticity model VPSC. Compression was applied along sample symmetry directions for different loading paths. An EBSD-based analysis of the distribution of boundary misorientation angles before and after reload was developed to analyze the evolution of {10-12} tensile and {10-22} compression twins and their effect on the reload response of the aggregate. A de-twinning and double-twinning model accounting for back stress effects (1) was implemented within the framework of the visco-plastic self-consistent (VPSC) model along with a dislocation density (DD) based hardening scheme (2). In the model, plasticity was accommodated by prismatic , basal and pyramidal slip modes, and {10-12} tensile and {10-22} compression twinning modes. The VPSC model predicts the evolution of twinning, de-twinning and double-twinning processes for both tensile and compression twinning modes under different loading paths. The model predicts macroscopic stress-strain response, texture evolution, and twin volume fraction that are in good agreement with experimental data. The evolution of texture is investigated in detail by separately analysing the twinned domains, rather than the evolution of the global texture.

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