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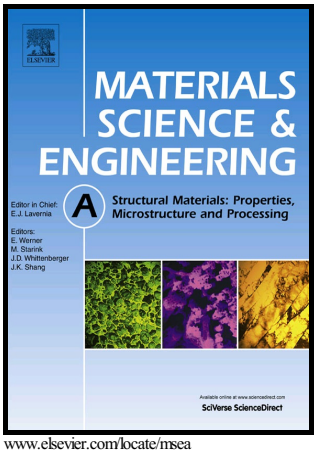

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Anisotropic twinning and slip behaviors and their relative activities in rolled alpha-phase titanium

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Abstract

Loading-direction-dependent anisotropic behaviors of twinning and dislocation slip of rolled alpha-phase titanium (α-Ti) were investigated via uniaxial compression tests performed along three orthogonal directions (the rolling direction (RD), transverse direction (TD), and normal direction (ND)). The initial texture with basal poles inclined at ~30° from the ND toward the TD caused the angle relationship between the *c*-axis and the loading axis, which governed the Schmid factor (SF) for twinning and slip systems, to differ with the applied loading direction. Analyses of the SF and Taylor axis along with electron backscatter diffraction measurements revealed the dominant deformation mechanisms to be {10-12} twinning and prismatic slip under compression along the RD and TD and {11-22} twinning and basal slip under compression along the ND. Calculation of twinning strain and analysis of the in-grain lattice rotation angle revealed that the relative contribution of twinning to deformation increased in the order of ND > RD > TD, but that of prismatic slip decreased in the order of ND < RD < TD. These results demonstrate that activations of twinning and slip systems and their relative activities vary significantly with the applied deformation direction owing to the preferred crystallographic orientation of the initial material.

Keywords: Titanium, Deformation; Twinning; Dislocation slip; Anisotropy.