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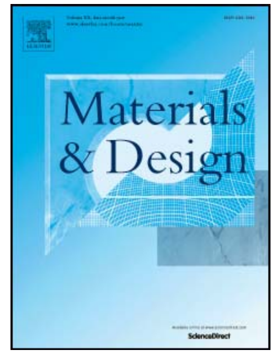

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Predicting the effects of microstructural features on strain localization of a two-phase titanium alloy

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Abstract

Strain localization influenced by microstructural features has an important effect on mechanical properties of α+β titanium alloy. To address the effect, a microstructure-based finite element model is established. In this model, regions for primary α (α_p) and transformed β matrix (β_t) are generated from real microstructures of a two-phase titanium alloy (TA15 alloy); the plastic flow behaviors of these two features are determined directly rather than from single phase alloy. A constitutive equation of α_p is developed with consideration of dislocation-obstacle interaction, whereas the constitutive equation of β_t is determined by nanoindentation tests. Finally, the calculated stress-strain responses of the alloy are verified by experiments. The simulated results show that strain localization bands (SLBs) have two morphologies: short and long-continuous SLBs. Lots of short SLBs appear mainly in β_t and α_p when the volume fraction of α_p is small and moderate, respectively. Long-continuous SLBs appear mainly in α_p when the volume fraction of α_p is large. With the increase of α_p in SLBs, the strength of the alloy decreases while the ductility increases. By decreasing the disparity of strength between α_p and β_t, the strain gradient in SLBs reduces and the ductility of the alloy increases.

Keywords: Strain localization; Titanium alloy; Constitutive equation; Finite element analysis.