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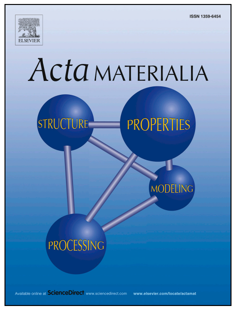

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Conventional vs Harmonic-structured β-Ti-25Nb-25Zr alloys: a comparative study of deformation mechanisms

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Abstract

Harmonic alloys processed by powder metallurgy are constituted by a core of coarse grains embedded in an interconnected small grains shell. They have attracted attention due to their excellent strength combined with large ductility, the two properties being rather antagonist from the classical metallurgy point of view. In contrast, conventional β-Ti alloys are currently vastly studied owing their excellent properties especially for biomedical applications. In the present study, we explore at the micron scale the deformation mechanisms operating both in standard and harmonic-structured β-Ti-25Nb-25Zr alloys using transmission electron microscopy (TEM). Although we show some similarities, deformation mechanisms appear significantly different due to the activation of martensitic transformation in conventional samples. The combined use of automated crystal orientation in TEM and in-situ TEM straining reveals that deformation bands nucleate and grow according to a mechanism involving both martensitic transformation and twinning. The comparison between in-situ and post-mortem experiments shows globally a good agreement and highlights a strain relaxation mechanism between martensite and twin. More importantly, a cross-glide mechanism similar to what is observed in dilute solid solutions is proposed to explain the dynamics of dislocation motion. Stress estimations derived from the observations of dislocation curvature

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