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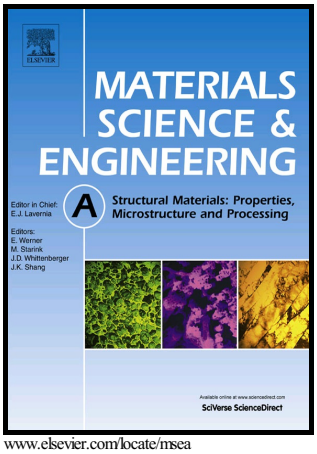

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Ultra-grain refinement and enhanced low-temperature superplasticity in a friction stir-processed Ti-6Al-4V alloy

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Abstract

An ultrafine microstructure consisting of α grains (~0.51μm) and a small amount of β phase was successfully achieved in a friction stir-processed (FSPed) Ti-6Al-4V alloy. The fraction of high angle grain boundaries (HAGBs) with random crystallographic orientations reached 89.3% revealed that dynamic recrystallization was responsible for the ultra-grain refinement mechanism during friction stir processing (FSP). Low-temperature superplasticity (LTSP) of such an ultrafine microstructure was demonstrated in the temperature range of 550~650 ℃ and strain rates of 1×10^{-4} to 3×10^{-3} s^{-1}. Specifically, an extremely superior LTSP of 1130% was achieved at 600℃ and 3×10^{-4} s^{-1}, which was explained by means of the ultrafine equiaxed grains, a large proportion of HAGBs with random orientations as well as the presence of β phase. The predominant superplastic deformation mechanism was considered as grain boundary sliding associated with grain boundary diffusion.