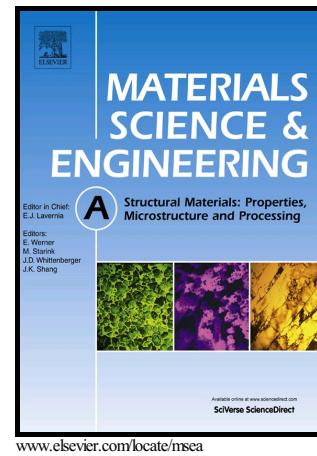


Author's Accepted Manuscript

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PII: S0921-5093(18)30345-9
DOI: <https://doi.org/10.1016/j.msea.2018.03.009>
Reference: MSA36202

To appear in: *Materials Science & Engineering A*

Received date: 7 February 2018

Accepted date: 2 March 2018

Cite this article as: Wenjing Zhang, Hua Ding, Minghui Cai, Wenjing Yang and Jizhong Li, Ultra-grain refinement and enhanced low-temperature superplasticity in a friction stir-processed Ti-6Al-4V alloy, *Materials Science & Engineering A*, <https://doi.org/10.1016/j.msea.2018.03.009>

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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 ($\sim 0.51\mu\text{m}$) 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 °C and strain rates of 1×10^{-4} to $3\times 10^{-3} \text{ s}^{-1}$. Specifically, an extremely superior LTSP of 1130% was achieved at 600°C and $3\times 10^{-4} \text{ s}^{-1}$, 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.

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