Thermal stability of an ultrafine grained Ti-6Al-4V alloy during post-deformation annealing

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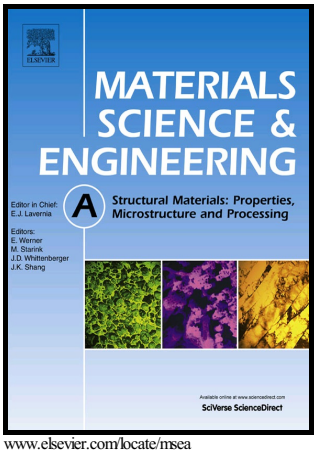

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PII: S0921-5093(17)30394-5
DOI: http://dx.doi.org/10.1016/j.msea.2017.03.082
Reference: MSA34865

To appear in: *Materials Science & Engineering A*

Received date: 23 February 2017
Accepted date: 22 March 2017

Cite this article as: Qi Chao, Peter D. Hodgson and Hossein Beladi, Therma stability of an ultrafine grained Ti-6Al-4V alloy during post-deformatio annealing, *Materials Science & Engineering A* http://dx.doi.org/10.1016/j.msea.2017.03.082

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Abstract

In the current study, a Ti-6Al-4V alloy plate with a supersaturated martensitic starting microstructure was initially warm rolled, producing a gradient ultrafine-grained (UFG) microstructure throughout the thickness: fully equiaxed UFG in the surface layer and a combination of UFG and elongated grains in the center layer. The thermal stability of the warm rolled UFG microstructures was then investigated through the course of post-deformation annealing treatment. Upon annealing, the fully UFG surface layer experienced concurrent α grain growth and β precipitation (i.e. partitioning), whereas the center layer revealed the replacement of partially fragmented α lath by equiaxed grains, most likely through static recrystallization. With increasing annealing time, the overall texture characteristics were mostly preserved for both surface and center layers, apart from a gradual strengthening of the (0°, 0°, 30°) texture component in the surface layer at the expense of the (0°, 0°, 0°) and (0°, 90°, 0°) components. The current post-deformation annealing treatment led to an enhanced tensile elongation of the alloy at the expense of strength, with an increase in the annealing time.

Keywords: titanium alloys; ultrafine-grained materials; annealing; recrystallization; texture evolution; mechanical property