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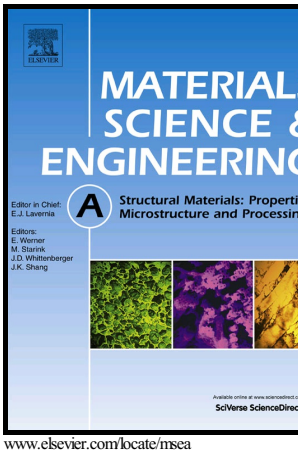

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Tracking microstructure, texture and boundary misorientation evolution of hot deformed and post-deformation annealed Ti-6Al-4V alloy

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Abstract: The microstructure and texture of the two phase Titanium alloy Ti-6Al-4V is profoundly affected by its thermomechanical history. We performed compression tests on double cone samples to characterize the effects of strain and deformation speed on globularization of the lamellar microstructure, crystallographic texture and boundary misorientation development. Globularization is enhanced as strain increases and by post-deformation heat treatment. The morphology and crystallographic texture of the lamellae varies with strain: the lamellae gradually orientate perpendicular to the deformation direction, as do the basal planes. In contrast, the globular grains have a much weaker basal transverse texture after deformation. Post-deformation annealing has little effect on the texture for both the non-broken lamellar and globularized grains but it does increase the texture intensity of both structures and sharpen the basal transverse texture for the globularized grains. This implies that any modification of texture in this alloy must be conducted during deformation. The misorientation peaks which dominate the misorientation distribution of the initial colony lamellar microstructure are replaced mostly with lower angle boundaries in the lamellar microstructure and then with rather uniform distribution of high angle boundaries as strain increase. After post-deformation annealing, these peaks re-appear due to the increased presence of secondary alpha (transformed beta) phase caused by the annealing condition selected. A simple processing design chart was also established to identify microstructure and texture development with respect to percentage of reduction for hot compression at 850^{o}C.

Keywords: Titanium alloy; Microstructure; texture evolution; double-cone; annealing.

Introduction

Ti-6Al-4V is a two phase Titanium alloy widely used in aerospace because of its favorable corrosion resistance and mechanical properties that can be manipulated by varying the thermomechanical processing. The alloy's duplex microstructure obtained via thermomechanical processing confers advantages in terms of yield stress, ductility, crack nucleation resistance and micro-crack propagation resistance because of smaller α colony size and such microstructure was usable for most applications [1]. Before obtaining the duplex microstructure, the initial microstructure of Ti-6Al-4V ingot is generally made of colonies of