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Texture evolution and Dynamic Recrystallization in a Beta Titanium Alloy during Hot-Rolling Process

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Abstract:

Crystallographic texture evolution in a β-titanium alloy (Ti-15Mo-3Al-2.7Nb-0.2Si) during hot-rolling process is investigated. The results reveal that the shear strain in the surface area leads to weakening of texture intensity, that in turn gives rise to formation of significant through-thickness texture gradients. It is observed that the dynamic recrystallization (DRX), during the hot-rolling, occurs and is accompanied with the other weakening of deformation texture. The mechanism of the formation and evolution of the DRX grains, revealed by EBSD analysis, suggests that the weakening of the texture is associated with the rotation of the DRX grains towards the preferred slip systems having large misorientations between themselves.

Keywords: β-titanium, hot-rolling, inhomogeneity texture, dynamic recrystallization

1. Introduction

Beta type titanium alloys are not only capable of retaining 100% β when quenched from the β phase field, offering an excellent processability [1], but also achieve significantly high strength by separating out the α phase when aging at α+β phase field [2, 3]. The high specific strength reached by β-titanium makes it widely used in both the aerospace and automotive industries, especially in manufacturing the fasteners [4]. Particularly, the intrinsic high longevity and biocompatibility of the β-titanium alloys also make them extensively employed for biomaterials [5].

The rolling process, especially shape rolling, is widely utilized in material processing for manufacturing fasteners and bio-implants [6]. It is well known that plastic deformation in metallic materials can result in microstructure and texture changes of materials, which can further alter their phase transformation behaviors and mechanical properties [7]. Thus, a number of comprehensive studies have been carried out on the formation and evolution of microstructure and texture during rolling process in β-titanium alloy [7-13]. However, most of these works have concentrated on the plate/strip rolling process. Little attention has been given to the shape rolling process, such as the bar rolling process, in which the deformation state of the workpiece between