Superplasticity of Ti-6Al-7Nb Alloys with Different Initial Microstructures Processed by High-Pressure Torsion

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Recently, superplastic elongation has been reported for a biomedical Ti-6Al-7Nb alloy processed by High-Pressure Torsion (HPT) [1]. However, the effect of the initial microstructure of this material on the microstructural evolution by HPT processing has not been studied systematically. HPT is a method of severe plastic deformation used to produce nanostructures in metallic materials which may lead to enhanced properties [2]. Thus, this work is motivated to study further the modification of the internal structure by HPT processing of the Ti-6Al-7Nb alloy following different heat treatments. Discs with 10mm diameter were treated at various transformation temperatures followed by quenching at different cooling rates. The discs were then processed by HPT at room temperature under a pressure of P=6 GPa for N=1 and N=5 revolutions at an angular velocity of 1 rpm. Tensile specimens were extracted from the discs and deformed in tension at 800 ºC using an initial strain rate of 2×10^{-3} s^{-1}. Microstructural analyses were performed by optical microscopy, scanning electron microscopy with electron back scatter diffraction (EBSD) and transmission electron microscopy (TEM) as well as phase analyses by X-Ray Diffraction. Enhanced grain refinement in a martensitic α' phase, as well as the highest elongation to failure of ~600% was achieved after N=5 revolutions in the structures quenched from 1060 ºC in liquid nitrogen. TEM and EBSD analyses on the failed specimens with superplasticity showed that the metastable structure achieved by quenching transformed to a stable α+β structure after tensile testing and grain coarsening occurred near the fractured tip of the specimen in comparison with the grip portion.

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