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International Conference on

Materials Science and Engineering

July 23-25, 2018 | Moscow, Russia

From porous to dense nanostructured β-Ti alloys through high-pressure torsion

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β-Ti alloys have low elastic modulus, good specific strength and high corrosion resistance for biomaterial applications. Noble elements, such as Nb, Ta and Mo, are used to obtain β-Ti due to their chemical biocompatibility. However, due to their refractory nature, β-Ti requires specific processing routes. Powder metallurgy (P/M) allows for the development of new β-Ti alloys with decreasing costs but dealing with high-elemental-content alloys can lead to a lack of diffusion and grain growth. One method to refine the structure and improve mechanical properties is a severe plastic deformation technique through high-pressure torsion (HPT). The aim of this work was to evaluate the conversion of P/M porous β-Ti-35Nb-10Ta-xFe alloys to dense nanostructures through high-pressure torsion in one deformation step and the influence of the structure variation on the properties and microstructure. TEM analysis and ASTAR crystallographic mapping was utilized to characterize the nanostructures, and the properties of P/M β-Ti-35Nb-10Ta-xFe alloys processed by HPT were compared. The initial microstructure consisted mainly by the β-Ti phase with some α-Ti phase at the grain boundaries. The HPT process refined the microstructure from 50 μm (P/M) down to nanostructured grains of approximately 50 nm.

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