Title: Phase transformations in ultra-fine grained titanium alloys

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Abstract:

Ti15Mo alloy in a metastable β solution treated condition was processed by high pressure torsion (HPT) and equal channel angular pressing (ECAP). The microstructure after HPT is severely deformed and ultra-fine grained, while ECAP deformation results in rather coarse-grained structure with shear bands containing high density of lattice defects. Two types of thermal treatments – isothermal annealing and linear heating - were carried out for the solution treated condition and both deformed materials. Wide spectrum of experimental techniques was employed to elucidate the differences in phase transformations, especially in α phase precipitation, occurring in deformed and non-deformed material upon thermal treatment.

It was shown that the α phase precipitation is accelerated in the deformed materials due to a high density of lattice defects, which provide a dense net of preferred sites for nucleation and also fast diffusion paths necessary for accelerated growth. The enhanced precipitation of the α phase in deformed materials also affects the stability of the ω phase, promoting its dissolution. Moreover, in contrast to the non-deformed materials, where α particles form as elongated precipitates along grain boundaries and as lamellae, in deformed counterparts the α precipitates remain equiaxed.

Keywords:

metastable β titanium alloy; severe plastic deformation (SPD) methods; phase transformations; α phase precipitation