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## VIII ВСЕРОССИЙСКАЯ НАУЧНО-ПРАКТИЧЕСКАЯ КОНФЕРЕНЦИЯ С МЕЖДУНАРОДНЫМ УЧАСТИЕМ, ПОСВЯЩЕННАЯ 50-ЛЕТИЮ ОСНОВАНИЯ ИНСТИТУТА ХИМИИ НЕФТИ

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# GRAIN CHARACTERISTICS AND MECHANICAL PROPERTIES OF BIOINERT Ti-40 WT. %Nb ALLOY

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Advanced developments in up-dated implants impose new requirements not only in furthering rest-hardening, but also in designing new materials with low elastic modulus level. The most preferable ones are valve metals of titanium, zirconium and niobium and their alloys. This, in its turn, allows the distributions of deformation and strain on bone-implant interfaces and excludes possible breakdown at rigid fixation of the implant to the bone. Elastic modulus for most titanium alloys ranges from 100 to 120 GPa and is more than that of bones (15–50 GPa) [1]. Accordingly, a perspective trend in medical materials technology is the development of biocompatible titanium alloys with low elastic modulus, for example, Ti–Nb alloy systems. Titanium alloyed by niobium 40-45 wt. % could decrease the elastic modulus up to 60 GPa.

Severe plastic deformation (SPD) methods promote the production of ultrafine-grained billets with significantly high mechanical properties in comparison to their coarse-grained analogues [2]. Usually, ultrafine-grained state in metals and alloys is attained by combining two or more different SPD methods.

This paper focuses on the development of microstructure grain characteristics and mechanical properties (microhardness) of bioinert ultrafine-grained Ti-40 wt. % Nb alloy. The ultrafine-grained structure with average structure elements size of 0.3 μm alloy was produced by two-stage severe plastic deformation (SPD). SPD method included the multiple abc-pressing and multi-pass rolling in grooved rolls at room temperature and further pre-recrystallization low-tempereture annealing. In ultrafine-grained state Ti-40 wt. % Nb alloy had a structure represented by β-phase grains with ellipsoidal particles of ω-phase, localized in the bulk of β-grains, and α-phase subgrains.

It was shown that a relatively large amount of micron grains and subgrains in the alloy structure were produced by SPD method. Grain misorientation angle of the sample, the grain distribution, phase distribution were studied by electron backsatter diffraction EBSD-method. Many local deformation bands and sub-grain formation were caused during SPD. Local shear zone, twins and low-angle grain boundaries were created in meantime. The misorientation angles less than 6.45 ° account for 53.8% of the alloy. It plays a strong role for improving the material strength. Microhardness of the alloy increased from 1730 MPa up to 3000 MPa. Ultrafine-grained Ti-40 wt. % Nb alloy is β-phase alloys. In the alloy the proportion of α-phase (3.3%) much proportion of β-phase (96.7%). The misorientation angles less than 6.45 ° account for 53.8% of the alloy. It is clear that slip of dislocation is the base mechanism of deformation in the alloy. Measured elastic modulus of ultrafine-grained alloy is to less then 60 GPa.

Thus, the ultrafine-grained Ti-40 wt. % Nb alloy has low elastic modulus and good mechanical properties, compared with ones of biomedical medium-strength titanium alloys.

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