OBTAINING OF BIOINERT ALLOY WITH LOW YOUNG'S MODULUS AND PRODUCTS FOR MEDICAL APPLICATIONS BY SELECTIVE LASER MELTING

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Ti-Nb alloys are perspective materials for implants production. Due to their features alloys of Ti-(40-50) wt. % Nb have Young's modulus close to that of bone tissue. Selective laser melting (SLM) allows obtaining low-modulus Ti-Nb alloys and parts of them. SLM significantly reduces material consumption and allows controlling shape, size and porosity of produced items. Change of SLM parameters affects the size of structural elements and phase composition of resulting product. By using methods of mathematical simulation of physical processes it is possible to predict SLM-modes necessary for production of the item with certain properties.

By the molecular dynamic methods, the model of processes at laser beam influence on separate particles of metallic powders was created. The mathematical two-dimensional model of laser alloying of composite Ti-Nb powder layer on the Ti substrate was suggested. It was shown that melting kinetics has a great influence on the SLM process dynamics. The 3-D specimens of Ti-(40-50) wt. % Nb alloy were obtained in Yurga Institute of Technology (Russia) on "VARISKAF-100MVS" installation and in Tomsk Polytechnic University on "LUCH" installation. To produce the specimens composite powder of titanium and niobium was obtained by mechanical alloying of titanium and niobium powders mixture in AGO-2S ball mill (AltSTU, Barnaul, Russia) and was layered on titanium substrate. The microstructure of 3-D specimens was investigated by methods of optical metallography (OM) on AXIOVERT-200MAT microscope in bright-field and DIC (differential interference contrast) and on Zeiss Axio Observer microscope, transmission electron microscopy (TEM) on JEM-2100 microscope and scanning electron microscopy on SEM 515 Philips microscope. Change of elemental composition was evaluated by energy dispersive microanalysis. Evaluation of phase composition was carried out by the method of X-ray diffraction analysis (XRD) on DRON-7 (Burevestnik, Russia) in CoK_{α}-radiation and on Shimadzu XRD-6000 (Shimadzu, Japan) in CuK_{α}-radiation. Such physical mechanical properties as nanohardness and Young's modulus were investigated on NANO Hardness Tester NHT-S-AX-000X. The microhardness was measured on DURAMIN-5. The research was conducted in CCU "Nanotech", Institute of Strength Physics and Materials Science (ISPMS), SB RAS and TRCCU National Research Tomsk State University (Tomsk).

The results of investigation have shown that Ti-(40-50) wt. % Nb alloy obtained by SLM-method has a structure represented by two-phases. They are the main β-solid solution of titanium and niobium and α"-martensite phase. The microstructure contains zones with fine and medium grains. The Young's modulus changes due to the change of elemental composition and SLM-mode in the range of 55-90 GPa.

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