# TOWARDS DEVELOPMENT OF PERSONALIZED IMPLANTS WITH ANTIBACTERIAL BIOACTIVE COATING BY THE SELECTIVE LASER MELTING AND RF MAGNETRON SPUTTERING METHODS

*Prosolov K.A.[1,2,a], Khimich M.A.[1,3,b], Ibragimov E.A.[2,c], Kovalevskaya Z.G.[1,2,d], Saprykin A.A.[2,e], Sharkeev Yu.P.[1,2,f]*

[1]Institute of Strength Physics and Materials Science Siberian Branch of Russian Academy of Sciences, Tomsk, Russia
[2]National Research Tomsk Polytechnic University, Russia
[3]National Research Tomsk State University, Russia
[a]konstprosolov@gmail.com, [b]khimich@ispms.tsc.ru, [c]egor83@list.ru, [d]kovalevskaya@ispms.tsc.ru, [e]sapraa@tpu.ru, [f]sharkeev@ispms.tsc.ru

Ti-Nb system alloys are very promising material in the field of dentistry and orthopedics. Those alloys have a special mechanical property of reduced Young's modulus values in the range of (40-50) wt% Nb concentration in comparison to the other metallic implants made of steels, titanium alloys or Co-Cr alloys [1]. Also both Ti and Nb have an inherent property to be covered by the thin native oxide layer. As it is mentioned in the literature this layer provides the desired biocompatibility [2]. As Ti-Nb alloy has reduced Young's modulus it could be a promising solution to the problem of stress-shielding effect that is nowadays extensively researched. Thus, the use of Ti-Nb alloys in the field of tissue engineering is important and production of low modulus alloys is vital for the advances in the field of implantology and orthopedics.

Selective laser melting (SLM) is one of the methods of additive manufacturing. This method is cost effective and environmental friendly as it uses only necessary quantity of initial material and all the waste product could be recycled and used again. SLM could be advantageous for the personalized medical implants manufacturing, as it allows production of the material of special, unique and personalized size and shape especially designed for the needs of the exact patient. The SLM allows controlling the structural state (porosity, microstructure, etc.) of the produced implants. Moreover, this method allows formation of non-equilibrium phase state in the produced metallic products due to the high heating, melting, crystallization and cooling rates. So, due to the amount of features provided by SLM one can produce special porous medical implant made of Ti-Nb alloy with low Young's modulus and desired phase composition [3].

However, none of the metallic materials can provide bioactivity that has become recently important for the field of tissue engineering. It is crucial when we are taking in account the number of revision surgeries that are made due to the aseptic loosening of the implant or infection in the implantation site. Those challenges could be addressed by the deposition of bioactive coatings on the surface of metallic implants.

From the various methods of coating deposition for medical implants, radiofrequency (RF) magnetron sputtering is providing the best adhesion to substrate and many more useful features needed for the biomaterials production. Such as, for example, close resemblance of deposited coating and sputtered target. This is a viable factor when it is important to deposit a coating containing small volume of dopants that provide desired property of the thin film. With this method we were able to deposit thin Zn substituted hydroxyapatite coatings on the Ti-Nb SLMed samples.

As it was previously discussed [4], Zn is an essential element for bone remodeling and could also provide some antibacterial properties. In our work we used various analytical methods such as scanning electron microscopy, energy-dispersive microanalysis, x-ray diffraction analysis, transmission electron microscopy, the macro- and microstructure, phase and elemental composition were studied. The produced Ti-Nb alloy specimens are porous with the rough surface. The alloy is represented by two-phased state and has reduced Young's modulus of 82 GPa. The bioactive coating homogeneously covered the complex shape of the manufactured samples repeating the topology of the surface. The elemental composition of the coatings is presented by a Ca/P ratio which lays in between from 1.3 to 1.7 in our case.

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