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Functionalization of the Surface of Porous Titanium Nickel Alloy

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Abstract : The preferred materials for bone grafting are titanium-nickel alloys. They have a porous, permeable structure similar to that of bone tissue, can withstand long-term physiological stress in the body, and retain the scaffolding function for bone tissue ingrowth. Despite the excellent functional properties of these alloys, there is a possibility of post-operative infectious complications that prevent the newly formed bone tissue from filling the spaces created in a timely manner and prolong the rehabilitation period of patients. In order to minimise such consequences, it is necessary to use biocompatible materials capable of simultaneously fulfilling the function of a long-term functioning implant and an osteoreplacement carrier saturated with drugs. Methods to modify the surface by saturation with bioactive substances, in particular macrocyclic compounds, for the controlled release of drugs, biologically active substances, and cells are becoming increasingly important. This work is dedicated to the functionalisation of the surface of porous titanium nickelide by the deposition of macrocyclic compounds in order to provide titanium nickelide with antibacterial activity and accelerated osteogenesis. The paper evaluates the effect of macrocyclic compound deposition methods on the continuity, structure, and cytocompatibility of the surface properties of porous titanium nickelide. Macrocyclic compounds were deposited on the porous surface of titanium nickelide under the influence of various physical effects. Structural research methods have allowed the evaluation of the surface morphology of titanium nickelide and the nature of the distribution of these compounds. The method of surface functionalisation of titanium nickelide influences the size of the deposited bioactive molecules and the nature of their distribution. The surface functionalisation method developed has enabled titanium nickelide to be deposited uniformly on the inner and outer surfaces of the pores, which will subsequently enable the material to be uniformly saturated with various drugs, including antibiotics and inhibitors. The surface-modified porous titanium nickelide showed high biocompatibility and low cytotoxicity in in vitro studies. The research was carried out with financial support from the Russian Science Foundation under Grant No. 22-72-10037.

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