Summary

The limitation of use of titanium alloys for long-term implants subjected to variable loads is, in addition to the phenomenon of metallosis, their relatively low friction wear resistance. The process of tribological wear on the surfaces of the co-operating elements of the cooperating pair reduces the service life of the artificial joints, which is most often the cause of the revision surgery, as a result of the loosening of the prosthetic support elements and the destruction of the implant as a result of the friction phenomenon of the co-operating elements of the implant.

The Ti-13Nb-13Zr alloy is one of the most promising new-generation titanium alloys, its composition includes elements well tolerated by the living organism, has a lower Young's modulus compared to other metallic biomaterials, and is characterized by much higher biocompatibility and corrosion resistance than the Ti-6Al-4V titanium alloy.

Based on the analysis of previous studies, the following thesis of this thesis was formulated: the modification of the Ti-13Nb-13Zr surface layer by ion implantation will improve the selected usability (wear resistance by friction, hardness, surface roughness and Young's modulus) Its intensity of wear through friction in the studied biotribological system. The scientific purpose of this work was to determine the influence of applied parameters of ion implantation process on microstructure and selected properties of Ti-13Nb-13Zr alloy. In addition, the influence of the use of nitrogen ions on the Ti-13Nb-13Zr alloy layer on wear resistance by friction and wear pattern of the biomaterial studied. The purpose of this work was to determine the influence of the implantation process with nitrogen ions to the Ti-13Nb-13Zr alloy on its durability and to determine the possibility of applying Ti-13Nb-13Zr alloy to the steam vapors

In the hip endoprosthesis after implantation with nitrogen ions into its top layer the microstructure and performance characteristics of the Ti-13Nb-13Zr surface layer after carbon implantation (C) and nitrogen (N) implantation confirmed positive effects of carbon implantation (C) and nitrogen (N) on its microstructure, surface roughness, Young's modulus, an increase in seizure resistance, and an increase in surface hardness and wear resistance by friction. The process of implantation with nitrogen ions into the Ti-13Nb-13Zr alloy affects the formation of nanocrystalline TiN in the surface layer of the melt tested. In contrast, implantation with carbon ions to Ti-13Nb-13Zr alloy using ion implantation parameters did not influence the formation of TiC type precipitates. The modified Ti-13Nb-13Zr alloy surface layer after ion implantation with nitrogen and carbon at the highest ion implantation application rates / cm^2 is characterized by high nanohardness. The Ti-13Nb-13Zr alloy layer is characterized by a lower Young module compared to the Ti-13Nb-13Zr alloy in delivery, which is a beneficial effect of ion implantation. The modified Ti-13Nb-13Zr alloy layer showed a decrease in Young's modulus value with increased implantation rates for both nitrogen and carbon ions. On the basis of the obtained results of resistance tests on the concentrated contact of the modified Ti-13Nb-13Zr alloy surface, it was noted that Ti-13Nb-13Zr alloy samples after ion implantation using ionic doses: $4x10^{17}$ N^+/cm^2, $8x10^{17}$ N^+/cm^2 and $1x10^{17}$ C^+/cm^2, $4x10^{17}$ C^+/cm^2 showed high seizing resistance of the implanted surface layer compared to the Ti-13Nb-13Zr alloy sample in delivery condition and ion implantation samples at lower ionic strengths/cm^2, as confirmed by macroscopic and microscopic observations Samples after tribological tests where almost invisible traces of friction were observed. The significant utility of biomaterials for the steam vapor is their wear resistance through friction. Implantation with nitrogen ions to Ti-13Nb-13Zr alloy increased the wear resistance through friction in the examined friction nodes, and also the durability of the tested biotribology system.