

The subject of the present project concerns the modification of the surface of Ti6Al7Nb titanium alloy using the dry etching technique, allowing the shaping of its topography in accordance with the geometry of the mask used in process.

Its aim is to examine the influence of parameters of the etching process in fluorine-based plasma (such as: negative self-bias, pressure, temperature of substrates), implemented to create on the surface of the alloy the assumed shape with defined dimensions, on the obtained etching profiles and the selected physicochemical, mechanical and biological properties. Specified types of geometric surface structures will be obtained using masks made of materials with high resistance to fluorine-based plasma activity, characterized by various metal fiber configurations or microgeometry obtained, for example, in laser ablation processes.

The plasma-etched surfaces will be characterized in terms of microstructure, morphology and surface geometrical structure using a number of methods widely used in surface engineering. They will allow to determine the basic parameters characterizing the processes of plasma etching, which include: assessment of the anisotropy index, selectivity and etch rate. Special emphasis will be put on the chemical composition of the modified surfaces. After the process some residues from the etching processes can be found, which are the products of chemical reactions of the base material and the mask with the gaseous working atmosphere. Therefore, the surface of modified substrates will be analyzed using a number of solid state physics methods, that allow the analysis of chemical and phase composition.

The modified substrates will be subjected to basic parameters analysis which include: physicochemical properties (wettability and free surface energy), mechanical properties (hardness, level of residual stress), tribological properties (coefficient of friction and resistance against wear) or biological properties (cell proliferation tests, studies of the effect of the pattern geometry on cells growth).

The dry plasma etching process itself is the source of information on the etching mechanisms of titanium alloys using different gas atmospheres and process parameters. The results of the tests, enabling dynamic control of the chemical composition and thermodynamic parameters of the glow discharge plasma, will contribute to a better understanding of the dry etching process and, at the same time, to a better description and better control of the phenomena occurring in respect to the individual process parameters.

The topography of the material surface has a significant impact on many of its functional properties. Its significant role has been observed in the friction and wear processes of surfaces cooperating under rolling and sliding friction conditions, as well as on deformation and contact stiffness. The surface topography affects the concentration of stress and fatigue strength, corrosion resistance, tightness of connections, vibration damping as well as contact resistance. It was also shown the effect on magnetic properties, the phenomenon of reflection and absorption of waves (light, electromagnetic, etc.), adhesion and strength of applied coatings.

In addition, surface topography plays an extremely important role in the aspect of biological properties of materials, including determining the process of adsorption of proteins or affecting the effectiveness of the osseointegration process, and ultimately stabilizing medical implants.

The possibility of controlled shaping of the topography through the plasma etching of titanium alloys, the material so widely used in the technique, undoubtedly has enormous cognitive potential and provides the opportunity to influence the development of science in the field of surface engineering.