DOI: 10.34854/ICPAF.52.2025.1.1.164

MODIFICATION OF TITANIUM NITRIDE THIN FILMS BY PULSED ARC EVAPORATION OF PLATINUM FOR PACEMAKER ELECTRODES COATINGS *)

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Scientific research is being conducted in the laboratory of laboratory of coating technologies NRC “Kurchatov institute” as part of the project "Development of Technologies for Controlled Thermonuclear Fusion and Innovative Plasma Technologies", aimed at creating coatings that are promising for use in implantable medical devices, in particular, as coatings for electrodes of pacemakers [1].

Currently, Pt or Pt-Ir alloys are widely used as materials for pacemaker electrodes. Along with the materials above, thin films of titanium nitride are of great interest due to the simplicity of the method of production, for example, by magnetron sputtering of titanium in nitrogen and the possibility of forming a developed surface with a high value of effective surface. Electrochemical processes occurring in the double electric layer (DEL) in the area of electrode contact with myocardial tissue expose the electrode surface to negative effects, mainly oxidation, as well as hydrogen adsorption. The implementation of platinum into the coatings of implantable medical devices leads to an increase in corrosion resistance and stability of electrochemical parameters throughout the service life [2].

In order to determine the effect of platinum on the functional properties of titanium nitride thin films, thin-film layers of titanium nitride were formed by reactive magnetron sputtering and their modification was carried out by pulsed arc evaporation of platinum. The comparative analysis of the coatings was conducted based on the impedance spectroscopy results and the resource testing of electrode prototypes.

For platinum deposition, a pulsed arc evaporator (PAE) was used, designed in the laboratory of coating technologies of the NRC “Kurchatov institute”. The principle of operation and design of the PAE using a target made of a 950 platinum alloy with a diameter of 25 mm, make it possible to create flows of ionized target material with a diameter of 220 mm, forming a thin-film layer on the surface of the substrate at a speed of 3 nm/min at a distance of 320 mm.

Electrochemical studies and resource tests of titanium nitride thin films and films modified with platinum compounds were carried out at the Admittance device and the potentiostat – galvanostat P-45X. Resource tests made it possible to assess the condition of the coating after passing through the sample such an amount of charge that passes through the cardiac electrode during operation in the human body for several years. The reversibility of electrochemical reactions accompanying the flow of electric current through the sample was evaluated by the kind of cyclic volt-ampere characteristics of the tested coating samples.

References

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