Abstract

In the context of this doctoral dissertation, research was conducted with the aim of utilizing insoluble compounds of zinc, copper, and silver in the process of electrochemical plasma oxidation to obtain porous oxide layers on titanium alloys surfaces characterized by antibacterial properties.

The first stage of the research involved determining the optimal parameters for the electrochemical plasma oxidation process, such as voltage and current density. Scanning electron microscopy was used to determine the morphology of the obtained surfaces, which, in combination with X-ray energy dispersive spectroscopy and roughness measurements of the surfaces, allowed for the selection of the most suitable current conditions for the electrochemical plasma oxidation process.

A series of following studies were conducted using the other insoluble compounds of zinc, copper, and silver. The physicochemical characterization of the obtained oxide layers included measurements of contact angle, oxide layer thickness, and Raman spectroscopy. The release of zinc, copper, and silver ions was determined through long-term immersion studies in a Ringer's solution. The bacteriostatic properties of the created coatings were confirmed in studies of bacterial adhesion, involving *Staphylococcus aureus* ATCC 25923 and *Escherichia coli* ATCC 25922. Additionally, cytocompatibility studies of the modified surfaces were performed. As a result, it was confirmed that oxide layers containing elements such as zinc, copper, and silver represent an innovative direction in the development of implantable biomaterials. The electrochemical plasma oxidation process allowed for the production of layers with increased porosity, roughness, and hydrophilicity, which supported their bioactivity and proper integration with bone tissue. The addition of antibacterial elements contributed to the improvement of the bacteriostatic properties of the obtained coatings.