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Electrophoretic deposition and characteristics of chitosan/AgNPs coatings on the Ti13Zr13Nb alloy

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Introduction: The surface of materials intended for implants is modified, among others to improve their biocompatibility and providing protection against bacteria. It is important to provide long-term protection against bacterial colonization, hence intensive work on the production of coatings that will release the drug substance in a controlled manner. Chitosan belongs to the group of so-called "intelligent" biopolymers, because it reacts to pH changes. Chitosan coatings can therefore be a matrix that will release the drug substance when the inflammation occurs, which is associated with a decrease in the pH value of the environment of peri-implant tissues.

Methodology: As part of this work, chitosan coatings with silver nanoparticles were produced by electrophoretic method on the surface of the Ti-13Zr-13Nb titanium alloy, previously anodized electrochemically to obtain a nanotube oxide layer. Microstructure, morphology and phase composition were examined with scanning electron microscopy and X-ray diffractometer. The mechanical behavior was studied by nanoindentation and nanoscratch tests. The silver dissolution rate in simulated body fluid was measured with atomic absorption spectrometry.

Results: The produced nanotubes were highly ordered. The average diameter of nanotubes was about 40 nm, while their length - about 1 μ m. The obtained composite coatings were characterized by high homogeneity, silver nanoparticles were quite evenly distributed in the coating, however, they tended to form agglomerates. Mechanical tests showed that the coatings are characterized by relatively high values of parameters such as: hardness and Young's modulus, (1.24 \pm 0.16) GPa and (52.29 \pm 3.73) GPa respectively. The adhesion of the coatings to the substrate was also satisfactory. The mean value of the critical force resulting in the total removal of the composite coating from the substrate was (155.03 \pm 29.89) mN. The concentration of released silver reached a level sufficient to combat bacteria.

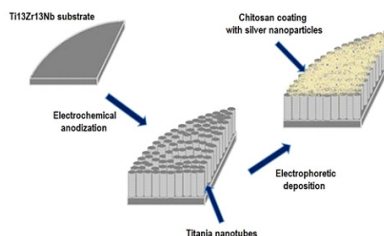


Figure 1. Graphical abstract

Biography

Lukasz Pawlowski is PhD student at Gdansk University of Technology, Department of Materials Engineering and Bonding, Biomaterials Group, Poland. His doctoral thesis concerns surface modification of titanium alloys mainly by electrophoretic deposition of composite coatings, which release drug substance in a controlled manner.

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