

OR2303

Biocompatible Coatings with Antibacterial Effect Produced by Pulsed Electrospark Deposition

Evgeny Levashov¹, Evgeniya Zamulaeva², Alexander Sheveiko², Natalia Litovchenko², Dmitry Shtansky², Natalia Glushankova³

¹National Univ of Science and Techn MISiS, Moscow, Russian Federation ²National University of Science and Technology "MISIS", Moscow, Russian Federation ³Blokhin Russian Cancer Research Center, Moscow, Russian Federation

levashov@shs.misis.ru

Composite electrodes Ti-Ti₃P-CaO, TiC_x-Ti₃PO_x-CaO, TiC_x-Ti₃PO_x-CaO-CoTi, TiC_x-Ti₃PO_x-CaO-CoTi-Ag₇Ca₂ and others were synthesized by sintering, combustion synthesis and used in pulsed electrospark deposition (PED). Coatings deposited using the Ti-Ti₃P-CaO electrode onto Ti substrate mainly consisted of TiO_x phase and Ti solid solution. When the TiC_{0.5}-Ti₃PO_x-CaO electrode was used, TiC_x phase was additionally observed. The Co-free coatings contained 0.2-0.9 at.% of Ca and 0.6-1.0 at.% of P. Addition of Co improves mass transport from electrode to substrate and leads to an increased Ca (1.5-2%), P (0.8-1.2%), and Ag (0.8-1.1 at.%) contents. It was shown that interaction between anode and cathode resulted in the formation of secondary structures both on the electrode working tip and in the coating. Three main phases were observed in coatings deposited in air and in water: (1) Ti solid solution; (2) composite structure Ti-TiC(N)-Ag; (3) nano- sized particles of TiO_x and complex oxide of Ca and Ag.

Optimal pulsed energy provided the deposition of layer with a thickness 20-30 μm, hardness 10-12 GPa, roughness Ra=1,9 μm. The coating structure and composition were well characterized using SEM, XRD, Fourier transform infrared spectroscopy, Raman spectroscopy, and glow discharge optical emission spectroscopy. The coatings were also characterized in terms of their mechanical and tribological properties. Bioactivity of coatings were evaluated in vitro using SBF and compared with that of bioactive glass Biogran. The results showed that the PED coatings were bioactive, induced the formation of an apatite layer during exposure in SBF, and provide antibacterial properties due to the presence of Ag in the required quantity.

Keywords

electrospark
deposition
structure
mechanism
biocompatibility