Evaluation of physical and chemical properties of biodegradable polymer coatings containing hydroxyapatite and active substance

Abstract

The doctoral dissertation addresses the modification of anodically oxidized Ti6Al7Nb titanium alloy for osteosynthesis implants. Despite its popularity, due to its degradation in the tissue environment and the resulting release of degradation products into the body, it is necessary to ensure its biocompatibility by surface modification. Another major problem associated with surgical treatment of fractures is the high risk of peri-implant infections and contamination, which can lead to impaired bone fusion, prolonged recovery time and decreased patient comfort. In order to reduce these problems, it was proposed to modify the surface by applying a biodegradable polymer coating containing hydroxyapatite and an active substance (dexamethasone).

Implementation of the developed research program made it possible to evaluate the physical and chemical properties of the biodegradable polymer coating containing dexamethasone and hydroxyapatite, and to assess its suitability for implant applications in orthopedics and traumatology. In order to implement the undertaken subject matter, physical and chemical properties, corrosion resistance, cytotoxicity and pro-inflammatory cytokine determination were carried out for the coating applied by ultrasonic spraying. The obtained coating is characterized by continuity, homogeneity and good adhesion to the substrate. In addition, it exhibits hydrophilic properties. The applied polymer coating improved the corrosion resistance of the alloy and reduced the amount of alloying element ions penetrating into the environment. The dexamethasone contained in the coating has an effect on reducing the activity of pro-inflammatory cytokines, and the produced coating does not cause a cytotoxic effect.

The results obtained in this study indicate that the PLGA coating, containing HAp and DEX, can improve the biocompatibility of osteostynthesis implants by acting as a barrier to alloy metal ions released from the surface. The coating in question may support the recovery process by lowering the risk of peri-implant infection and reducing the need for systemic pharmacotherapy, as well as stimulating bone fusion by hydroxyapatite released from the surface.