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"Structure and characterization of multifunctional layers on NiTi shape memory alloy"

In the work, a way to modify surface of the NiTi shape memory alloy for medical applications, by producing multifunctional layers composed of titanium oxides and calcium phosphates (CaPs) such as hydroxyapatite (HAp), whitlockite (β-TCP) and biphasic calcium phosphate (BCP), was proposed. Surface modification of the NiTi alloy was performed to improve its biocompatibility while preserving the shape memory phenomena. Titanium oxides layers were obtained using passivation in a steam autoclave while CaPs by electrophoretic deposition (EPD). The realization of the purpose of the work included:

- Characteristics of the materials in the initial state;
- Selection of optimal conditions for the production of TiO_2 / CaPs layers on the NiTi surface;
- Characterization of structure, morphology and topography of produced CaPs coatings;
- Characteristics of mechanical properties of layers such as adhesion and ability of layers to deformation associated with the shape memory effect;
- Determination of an influence of the applied fabrication parameters on the course of the martensitic transformation in NiTi alloy;
- Characteristics of the tendency of layers to corrosion processes in a simulated body fluid;
- Measurements of the surface wettability;
- Characteristics of biological biocompatibility and microbiological activity.
- Selection of conditions for the production of the layers on the implant and its characteristics.

Studies showed that applied electrophoretic deposition method (EPD) enables to produce biocompatible, thin and homogeneously morphologically and structurally phosphate layers on a passivated NiTi alloy. Whitlockite layers subjected to heat treatment at 1000 ° C for 2 hours revealed the best corrosion resistance, however were not resistant to colonization of microorganisms. Deposited BCP layers heat-treated at 800 ° C for 2 hours revealed the best hydrophilic properties, however their low deformation resistance due to induction of shape memory effect disqualifies them for medical applications. Obtained HAp layers after heat treatment at 800 ° C for 2 hours exhibited the best adhesion, ability of layers to deformation associated with the shape memory effect and the highest biocompatibility, making them a potential material for clinical practice applications.