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ABSTRACT

Ceramic coatings with the addition of oxides of reactive elements on metallic substrates for biomedical applications

The aim of the doctoral thesis was to use 316L stainless steel for the production of biomaterials working in an aggressive corrosive environment. The 316L steel substrate was ceramic coated to improve corrosion resistance and reduce the transfer of metal ions into the human body. The ceramic layers were applied by the known sol-gel method. Single and multi-layer and mixed coatings consisting of SiO_2, ZrO_2 and Y_2O_3 were applied. Yttrium oxide belongs to the group of reactive elements. Used in a small amount, it improves the protective properties of 316L steel and helps in the formation of apatite ceramics on the surface.

The doctoral dissertation uses modern research equipment and various research techniques: Scanning electron microscopes (SEM and SEM/Ga-FIB) with an EDS detector, X-Ray photoelectron spectroscopy (XPS), Raman spectroscopy, Inductively coupled plasma optical emission spectroscopy (ICP-OES) and in electrochemical tests: Potentiostat SI 1286. The following tests were also carried out: adhesion – Scratch test, layer thickness measurement with a Reflectometer, roughness measurement on a 3D contact Profilometer. In vitro biological studies were also performed to assess the proliferation and cytotoxicity of MG-63 cells.

As a result of the research presented in the doctoral dissertation, continuous layers with good barrier properties in the environment of body fluids and with good cytotoxicity were obtained. Studies have shown that the SiO_2-Y_2O_3 mixed coatings have the best properties for use as medical implants. The obtained research shows that the produced SiO_2-Y_2O_3 ceramic coatings obtained by the sol-gel method indicate potential commercial use.