Nanostructured Magnesium-Substituted Fluorapatite Coating on 316L Stainless Steel Human Body Implant

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Properties of hydroxyapatite, such as bioactivity, biocompatibility, solubility, and structural properties can be tailored over a wide range by incorporating different ions into hydroxyapatite lattice. In this study Magnesium-substituted fluorapatite coatings with different magnesium content were prepared on 316L stainless steel substrates by sol-gel dip coating method to improve the biological performances of the substrate. Sol-gel dip parameters such as times of dip coating and aging time were optimized to obtain uniform and crack-free coatings. In vitro bioactivity evaluation was performed by immersing the coated substrates in simulated body fluid (SBF) within 21 days at 37±0.5˚C. X-ray diffraction (XRD) and Fourier transformed infrared spectroscopy (FTIR) techniques were utilized in order to evaluate phase composition and functional groups of nanostructured magnesium-substituted fluorapatite coatings, respectively. Scanning electron microscope (SEM) was used to perceive coating morphology. In order to evaluate bioactivity, Mg^{+2} ion concentration in the SBF was measured by inductively coupled plasma optical emission spectroscopy (ICP-OES) and Surface of the samples were studied by SEM to evaluate the precipitated apatite after immersion periods. It was noticed that an aging of 24 h in sol-gel dip coating process was needed to achieve a homogenous and crack-free coating. In addition, when the layers of coating were more than one, the cracks in the coating increased significantly. The magnesium amount in the SBF increased with increasing of immersion period and substitution of Mg^{+2} in the coatings. In vitro bioactivity tests showed that magnesium stimulates apatite formation on the 316L SS coated samples while immersion in the SBF.