Enhancing corrosion resistance and osseointegration of titanium alloys for medical implants: A surface functionalization approach using Plasma Electrochemical Oxidation (PEO) and sol-gel

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As well known, the superior mechanical qualities, biocompatibility and corrosion resistance of titanium alloys make them popular choices for dental and medical implants, which are used to restore form and function by replacing biological structure that has been lost or damaged. In this sense, biomaterials in the dental and osteoarticular fields are helping to improve the quality of life of an ageing population. However, the clinical problems associated with Ti-implants also include delayed biological reactions at the surface, slow osseointegration and bacterial colonization, leading to loosening and loss of implant viability. To achieve multifunctional biological characteristics, this work proposes a surface functionalization method based on electrolytic oxidation (PEO) using a bipolar regime. The PEO layers are sealed with an APTES/TEOS sol-gel layer to improve corrosion resistance and biocompatibility due to the ability to load antimicrobial additives. In this study, the effects of the PEO bath composition and process parameters such as treatment time, current density, frequency and applied voltage were evaluated and correlated with the morphology, microstructure and phase constitution of the PEO layer. Electrochemical impedance spectroscopy (EIS) and polarization curves were used to assess corrosion behavior in a body fluid electrolyte. Contact angle, scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDS) and X-ray diffraction (XRD) were used to study the sealing process and surface morphology.

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