Physical, chemical and topographic characterization of titanium surface oxide layers fabricated by anodic oxidation

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Titanium and titanium alloys have been widely used in orthopeadics and dental implants because of their excellent properties such as low modulus, good fatigue strength, good corrosion resistance and biocompatibility. However, their poor wear resistance still limits their application. When inserted in the oral environment dental implants are under a complex degradation phenomenon as a result of the combined action of chemical and mechanical solicitations, which can result in its failure. The relatively poor wear resistance of titanium may be improved by surface modification, namely by anodic oxidation. Also, as suggested by recent works carried out using animal models, bone regeneration may be enhanced by acting on the surface topography of the implant, essentially if the an oxide is present at the surface.

The present study aims to investigate the surface properties of the anodic oxide films created on c.p. Ti. Oxide films were prepared by anodization (potentiostatic mode) in citric acid with different molar concentration and different applied voltages. The thickness, composition, structure and topography of the prepared films were investigated by XRD, RBS, and AFM. Also electrochemical impedance spectroscopy was used to characterize the original native oxide film before anodization, in comparison with the oxide film after anodic oxidation treatment.

AFM results demonstrate substantial differences on film topography, with an enhancement on surface roughness. Also, changes on structure, thickness and chemical composition of the anodic oxide layers influences the electrochemical characteristics of the films.

Keywords: Dental materials, Titanium, Anodization, EIS.