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Effect of anodizing on surface integrity of Grade 4 Titanium for biomedical applications

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Abstract

Titanium-based alloys are widely used in the biomedical field due to various favourable material properties. These include low density, high corrosion resistance and good mechanical and biocompatible properties. Surface integrity descriptors such as topography, surface chemical composition and aesthetic appearance are important for adequate part performance. Various surface engineering treatments are routinely applied to obtain improved performance. The current investigation examines the effect of anodizing on the oxide layer thickness and composition, surface topography and aesthetic appearance. Anodizing is conducted on especially finished (Sa ± 13 nm) Grade 4 titanium specimen at various voltages in a H_2SO_4 electrolyte. Surface analysis consisted of atomic force microscopy (AFM), scanning electron microscopy (SEM) with energy dispersive spectroscopy (EDS), X-ray diffractometry (XRD) and UV spectrophotometry. The results show that highly-ordered oxide structures in partially anatase and rutile TiO_2 substrates are readily achieved. Various interference colours are readily achieved with different anodizing process parameters. An increase in anodizing voltage leads to layer thickness growth, increased roughness and changes in surface phase composition. An increase in oxide layer thickness is coincident with an increase in surface roughness. Reference is made throughout the paper to the effect of the various surface integrity descriptors measured, on the perceived biomedical effect of implant performance of the specific descriptor in question based on published data.

Keywords: Anodization, sulphuric acid; surface roughness; TiO_2; AFM; titanium alloy and Crystal structure.

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