

Zamen Karm Mekhelf . Corrosion Behavior Of Anodized Titanium Nanotube Used In Implant Materials .University of Technology, Department of Production Engineering and Metallurgy, M.Sc. Supervised by Asst. Prof. Dr. Sami Abulnoun Ajeel Dr. Abdulkareem Mohammed Ali

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Abstract

Surface characterization of titanium implants play an important role in osseointegration, lot of engineering techniques have been applied to improve bioactivity of the implants surface; one of the possible procedures is nanostructuring of the surface that means covering of the implant surface by a layer of nanotubes by using anodization.

The biocompatibility of pure titanium was modified by anodizing the surface. anodization of a pure titanium foil with (99.0166%) purity in an electrolyte solution containing 0.5 wt% NH_4F with 99.5wt% glycerol, anodized at voltages of (10V and 30V) with and without stress relief.

Examinations of surface characterization have been made by using atomic force microscopy (AFM), scanning electron microscopy (SEM), and X-ray diffraction (XRD). Also it was observed that the pore size of the titanium nanotubes in the ranges of (40.82 - 61.23) nm and average surface roughness in the ranges of (1.54 - 5.97) nm were observed by AFM microscopy measurements. The average pore size of titanium nanotubes ranges from 50 to 68 nm and average length of the nanotubes ranges (1.05 - 1.17) μm as indicated by SEM microscopy. XRD showed that the titanium oxide nanotubes arrays have brookite (amorphous) structures for all anodizing specimens with stress relief.

In this research, corrosion behavior of pure titanium and anodizing of titanium in simulated body solutions were studied. The obtained values of the open circuit potential, corrosion potential and corrosion current density which is used to determine the corrosion rates and efficiency in current density for anodized titanium in synthetic plasma blood solution, synthetic saliva solution and normal saline solution; All the test results observed show that titanium anodizing has excellent corrosion resistance in the three synthesized body solutions especially in the synthesized saliva solution.

It was observed that pure titanium records higher corrosion current density (i_{corr}) than anodized titanium in synthetic body solutions, highest corrosion current density was recorded ($8.33 \mu\text{A}/\text{cm}^2$) of pure titanium in normal saline solution. Lowest corrosion current density recorded was ($114.05 \text{ nA}/\text{cm}^2$) for anodized titanium at 10V with stress relief in synthetic saliva solution. SEM examination for specimens after corrosion test reveals the presence of deposited layer on the anodized surface. This may be due to the presence of Ca, O, P, F elements in deposited layer. The results show the anodizing titanium at 10V has the lowest corrosion current density because of the low pores leading to entering solution to the surface of the metal, causing decompose slower than the surface anodizing titanium at 30V. The highest protection efficiency was (97.19%) when using anodized titanium at 10V with stress relief in synthetic saliva solution.

Keyword: implants, osseointegration, bioactivity, biocompatibility, roughness.