# Fabrication Of Nanotube Arrays By Anodization And Their Bioactive Surface On Titanium Alloy


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**ABSTRACT**

In this study, the self-organized titanium nanotubes grown by anodization of commercially pure titanium (c.p. Ti) and Ti alloy were investigated. First, effects of anodization condition such as the electrolyte temperature, pH value, concentration, applied voltage and anodizing time of c.p. Ti were researched. The results indicated that the optimal parameter of electrolyte room temperature、pH value P2、concentration X1 S1 + Y2 S2、applied voltage V3 and anodizing time t9. The anodic oxidation was carried out at V1 or V3 for t9 using a potentiostat. The nanotube arrays were annealed at T1 ℃ for t11, and subsequently immersed in simulated body fluid (SBF) at 37 ℃ for ta, tb and tc days. The purpose of this experiment was to evaluate the apatite-formation abilities of anodized nanotubular Ti alloy and c.p. Ti with different tube diameter and length. The surface morphologies, chemical compositions and phases were investigated using field-emission scanning electron microscope (FE-SEM), energy dispersive spectroscopy (EDS), high resolution X-ray diffractometer (HR-XRD), and X-ray photoelectron spectroscopy (XPS). It was found that, when the anodizing potential was increased from V1 to V3, Ti alloy the single-pore diameter of the nanotube increased from about 23~27 nm to 31~44 nm, and the tube length was increased from about 550±20 nm to 700±20 nm; c.p. Ti the single-pore diameter of the nanotube increased from about 24~30 nm to 35~53 nm, and the tube length was increased from about 590±20 nm to 730±40 nm. Furthermore, the coatings were amorphous in this condition, and that cannot nucleate apatite easily and require crystallization heat-treatments for apatite induction. Amorphous titanium oxide nanotubes were crystallized to anatase by heat-treatment at T1 ℃ for t11. After tc days of soaking SBF, no apatite can be found on the surfaces of untreated Ti alloy and c.p. Ti. In vitro SBF testing of heat-treated nanotube arrays indicated that a quick Ca-P formation on these nanostructures occurred after only ta days of Ti alloy immersion in the SBF, especially for those anodized at V3. Upon immersion of tc days in SBF, the surfaces of Ti alloy and c.p. Ti were entirely covered by apatite. It is worth noting that the anodized Ti alloy had thicker apatite layers than its c.p. Ti counterpart. The thickness of the Ca-P layer increases with increasing applied potential for Ti alloy and c.p. Ti. The average thickness of the Ca-P layer on Ti alloy and c.p. Ti anodized at V1 and V3 was about 200±20 nm to 280±30 nm and 170±20 nm to 190±10 nm after immersion in SBF for tc days, respectively.



Keywords : Titanium alloys、Anodization、Nanotube、Bioactivity、Apatite、Simulated body fluid (SBF)


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