Nanotube Morphology Change of Ti-6Al-4V Alloys by Heat Treatment

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Abstract: In order to investigate nanotube morphology change of Ti-6Al-4V alloys by heat treatments, the Ti-6Al-4V alloys were used in this study. In non-treated Ti-6Al-4V alloy case, nanotubes only exhibited at α phase region with dissolved V-oxide area of β phase. However, in Ti-6Al-4V alloy at 800℃ WQ case, nanotubes exhibited at both α and β phase region. Electrochemical corrosion studies showed that the nanotubular alloy at 800℃WQ possesses slightly higher corrosion resistance than non-treated nanotubular alloy.

1. Introduction

The implant applications are mainly limited to the Ti-6Al-4V alloy and commercially pure titanium (CP-Ti). Ti alloys can be classified into three kinds of phases; α/near-β, α+β, and β alloys. Above all, the α+β alloys are the most widely used, because of the wide range of microstructural features that can be created by different heat treatments. To improve bone tissue integration on Ti implant surfaces, surface modification techniques for nanotubes have been used to increase the roughness. Cell adhesion and proliferation depend on surface roughness. In vitro studies, cell cultured on nanotubular TiO_2 surface showed higher adhesion, alkaline phosphate activity, and bone matrix deposition compared to those grown on no surface treated Ti surfaces.

In this study, we investigated electrochemical behaviors of nanotube formed α-β phase on the Ti alloys in electrolyte and heat treatment effects of Ti alloy microstructures.

2. Experimental

The Ti-6Al-4V alloy for dental implant was used in this study. Heat treatment was carried out for 1 hour at 800 ℃ in the argon atmosphere, followed by water quenching, that will be have a specimen name of 800WQ. FE-SEM with EDS and XRD using a Cu-Kα radiation were used to study the microstructure of the specimens. The formation of nanotube structure was conducted by electrochemical method on Ti-6Al-4V alloy in mixed electrolyte (1 M H_3PO_4+0.8 wt.% NaF) at 30 V for 1 hour. For investigating the corrosion behaviors, all electrochemical methods were carried out using potentiostat (Model 2273, EG&G Co., USA) in 0.9 wt.% NaCl solution at 36.5 ± 1 ℃ to simulated body temperature during all experiments.

3. Conclusion

In non-treated Ti-6Al-4V alloy case, nanotubes only exhibited at α phase region with dissolved V-oxide area of β phase. However, in Ti-6Al-4V alloy at 800℃ WQ case, nanotubes exhibited at both α and β phase region. Electrochemical corrosion studies showed that the nanotubular alloy at 800℃WQ possesses slightly higher corrosion resistance than non-treated nanotubular alloy.

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