

Hydroxyapatite Precipitation Phenomena on Micro-pore Formed Ti-Nb Alloy by PEO technique

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Abstract: The purposed of this work was to observe hydroxyapatite precipitation phenomena on micro-pore formed Ti-Nb alloy by PEO technique. The Ti-30Nb and Ti-30Ta alloys were remelted at least ten times in order to avoid inhomogeneity, and then cylindrical specimens (diameter 10 mm, thickness 4 mm) were cut by using laser from cast ingots of the Ti alloys. Heat treatment was carried out at 1050 °C for 2 h for homogenization in argon atmosphere. The morphologic change of the alloys were examined by X-ray diffractometer (XRD) and field emission scanning electron microscopy (FE-SEM).

1. Introduction

Commercial pure titanium (CP Ti) and Ti-6Al-4V alloy have been widely used for orthopedic implant materials and dental implant materials because of its excellent combination of biocompatibility, corrosion resistance and mechanical properties. However, the Ti-6Al-4V alloy is currently utilized and should be replaced, since the release of Al and V ions causes long-term health problems. And it can also lead to resorption of adjacent bone tissue due to the great elastic modulus difference between the implant and bone. Thus, there are efforts for developing new titanium alloys with non-toxic elements. In our research group, it was reported that Ti-30Nb and Ti-30Ta alloys exhibited very low elastic moduli of 80 and 58 GPa. Also, the electrochemical method for calcium phosphate coatings has been used for surface modification of dental implant and orthopedic fixation devices for improving biocompatibility. It is well known that morphology and properties of electrochemical deposited calcium phosphate strongly depend on the anodizing electrolyte. In this study, hydroxyapatite precipitation phenomena on micro-pore formed Ti-Nb alloy by PEO technique were observed.

2. Experimental

Micro-pore formation was first performed using a potentiostat with a conventional two-electrode configuration at 180-400 V and 30 mA in 0.15 M Calcium acetate monohydrate + 0.02 M Calcium glycerophosphate electrolyte at room temperature for 3 min. Electrochemical deposition of calcium phosphate was conducted at 85 °C in modified simulated body fluid (M-SBF). The electrolyte was prepared by dissolving given amounts of reagent-grade of 5mM $\text{Ca}(\text{NO}_3)_2$ + 3 mM $\text{NH}_4\text{H}_2\text{PO}_4$, 20mM $\text{Ca}(\text{NO}_3)_2$ + 12 mM $\text{NH}_4\text{H}_2\text{PO}_4$, respectively. CV was carried out at 85 °C using the above described three electrode configuration by scanning the potential between 0 V to -1.5 V at scan rate 100 mV/s. The morphology and crystalline structure of nano-phase HAp film on the Ti-xTa Alloys surface were characterized by thin film X-ray diffractometer (XRD) and field emission scanning electron microscopy (FE-SEM). Elemental analysis was performed using an energy dispersive X-ray spectroscopy (EDS).

3. Conclusions

Calcium phosphate coating on anodized Ti alloys were well coated by electrodeposition method. The phase and morphologies of deposits HA were influenced by the electrolyte concentration and current density. (Supported by Innovation and Creativity through the Ministry of Education and National Research Foundation of Korea 2015H1C1A1035241:hcchoe@chosun.ac.kr)

Reference

1. I.S. Byeon, K. Lee, H.C. Choe, W.A. Brantley, Thin Solid Films, 587 (2015) 163-168