

Hydroxyapatite Precipitation Phenomena on Nanotubular Ti-29Nb-xHf Ternary Alloys

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Abstract: In order to investigate on hydroxyapatite precipitation phenomena on nanotubular Ti-29Nb-xHf ternary alloys, Ti-29Nb-xHf alloys contained (0% to 15%) Hf were manufactured using arc melting furnace. Formation of nanotubular structure was achieved by an electrochemical method in 1M H₃PO₄ electrolytes containing 0.8%wt. % NaF. Electrochemical deposition was carried out using cyclic and voltammetry(CV) method at 85°C in 5 mM Ca(NO₃)₂ + 3mM NH₄H₂PO₄. HA coating on nanotube formed Ti-29Nb-xHf ternary alloys showed a good wettability.

1. Introduction

Titanium (Ti) and its alloys are widely used as a dental implant material because of the good mechanical, anticorrosive, and biocompatibility. However, above alloys are also found to release toxic ions into the body. Therefore, some investigators have focused on the Ti alloys that contain non-toxic element such as Nb, Hf, Zr, and Sn for biomedical applications. From the surface treatment of Ti alloy for biomaterial fields, titanium oxide layer has been used to form the nanotubular structure for improving the biocompatibility of implants. The advantage of using TiO₂ nanotubular structure is that it can be grown directly on the Ti and Ti alloys surfaces, by electrochemical methods such as anodic oxidation. Hydroxyapatite (HA, Ca₁₀(PO₄)₆(OH)₂) with characteristic features of a biomaterial, a crystallographic similarity with natural bone minerals, high corrosion resistance and good chemical stability for biomedical application. In this research, HA precipitation coating film can achieve a good adhesion property between nanotubular surface and human bone for biocompatibility.

2. Experimental

In this study, we investigated the hydroxyapatite precipitation phenomena on nanotubular Ti-29Nb-xHf ternary alloys. The Ti-29Nb-xHf contained (0% to 15%) Hf was manufactured by arc melting furnace in argon atmosphere. The specimens were cut from ingots to get disk of 3 mm thickness by high-speed diamond cutting machine. Formation of nanotubular structure was achieved by an electrochemical method in 1M H₃PO₄ electrolytes containing 0.8%wt. % NaF. Electrochemical deposition was carried out using cyclic and voltammetry(CV) method at 85°C in 5 mM Ca(NO₃)₂ + 3mM NH₄H₂PO₄. The surface characteristics of HA precipitated nanotubular Ti-29Nb-xHf ternary alloy were investigated using XRD, FE-SEM, wettability test, and EDS.

3. Conclusions

The martensitic structures were disappeared, whereas the equiaxed structure appeared, as Hf content increased. Also, diameter of nanotube of Ti-29Nb-xHf ternary alloys decreased and number of small size nanotube increased, as Hf content increased. HA coating on nanotube formed Ti-29Nb-xHf ternary alloys has a good biocompatibility. (Supported by NRF: 2013 R1A1A 2006203; hcchoe@chosun.ac.kr)

References

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