The Electrochemical Characteristics of Anodized Ti-29Nb-xZr Alloys

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Abstracts: In this study, electrochemical impedance characteristics of anodic oxide layer formed on titanium ternary alloy surface have been investigated. Titanium oxide layers were grown on Ti-29Nb-xZr(x=3, 5, 7, 10 and 15 wt%) alloy substrates using phosphoric acid electrolytes.

1. Introduction

Surface properties of biomaterials are the main factors for affecting to the biocompatibility of biomaterials. The biological CP Ti has excellent biocompatibility, and it widely used dental implants and artificial joint. But it is not strong enough for some dental application. Ti, Ta, Nb and Zr as non-toxic elements do not cause any adverse reaction in human body. In addition, Nb acts as β-stabilizers, to form homogeneous solid solutions, while Zr acts as a neutral element for forming a homogeneous solid solution in the α-and β- phase. The advantage of using titanium oxide layer is that it can be grown directly on the Ti and Ti alloys surfaces, by cost-effective techniques such as anodic oxidation. In this study, electrochemical characteristics of anodic oxide layer formed on titanium ternary alloy surface have been investigated. Titanium oxide layers were grown on Ti-29Nb-xZr(x=3, 5, 7, 10 and 15 wt%) alloy substrates using phosphoric acid electrolytes.

2. Experimental

For this study, the Ti-29Nb-xZr(x=3, 5, 7, 10 and 15 wt%) were manufactured by arc melting on a water-sealed copper hearth under an argon gas atmosphere with a non-consumable tungsten electrode. These specimens were melted six times by inverting the metal for homogeneous structure. Ti-29Nb-xZr alloys were homogenized in argon atmosphere at 1000℃(which is above the β transformation temperature) for 24h followed by a rapid quenching in ice water. The samples were incrementally polished by using from # 100 grit emery paper to # 1200 grit emery paper. The polished and cleaned binary alloy disks were anodized in solution containing typically 1 M H_3PO_4 at room temperature. A direct current (D.C) power source was used for the process of anodization. The anodized surface and chemical composition were investigated using SEM and EDS.

3. Conclusions

From the surface morphologies of anodic layers, pore size and numbers of anodized Ti-29Nb-xZr alloys increased at below 200 V. However, regardless of Zr contents, anodic pore size of all specimens were increased with increasing applied voltages at above 200 V. Anodized surface, pore size and numbers were increased with increasing applied voltages. The polarization curves result of anodized Ti-29Nb-xZr alloys were higher than those of the non-anodized Ti alloys in 0.9% NaCl solution. From EIS results, R_P values of anodized Ti-29Nb-xZr alloys were higher than those of the non-anodize Ti-29Nb-xZr alloys.(2008년 지식경제부 지역연계 기술개발과제지원에 의하여 수행된 것임)

References

[1] R. Adell, U. Lekholm, B. Rockler, P. I. Branermark, Int. J. Oral. Surg. 1981, 10, 387.
[2] S. G. Steimenamnn, Evalution of biomaterials, Willey, New york, 1980, 1.
[3] K. Lee, H. C. Choe, Y. M. Ko, J. Kor. Res. Soc. Den. Mat, 35, 2008, 285