Corrosion Behaviors of Ti-xNb Alloys for Biomaterials

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Abstract: In this study, corrosion behaviors of Ti-xNb alloys for biomaterials. The Ti-xNb binary alloys contained from 10 wt. % to 50 wt. % contents were manufactured by vacuum arc-melting furnace. Microstructures of the alloys were examined by optical microscope (OM) and field emission scanning electron microscope (FE-SEM). In order to identify the phase constitutents of the Ti-xNb alloys, X-ray diffractometer (XRD) with a Cu K radiation was used. The corrosion behaviors were investigated using potentiostat (Model2273,EG & GCo, USA) in NaCl solution at (36.6±1.0)℃.

1. Introduction

Commercially pure (CP-Ti) titanium alloys are widely used as dental implant materials, especially the Ti-6Al-4V alloy (α + β type) are the most attractive biocompatible alloys due to their favorable mechanical properties, excellent corrosion resistance. However, the Ti-6Al-4V alloy of element V has been found severely to react with tissues in humans because by toxic and Al is has Alzheimer' s disease effect. Therefore to alleviate this potential problem, we need to improve this effect by manufacture of Ti-type alloys consisting of non-toxic elements such as Nb, Ta, Zr, and Hf alloying elements. The Nb is found to reduce the modulus of elasticity when alloyed with better corrosion resistance due to the formation of a stable oxide surface layer.

2. Experimental

In this study, Ti-xNb alloys were melted to improve chemical homogeneity in a vacuum arc melting furnace. Heat treatment was carried out at 1000 ℃ for 2 h for homogenization in argon atmosphere. Microstructures of the alloys were examined by optical microscope (OM) and field emission scanning electron microscope (FE-SEM). In order to identify the phase constitutents of the Ti-xNb alloys, X-ray diffractometer (XRD) with a Cu K_α radiation was used. The corrosion behaviors were investigated using potentiostat (Model 2273, EG & GCo., USA) in NaCl solution at (36.6±1.0)℃. A conventional three-electrode system with high-density graphite as counter electrode and saturated calomel electrode (SCE) as reference was used. After corrosion test, all morphology were by FE-SEM.

3. Conclusions

Images show that the apparent volume fraction of martensite decreased with increasing Nb content in the Ti-xNb alloys. And it can be seen from that I_{corr} for the samples decreases with increasing Nb content, with the lowest I_{corr} observed for the Ti-50Nb alloy. Also lt is that the increase in corrosion resistance with Nb content is attributed to rapid formation of a passive mixed TiO_2 and Nb_2O_5 film of a few nanometers thickness on the specimen surface.(Supported by NRF: 2013 R1A1A 2006203)

Reference

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