Mechanical Properties and Surface Characteristics of Ti-25Ta-xHf Alloys

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Abstract: In this study, we investigated mechanical properties and surface characteristics of Ti-25Ta-xHf alloys. The samples were manufactured for composition of Ti-25Ta-xHf(x=0 to 15 wt. %) alloys. Each alloy was melted twenty times in an arc-melting vacuum furnace. The microstructural phases and phase transformation of Ti-25Ta-xHf alloys were identified with the aid of an XRF, XRD and DSC. And mechanical properties were investigated using Vickers hardness, nanoindentation, and tensile test

1. Introduction

Titanium alloys are widely used for biomedical applications such as joint replacements, bone screws and plates. However, the Ti-6Al-4V alloy could have harmful effects on the human body because the vanadium ions have been found to cause cytotoxic effects and adverse tissue reactions, while the aluminum ions have been associated with neurological disorders. In order to overcome these weakness of Ti-6Al-4V alloy, we investigated β type alloys composed of non-toxic elements. The phase transformation temperature can be increased by adding α - stabilizers (e.g. Al, O, N) or lowered by adding β - stabilizers (e.g. Mo, Nb, Ta, V). These elements can play role to control the mechanical and electrochemical properties. Especially, the β type alloys are far superior biocompatibility because their Young' s modulus is much less than those of α + β type alloys like Ti-6Al-4V alloy. They are also able to gain greater strength and toughness balance compared with α + β type alloys. The β type titanium alloys such as Ti-Nb-Zr and Ti-Mo-Zr-Al with low Young' s modulus and greater strength and corrosion resistance have been, therefore, developed for biomedical applications. A new β type titanium alloy composed of non-toxic elements like Nb, Ta, Zr, and Hf has been recently developed in order to achieve lower Young' s modulus and excellent mechanical performance

2. Experimental

The samples were manufactured for composition of Ti-25Ta-xHf(x=0 to 15 wt. %) alloys. Each alloy was melted twenty times in an arc-melting vacuum furnace. The alloys were heat-treated at 1000 ℃ for 2 h in an argon atmosphere to homogenize and 0 ℃ water-quenching. Each sample having 2.5 mm thickness was cut from the ingots using a high-speed diamond cutting machine with 2000 rpm speed, followed by polishing with 3 μm Al_2O_3 paste. To investigate the microstructure, the ternary titanium alloys were chemically etched in Keller's solution, followed by observation with an OM and FE-SEM. The microstructural phases and phase transformation of Ti-25Ta-xHf alloys were identified with the aid of an XRF, XRD and DSC. And mechanical properties were investigated using Vickers hardness, nanoindentation, and tensile test

3. Conclusion

Ta and Nb content Ti alloy was improving corrosion resistance. The surface characteristics of anodized alloy was depend on the voltage, currant density, anodization time and alloy element. (Supported by NRF: 2008-0062283; hcchoe@chosun.ac.kr)

Reference

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