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Eren Yilmaz, Azim Gökçe, Fehim Findik, H.Özkan Gülsoy

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Metallurgical properties and biomimetic HA deposition performance of Ti-Nb PIM alloys

Eren Yilmaz[1], Azim Gökçe[2,*], Fehim Findik[1,2], H.Özkan Gülsoy[3,4]

[1] Biomedical, Magnetic and Semiconductor Materials Application & Research Center (BIMAS-RC), Sakarya University, Sakarya, 54187, Turkey
[2] Metallurgy & Materials Engineering Department, Faculty of Technology, Sakarya University, Sakarya, 54187, Turkey
[3] *Metallurgy & Materials Engineering Department, Faculty of Technology, Marmara University, Goztepe, Istanbul, 34722, Turkey*
[4] *University of Louisville, 2210, S Brook Street, Shumaker Research Building, 359, Louisville, KY 40208, USA*

[*] azimg@sakarya.edu.tr (Corresponding author)

Abstract

Ti-Nb alloys are potential candidates owing to their excellent mechanical properties and high corrosion resistance for bioactive implant applications compared to other metallic materials. The purpose of this work is to investigate the effect of the Nb amount on the microstructure, mechanical properties, corrosion behavior and hydroxyapatite (HA) formation ability of Ti-Nb alloys produced via powder injection molding. According to the phase/microstructure studies, including XRD analyses, optical microscope, and SEM imaging, all of the alloys are composed of α+β phases, and with the increment of Nb content, β phase stability increases. Also, it is observed that Nb content has significant effects on the mechanical properties of the considered alloys. While the hardness / Transverse rupture strength values of Ti-Nb alloys (303-340HV, 992-440MPa) are higher than that of the titanium (269HV, 300MPa), the elastic modulus is measured as lower than (100-115GPa) that of the titanium (132-140GPa). The increment of Nb content causes to decrease of the hardness, bending strength and elastic modulus of Ti-Nb alloys. Also, the addition of Nb contributed to the improvement of corrosion resistance and induced to increase of hydroxyapatite formation ability.

Keywords: Metallurgical characterization, Titanium alloys, Powder methods, Biomaterials

1. Introduction

Load bearing applications such as hip or knee prosthesis should possess appropriate mechanical properties (mechanical values are targeted near the bone) and high corrosion resistance. Furthermore they should not cause any allergic or inflammatory reactions in the human body for preventing the rejection of the implant from body and making it durable for a long period. Also, it is desirable that surface of the implant should be integrated with the adjacent bone for osseointegration [1].