11th International Conference on Advanced Materials

ICAM2009

Rio de Janeiro Brazil
September 20 - 25

Preparation, structural, and elastic characterization and biocompatibility of Ti-Nb alloys used as biomaterial

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Abstract – Titanium and its alloys have been widely used in the medical field due to their excellent biocompatibility. The Ti-6Al-4V alloy is the most widely used currently, but studies indicate cytotoxic effects in some tissues caused by vanadium, while aluminum is associated with neurological disorders. The most promising alloys to replace Ti-6Al-4V are those with niobium, zirconium, tantalum, and molybdenum, substituting for part of titanium. Thus, studies have been performed to characterize and understand the behavior of these alloys. The objective of this work is the preparation and characterization of a Ti-Nb alloy for use as a metallic biomaterial.

Since the early 1940s when titanium was implanted in the femur of rats and no adverse reactions were observed and, later in the 1950s, when its biocompatible nature was confirmed, the use of titanium in the medical field has been growing [1]. The Ti-6Al-4V alloy is the most widely used alloy in orthopedic implants; however, some studies indicate problems due to the presence of aluminum and vanadium [2]. Ti-Nb alloys belong to a new class of Ti-based alloys with no presence of aluminum and vanadium and with elasticity modulus values very attractive for use as a biomaterial [3]. The objective of this work is the preparation and characterization of Ti-Nb alloy for use as a metallic biomaterial.

The samples used in this study were prepared by arc-melting in an argon atmosphere. After melting, the ingots were submitted to swaging to obtain cylindrical bars. The chemical analysis showed the main elements that compose the alloy to be in good agreement with the stoichiometry (5 and 10 wt% Nb). The samples were characterized by X-ray diffraction and observed peaks were due to the α' phase of titanium (Fig. 1), according to a previously published study [4]. The optical micrography showed structures in the form of needles, typical of the α' phase of titanium [4]. The mechanical spectroscopy measurements showed complex structures (peaks) caused by stress-induced ordering of the interstitials elements around matrix metal atoms. The elasticity modulus obtained from mechanical spectroscopy measurements showed that this alloy is a promising material for use as orthopedic implants. In direct or indirect cytotoxicity tests, the studied alloys presented no cellular toxicity, indicating good *in vitro* biocompatibility.

The authors wish to thank the Brazilian agencies CNPq and FAPESP for their financial support.

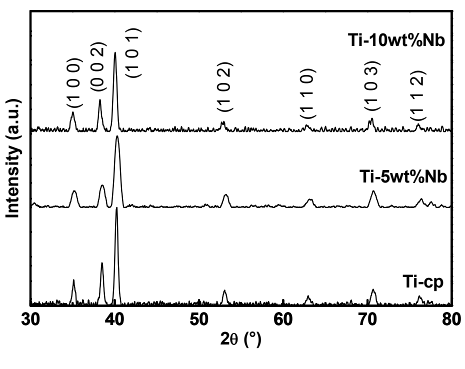

Figure 1: X-ray diffraction for Ti-Nb alloys.

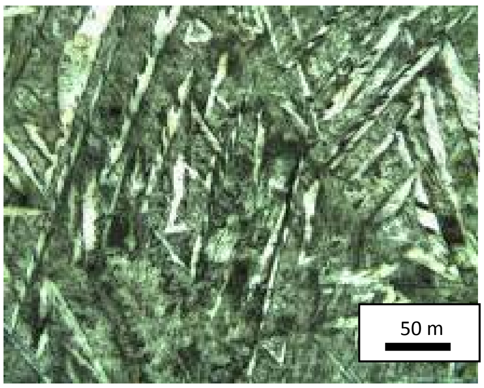

Figure 2: Optical Microscopy of the Ti-5Nb alloy.

References

[1] C. Leyens, M. Peters, Titanium and Titanium Alloys: Fundamentals and Applications, Wiley-VCH, New York, 2005.
[2] J. Black, Biological performance of materials – Fundamentals of Biocompatibility, Marcel Dekker, New York, 1992.
[3] M. Geetha, A. K. Singh, R. Asokamani, A. K. Gogia, Progress in Materials Science 54 (2009) 397-425.
[4] C. M. Lee, C. P. Ju, J. H. Lin, Journal of Oral Rehabilitation 29 (2002) 314-322.