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Preparation, characterization, and biocompatibility of Ti-15Mo alloy used as biomaterial

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Abstract – Titanium and its alloys have been used thoroughly in the production of prostheses due to their properties, such as high corrosion resistance, low elasticity modulus, high mechanical strength/density ratio, and good biocompatibility. In this paper it is presented the preparation, structural, microstructural, and elastic characterization and biocompatibility of the Ti-15Mo alloy.

Titanium alloys are the more suitable material used for implants for orthopedic applications, due to the metal's desirable properties, such as good corrosion resistance, low elasticity modulus, and excellent biocompatibility [1]. In Brazil, Ti-6Al-4V is the titanium alloy used more frequently as a biomaterial. However, earlier studies have shown that vanadium and aluminum cause cytotoxic effects in the organism [2]. This alloy possesses a high elasticity modulus (approximately 120 GPa) when compared to that of the human bone (approximately 28 GPa) [3]. Therefore, the identification of other alloys with higher mechanical strength, low modulus of elasticity, and similar biocompatibility as the Ti-6AL-4V alloy is necessary. The most promising alloys are those with niobium, zirconium, tantalum, and molybdenum as the alloying elements. The objective of the present research is the characterization structural, microstructural, elastic, and biocompatibility of the Ti-15Mo alloy.

The samples used were Ti containing 15% molybdenum (in weight) and were produced by arc-melting in an argon atmosphere, using Ti cp (99.7% purity) and Mo (99.95% purity), both supplied by Aldrich Inc. After melting, the samples were characterized by density, X-ray, and optical microscopy measurements. The elasticity modulus was obtained by mechanical spectroscopy measurements that were performed using a torsion pendulum. The X-ray difractograms showed peaks that characterize a body-centered cubic structure typical of the beta phase of the alloy, as described in the literature [4]. This was corroborated by microscopy, where the micrographs showed good homogeneity and structures characteristic of the beta phase of the alloy [1]. The mechanical spectroscopy measurements showed a complex structure, which may be caused by stress-induced ordering of heavy interstitial elements around elements of the alloy. The elasticity modulus obtained showed this alloy to be a promising material for use as orthopedic implants. In direct or indirect cytotoxicity tests, the studied alloy showed no cellular toxicity. The Ti-15Mo alloy tested presented a good *in vitro* biocompatibility.

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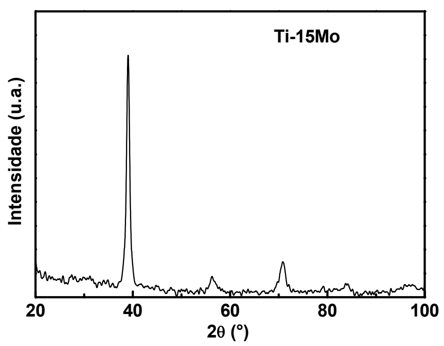

Figure 1: The X-ray difractogram Ti-15Mo.

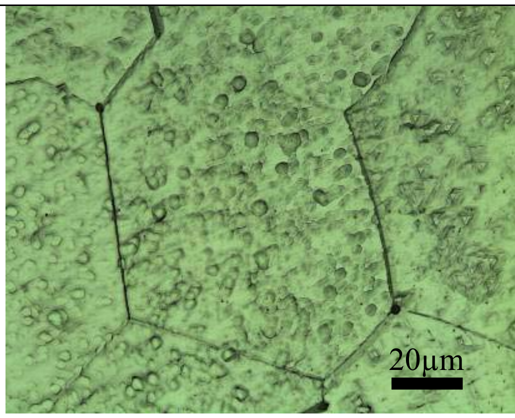

Figure 2: Optical microscopy of the alloy Ti-15Mo, magnification x500.

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