DEVELOPMENT OF Ti-Al-V ALLOYS FOR USE AS SINGLE-AXIS KNEE PROSTHESES

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ABSTRACT

Single-axis knees prostheses are bending mechanic devices that look like a simple hinge with a simple rotation movement [1]. For the manufacture of biomedical materials, metallic materials are largely used, due to their mechanical and corrosion performance, ranging from the placement of bone fixation devices to the replacement of hard tissues in damaged joints [2]. Ti-6Al-4V alloy is a potential candidate for the manufacture of single-axis knee prostheses, since it is the most widely used form of titanium worldwide, possessing high mechanical strength, in addition to its low density by the use of aluminum as alloying element [3]. Therefore, this investigation aimed to evaluate the viability of Ti-Al-V alloys with distinct Al content for the use as single-axis knee prostheses. The Ti-(10 - x)Al-xV (x = 0, 2, and 4 wt%) samples were produced in an argon arc-melting with copper crucible and non-consumable tungsten electrode water cooled. The samples were submitted to a prior heat treatment (1000°C / 12 hours / furnace cooling), followed by a hot-rolling (1000°C / air cooling), and a solution treatment (850°C / 6 hours / water cooling). For physicochemical characterization, the EDS technique coupled to a scanning electron microscope was used to measure the chemical composition. The density values were collected by the Archimedes' principle. For analysis of the phase composition, X-ray diffraction measurements were performed using the powder method. For microstructural analysis, optical and scanning electron microscopy were employed. To study the mechanical properties, the samples were analyzed by Vickers

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microhardness measurements and Young's modulus by means of the impulse excitation method. The samples exhibited a homogeneous solid solution with a α-phase and minor amount of β-phase. With the Al content rising, the density and Vickers microhardness values decayed while the Young's modulus increased, as a result of the α-phase stabilization and solid solution softening. The obtained results shows that the samples with high amount of Al can have great potential for the use as single-axis knee prostheses, once it combines interesting properties with lower cost. (Financial support: CNPq and FAPESP).

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