MmeBi09-007

Evaluation of the electrochemical behavior of Ti-12Mo-25Nb alloy treated in Ringer's solution for biomedical application

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The production of ?-metastable Ti alloys stands out for combining essential properties for their application as biomaterials in bone replacement. The combination of low Young's modulus, corrosion resistance in bodily fluids, mechanical properties, and biocompatibility has been the focus of research in the development of new alloys. Commercially, implants are made of pure Ti or the Ti-6Al-4V alloy. However, this alloy contains potentially cytotoxic elements such as Al and V. In response, new Ti alloys free of these elements are being investigated, such as those in the Ti-Mo-Nb system. In this context, the present study aims to evaluate the corrosion resistance of the Ti-12Mo-25Nb treated alloy and compare it with the Ti-6Al-4V alloy. The Ti-12Mo-25Nb alloy was produced by arc melting with a non-consumable tungsten electrode in an argon atmosphere and subsequently encapsulated for heat treatment at 950°C for 1 h for homogenization. The microstructure of the Ti-12Mo-25Nb and Ti-6Al-4V alloys was characterized by X-ray diffraction (XRD), optical microscopy (OM), and Vickers microhardness. The Young's modulus of the alloys was obtained using the impulse excitation technique, and the mechanical properties were pre-evaluated using the hardness/modulus ratio. Electrochemical characterization of the samples was initially performed with open circuit potential (OCP) measurements for 1 h to verify the thermodynamic stability of the alloys; then, the samples were polarized between potentials of -2.0 V to +2.0 V vs. (SCE), in Ringer's solution without lactate addition, as the electrolyte. Microstructural characterization of the Ti-12Mo-25Nb alloy treated at 950°C for 1 h showed that the alloy exhibits only the ? phase in its microstructure, with hardness equal to 210 HV ± 2, Young's modulus to 68 GPa ± 0.02, and hardness/modulus ratio equal to 3.1, showing superior results to the Ti-6Al-4V alloy, with a hardness/modulus ratio of 2.8. The results indicated that the Ti-12Mo-25Nb alloy treated at 950°C for 1 h may present superior corrosion resistance performance compared to the Ti-6Al-4V alloy, due to the presence of Nb in its composition. Therefore, the Ti-12Mo-25Nb alloy treated presents an alternative for the production of biomedical implants, due to the replacement of cytotoxic elements and superior mechanical and corrosive properties compared to the commercial alloy.