Development of metastable β-type Ti alloys with low elastic modulus for biomedical application

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Titanium alloys include a series of advantageous properties for biomedical applications, such as high mechanical strength, wear and corrosion resistance, hardness and modulus of elasticity. The most widely used titanium alloy for biomedical applications is the Ti-6Al-4V, however, previous studies showed that vanadium cause allergic reactions in human tissue and aluminum has been associated with neurological disorders. Hence, to solve this problem, new titanium alloys without the presence of these elements are being developed, with the addition of different elements, usually the beta-stabilizers. The most promising are the alloys that have niobium, zirconium, molybdenum and tantalum as alloying elements, added to titanium. In general, alloys with predominance of body centered cubic structure (β phase) have lower elastic modulus than other structures as hexagonal compact (α phase), preventing stress shielding effect, very interesting for biomedical applications. In this study, the development and chemical, structural, microstructural and mechanical characterization of novel ternary titanium alloys is presented. The alloys were prepared in arc-melting furnace. The structure and microstructure of alloys were evaluated by x-ray diffraction, optical, scanning and transmission electron microscopy, whose results indicated the presence of α', α'' and β phase, stable ou metastable, depending of substitutional element quantity and heat treatment. The results of Vickers microhardness and modulus of elasticity suffered a strong influence regarding the processing and the substitutional element content. (Financial support: Capes, CNPq and FAPESP).