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Influence of Phases Precipitation in β-metastable Ti-12Mo-xNb Alloys

Sinara Borborema [1]
Vitor de Holanda Ferrer [2]
Monica Costa Rezende [3]
Caio Marcello Felbinger Azevedo Cossú[4]
Loic Malet [5]
Carlos Angelo Nunes [6]
Luiz Henrique de Almeida [7]

RESUMO

Titanium and its alloys have become one of the most attractive implant materials due to their light weight, high biocorrosion resistance, biocompatibility and mechanical properties, including lower elastic modulus. The beta titanium alloys can be classified into three categories, stable β, metastable β and near β , as function of the molybdenum equivalent [Mo eq]. If the [Mo eq] is lower than 11 wt. %, martensitic transformation may occur during quenching from temperatures above the β transus. The type of martensite phase formed (α' or α'') depend on the solute concentration in the titanium alloy. The α' martensite phase forms in diluted alloys and has a hcp structure, while the α'' phase is formed in concentrated alloys with an orthorhombic crystal structure . Besides, another metastable ω phase (hcp structure) also may precipitate in the β-Ti matrix during quenching. Mechanical properties of Metastable β-Ti alloys are highly dependent of the final microstructure which is controlled by the thermomechanical treatments, in particular the Young's modulus. These alloys for biomedical application require high mechanical strength and a low Young's modulus to avoid stress shielding. The aim of this study was to analyze the influence of phases precititation in the treated

[1] Professor orientador: Doutor, Universidade do Estado do Rio de Janeiro - RJ, sinarab@msn.com;
[2]Graduando pelo Curso de Engenharia Mecânica da Universidade do Estado do Rio de Janeiro, RJ, vitorhferrer@gmail.com;
[3] Professor orientador: Doutor, Universidade da Zona Oeste - RJ, monica_crezende@hotmail.com
[4]Doutorando do do Curso de Engenharia de Materiais da Universidade de São Paulo - SP, caio.cossu@gmail.com;
[5]Pesquisador do Departamento de Materiais da Universidade Livre de Bruxelas, Bélgica, loic.malet@gmail.com;
[5] Professor orientador, Departamento de Materiais da Universidade de São Paulo - SP, cnunes@demar.eel.usp.br
[6] Professor orientador: Doutor, Departamento de Engenharia Metalúrgica e de Materiais da Universidade Federal do Rio de Janeiro - RJ, lha@metalmat.ufrj.br;

Ti-12Mo-xNb (x = 0, 3, 8, 13, 17 and 20) alloys. The alloys were prepared from pure elements through arc melting under argon. The obtained ingots were solution treated at 950 ºC under argon atmosphere for 1 h into a tubular furnace and then quenched in water at room temperature. The microstructures were analyzed by transmission electron microscopy (TEM) and X-ray diffraction (XRD). Mechanical properties characterization was based on Vickers microhardness tests and Young's modulus measurements. The resulted of microstructural characterization showed the presence of α'', ω in the β matrix for the Ti-12Mo alloy. The Nb addition resulted in the suppression of α'' phase and decrease of the ω phase, confirming the effect of "Mo eq" on β stabilization. Although the amount of ω phase decreases for higher Nb contents, ω precipitates with a near-spherical morphology can be observed on thin foil of Ti-12Mo-20Nb alloy All the alloys produced in this study showed potential for biomedical application, presented a higher hardness/modulus ratio than Ti and Ti-6Al-4V alloy. However, among the six alloys, cp Ti and Ti-6Al-4V alloy, the Ti-12Mo alloy showed a higher hardness/modulus ratio with a microstructure consisting of α" + ω precipitates in the β matrix.

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Fulano da Silva Santos [8]
Sicrano da Silva Santos [9]
Beltrano da Silva Santos [10]
Pessoa da Silva Santos [11]
Orientador do Trabalho [12]
Sicrano da Silva Santos [13]
Beltrano da Silva Santos [14]
Pessoa da Silva Santos [15]
Sicrano da Silva Santos [16]
Orientador do Trabalho [17]

[8] Graduando do Curso de XXXXX da Universidade Federal - UF, autorprincipal@email.com;
[9] Graduado pelo Curso de XXXXX da Universidade Federal - UF, coautor1@email.com;
[10] Mestrando do Curso de XXXXX da Universidade Estadual - UE, coautor2@email.com;
[11] Doutor pelo Curso de XXXXX da Universidade Federal - UF, coautor3@email.com;
[12] Professor orientador: titulação, Faculdade Ciências - UF, orientador@email.com.
[13] Graduado pelo Curso de XXXXX da Universidade Federal - UF, coautor1@email.com;
[14] Mestrando do Curso de XXXXX da Universidade Estadual - UE, coautor2@email.com;
[15] Doutor pelo Curso de XXXXX da Universidade Federal - UF, coautor3@email.com;
[16] Graduado pelo Curso de XXXXX da Universidade Federal - UF, coautor1@email.com;
[17] Professor orientador: titulação, Faculdade Ciências - UF, orientador@email.com.

SUMMARY

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