Improving the mechanical strength of ternary beta titanium alloy (Ti-Ta-Sn) foams, using a bimodal microstructure

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The effects of a bimodal microstructure and porosity on the elastic modulus and yield strength of a Ti-13Ta-12Sn alloy foam was analyzed. In order to obtain a bimodal microstructure, the powder metallurgy approach was used, with the amount of Sn being chosen depending on a thermodynamic analysis, so that there could be a bcc solid solution after the consolidation process. The foams were obtained using an ammonium carbonate space holder (30, 40 and 50 v/v% porosity). Foams with a bimodal microstructure were synthetized by mixing 50 wt% of milled powder (at 50 h) + 50 wt% unmilled powder, while foam without a bimodal microstructure were synthetized using only milled powders. The elastic modulus and compression yield strength were experimentally measured and compared with estimations given by the Gibson-Ashby model and finite element analysis. The foams with a bimodal microstructure have shown a higher compression strength (over 70 MPa more) than the samples without bimodal microstructure, for all of the porosity values. The samples with bimodal microstructures, as well as 30, 40 and 50% porosity, have an elastic modulus smaller than 30 GPa and a yield strength over 120 MPa, therefore, having a great potential to be explored for biomedical applications.

Bimodal microstructure

Mechanical properties

Metallic foam

Powder metallurgy

Titanium alloys

Compressive strength

Elastic moduli

Medical applications

Microstructure

Nitrogen compounds

Porosity

Powder metallurgy

Tantalum alloys

Ternary alloys

Thermoanalysis

Titanium alloys

Yield stress

Ammonium carbonate

BCC solid solution

Beta titanium alloy

Bi-modal microstructures

Biomedical applications

Compression strength

Consolidation process

Thermo dynamic analysis

Tin alloys