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Synthesis of Ti-Nb-Ta-Zr Alloys Foams by Powder Metallurgy

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Human has some degenerative diseases which lead to degradation of mechanical properties of the bone [1]. It is know that biomaterials are solution for bone replacement. Titanium and titanium-based alloys are used due to its superior biocompatibility and corrosion resistance in conjunction with low density and an elastic modulus much more similar to that of human bones [2]. The elastic modulus of titanium and titanium-based alloys are much higher than of human bone (10-30 GPa) [3]. The elastic modulus mismatch would cause bone loss, implant loosening and premature failure of the artificial hip [4]. Therefore, an important requirement of biomaterials is a modulus close to that of natural bones. Torres et al. [5] reported that elastic modulus values decreased with the porosity increased in cp Ti foams. This work, study the application of NaCl to synthetize foams of Ti-2Nb-4Ta-8Zr. Ti based alloys were produced by mechanical alloying using a planetary mill for 4 and 12 h of milled. Foams were obtained using NaCl (60%v/v) as space-holder with a mean particle size of 35 μm. Powders and space-holder were mixed and uniaxial pressing was performed at 420 MPa of compaction pressure. Green compacts were introduced in distilled water at 60°C for remove NaCl. Four cycles of 2h each were applied to remove NaCl particles. Finally samples were sintered at 1300°C for 3 h in Ar atmosphere. Scanning electron microscopy and porosity analysis were carried out. Figure 1 shows the morphology of Ti-2Nb-4Ta-8Zr alloy powders milled at 4 and 12 h. Figure 1(a) shows the agglomerated particles with sizes between ~ 3 to 15 μm with an irregular morphology and the figure 1 (b) shows a size between ~ 5 to 30 μm, this size could be due to cold weld. Figure 2 shows the foams where there are two types of pores. The distribution of big and small pores is homogeneous and the shape is irregular. The figure 2(a) shows the pores produced by space holder have sizes between 100 to 200 μm during 4 h of milled and the pores produced by 12 h of milled with a sizes smaller than 5μm are showed in figure 2b. The morphology of pores may fall in two categories: (1) spherical shape (2) shape based on the space holder materials (Mostly in irregular shape) These results shows that is possible to synthetize Ti-2Nb-4Ta-8Zr foams using NaCl. Foams present a homogeneous distribution of big pores and small pores with shape irregular. The pores produced by 4 h of milled have sizes between 100 to 200 μm and the pores produced by 12 h of milled process with a size smaller than 20 μm and finally it is important to tell that this method of synthesis can be applied to synthesize different foams of biomaterials.

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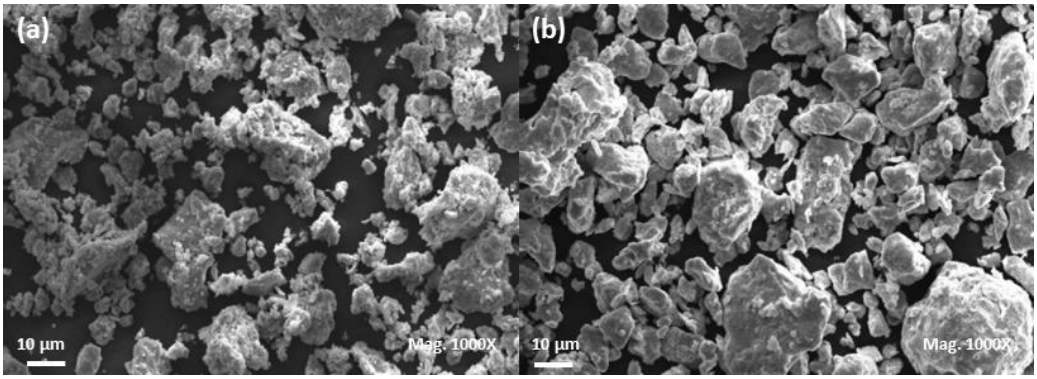

Figure 2.SEM images of Ti-2Nb-4Ta-8Zr powder milled (a) 4h and (b) 12h.

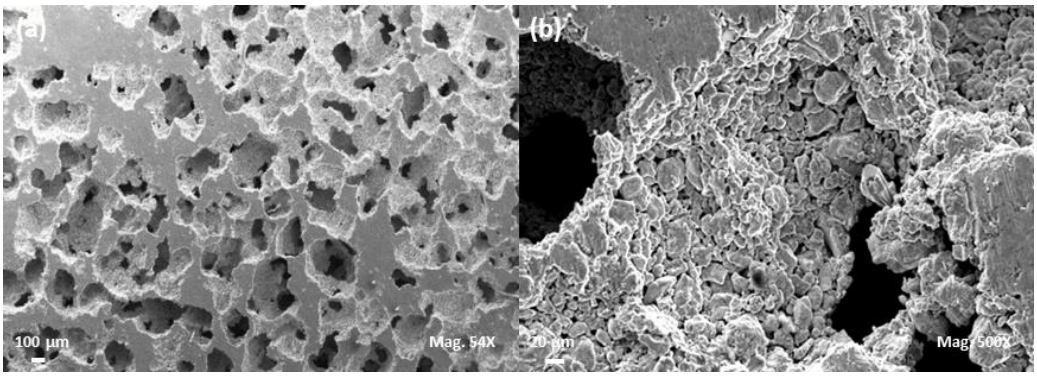

Figure 4. SEM images of foams formed (a) 4 h and (b) 12 h.