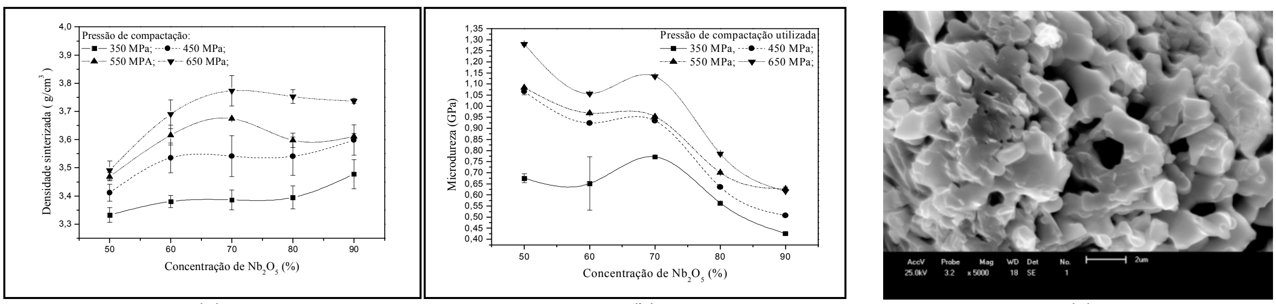
ICAM 2009
11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25

Composition and compression influence in physical-mechanical and microstructural properties of niobium – hydroxyapatite based composites.

W. J. Nascimento, W. R. Weinad, M. L. Baesso and W. M. Lima
Universidade Estadual de Maringá, Departamento de Física, Centro de Ciências Exatas
Av. Colombo, 5970 – CEP:87020-900, Maringá, Pr, Brasil
walter@dfi.uem.br

Abstract – The aim of this work is the search of the optimum experimental conditions to produce biocompatible composites with low cost, selecting different condition that could improve the physical, mechanical and microstructural properties of the niobium pentoxide and hydroxyapatite based composites. The used processing conditions allowed to evaluate the amount of reinforcement that must be added and to establish criteria to optimize the compacting pressure. Experimental results shows that the composition coupled with the compacting pressure influenced the physical and mechanical properties as well as the composite microstructure.

The necessity of wrecked or damaged human body bones replacement induces the scientist to research new materials for implant. The calcium phosphates bioceramics, among them the hydroxyapatite (HAp), have been increasingly used in the reconstruction and replacement of bones because their characteristics and properties, such as, biocompatibility, osteoconductibility, osteoindutibility intrinsic, and by their structural, chemical and physical similarities when compared with mineral bone matrix [1-3]. However, due to its low mechanical strength, many researchers have been directed to obtain a biocompatible composite based on titanium, niobium, zirconium and other materials [4-7] that can improve these features. In this study, the hydroxyapatite and niobium pentoxide (Nb_2O_5) were mixed at 300 RPM for 3 hours. The material proposed have five composition definite by: (x)HAp + (1-x)Nb_2O_5, where x vary from 0.1 to 0.5. The samples compacted at 10 mm in diameter and 2 mm thick under pressures of 350, 450, 550 and 650 MPa were sintered in air at 1000 °C. The effects of the composition and compression in physical-mechanical properties were measured employing powder metallurgic technique, while the microstructure properties by scanning electron microscopy (SEM). Experimental results show that with the concentration of Nb_2O_5 and compacting pressure increase, samples provides adequate interaction between the elements and a gradual improvement of the sintering condition, which produces a good densification (Fig. 1a). However it was observed that microhadiness exhibit a decrease with the concentration of Nb_2O_5 increase (Fig. 1b). Although 0.3 HAp + 0.7 Nb_2O_5 sample pressed at 650 MPa showed the best mechanical-physical properties this material was fragile, and how consequence exhibit intergranular fracture type, as can be seen in microscopy analyze (Fig. 1c). Wherefore, the utilization of low temperature sintering, when compared with pure niobium based samples, produces a reduction in production cost of implant pieces.



(a) (b) (c)

Fig. 1: Influence of the composition and of the compaction pressure in sinterability: (a) Density; (b) Microhardiness; (c) Microstructure and porosity of 0.3 HAp + 0.7Nb_2O_5 sample pressed at 650 MPa.

[1] O. Stroz; H. Gasthurber; M Woydt, Surf. Coat. Technol. **76**,140 (2001).
[2] Q. L. Feng; F.Z. Cui; H. Wang; T.N. Kin; J.O. Kin, J. Cryst. Growth. **210**, 735 (2000).
[3] M.T. Phan; M. F. Maitz; W. Matz; H. Reuther; H. Richter; G. Steiner, Thin Solid Films. **1**, 379 (2000).
[4] M. Long; H. J. Rack, Biomaterials. **19**, 1621 (1998).
[5] H. Guo; K. A. Khor; Y. Ch. Boey; X. Miao, Biomaterial. **24**, 667 (2003).
[6] A. Yokoyama; F. Watari; R. Miyao, Bioceramics 13: Key Engineering Materials, 192-**195**, 445 (2001).
[7] L. Fu; K. A. Khor; J. P. Lim, Materials Science Engineering A, **316**, 46 (2001).