SINTERING EFFECTS ON MECHANICAL PROPERTIES OF DENTINE DERIVED HYDROXYAPATITE-GLASS COMPOSITES

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Introduction

Hydroxyapatite (HA) is one of the most widely used bioceramics to reconstruct most of the skeleton. HA biomaterials are nontoxic and biocompatible with bony tissues. It can be derived from natural sources like bovine bone and other original sources. It can be also produced synthetically from reagent materials. Due to the fact that HA is not able to be used at load bearing biomedical applications, it is to be reinforced with materials such as whiskers, metallic oxides, glasses and others. As a favorable study on glass compositions, Oktar and Goller spotted an alternative way for doping apatite matrix and presented the incorporation of mixtures of two and three bioactive oxide-glasses in biologically derived apatites [Oktar F.N., 2002].

Methods

In this study, sintering effects on physical and mechanical properties, such as density, maximum compression strength and microhardness, of the dentine derived composite are considered with respect to glass content. HA source material is dentine material extracted partly from human teeth. According to that material, calcined human tooth is mixed with 5 and 10 % inert glass respectively. Then, this type of composite material is sintered in the temperature range of 1000°C to 1300°C at 100°C increments. After ending up with micro-structural and crystallographic analyses, both physical and mechanical characterization of human teeth dentine HA – inert glass composites are completed by performing density, micro- and macro-mechanical test procedures, i.e., Vickers microhardness and compression testing. Briefly, density measurements are conducted corresponding to the Archimedes principle. Vickers microhardness measurements are obtained under a 200 g load. Compression testing is performed at a rate of 2 mm/min.

Results

Both physical and mechanical behaviour of the dentine derived HA-glass composite is improved associated with the level of glass content and this reinforcement approach distinguishes the dentine derived composite material from other type glass composites, e.g., bovine HA-glass composite [Gunduz O., 2009]. For the mechanical properties point of view, results show that the dentine derived HA-glass composite is not only affected by the sintering temperature (i.e., microstructure) but also by the glass content. When increasing the sintering temperature further to 1100°C, a small increase is observed. However, at 1200°C, a high increase is determined. At last, increasing temperature from 1200°C to 1300°C gives a very small increase (microcrack formation effect). Shortly, results indicate that human tooth dentine HA–inert glass composites seem to have remarkable load bearing capacity.

Discussion

In this study, it is clearly noted that human tooth dentine HA–inert glass composite material is stronger and promising material. One may conclude that this type composite represents good potentials for future studies to determine whether its stress distribution characteristics under bending/combine loading, (e.g., fracture toughness) is good for biomedical applications.

References

Oktar F.N. *et al*, Ceramics Int, 28(6):617-621, 2002.

Gunduz O. *et al*, J Thermo Comp Met, 22:407-419, 2009.