11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

NANOSTRUCTURED SYNTHETIC HYDROXYAPATITE AND DENTAL ENAMEL HEATED E IRRADIATED BY ER,CR:YSGG CHARACTERIZED BY FTIR AND XRD

J. S. Rabelo[(1)*], T. M. Pereira[(1)], V. L. Mazzocchi[(1)] , M. E. G. Valério[(2)] and D. M. Zezell[(1)]

(1) Nuclear and Energy Research Institute, IPEN – CNEN/SP, Av. Lineu Prestes, 2242, São Paulo, SP, Brazil 05508-000.
(2) University of Sergipe, UFS, Physics Department - DFI, Cidade Universitária Prof. José Alísio de Campos, São Cristóvão, SE, Brazil 49100-000
* jsrabelo@usp.br

Abstract – The study evaluate the physical changes and/or chemical that occurs in synthetic hydroxyapatite (HAP) and in enamel under action of thermal heating in the furnace or laser irradiation of Er,Cr:YSGG that may cause changes in its structure to make them more resistant to demineralization aiming the formation of dental caries.

The synthetic HAP was produced by reaction of solutions of Ca(NO3) and (NH4)2HPO4 with controlled temperature and pH. The enamel powder was collected from the bovine teeth. Samples of powder enamel and synthetic HAP were subjected to thermal heating in furnace at temperatures of 200 °C, 400 °C, 600 °C, 800 °C and 1000 °C. For the laser irradiation of materials, were made with 5,79 J/cm^2 of irradiation, 7,65 J/cm^2, 10,55 J/cm^2 and 13,84 J/cm^2 for synthetic HAP and 7,53 J/cm^2, 10,95 J/cm^2, and 13,74 J/cm^2 for the enamel. The samples were evaluated by X-ray diffraction (XRD) and by the Rietveld method, to determine their respective proportions in the material, as well as results of changes of the lattice unit cell parameters (axis-a, axis-c and volume), crystallites sizes and the occupation rate of sites of Ca and P atoms. The samples were analyzed by Fourier transform infrared spectroscopy (FTIR), which should compositional changes due to treatment related to carbonate, phosphate, adsorbed water and hydroxyl radicals content. Besides the major hydroxyapatite crystallographic phases, there was formations of octacalcium phosphate (OCP) in the irradiated sample of the synthetic HAP under 5,79 J/cm^2 and OCP and phase β of tricalcium phosphate (β-TCP) in enamel heated at 800 °C. There was reduction of the axis-a, volume and size of crystallites to the temperatures between 400 °C and 600 °C and also on laser irradiated samples. Above the temperature of 600 °C it is observed the effect in the lattice parameters. The Rietveld method showed a interval of crystallites sizes from 10,18 ± 0,15 nm to 29,54 ± 0,47 nm under laser and oven heat. The Ca/P relation in all the samples decreased. The enamel samples irradiated by 7,53 J/cm^2 showed Ca/P equal to 1.6817 and by 13,74 J/cm^2 Ca/P was 1,6831. Spectroscopy results showed that both the heating and laser irradiation cause changes primarily in the bands of carbonate, water adsorbed and hydroxyl and the crystallographic changes of the lattice may be correlated with changes in carbonate in the sites of hydroxyl and phosphates. The effects of furnace heating and laser irradiation also causes reduction of carbonate content, and this effect was more evident in laser irradiated samples, there was also decreases in water and adsorbed hydroxyl contents. All these changes alter the properties of the material, as its solubility and therefore affect the demineralization process and can be useful for caries prevention.

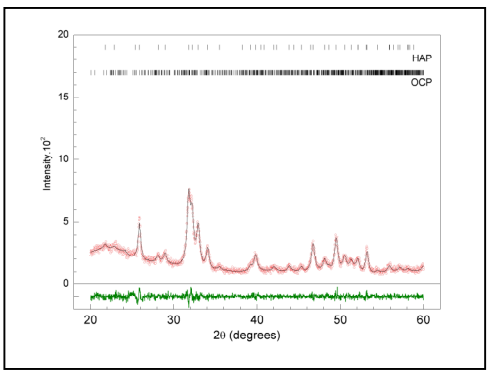

Figure 1: Graph the result of the Rietveld method for the sample of synthetic hydroxyapatite irradiated with 5,69 J/cm^2.

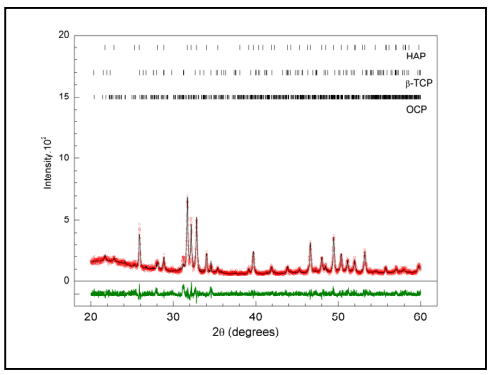

Figure 2: Graph the result of the Rietveld method for the sample of enamel heated at 800 ° C.

References

[1] Elliot, J. C., Structure and chemistry of the apatites and other calcium orthophosphates. Elsevier: Amsterdam. 1994. xii + 389 pp. ISBN 0-444-81582-1.
[2] Wilson, R.M.;Elliott, J.C.;Dowker, S.E.P., Rietveld refinement of the crystallographic structure of human dental enamel apatites. American Mineralogist, 84, 1406-1414 (1999).
[3] LeGeros R.Z., "Calcium Phosphates in Enamel, Dentin and Bone". In Calcium Phosphates in Oral Biology and Medicine. Monographs in Oral Science Editor. H.M. Myers, (1991).