STUDY OF DIFFERENT CONCENTRATIONS AND SYNTHESIS PROCESSES OF NANOCRISTALLYNE Eu AND Dy DOPED $BaSO_4$ AND THEIR RESPONSES ON OPTICALLY STIMULATED LUMINESCENCE

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Introduction: During the last decades, a sensitive grow in the fields of nanotechnology and nanomaterials applied to dosimetry has been observed. The study of nanoparticles showed that they have physical properties that may be very different from their bulk counterparts [1]. In this sense, the study of nanomaterials applied to medical dosimetry is a growing field of research, demanding the characterization and study of new materials, as well as the differences among commercially available materials in the nano scale. In this work, samples of $BaSO_4$:Eu and $BaSO_4$:Dy nanocristals were sintetyzed in different ways. The concentrations of Eu and Dy tested were: 0.05%, 0.1%, 0.2% and 1.0%. The OSL characteristics of all samples were analyzed to verify their differences for dosimetric procedures.

Experimental: The samples were synthesized by the Chemical co-precipitation method. In this method analytical reagent grade Barium chloride ($BaCl_2$) was dissolved in double distilled water. The Europium chloride ($EuCl_3$) was obtained by Europium oxide (Eu_2O_3). In an aqueous solution in concentrated hydrochloric acid (HCl), the mixture was maintained in heating at 80°C to obtain a pH 4.5 - 5.5. The solution was dried in a water bath for crystal formation. This salt was maintained in a desiccator, and weighed and added in sufficient amounts to 0.05%, 0.1%, 0.2% and 1.0% solution of barium chloride. The solution was then mixed with a solution of ammonium sulfate (NH_4SO_4) stoichiometrically in the presence of ethanol. A solution of ammonium sulfate was slowly added to barium sulfate solution until complete precipitation. The precipitate was washed three times with distilled water. The nanocrystals were finally obtained by drying the precipitate at 110º C for 4 h. Part of the samples were submitted to a sintering process using the calcination technique. The same procedure was adopted to obtain the $BaSO_4$:Dy powders. Finally, the sintered pellets were prepared, using Teflon as binder, and the parts were mixed in the ratio 2 (Teflon):1(powdered sample) in open atmosphere nitrogen, to facilitate its handling. This mixture was cooled with liquid nitrogen to optimize the homogenization. These pellets are 6 mm in diameter by 1 mm thickness, and 50 mg of mass. The samples were irradiated using a Gamma Cell-220 System of ^{60}Co (dose rate of 1.38 kGy/h). The irradiations were made at ambient temperature. The OSL measurements were taken using a RISÖ TL/OSL Reader and Controller, model DA-20, and the data acquisition was realized using a personal computer.

Results and Discussion: The main dosimetric properties of the $BaSO_4$:Eu and $BaSO_4$:Dy samples studied in this work were reproducibility of the response, lower detection limits and dose-response curve to gamma radiation (^{60}Co). Comparing the synthesis processes, it was observed that the calcinated samples presented the best response. Comparing the different concentrations of Dy and Eu, it was possible to verify a decrease of the OSL response with the increase on their concentrations (Fig. 1). The response of the dosimeters was suitable for dosimetric procedures in all concentrations for high doses at the Gamma Cell-220 System.

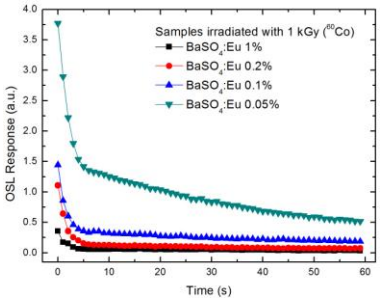

Fig. 1 - OSL response of $BaSO_4$:Eu-Teflon pellets irradiated with 1 kGy (^{60}Co)

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Reference:

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