First Latin-American Congress
on Solid State Dosimetry and Radiation Measurements
13-17 September, 2021

SINTERING SODIUM CHLORIDE CRYSTALS FOR APPLICATIONS IN OPTICALLY STIMULATED LUMINESCENCE (OSL) DOSIMETRY

LUCENA, J.V.[1] ; ROCCA, R.R.[2]

[1]Departamento de Ciência do Mar, Universidade Federal de São Paulo, Baixada Santista, SP, Brasil.
vieira.lucena@unifesp.br
[2]Departamento de Ciência do Mar, Universidade Federal de São Paulo, Baixada Santista, SP, Brasil.

Introduction: For the manufacture of personal or environmental dosimeters using thermoluminescence (TL) and optically stimulated luminescence (OSL) emissions, common salt (NaCl) is a material that has already been studied, as it has high sensitivity when exposed to ionizing radiation. Thus, sea salt crystals have great possibilities to be used for the manufacture of a dosimeter. They also have a high sensitivity when exposed to the beta source and excellent reproducibility; in addition to being crystals that are easy to manufacture, very low cost and above all it would not harm the environment. Therefore, the main objective of this study is to find the best parameters for the manufacture of this dosimeter and study the dosimetric performance requirements tests.

Materials and methods: The samples were prepared from sea water collected in the aquarium in Guarujá city, São Paulo state, being treated and clean water. Samples holders discs made with recycled aluminum plates, with a 1 cm diameter cutter, were used to support the growth of crystals. For more homogeneous samples, we sprayed the sea salt solution, this solution being concentrated sea water, on aluminum discs placed on a stove at 60 ºC, so that the deposited water evaporates completely and the NaCl crystals grow evenly. Then we performed a waterproofing with commercial enamel, because the salt has a hygroscopic property. With the aliquots ready, we used a MiniFlex 300, Rigaku spectrometer for X-Rays Diffraction (XRD) measurements to identify the crystalline structures and OSL measurements were made using a RISØ TL/OSL reader (model DA-20), with blue light stimulation (470 nm), coupled with a 90Sr/90Y beta source, with a dose rate of 81 mGy/s, it was used in the aliquots irradiations. TL measurements were performed at a rate of 5 °C/s.

Results: To analyze XRD data it was used the X'Pert highscore plus program. We identified the highest intensity peaks, which are in agreement with the literature, as Sodium Chloride and Magnesium Chloride.

In order to find the best assisted temperature, it was varied between 80 up to 130 °C, and 110 °C supplied the most intense and stable OSL signal. For the reproducibility test of the aliquots, several consecutive measurements were performed in the same laboratory condition, using a constant dose of 81 mGy, with an assisted temperature of 110 °C and stimulated for 20 s with blue light, we found good reproducibility, with a variation of only 3%. For fading analyses, we attest that the OSL intensity drops 45% in 3 hours. The deconvolution of the TL was carried out showing the existence of 6 peaks, at 98, 125, 154, 213, 272 and 378 °C.

To perform the OSL growth curve, the sample was measured with doses ranging from 81 to 8100 mGy. In Figure 1, a linear response of OSL intensities up to 0.4 Gy can be seen, and we note that a saturation starts next.

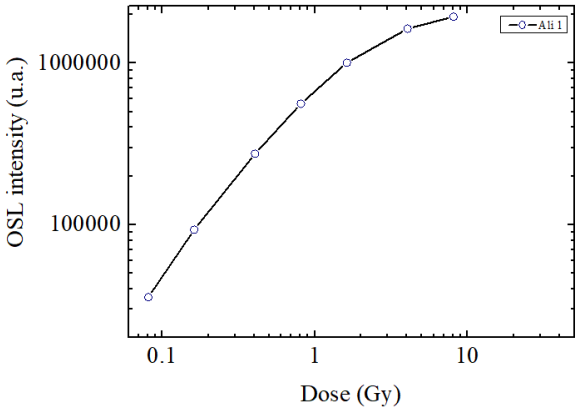

Figure 01: Growth curve.

Conclusion: Thus, sea salt crystals present high sensitivity and good parameters to be used in manufacture of an environmental or personal dosimeter, with a low cost and without any damage to the ecosystem.