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LUMINESCENT PROPERTIES OF THE PINK SALT AND ITS POTENTIAL DOSIMETRIC APPLICATIONS

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Introduction: Common salt has been the object of study for dosimetric applications with promising results, such as a low minimum detectable dose, reproducibility, sensitivity and dose response [1] [2] [3] [4] [5] [6] [7] [8]. Conversely, pink salt, compared to common salt, has, in its chemical constitution, concentrations of other elements besides Cl and Na, such as Mg, K, S, Fe, Br, Mn, between others [9]. Therefore, as the existence of electron traps depends on the defects and impurities in the crystal structure, the pink salt has a higher Optically Stimulated Luminescent (OSL) signal. Consequently, the objective of this study was to analyze the luminescent characteristics of pink salt to verify its potential for dosimetric applications.

Materials and methods: The pink salt crystal samples were separated into three groups according to their color: light, medium and dark. Thus, the crystals were ground with a pistil and an agate mortar, and subjected to a previous thermal treatment at different temperatures. Furthermore, for the crystallographic characterization of the material, X-Rays diffraction (XRD) was performed with a spectrometer MiniFlex 300 from Rigaku.

Samples holder discs were made from a recyclable aluminum plate, with a diameter of 1 cm. With the aid of sieves of 0.075, 0.150 and 0.212 mm of opening, the salt was homogeneously placed on the discs and then waterproofed with commercial enamel. Finally, for luminescent measurements, a RISØ TL/OSL reader (model TL/OSL-DA-20) was used, coupled with a beta source of Sr^{90}/Y^{90}.

Results: The X'Pert highscore plus program was used to analyze XRD diffractograms, thus we verified that the crystals of NaCl halite structure . Furthermore, heat treatments were carried out from 250 to 500 °C, where the effective OSL signal was more intense for the 350 °C treatment.

Moreover, the deconvolution of the Thermoluminescence (TL) curve was performed – rate of 5°C/s – which shows the existence of five peaks at 105, 125, 140, 269 and 306 °C. Thus, in order to obtain a stable OSL signal, several tests were performed, such as assisted temperature variations (ATs), from 90 to 150°C. However, during the OSL measurements, the luminescent signal gradually dropped as the ATs increased. For the reproducibility test, we verified a fluctuation of 2.% for light crystals, 3% for medium colored ones and 2% for dark ones. Fading tests showed stability after 1 hour, decreasing 21 % of its initial intensity. Finally, the OSL intensity curve as a function of stimulation time can be seen in figure 01, where the signal has a linear behavior up to 0.5 Gy and its saturation starts after this dose.

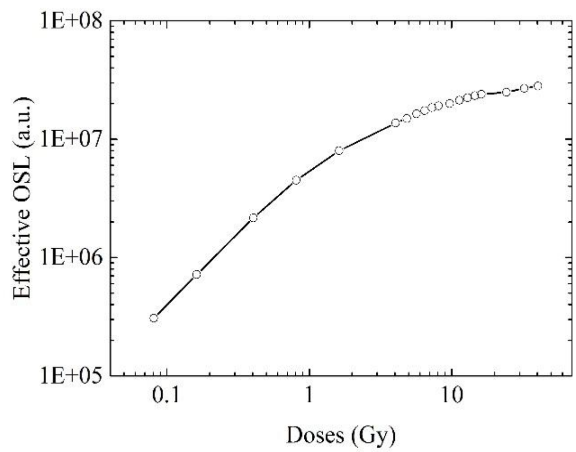

Figure 01: OSL growth curve.

Conclusion: The manufactured dosimeters have high sensitivity, good reproducibility and presenting linear behavior for low doses, thus being able to be used for personal and environmental dosimetry. Finally, there is the lower cost compared to commercial dosimeters, in addition to disposal with less harm to the environment.

References: