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DOSIMETRIC CHARACTERIZATION OF GLASSES AND GLASS CERAMICS USING STIMULATED LUMINESCENCE TECHNIQUES

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Introduction: Ionizing radiation can be applied in diagnosis and treatment. There are different luminescent techniques that can be used in dosimetric evaluations such as Optically Stimulated Luminescence (OSL) and Thermoluminescence (TL). Obtaining OSL and TL signals involves basically three stages: excitation, latency and stimulation[1]. Different materials can be evaluated based on important parameters connected to dosimetric applications. Glasses are non-crystalline materials that present the glass transition phenomenon[2], with the glass ceramics being, in a brief description, obtained from controlled crystallization of glasses. A better understanding on the origin of the luminescent signal could be used as a guide to the development of new dosimeters. The objective of this work is to analyze the OSL signal in Lithium Disilicate's samples, seeking to establish connections between different cristalization levels and the luminescent signal's origin.

Material and method: 3 batches of glasses, each one with 3 samples, were produced and named as TT1, TT2 and TT3. All samples were submitted to the same nucleation treatment (455°C for 2 hours). After that, the growth process of the crystals was realized at 610°C for the batches TT2 and TT3, with different maintenance times in the temperature: half an hour and 1 hour, respectively. XRD analysis were perfomed for samples of each batch. Regarding the luminescent analysis, the irradiation process was performed using a ^{90}Sr/^{90}Y source, with 0.853 Gy/s as the dose rate. Blue LED (λ = 470 nm) was used as stimulation light and the continuous mode of analysis (CW-OSL) was used in all measurements.

Results: Considering the XRD analysis in Figure 1, it is possible to notice that TT1 has presented a typical behavior of a non-crystalline material, while TT3 presented characteristics of a crystallized material, with narrow and intense peaks. Analyzing the dose-response curves, it is possible to see that TT3 presented the highest sensitivity when compared to the other batches. This sample seems to present a plateau in its fading starting in 40 minutes after the exposure. As it is possible to see in Figure 2, TT3 was the batch that presented the highest initial intensity on CW-OSL curves. Moreover, when the curves were normalized, TT1 has presented a slower decay in comparison to TT2 and TT3, which have ovellaped.

Conclusions: Considering only the intensity of the emitted signal, which is one of the annalyzed factors for dosimetric applicability, it is possible to conclude that TT3 material is shown as the most promising. From the analysis, it is also possible to conclude that the higher the crystallization level of the sample, higher the signal's intensity, fact that goes in the direction of previous literature findings.

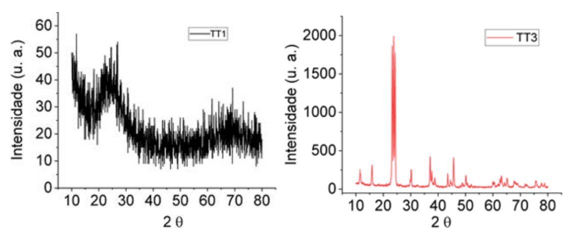

Figure 1: XRD for sample of a) TT1 and b) TT3.

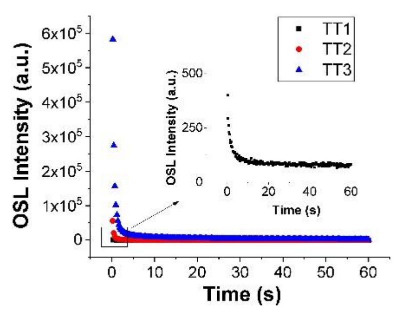

Figure 2: CW-OSL curves for TT1, TT2 and TT3.

References:
1. E. G. Yukihara and S. W. S. McKeever, *Optically Stimulated Luminescence*, Oklahoma: John Wiley & Sons Ltd, 2011.
2. J. Zarzycki, *Glasses and the Vitreous State*, Cambridge: Cambridge University Press, 1991.