

SILVER ADDITION IN $\text{CaSO}_4:\text{Eu}$, TL AND TSEE PROPERTIES

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Introduction: In this work we undertook to improve the dosimetric properties of $\text{CaSO}_4:\text{Eu}+\text{Ag}$ powder by varying the dopant concentration and using Ag incorporation with the aim of improving its luminescent response. The thermoluminescence (TL) and thermally stimulated exoelectronic emission (TSEE) of this new material is being studied in order to evaluate its applicability to dosimetry. In order to increase the efficiency of the method the $\text{CaSO}_4:\text{Eu}+\text{Ag}$ powder was mixed with glass powder in various proportions from which pellets were made. Although TL is commonly used in radiation dosimetry, TSEE was also found to be a very useful technique to be applied in dosimetry, because it is good for detecting the radiation that does not penetrate deeply into the material, like low energy x-ray and alpha and beta particles (Souza, et al. 2000).

Materials and Methods: In order to produce $\text{CaSO}_4:\text{Eu},\text{Ag}$ the product of the oxidation reduction reaction of the AgNO_3 was added to the CaSO_4 crystal doped with Eu during its crystallization process.

The TSEE and TL measurements were performed from room temperature up to 300°C, following linear heating programs.

Photoluminescent emission spectra were collected between 580 and 630 nm with excitation at 230 and 396 nm using an ISS PC1 spectrofluorometer with 300 W xenon lamp. A 25 cm monochromator, equipped with a photomultiplier with a resolution of 0.05 nm in the visible range was utilized. The excitation and emission slit widths were 2.0 mm and 1.0 mm, respectively, both monochromators having 1200 grooves/mm.

The X-ray measurements were performed in a Rigaku device with a Cu radiation tube operated at 40 kV/25 mA with counting time of 5 s and steps of 0.02°. The crystalline phases were identified using the International Center for Diffraction Data catalogue.

Results: The analysis showed that the glow curves have TL peaks in temperature range from 100 to 175°C and TSEE peak at 150°C. A typical TL glow curve from a $\text{CaSO}_4:\text{Eu}+\text{Ag}$ sample is shown in Figure 1.

DRX analyses confirmed the crystalline phase of the samples.

Photoluminescent emissions exhibited two bands between 590 and 615 nm, the most intense peak at 615 nm (Figure 2).

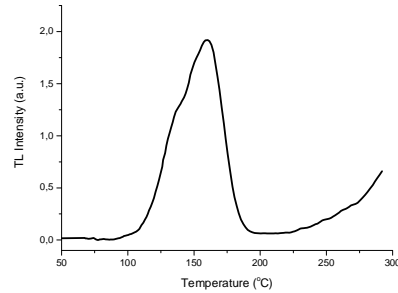


Figure 1: Typical TL glow curve from a $\text{CaSO}_4:\text{Eu}+\text{Ag}$ sample.

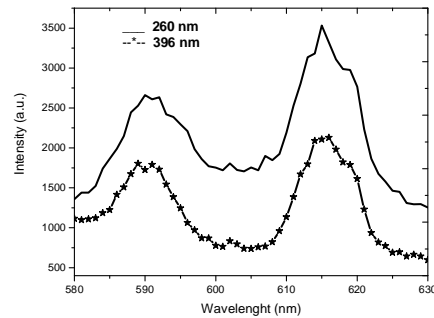


Figure 2: Photoinduced emission spectrum obtained from $\text{CaSO}_4:\text{Eu}+\text{Ag}$, using excitement and emission slit widths of 2.0 mm and 1.0 mm, respectively.

Conclusions: The reproducibility of the sample preparation process, the relative influence on the TL and TSEE sensitivities to X-ray, beta and ultraviolet radiation are being investigated. Previous results have shown that $\text{CaSO}_4:\text{Eu}+\text{Ag}$ presents good dosimetric properties. After the TL and photoinduced emission measurements the incorporation of silver is clearly observed.

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References

Souza, D.N., Valerio, M.E.G., Lima, J.F., Caldas, L.V.E. 2000. Nuc. Inst. Meth. B. 166, 209-214.