

Thermoluminescence and Photoluminescence Study of Cu, Eu and Mn Doped CaSO_4 Phosphor

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ABSTRACT

The present investigation reports the combustion synthesis of Cu, Eu and Mn doped CaSO_4 phosphor and study of their luminescence properties such as TL, PL and OSL. Cu, Eu and Mn are act as activator to explore the possible compound for TLD application. Thermoluminescence dosimetry has been very successful in monitoring the personnel level doses due to high sensitivity and reusability. However, these dosimeters saturate at high doses involved in radiation processing. The TL readings were carried out between 24 and 32 h after irradiation using a Harshaw 3500 TL reader and PL were measured by FLS1000 Spectrometer.

Keywords : TL, PL, OSL, CaSO_4 : Cu, Eu, Mn

I. INTRODUCTION

Thermoluminescent dosimeters are applicable in radiation therapy, diagnostic radiology, etc. It is depending on the specific requirements of the application. In radiation therapy TL materials exhibit a supralinear dose response curve, and a dosimeter with linear response characteristics provides lot of advantages [1-6]. Thus, it is important to understand the advantages and limitations of the specific dosimetric system and its applicability to a given dosimetric problem. CaSO_4 : Cu, Eu, Mn is applicable in medical sterilization and material processing. In the present investigation TL, PL and OSL properties of Cu, Eu, Mn Doped CaSO_4 Phosphor has been studied [7-9].

II. Experimental

Cu, Eu, Mn doped CaSO_4 was prepared by combustion synthesis. This method is modified number of times for systematic synthesis of samples

by changing the starting materials and synthesis conditions and prepared precipitation. Many attempts were made for improvement in thermoluminescence and photoluminescence emission of the synthesized phosphors [10-15]. For TL measurement γ -ray exposure of 5 Joule/Kg were used.

III. Results and Discussion

Figure 1 shows the typical glow curves for CaSO_4 doped with Cu, Eu, Mn and exposed to γ -ray exposure of 5 Joule/Kg. The intensity for the activator Cu was found to be more than Eu and Mn activators. The main peak in this host for all activators is found around 200°C. The moderate value of full width at half maximum of the peaks are used for the dosimetric studies provided it satisfies the other requirements. Thus, the activator Cu is found to be suitable dopant in CaSO_4 . These TL peaks, however, are resolved in the samples, which were annealed to 900°C for an hour after exposure to high doses.

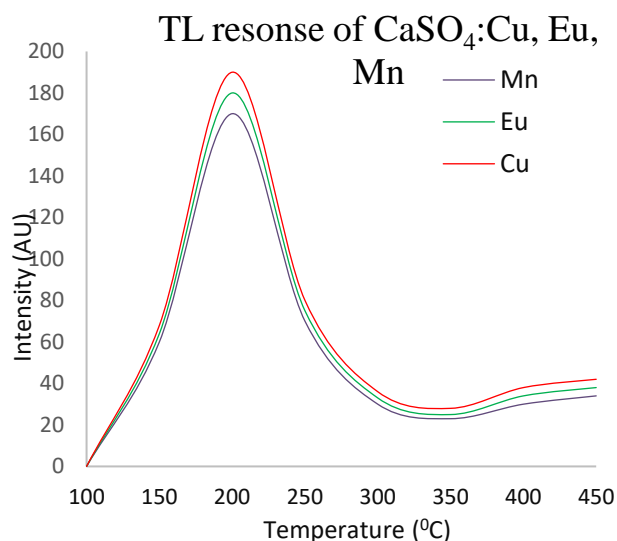


Figure 1: Typical glow curves for CaSO_4 doped with activators Cu, Eu and Mn exposed to 5 Joule/kg

Figure 2 represents the PL spectrum of Cu, Eu and Mn doped CaSO_4 phosphor for excitation at 300 nm. The narrow band around 375 nm in the emission is arising from a transition from the lowest level of the $4f^6, 5d^1$ configuration to the $^8S_{7/2}$ level of the $4f_7$ configuration. The typical excitation spectrum at 375 nm emissions consists of several overlapping bands. These are characteristic of transitions from the $^8S_{7/2}$ level of the $4f_7$ configuration to the levels of the $4f_6, 5d_1$ configuration. It is observed that no PL was observed until the quenching temperature exceeds 300°C thereafter we found consistent rise in PL emission without changing the emission wavelength suggesting that Cu is in bivalent state which is not even altered up to 700°C quenching.

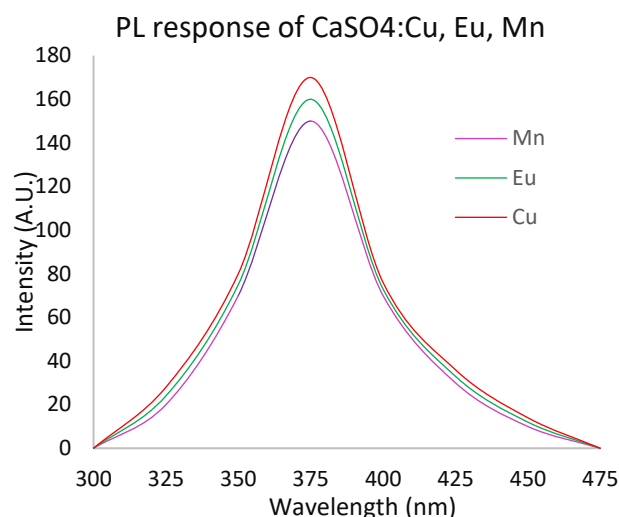


Fig. 2. PL response of CaSO_4 : Cu, Eu, Mn

Figure 3 shows the optically stimulated luminescence (OSL) of CaSO_4 : Cu, Eu, Mn irradiated by exposure of 0.5 Joule/Kg, indicating that the OSL intensity of CaSO_4 : Cu is very high about 11000 at beginning as compare to others, then it exponentially decreases rapidly, it is due to sudden fall in the intensity of CaSO_4 : Cu and all. Blue light was used for stimulation. The number of counts obtained were directly related to the time for which the stimulant light falls on the sample. We can estimate the dose absorbed by the sample by considering integrated counts.

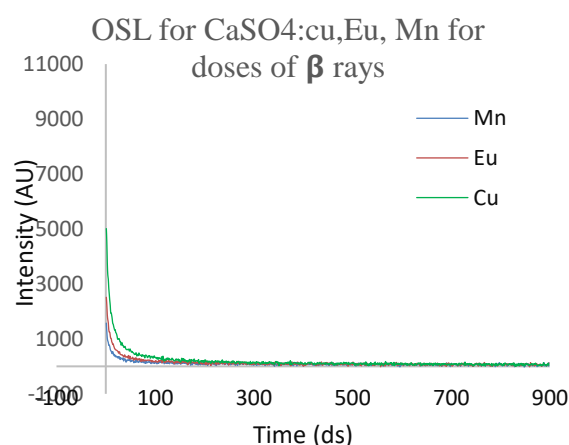


Figure 3. OSL of CaO_4 : Cu, Eu, Mn irradiated by β exposure of 0.5 Joule/Kg

IV. CONCLUSION

1. The TL, PL and OSL behavior of CaSO₄: Cu, Eu, Mn has been studied.
2. Cu is the most suitable activator than others studied and has 375 nm emissions in PL emission spectrum which confirms that Cu is in bivalent state.
3. We can estimate the dose absorbed by the sample through OSL study by considering integrated count.
4. Effect of temperature on TL is applicable to decide the perfect quenching temperature

V. REFERENCES

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Cite this article as :

U. A. Thakare , "Thermoluminescence and Photoluminescence Study of Cu, Eu and Mn Doped CaSO₄ Phosphor", *International Journal of Scientific Research in Science and Technology (IJSRST)*, Online ISSN : 2395-602X, Print ISSN : 2395-6011, Volume 6 Issue 1, pp. 628-630, January-February 2019. Journal URL : <https://ijsrst.com/IJSRST218111>