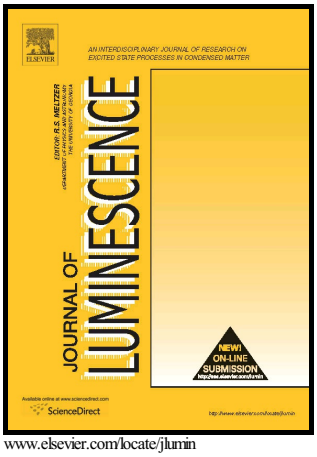

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TL dosimetric characterization of gamma irradiated $SrSO_4$:Eu phosphors

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Abstract - *Thermoluminescence (TL) characteristics of $SrSO_4$:Eu nanostructured phosphor under gamma excitation has been studied and their suitability for environmental radiation dosimetry applications is discussed. The dopant level is tuned for optimum TL response. The effect of radiation dose and heating rate were investigated. The phosphor preserves linearity in the low dose region, 0.1Gy to 20Gy. PL studies of irradiated and un-irradiated phosphors reveal that the dopant Eu exists in divalent state and are the luminescence emission centres in the material. The fading properties of $SrSO_4$:Eu phosphor are observed to be better than that of the commercial dosimeters TLD-200 and TLD-400. The kinetic parameters are calculated using Chen's method and initial rise method and verified by Computerized Glow curve Deconvolution (CGCD). The sensitivity of the synthesized phosphor is found to be very high when compared with that of the commercial standard dosimeter $CaSO_4$:Dy. The phosphor is found to be stable for short term radiation monitoring.*

Keywords: Thermoluminescence, Radiation dosimetry, Phosphors.

1. Introduction

The most important application of thermoluminescence (TL) is in radiation dosimetry, in which TL phosphors are used as passive dosimeters to monitor the integrated radiation dose received by an individual from various sources. The main requirements for materials for dosimeters are, in general, the linear response over a wide range of irradiation dose , high sensitivity, low dependence on energy of irradiation, low fading, and low threshold dose, simple TL curve with one isolated peak, radiation resistance, chemically inert and considerable mechanical strength. But often, all these requirements cannot be fulfilled by a single material and hence doped materials are used as phosphors. The host-dopant combination and optimum incorporation of luminescent centres into the host plays significant role in making sensitive phosphors. TL responses of Rare earth (RE) doped alkaline earth sulphates are extensively studied due to their range of radiation dose response, sensitivity to very small dose and low fading.

The luminescence properties of $CaSO_4$, $BaSO_4$ and $MgSO_4$ activated with one or more rare earth ions and transition metal ions have been extensively studied earlier [1-5]. Dy doped $CaSO_4$ is a highly sensitive TL phosphor and is one of the widely studied material used for radiation dosimetry applications [6-8]. $SrSO_4$ is reported to be a suitable host lattice for different RE dopants like Dy, Tb, Ce for TL emission [9,10]. Eu doped $SrSO_4$ is also known for its extremely high sensitivity [11]. Highly sensitive Eu doped $SrSO_4$ nanophosphors for TL and OSL applications were reported whose sensitivity is 1.26 times than that of commercial Al_2O_3:C phosphor[12]. However, there are only a few reports on the systematic studies of $SrSO_4$:Eu as a TL material. The role of Eu^{3+} and Eu^{2+} in $SrSO_4$ were studied by Zhang et al. and they reported multiple emissions with different emission temperatures for both valence states of Eu[13]. The $Eu^{3+} \leftrightarrow Eu^{2+}$ conversion in a large number of Eu doped phosphors are reported [14] Q. Tang et al. reported the