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# Facile ultrasound route for the fabrication of green emitting $Ba_2SiO_4$: $Eu^{2+}$ nanophosphors for display and dosimetric applications

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ABSTRACT

A series of $Eu^{2+}$ (1–5 mol%) activated $Ba_2SiO_4$ nanophosphors were prepared by ecofriendly ultrasound assisted sonochemical route using Epigallocatechin gallate (EGCG) extract as bio-surfactant. The obtained nanophosphors were well characterized by Powder X-ray diffraction (PXRD), scanning electron microscopy (SEM) etc. The average crystallite size was estimated using Debye–Scherer's formula and Williamson–Hall (W–H) plots and were found to be in the range 20–32 nm. The photoluminescence excitation spectrum exhibited two broad bands around 330 and 370 nm ascribed to the transitions of $Eu^{2+}$ from 4f-ground state to 5d-excited state. The emission spectra showed broad band around 505 nm wavelength ascribed to 5d → 4f allowed transition of $Eu^{2+}$ ions. Thermoluminescence (TL) of $Eu^{2+}$ doped $Ba_2SiO_4$ nanophosphors were investigated using γ-irradiation in the dose range1–6 kGy at a warming rate of 5 °C $min^{-1}$. The phosphors show a well resolved single glow peak at ~175 °C. The TL intensity of 155 °C glow peak increase linearly with γ-dose and room temperature fading was ~76% which was highly useful in radiation dosimetry. The kinetic parameters (*E*, *s*) were estimated and the results were discussed. The chromaticity co-ordinates of all the prepared phosphors were located in green region, as a result $Eu^{2+}$ activated $Ba_2SiO_4$ was a promising single phased phosphor for WLEDs.



## 1. Introduction

Divalent rare earth activated alkaline earth silicate phosphors are important candidates for white light-emitting-diodes (WLEDs) owing to their outstanding thermal steadiness, water and acid resistance, good thermal quenching properties and excellent luminescence properties [1–3]. Due to their exceptional properties, they are highly useful in new-generation lighting sources. WLEDs have fascinated a lot of attention due to energy saving capability, high quantum efficiencies of emission, non-toxicity, stable color, thermal and photochemical stability, extended operation lifetime and eco-friendly as a consequence they were promising candidates to substitute totally conventional incandescent and fluorescent lamps in the coming future. Currently the commercial WLED is encapsulated by the blending of a blue LED chip along with YAG: $Ce^{3+}$ yellow phosphor [4]. Conversely, it suffers with many draw backs namely low color rendering index (CRI) and high correlated color temperature (CCT). Further, the blue chip-based white LED shows poor color stability resulting from the fluctuation of driven current [5].

The light emitted by the n-UV LEDs was generally shorter than 400 nm and show least effect on the chromatic factors of the phosphor converted LEDs, which can be investigated by means of visible (380 nm and 730 nm) radiation distribution of phosphors. Therefore n-UV phosphor converted LEDs were expected to replace conventional green LEDs generally used in the traffic signals [6–8].

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