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Dual colour emitting Eu doped strontium orthosilicate phosphors synthesized by bio-template assisted ultrasound for solid state lightning and display applications

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Abstract

A novel Sr_2SiO_4: Eu (1 – 5 mol %) superstructures (SS) were synthesized using bio-sacrificial *A.V. gel* assisted ultrasound method. Powder X-ray diffraction patterns confirmed the presence of both α and β phase formation. It was evident that morphological growth was highly reliant on *A.V.* gel concentration, sonication time, pH and sonication power. The formation mechanisms for different hierarchical SS were proposed. From diffuse reflectance spectra, the energy band gap was estimated and found to be ~ 4.70 – 5.11 eV. The photoluminescence emission spectra for the excitation at 392 nm, shows characteristic emission peaks at 593, 613, 654 and 702 nm which were attributed to $^5D_0 \rightarrow {}^7F_0$, $^7F_1$, $^7F_2$ and $^7F_3$ transitions of Eu^{3+} ions respectively. Conversely, when the samples were subjected to the heat treatment at 850 °C for 3 h under argon atmosphere, display an intense broad emission peak with two de-convoluted peaks at 490 and 550 nm due to $4f^65d^1 \rightarrow 4f^1$ ($^8S_{7/2}$) transitions of Eu^{2+} ion. The concentration quenching phenomenon was discussed which attributes to energy transfer, electron–phonon coupling and ion–ion interaction. The *Judd- Ofelt* intensity parameters and other radiative properties were estimated by using emission spectra. The CIE chromaticity coordinate values of Sr_2SiO_4:Eu^{2+} and Eu^{3+} nanophosphor were located in green and red regions respectively. The calculated CCT and CRI values specify that the present phosphor can be fairly useful for both green and red components of white LED's. Luminescence decay and quantum yield suggest the suitability of this phosphor as an efficient luminescent medium for light emitting diodes. Overall, the results elucidated a rapid, environmentally benign, cost-effective and convenient method for Sr_2SiO_4: Eu synthesis and for the possible applications such as solid state lighting and display devices.

Keywords: Ultrasound; nanophosphor; Light Emitting Diodes; Photoluminescence, SS.

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