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Pure red luminescence and concentration-dependent tunable emission color from europium-doped zinc sulfide nanoparticles

K. R. Bindu[1,2], T. A. Safeera[3], and E. I. Anila[4,*]

[1] Optoelectronic and Nanomaterials' Research Laboratory, Union Christian College, Aluva, Kochi, Kerala 683102, India
[2] Sree Sankara Vidyapeetom College, Valayanchirangara, Ernakulam, Kerala 683556, India
[3] Department of Physics, MES Asmabi College, P Vemballur, Kodungallur, Thrissur, Kerala 680671, India
[4] Department of Physics and Electronics, CHRIST (Deemed to be University), Bengaluru, Karnataka 560029, India

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ABSTRACT

Nano-sized Eu^{3+}-doped ZnS particles were prepared by chemical precipitation method using polyethylene glycol as capping agent. The structural and morphological studies of ZnS:Eu^{3+} nanoparticles were carried out using X-ray diffraction (XRD), transmission electron microscopy (TEM), Fourier transform infrared spectroscopy (FTIR), and scanning electron microscopy (SEM). XRD results show that ZnS:Eu^{3+} nanoparticles have a cubic structure for all Eu^{3+} concentrations. Dependence of doping concentration on the photoluminescence (PL) of ZnS:Eu^{3+} nanophosphor was studied for excitations at 395 nm and 465 nm. At 395-nm excitation, emission colors of ZnS:Eu^{3+} nanophosphor lie in blue, green, yellow, and red regions of chromaticity diagram for different doping concentrations. But for all doping concentrations we got red emission when the excitation wavelength was 465 nm and the color purity was 92% for 0.03 M doped sample.

1 Introduction

The present day scientific and technical awareness in nano-sized semiconductor crystals is originated from the view of production of new materials with novel optoelectronic properties. Semiconductor nanophosphors have the opportunities for property modification and applications due to color purity, luminescence quantum efficiency, high optical gain, and photostability arising from the large surface-to-volume ratio and quantum confinement effect [1–8]. Continuing the work of Bhargava et al. [1] on ZnS:Mn, ZnS nanoparticles doped with different rare earth metal ions and transition metals ions (e.g., Ni, Tb, Cu, Co, Ag, and Au) have been prepared using a variety of synthesis methods and studied their properties [9–13]. The narrow peaks in the excitation and emission spectra are characteristic features of the rare earth ions and their relative intensities provide information about its local environment and point

Address correspondence to E-mail: anila.ei@christuniversity.in

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