Low temperature synthesis and photoluminescence properties of red emitting $Mg_2SiO_4:Eu^{3+}$ nanophosphor for near UV light emitting diodes

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Abstract

A simple and low-cost solution combustion method was used to prepare Eu^{3+} (1–11 mol%) doped Mg_2SiO_4 nanophosphors at 350 °C using metal nitrates as precursors and ODH (Oxali di-hydrazide) as fuel. The final products were well characterized by powder X-ray diffraction (PXRD), fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM) and UV–visible absorption (UV–Vis). The PXRD patterns of the as-formed products show single orthorhombic phase. The crystallite size was estimated using Scherrer's method and found to be in the range 20–25 nm. The effect of Eu^{3+} cations on the luminescence properties of $Mg_2SiO_4:Eu^{3+}$ nanoparticles were understood from the luminescence studies. The phosphors exhibit bright red emission upon 393 nm excitation. The characteristic emission peaks recorded at ~577, 590, 612, 650 and 703 nm ($^5D_0 \rightarrow {}^7F_{J=0,1,2,3,4}$) were attributed to the 4f–4f intra shell transitions of Eu^{3+} ions. The intensity of red emission was found to be related with the concentration of intrinsic defects, especially oxygen-vacancies, which could assist the energy transfer from the Mg_2SiO_4 host to the Eu^{3+} ions. The Commission International De I-Eclairage (CIE) chromaticity co-ordinates were calculated from emission spectra, the values (x,y) were very close to National Television System Committee (NTSC) standard value of red emission. Therefore, the present phosphor was highly useful for display applications.

Keywords

$Mg_2SiO_4:Eu^{3+}$, Combustion technique, Nanophosphor, Photoluminescence, CIE