Europium doped low cost Zn_2SiO_4 based glass ceramics: a study on fabrication, structural, energy band gap and luminescence properties

ABSTRACT

Nowadays, the demand for better light emitting diodes (LEDs) has led to a growing interest in producing Zn_2SiO_4 based glass ceramic phosphors using waste materials. In this research, Eu^{3+} doped Zn_2SiO_4 based glass ceramics were prepared based on a solid state method using recyclable glass wastes as silica source. The effect of sintering temperatures, ranging from 600 to 1000 °C and the influence of Eu^{3+} ions (x=0, 1, 2, 3, 4 and 5 wt%) on the structural, energy band gap and luminescence properties of the phosphors were investigated using XRD, FTIR spectroscopy, UV-Vis-NIR spectroscopy, Photoluminescence spectroscopy, and FESEM. XRD results showed the formation of α-Zn_2SiO_4 at higher sintering and poor crystallization when the dopant's concentration was increased. FTIR spectra showed that the progression of sintering temperature had sharpened the absorption bands. The band gap energies were identified by the measurement of the absorption edge. Results indicated that the absorption edges were blue shifted, thus increasing the band gap values when the powders were sintered at 1000 °C. The luminescent properties were studied by the measurement of excitation and emission spectra under 600 nm and 400 nm, respectively. It was observed that higher sintering temperatures of 900 and 1000 °C had decreased the red emission intensity, while the doping effect of Eu^{3+} concentration had gradually enhanced the red emission efficiency of $^5D_0 \rightarrow {}^7F_2$ transition. The morphologies from FESEM analysis showed the formation of densely packed grains with the increment of sintering temperatures.

Keyword: Eu^{3+} doped Zn_2SiO_4; Solid state method; Optical band gap; Photoluminescence