

Addition of ZnO nanoparticles on waste rice husk as potential host material for red-emitting phosphor

ABSTRACT

In this research, influence of zinc oxide (ZnO) addition in silica matrix to produce zinc silicate glass system (ZnO–SiO₂) derived from white rice husk ash (WRHA) have been investigated via solid state method. The 90 wt percentage (wt.%) of silica content in WRHA has been proved by X-ray fluorescence spectroscopy (XRF). Hence, the compositions of (ZnO_x–WRHA_{1-x}) glass system were varied by x = 0.50, 0.55, 0.60, 0.65 and 0.70 wt% to study their structural and optical behaviors. The X-ray diffraction (XRD) patterns revealed that with the addition of ZnO in the silica matrix, the broad halo peaks became weaker and caused a few crystalline peaks to appear. Meanwhile, Fourier transform infrared spectroscopy (FTIR) revealed that absorption bands related to SiO₄ unit group are weakened as amount of ZnO increased. This is due to the increase of non-bridging oxygen's (NBO's) formation in the glass structure which also affects the absorbance measurement by ultra violet visible spectroscopy (UV–Vis) to be shifted towards higher in wavelength as the composition of ZnO increases. Lattice distortion due to NBO's formation had decreased the band gap values from 4.28 eV to 3.95 eV. Overall, 60:40 ratio of ZnO against WRHA was selected as the best ratio to produce zinc silicate (Zn₂SiO₄) glass ceramics. Lastly, the characterization of europium (Eu³⁺) doped Zn₂SiO₄ glass ceramics with subject to sintering temperature also has been studied to prove that this material can be a great potential host matrix for red-emitting phosphor.

Keyword: Zinc oxide; Europium oxide; Zinc silicate glass; White rice husk ash; Optical band gap