Enhanced luminescence properties of low-cost Mn^{2+}doped willemite based glass–ceramics as potential green phosphor materials

ABSTRACT

Low-cost Mn^{2+}-doped willemite (α-Zn_2SiO_4:Mn^{2+}) based glass–ceramics were synthesized by conventional melt–quenching technique using waste soda lime silica (SLS) glasses, zinc oxide (ZnO) and Manganese oxide (MnO) as precursors. The effect of different MnO percentage doping on physical, structural, optical and luminescent performance α-Zn_2SiO_4:Mn^{2+} based glass–ceramics were comprehensively studies in this work. The presence of α-Zn_2SiO_4:Mn^{2+}crystal phase and microstructure was confirmed by X-ray diffraction and field emission scanning electron microscopy spectroscopy. From the Scherrer's formula, α-Zn_2SiO_4:Mn^{2+}have an average crystallite size of 30–40 nm, respectively. Fourier transform infrared reflection spectroscopy displays the structural growth of α-Zn_2SiO_4:Mn^{2+} crystal. The green emission centered at about 527 nm from the α-Zn_2SiO_4:Mn^{2+} crystal exhibit a resulted from $^4T_1$–$^6A_1$energy transition of Mn^{2+} ions. Intense emissions of Mn^{2+} ions at 260 nm excitation were occurs may be caused by the increase of Mn^{2+} ions into α-Zn_2SiO_4 crystal structure with lower phonon. Based on the results achieved, this low-cost α-Zn_2SiO_4:Mn^{2+} based glass–ceramic exhibit a huge potential to act as a green phosphor in opto-electronic devices.

Keyword: Manganese oxide; Glass frit; Willemite; Zn2SiO4; Green phosphor