

Novel eco-friendly synthesis of neodymium doped zinc silicate phosphor based waste glass ceramic: structural, thermal and luminescence properties

ABSTRACT

A novel Nd³⁺ doped Zn₂SiO₄ (at Nd 2 wt%) phosphor have been synthesized at different sintering temperature (600–1000 °C) by low cost solid state route. For the first time, the eco-friendly based glass ceramic phosphor were produced by utilizing waste soda lime silica glass (SLS) and ZnO as precursor. The obtained samples were investigated in terms of thermal properties by DSC technique and the results showed a possible crystallization peak around 620 °C. The crystalline phase formation by XRD revealed α-willemite at lower temperature of 800 °C. The analysis by FTIR exhibit the existence of ZnO₄ and SiO₄ structural bonding. The microstructure analysis by FESEM revealed the evolvement from irregular blocks to crystalline structure. EDX analysis confirmed the presence of main element contained in the samples. UV–Vis spectroscopy shows absorption peaks from the ground ⁴I_{9/2} state to various excited energy level of Nd³⁺ ion in 4f³ configuration. Under diode laser excitation of 800 nm photoluminescence, the samples shows possible upconversion emissions in the blue, green, orange and red region. Possible mechanism of upconversion were also studied proposing the suitability of Nd³⁺:Zn₂SiO₄ based waste glass ceramic for solid state laser.

Keyword: Eco-friendly synthesis; Sintering temperature; Waste glass ceramic