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Zinc silicates with tunable morphology by surfactant assisted sonochemical route suitable for NUV excitable white light emitting diodes

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Abstract

The cationic surfactants assisted ultrasound route was used to prepare Dy^{3+} doped Zn_2SiO_4 nanophosphors. The final products were characterized by powder X-ray diffraction (PXRD), ultraviolet visible spectroscopy, scanning electron microscopy, transmission electron microscopy and photoluminescence. Orthorhombic phase of Zn_2SiO_4:Dy^{3+} (JCPDS card no. 35-1485) was confirmed from PXRD. It was evident that the morphology of spherical and broom like structures were obtained with epigallocatechin gallate (EGCG) and cetyltrimethylammonium bromide (CTAB) surfactants respectively. Further the size and agglomeration of the products were varied with surfactants concentration, sonication time, pH and sonication power. The probable formation mechanisms to obtain various micro/nano superstructures were discussed. The characteristic PL peaks were observed at 484, 574 and 666 nm due to the electronic transitions $^4F_{9/2} \rightarrow {}^6H_j$ (j=15/2, 13/2, 11/2) of Dy^{3+} ions upon excited at NUV pumping wavelength of 350 nm [$^6H_{15/2} \rightarrow {}^6P_{7/2}$ ($^4M_{15/2}$)]. The Judd – Ofelt intensity parameters and radiative properties were estimated by using PL emission data. The photometric studies indicated that the obtained phosphors could be promising materials in white light emitting diodes (wLED's). The present synthesis route was rapid, environmentally benign, cost-effective and useful for industrial applications such as solid state lighting and display devices.

Keywords: Sonochemical synthesis; Nanophosphor; Photoluminescence; Cationic surfactant; Solid state lighting

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