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Effect of Tb3+ concentration on the structure and photoluminescence of Zn0.5Mg0.5Al2O4:x% Tb3+ (0 < x ≤ 1) nanophosphor synthesized by citrate sol-gel method

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The un-doped zinc magnesium aluminate (Zn0.5Mg0.5Al2O4) and Tb3+ doped nanophosphor were prepared by the citrate sol-gel method at low temperature (⊠ 80 ℃) and thermally treated at 1000 ℃ for 3 hrs. The effect of varying the x% Tb3+ in the range of (0 < x ≤ 1) on the structure, morphology and optical properties of the Zn0.5Mg0.5Al2O4 nanophosphors were investigated. The Energy dispersive x-ray spectroscopy (EDS) analysis confirmed the presence of the expected elements (Zn, Mg, Al, O and Tb). The x-ray diffraction (XRD) analysis confirmed that the nano-powders crystallized into the mixed cubic spinel structures of Zn0.5Al2O4 and Mg0.5Al2O4. Tb3+ doping influenced crystallinity of the prepared powder samples. The crystallite size and particle morphology were affected by variation in the Tb3+ concentration. Different emission peaks located around 390, 490, 546, 584 and 620 nm from Tb3+ transitions were observed. The most intense emission peak was found at 546 nm, which is ascribed to 4D4 ⟶ 7F5 transition from Tb3+. Increasing the Tb3+ concentration up-to x = 0.4% lead to luminescence intensity enhancement, while further increase of Tb3+ concentration lead to concentration quenching. CIE colour coordinates confirmed that the emission colour can be tuned from blueish ⟶ greenish by varying the Tb3+ concentration.

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