Sol-gel synthesis and photoluminescent properties of Tb^{3+} doped $SrGd_2O_4$ nanophosphor

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Abstract

Terbium doped $SrGd_2O_4$ nanophosphor was successfully synthesized via sol-gel process using tartaric acid as chelating agent at low temperature. Sol-gel process using tartaric acid as complexing agent for the preparation of various concentrations of Tb^{3+} activated $SrGd_2O_4$ nanophosphor at relatively low temperature. Tartaric acid with carboxylate (-COOH) and hydroxyl (-OH) functional groups usually forms more stable chelating complex with most metal cations, which is helpful to molecular level mixing of the metal ions in the precursor and the achievement of stoichiometric compositions. The effects of annealing temperature, different amounts of activator and tartaric acid concentrations on structural, morphology and luminescent properties were investigated. The obtained nanophosphor was further characterized by different techniques. X-ray diffraction (XRD), scanning electron microscope (SEM) and transmission electron microscope (TEM) studies have been carried out to study the crystallinity, morphology and particle size of $SrGd_2O_4$:Tb^{3+} nanophosphor. The incorporation of Tb^{3+} ions in these nanoparticles has been checked by photoluminescence characteristics. Upon excitation with UV irradiation, $SrGd_2O_4$:Tb^{3+} nanophosphor exhibits dominant peak at 544 nm corresponding to $^5D_4 \rightarrow {}^7F_5$ transition while other characteristic peaks due to $^5D_4 \rightarrow {}^7F_6$, $^7F_4$ and $^7F_3$ transitions of Tb^{3+} ions were also observed. Synthesis conditions such as chelating agent concentration, Tb^{3+} ions concentration and annealing temperature were varied in order to determine the exact optimal conditions for synthesizing $SrGd_2O_4$ nanophosphor having superior luminescent properties.

Keywords: Sol-gel; Tartaric acid; Nanophosphor; Photoluminescence