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Research paper

Facile synthesis, structural and luminescence studies of $MgTiO_3:Sm^{3+}$ nanophosphor for display applications

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Abstract

Luminescence properties of combustion prepared $Mg_2TiO_3:Sm^{3+}$ (1-11 mol %) phosphors were studied in the present work. The crystallite size (D) was in the range20- 40 nm as estimated and it was similar to Transmission electron microscopy (TEM) results. The band gap of the materials was in the range 4.45 to 4.87 eV as calculated using Kubelka-Monk function. The PL peaks of Sm^{3+} ions are due to the intra 4-f orbital transitions ($^4G_{5/2}\rightarrow{}^6H_{5/2}$, $^4G_{5/2}\rightarrow{}^6H_{7/2}$, $^4G_{5/2}\rightarrow{}^6H_{9/2}$ and $^4G_{5/2}\rightarrow{}^6H_{11/2}$). Among the samples, 5 mol % doped one shows the highest PL intensity under 413 nm excitation. The CIE chromaticity coordinates showed orange of red emission (CCT ~2036 K), as a result $Mg_2TiO_3:Sm^{3+}$ (1-11 mol %) Nanophosphors were obviously for solid-state lighting and warm white light emissive display applications.

***Keywords**:$MgTiO_3:Sm^{3+}$; Nanophosphor; J-O Parameters; Photoluminescence; CIE N CCT;*

1. Introduction

Inorganic luminescent materials doped with Sm^{3+} found its use in counterfeit light creation, white light-emitting diodes (LEDs) with high effectiveness and natural wellbeing [1-3]. Till today, commercial WLEDs have been based on the combination of LED with blue and yellow light. They have poor color render index (CRI), which can be solved by using tricolor (red, green and blue) phosphors energized by a near-ultraviolet (NUV) energy. This leads to the preparation of new efficient phosphors for new generation WLEDs [4-7]. In recent years, ABO_3 perovskite structures [8, 9] have turned out to be very vital materials as host segments in numerous applications [3]. Magnesium titanate ($MgTiO_3$), an excellent host material, can find a place in the perovskite group of mixes with ABO_3 structure and be a member of the ilmenite group (E_g ~ 4 eV) [10].

$MgTiO_3$was prepared using different wet and soft blend techniques including polymerized complex strategy, sol–gel process, co-precipitation method, etc [11]. However, solution combustion synthesis (SCS) method has been developed and successfully used for the low temperature production of pure and doped nanoparticles in the past few years [5]. In the present study, Sm^{3+} doped $MgTiO_3$ phosphor is prepared by SCS.

2. Experimental

2.1. Synthesis of $MgTiO_3:Sm^{3+}$

$MgTiO_3:Sm^{3+}$ phosphors were prepared by solution combustion method [8] using urea as a fuel. Stoichiometric quantities of starting materials were mixed well in a petridish with little amount of distilled water and was put in a muffle furnace (500±10 °C). Thereafter, the reaction was initiated finally leaving a white powder.

2.2. Characterization

Shimadzu X-ray diffractometer (operating at 50 kV and 20 mA by means of CuKα (1.541 Å) radiation with a nickel filter) was used for PXRD. JEOL, JEM-2100 (accelerating voltage up to 200 kV, LaB_6 filament) for TEM analysis and Shimadzu UV–Vis spectrophotometer model 2600 for DRS. Photoluminescence studies were carried out using a Hitachi F-4600 fluorescence spectrometer at RT with Xe lamp as a light source.

3. Results and discussions

3.1. Photometric properties