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Thermoluminescence response in gamma and UV irradiated Dy_2O_3 nanophosphor

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ABSTRACT

Low temperature solution combustion method was employed to synthesize Dy_2O_3 nanophosphors using two different fuels (sugar and oxalyl dihydrazine (ODH)). Powder X-ray diffraction confirm pure cubic phase and the estimated particle size from Scherrer's method in sugar and ODH fuel was found to be 26 and 78 nm, respectively, and are in close agreement with those obtained using TEM and W–H plot analysis. SEM micrographs reveal porous, irregular shaped particles with large agglomeration in both the fuels. An optical band gap of 5.24 eV and 5.46 eV was observed for Dy_2O_3 for sugar and ODH fuels, respectively. The blueshift observed in sugar fuel is attributed to the particles size effect. Thermoluminescence (TL) response of cubic Dy_2O_3 nanophosphors prepared by both fuels was examined using gamma and UV radiations. The thermoluminescence of sugar used samples shows a single glow peak at 377 °C for 1–4 kGy gamma irradiations. When dose is increased to 5 kGy, two more shouldered peaks were observed at 245 and 310 °C. However, in TL of ODH used samples, a single glow peak at 376 °C was observed. It is observed that TL intensity is found to be more in sugar used samples. In UV irradiated samples a single glow peak at 365 °C was recorded in both the fuels with a little variation in TL intensity. The trapping parameters were estimated by different methods and the results are discussed.

1. Introduction

Rare earth oxides have drawn much attention because they are interesting group of materials with potential applications, such as in the fields of infrared, laser, biology, optics, magnetics, catalyst, fluorescence materials and sensitivity sensor based on the electronic, optical and chemical characteristics arising from their 4f electrons [1–3]. Dy_2O_3 is highly insoluble and thermally stable, suitable for glass, optic, ceramic and dopants for others applications [4–8]. Rare earth oxides have been widely reported in hydrothermal [9] and sol–gel methods [10]. These methods have some disadvantages like the final product is very less in hydrothermal method and precursors used in sol–gel method is more expensive.

The objective of the present work is synthesis of Dy_2O_3 nanophosphors by solution combustion method using sugar and oxalyl dihydrazine (ODH) as fuels and to study the effect of fuel on their structure, spectroscopic and thermoluminescence properties. Combustion synthesis is a simple route which has attracted a considerable attention due to its feasibility, cost effective, high purity, single phase, nanosized particles. The synthesized powders are well characterized using powder X-ray diffraction (PXRD), scanning electron microscopy (SEM), transmission electron microscopy (TEM), Fourier transformed infrared (FTIR) spectroscopy. To the best of our knowledge, no thremoluminescence (TL) studies on Dy_2O_3 nanophosphor have been reported. Thermoluminescence is highly useful in identifying the defects and impurities present in the nano and bulk materials. In the preset study, the TL studies were performed by irradiating with gamma and UV irradiations. The material is heated at a constant heating rate and the light output was measured as a function of temperature of the material and a TL glow curve was plotted. The position of the peaks on the temperature scale is a measure of the

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