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Study of Erbium doped Sr_2CeO_4 Phosphor

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Abstract

The present paper reports the Photoluminescence (PL) of the Sr_2CeO_4 phosphor, singly doped with Erbium rare-earth ion, and with different concentrations (0.01, 0.1, 0.2, 0.5 and 1%) is described. The phosphors were synthesized using the standard solid state reaction technique. We have studied the effect of Erbium dopant on the structural, morphological, and Photo luminescent properties of the samples using X-ray diffraction (XRD), PL and SEM. PL emission of undoped Sr_2CeO_4 phosphor was observed at 470 nm followed by the primary Er emissions with good intensity at 525, 549 and 565nm.

***Keywords**: photoluminescence; solid state reaction method; XRD; Phosphor*

1. INTRODUCTION

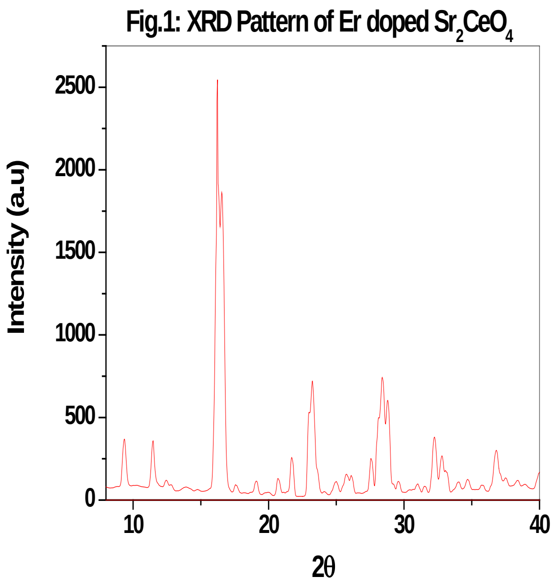
The phosphor research has taken a great shape and the need of the hour is to revolutionize the synthesis technique and modify it according to the needs today. Solid state reaction has been used as a very common technique to develop phosphor either at laboratory level or commercial level, but there is a remarkable shift in the paradigm with the advent of nanotechnology which is now driving the industry forward towards an unknown and unprecedented phase, where the small is gaining and the big losing literally. Nanometer-sized phosphor powders exhibit good spectroscopic properties that are different from their micrometer-sized counterparts. Generally, the observed luminescence in nanocrystalline materials has been explained using two arguments: (i) luminescence is dominated by quantum confinement effects and (ii) luminescence is dominated by defect interactions and chemical species. For the last one and half decade the nanotechnology, with size limitation of less than 100nm, has been moving at a pace and gaining momentum, research in this field is becoming more and more active. In this regard the phosphor research has also awakened to the challenge and new and better materials with the size limitations are being pursued rigorously. A number of publications have appeared on the same and the effect on the size with the effect on the optical property has been a topic of great interest today. The goal of this research effort was to develop comprehensive understanding of the factors that affect the luminescence behavior and study the optical properties of synthesized (using sol-gel method) nano crystal phosphors with crystallite sizes less than 100nm.

2. MATERIALS AND METHOD

The samples were synthesized by standard solid state reaction technique. To prepare Sr_2CeO_4 host phosphor, the starting chemicals, strontium nitrate and cerium nitrate of assay 99.9% were taken in appropriate stiochiometry of 2:1 were weighed, mixed and grounded using agate mortar and pestle for 1 hour to make fine powder. The samples were heated at 1200^oC for 3 hours using muffle furnace. The same procedure was followed to prepare Er (0.5%) doped Sr_2CeO_4 phosphor. The photoluminescence spectra were recorded at room temperature using Spectrofluorophotometer (JOBIN VYON, Fluoromax-3), XRD (Synchrotron Beam line) and SEM (XL 30 CP Philips) studies are done on the prepared samples.

3.0 RESULTS AND DISCUSSION

In order to determine the crystal structure, phase purity, chemical nature and homogeneity of the prepared Sr_2CeO_4: Er (0.5%) phosphor, Powder X-ray diffraction (XRD) analysis was carried out. Figure-1 shows the XRD pattern of Sr_2CeO_4: Er (0.5%) sintered at 1200^oC for 3 hours. The XRD pattern conforms the formation of majority of Sr_2CeO_4 compound in single-phase.



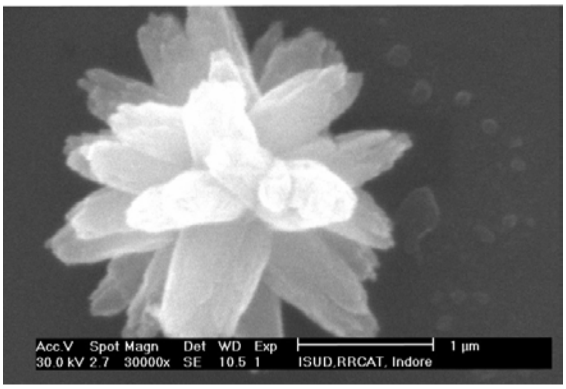
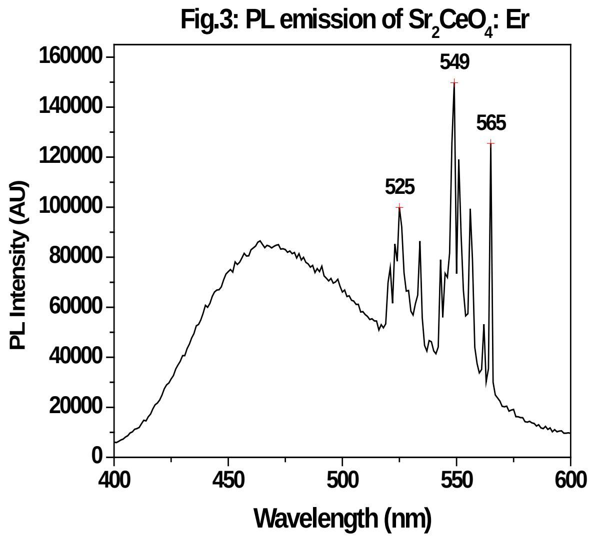


Fig.2: shows the SEM

Figure 2 shows the SEM image, the flower shape which can be seen. This may be due to the formation of a fractal attributed to sort of self organization. Length of each petal is around 1um originated from the central cluster with a dia of around 350nm ends with 100nm. SEM is interesting this type of formation may be due to the flux used in the synthesis of the phosphor material.

Fig.3 shows the emission spectrum of Er (0.5%) doped Sr_2CeO_4 phosphor. When excited with 350nm wavelength the corresponding PL emission mainly concentrates around 470nm followed by the primary Er emissions with good intensity at 525, 549 and 565nm. It is interesting to note the emission is bluish green.



4. CONCLUSIONS

The XRD pattern conforms the formation of majority of Sr_2CeO_4 compound in single-phase. PL emission of un doped Sr_2CeO_4 phosphor was observed at 470 nm followed by the primary Er emissions with good intensity at 525, 549 and 565nm. This phosphor can be considered a CFL candidate.

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