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Synthesis and Characterization of Blue LED Phosphor

Ch. Atchyutha Rao[1], K.V.R.Murthy[2], N.V.Poornachandra Rao[3]

[1]*Department of Physics, VRS & YRN College, Chirala – 523 155, Prakasam District, A.P*
[2]*Display Materials Laboratory, Applied Physics Department, Faculty of Technology & Engineering, M.S University of Baroda, Baroda – 390 001*
[3] *Department of Physics, VSR & NVR College, Tenali – 522 201, Guntur District, A.P*
Corresponding author Tel.: +919949522835
E-mail address: atchyuth_1674@yahoo.co.in

Abstract

Morphological and spectroscopic studies of Sr_2CeO_4 blue phosphor and doped with Eu, La rare earth ions in different concentrations, by increasing the Eu concentration from 0.01, 0.1, 0.2, 0.5, and 1 mol% where as the La concentration is kept constant at 0.5% are reported. Samples were prepared through solid state reaction method. Citric acid and Urea were used as fuels lead to a mixture which is heated at 1200 ºC for 3 h, resulting irregular particles (~ 9nm). Therefore, the solid state method is adequate for preparation of Sr2CeO4 in the form of fine nano particles.

Keywords: *photoluminescence; solid state reaction method; light emitting diodes; Phosphor; nano particles*

1. INTRODUCTION

The search for blue phosphor emitters has been increasing due to their applicability in many fields, such as cathode ray tubes (CRTs), projection televisions (PTVs), fluorescent tubes, X-ray detectors and field emission displays (FED). Very satisfactory red and green commercial materials are being produced, but comparable materials for the blue emission are still lacking and are under development for practical applications. Even in the paper industry, fluorescent dyes that absorb UV and emit in blue color are widely used as organic optical brightening agents (OBA) and new inorganic ones have been under investigation. Concerning many of these applications, such as FED and OBA, the availability of systems consisting of uniform particles in size and shape is also an essential prerequisite for improved performance, and new synthetic routes are been developed in order to reach these systems. Recently, a new promising blue phosphor, Sr_2CeO_4, was developed by combinatorial synthesis and prepared by different routes, such as conventional solid state reaction, chemical co-precipitation, microwave calcination, pulsed laser deposition, polymeric precursors and ultrasonic spray pyrolysis methods [1-4].

In this work, fine particles of the blue phosphor Sr_2CeO_4 and Eu, La rare earth ions doped Sr_2CeO_4, in different concentrations are prepared via solid state method and a spectroscopic study is reported.

2. MATERIALS AND METHOD

Analytical grade Strontium nitrate, Cerium oxide of assay 99.9%, Citric acid and Urea are used as fuels, were mixed in a 2:1 molar ratio, ground into fine powder using agate mortar and pestle about an hour. The samples were fired at 1200 ºC, 3 h with a heating rate of 4ºC/min in a muffle furnace [5, 6]. All products were characterized by X-ray diffractometry using (Synchrotron Beam line) and luminescence spectroscopy using (SHIMADZU RF5301 PC), recorded at room temperature.

3. RESULTS AND DISCUSSION

3.1 X-ray Diffractometry (XRD)

XRD pattern is shown in figure 1, throughout X-ray pattern sample analyses and comparison with literature data it is possible to verify that the majority phase found is the luminescent cerate, Sr_2CeO_4. The pattern compared with the ICSD card no.89-6654. The calculated crystallite size using Scherer's formula for Pure Sr_2CeO_4 is 9nm. This confirms the formation of nano phosphors, via solid state method [7, 10]. The same pattern was observed in the Eu, La doped Sr_2CeO_4 phosphor with less intensity.

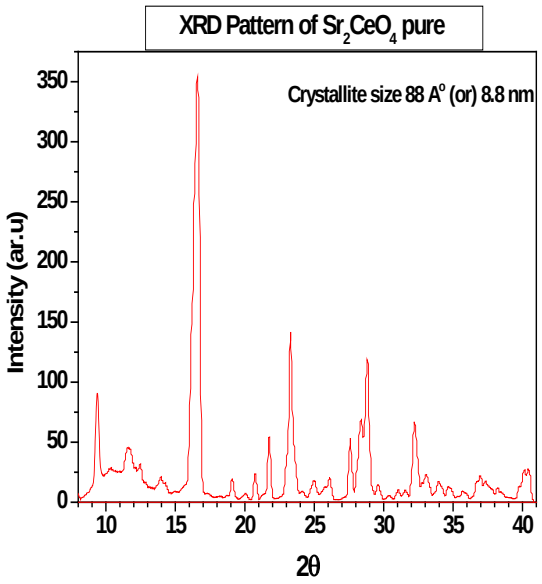

Fig.1: XRD Pattern of Sr_2CeO_4

3.2 Photoluminescence Study

Strontium Cerate (Sr_2CeO_4) blue phosphor and the effect of PL by using various fluxes. The phosphor was synthesized using the standard solid-state reaction technique. Fig.2 shows PL excitation and emission peaks of Sr_2CeO_4 with and without fluxes, it is observed that for 254nm excitation, pure Sr_2CeO_4 without flux shows broad emission from 350 – 650 peaking at 470nm. When urea used as a flux the intensity of 470nm emission (Sr_2CeO_4 + Urea) increased by 500%. Surprisingly when Citric Acid is used as flux the intensity of 470nm emission is increased by 600%. The phosphor is characterized using XRD. The calculated average crystallite size using Scherer's formula is ~9nm. This confirms the formation of nano blue phosphor with good PL. It is concluded that the citric acid plays a major role in formation of nano Sr_2CeO_4 phosphor [7, 9].

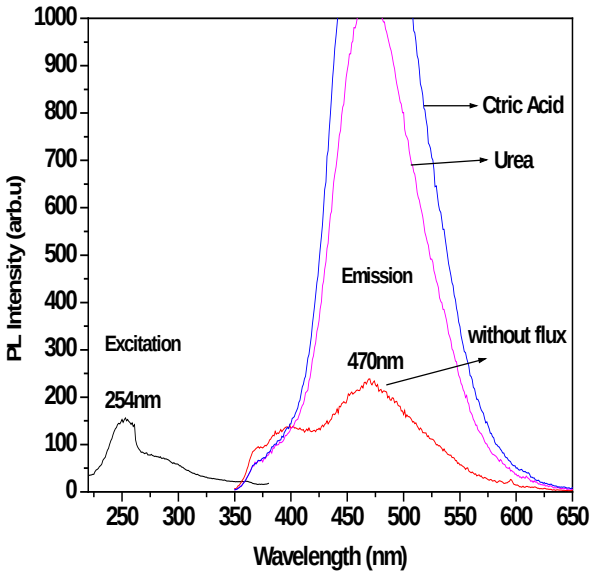

Fig 2: PL of Sr_2CeO_4 phosphor
With and without flux

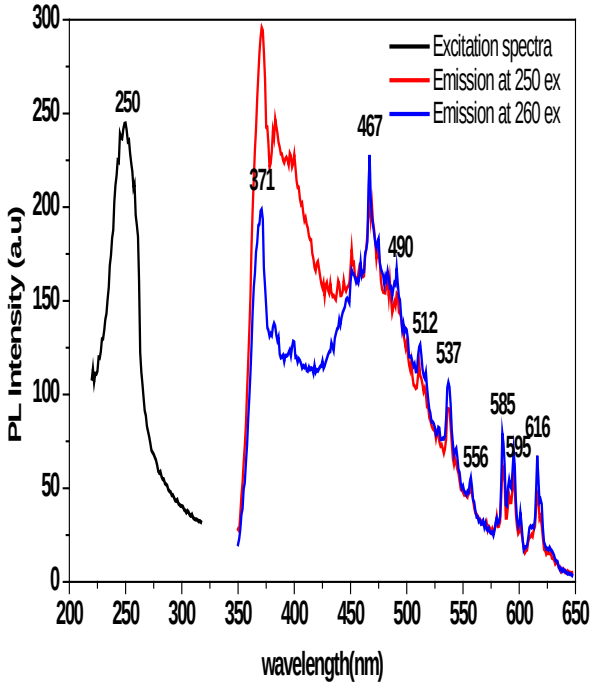

Fig 3: PL of Eu (0.5%) and La (0.5%) doped Sr_2CeO_4

Fig.3 shows the excitation and emission spectrum of Eu, La doped Sr_2CeO_4 blue phosphor. The excitation spectrum shows peak at 250nm and the corresponding emission peaks are around 467, 490, 512, 537, 556, 585,595and 616nm. When the excitation is 260nm the PL observed is look like the same but the intensity is high. The decrease of crystal field emission around 365nm is noted which is around 100AU which is 60% less.

Strontium Cerate (Sr_2CeO_4) blue phosphor and the effect of PL by using various fluxes. The phosphor was synthesized using the standard solid-state reaction technique. Fig.2 shows PL excitation and emission peaks of Sr_2CeO_4 with and without fluxes, it is observed that for 254nm excitation, pure Sr_2CeO_4 without flux shows broad emission peaking at 470nm with 250units of intensity. The specimen shows same emission with high intensity (>1000units) when the urea and citric acid were added as fluxes.

4. CONCLUSIONS

The present phosphor under study can be a good LED material if one can get good semiconductor LED emission in the range 240-280nm. The calculated average crystallite size using Scherrer's formula is ~9nm. This confirms the formation of nano blue phosphor with good PL.

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REFERENCES

[1]. Pallavi Page, Rahul Ghildiyal, Murthy, K.V.R. Materials Research Bulletin, Vol.41, 10, (2006), 1854-1860.
[2]. Pallavi Page and Murthy,K.V.R., Philosophical Magazine Letters, Vol. 90, No. 9, September 2010, 653–662
[3]. Pallavi Page, Rahul Ghildiyal.,Murthy, K.V.R. Materials Research Bulletin,Vol.41, 10, (2006), 1854-1860.
[4]. Bechtel, H., Justel, T., Glaser, H. and Wiechert, D.U., J. SID, 10, 63, 2002.
[5]. Blasse, G. and Grabmaier, B.C. Luminescent Materials, Springer-Verlag, Berlin (Germany) 1994.
[6]. Yen, W.M. and Weber, M.J. Inorganic Phosphors (Composition, Preparation and Optical Properties), CRC Press.Boca Raton, FL (USA) 2004.
[7]. Lakshmanan, A. R. Luminescence and Display Phosphors, Phenomenon and Applications, Nova Sci. Publishers, NY (USA) 2008
[8]. Kummer, F. The production of fluorescent lamp phosphors, in Proc. Physics and chemistry of luminescent materials, Struck, C.W., Misra, K.C. and Bartolo, B.Di., Eds., Electrochem. Soc. Pennington (NJ), 210, 1999.
[9]. Rao, R.P. J. Electrochem. Soc. 143, 189, 1996
[10]. ICDD Powder Diffraction, Card No.89-6654