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Near UV Blue Emission from Cerium Doped BaY_2O_4 Phosphor

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Abstract— *The present paper reports the synthesis, photoluminescence and thermoluminescence (TL) studies of Ce^{3+} doped BaY_2O_4 phosphor. The sample was prepared by the modified solid state reaction method, which is the most suitable for large-scale production. The prepared phosphor sample was characterized using photoluminescence (PL) and Thermoluminescence (TL) techniques. The PL emission was observed in the range 350- 650 nm ranges near UV - blue regions for the Ce^{3+} doped BaY_2O_4. Excitation spectrum found at 247nm. Broad intense peaks found around 396nm (near UV-blue). Thermoluminescence study was carried out for the phosphor with UV irradiation with linear heating rate 6.7^0 C s^{-1}. The kinetic parameters are calculated by (Computerized glow curve convolution technique) CGCD technique.*

Keywords— *UV-Blue emission; CIE coordinate; calcium yttrium oxide phosphor, Thermoluminescence*

1. INTRODUCTION

In recent years, practical application in optical devices, such as color display, optical data storage, biomedical diagnostics and temperature sensors have been produced on the basis of rare earth ion doped materials [1, 2]. Recently, the luminescence properties of rare earth ions in SrY_2O_4 have attracted much attention. SrY_2O_4 belongs to the ordered $CaFe_2O_4$ structure, which is composed of a $(R_2O_4)2-$ (R = rare earth metal) framework of double octahedral with rare earth ions residing within the framework. Due to the thermal and chemical stability, SrY_2O_4 have been used in thermal barrier coating (TBC) materials [3, 4]. It has been found that SrY_2O_4: Eu^{3+} is one of promising red phosphors for Field Emission Display (FED) application [5–9].

In present manuscript Sr replaced by Ba and synthesized BaY_2O_4 phosphor. Luminescence study of prepared phosphor shows good PL spectrum and thermoluminescence glow curve.

1.1 Experimental

For synthesis of BaY_2O_4 with fixed concentration of cerium (1 mol%), stoichiometric amounts of reactant mixture is taken in alumina crucible and is fired in air at 1100^oC for 2 hour in a muffle furnace. The Ce^{3+} activated BaY_2O_4 phosphor was prepared via high temperature modified solid state diffusion. The starting materials used for sample preparation $CaCO_3$, Y_2O_3, Ce_2O_3 and H_3BO_3 (as a flux). The mixture of reagents was grounded together for 45minute to obtain a homogeneous powder. Powder was transferred to alumina crucible, and then heated in a muffle furnace at 1350 °C for 4 hr [16-30]. The phosphor materials were cooled to room temperature naturally.

The samples were characterized by using Photoluminescence (PL), and thermoluminescence glow curve analysis. The photoluminescence (PL) emission and excitation spectra were recorded at room temperature by use of a Shimadzu RF-5301 PC spectrofluorophotometer. TL glow curve recorded by using TLD I1009 reader [30-33].

1.2 Results and Discussion

Under excitation wavelength of 247nm excitation (figure 1), the emission spectrum of synthesized BaY_2O_4:Ce^{3+} with fixed concentration of Ce^{3+} (1mol%) phosphor shows a broad emission band extending in blue region

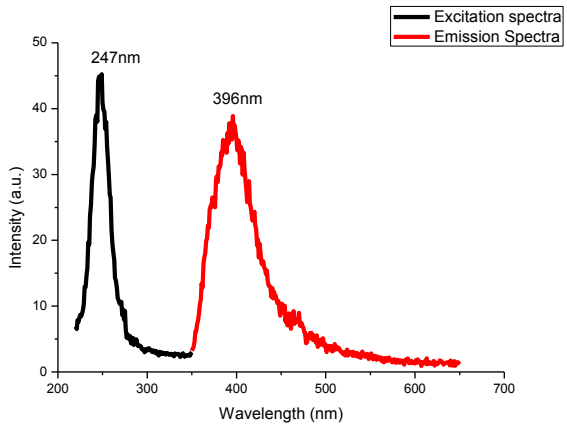

Fig. 1: PL excitation spectra of BaY_2O_4:Ce^{3+} phosphor

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Table 1: kinetic parameter calculation for $BaY_2O_4:Ce^{3+}$ phosphor

T_1 (K)	T_m (K)	T_2 (K)	τ	δ	ω	$\mu = \delta / \omega$	*Activation energy*	*Frequency factor*
347	373	394	26	21	47	0.447	2.07	2×10^{17}
375	415	447	40	32	72	0.444	1.518	1×10^{12}

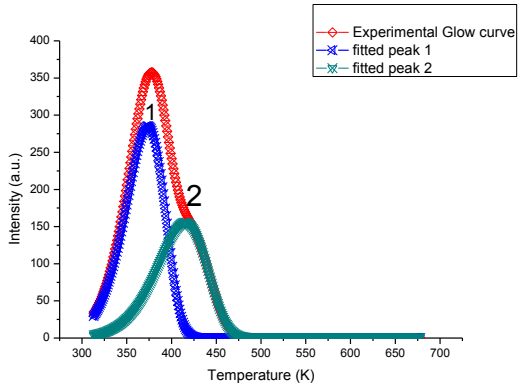

Fig. 2: CGCD glow curve of $BaY_2O_4:Ce^{3+}$ phosphor

from 396 nm (figure 1) with the maximum intensity at 396 nm, which is attributed to the electron transition from the 5d lowest energy level of Ce^{3+} to the $^2F_{5/2}$ to $^2F_{7/2}$ manifolds split by spin-orbit coupling [14, 15]. The broadness of the emission peak is ascribed to emission from more than one energy level.

From the TL glow curve of prepared phosphor shows good TL peak centred at 373K and it is fitted by theoretical glow curve and found two suitable peak 373K and 415K and order of kinetics found first order. Kinetic parameter calculated by peak shape method and activation energy found at 2.07 and 1.51eV.

2. CONCLUSION

It is concluded from above study cerium doped sample for fixed concentration cerium ion was prepared by solid state reaction method more suitable for large scale production. For PL emission was observed and shows broad emission peak centered at 3966nm (near UV - blue emission). Present phosphor can act as a host for UV - blue light emission in display devices.

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