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Short Communication

Synthesis and Luminescence Properties of Ce^{3+} doped host $YBaB_9O_{16}$ Phosphor

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Abstract

The blue emitting phosphor Ce^{3+} doped $YBaB_9O_{16}$ was synthesized by re-crystallization method. The prepared Phosphor was characterized by X-ray diffraction (XRD) and it is confirmed that $YBaB_9O_{16}$ crystallites with monoclinic structure formed at 900ºC for 4h. Photoluminescence (PL) property was studied by fluorescence spectrophotometer (F-7000). The emission was found to be 415 nm corresponding to blue region monitored at excitation wavelength 360 nm.

Keywords: $YBaB_9O_{16}$, $Ce^{3+,}$ X-ray powder diffraction, Photoluminescence, CIE Diagram.

Introduction

Saubat *et al.* was firstly reported about $LnBaB_9O_{16}$ polyborets (Ln= rare earths) and after that it was confirmed by efficient study of the Ln_2O_3-BaO B_2O_3 scheme[1,2]. These compounds have two dissimilar kinds of cations, Ln^{3+} and Ba^{2+} and by doping via Eu^{3+}, Tb^{3+} and Ce^{3+} of different rare earths ions, efficient for red, green and blue color phosphors. Hence these materials are considered to be fitting applicant as general hosts of luminescence materials for tri color lamps. $LaBaB_9O_{16}$:Pr^{3+} phosphor has been applicable for quantum cutting which absorbed one high energy UV photon and converts in to two low energy visible photons[3]. Ce^{3+} as an activator in tungstate compounds showed that the luminescent properties of the potential activators Ce^{3+} activated ions have not been adequately studied[4]. The PL excitation and emission spectra of $LaBaB_9O_{16}$:1%Ce^{3+} gives different emission spectrum at corresponding excitation wavelength[5]. Z. Yanga et al showed that replacement of Gd in place of Y in $LnBaB_9O_{16}$ host, no change in X-ray diffraction pattern[6]. These types of polyboretes has low melting point and can be easily synthesized at low temperature. In the present work we report the synthesis and luminescence Ce^{3+} doped $YBaB_9O_{16}$ phosphor was synthesized by re-crystallization method and investigated the photoluminescence properties under UV excitation.

Methodology

$Y_{(1-x)}$ BaB_9O_{16}: x%Ce^{3+} was prepared by re-crystallization method[7]. The materials taken were yttrium oxide [Y_2O_3] barium nitrate [$Ba(NO_3)_2$], boric acid [H_3BO_3], cerium nitrate [$Ce(NO_3)_3.6H_2O$]. All materials were taken as AR grade. Table-1 show that molar ratio and molar mass of precursors used in the preparation of phosphor and corresponding chemical reactions. The yttrium oxide Y_2O_3 was converted to respective nitrate by adding with nitric acid [HNO_3]. All nitrates were taken in china basin and mixed together by adding appropriate amount of double distilled water. Moreover, excess amount of water vaporized up to solution was dried. The dried mixture was heated in muffle furnace at 900 ^oC for 4 h. The body color of final product was appeared as white polycrystalline powder. The phase transparency was checked by XRD. The XRD pattern was recorded on a Miniflex II powder diffractometer with Cu-Kα radiation from a rotating anode of Wavelength is 1.5405 Å. PL spectra were recorded with a Hitachi F-7000 fluorescence spectrophotometer and PL emission and PL excitation spectra were recorded.

Table-1
Balanced molar ratio of precursors and weights of the ingredients for $YBaB_9O_{16}$:Ce^{3+}

$YBaB_9O_{16}$:Ce^{3+}	$Ba(NO_3)_2$	Y_2O_3	$Ce(NO_3)_3.6H_2O$	H_3BO_3
Molar ratio	1	0.99	0.01	9
Weights (gms)	1.30	0.55	0.021	2.78

Results and Discussion

XRD investigation: Figure-1 show the XRD pattern of $YBaB_9O_{16}$:Ce^{3+} was successfully synthesized by re-crystallization method. The formation of the crystalline phase was confirmed by XRD and XRD patterns for sample agree well with ICCD card No. 00-055-0792. According to the standard X-ray diffraction pattern ICCD card No. 00-055-0792, the $YBaB_9O_{16}$:Ce^{3+} lattice possesses Monoclinic structure with a

space group P2/ m (10) with lattice parameter a = 15.5720 Å, b = 3.892 Å and c = 6.7427 Å.

PL Excitation and Emission properties: Figure-2. Show the emission and excitation spectra of $YBaB_9O_{16}:Ce^{3+}$ exhibits blue emission at 415 nm under UV excitation which is excited by 360 nm. The excitation spectrum for 415 nm emission mainly consists of a strong wide band peaking at 360 nm. The emission spectrum also consists of a strong broad peak at 415 nm which is excited by 360 nm under UV excitation which corresponds to 5d excited state to the $^2F_{5/2}$ state and the $^2F_{7/2}$ ground state. It is accepted that the emission of Ce^{3+} can be accredited to transitions from the lowest 5d excited state to the $^2F_{5/2}$ state and the $^2F_{7/2}$ ground state, so that two different emission spectra observe[8].

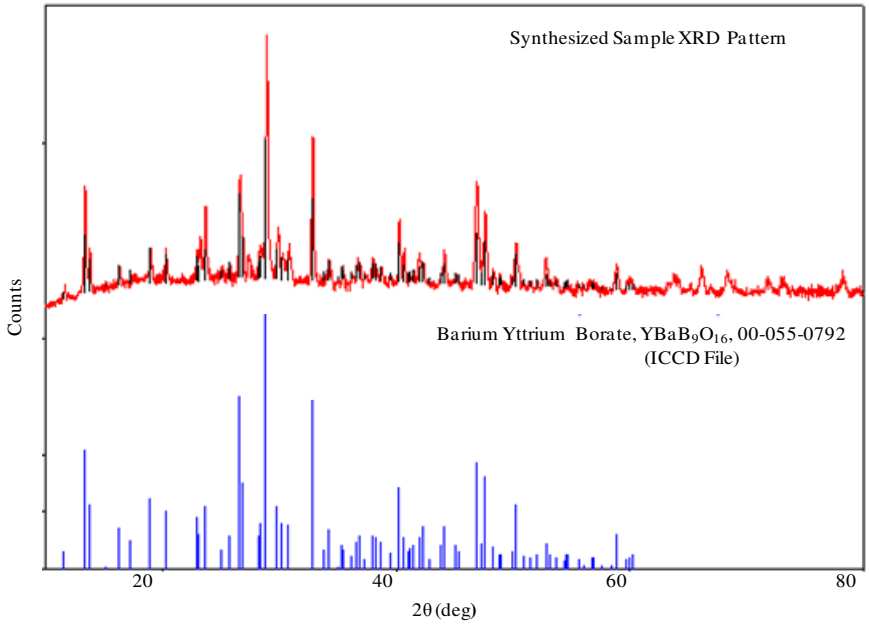

Figure-1
XRD pattern of $YBaB_9O_{16}:Ce^{3+}$ and matched with the ICCD card No. 00-055-0792

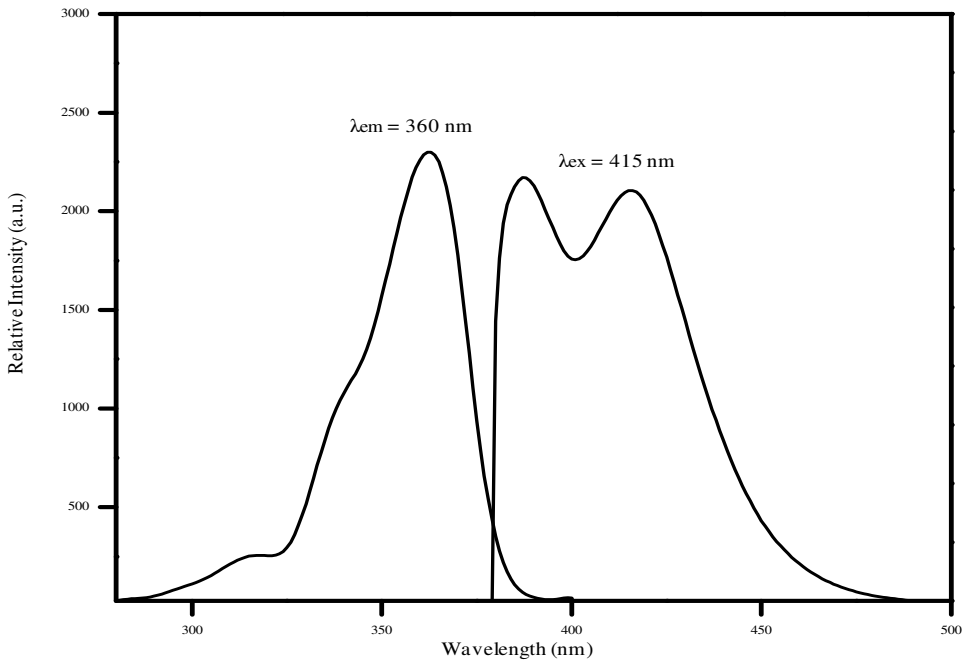

Figure-2
Excitation and Emission Spectra of $YBaB_9O_{16}:Ce^{3+}$ monitored at 415 nm and 360 nm respectively

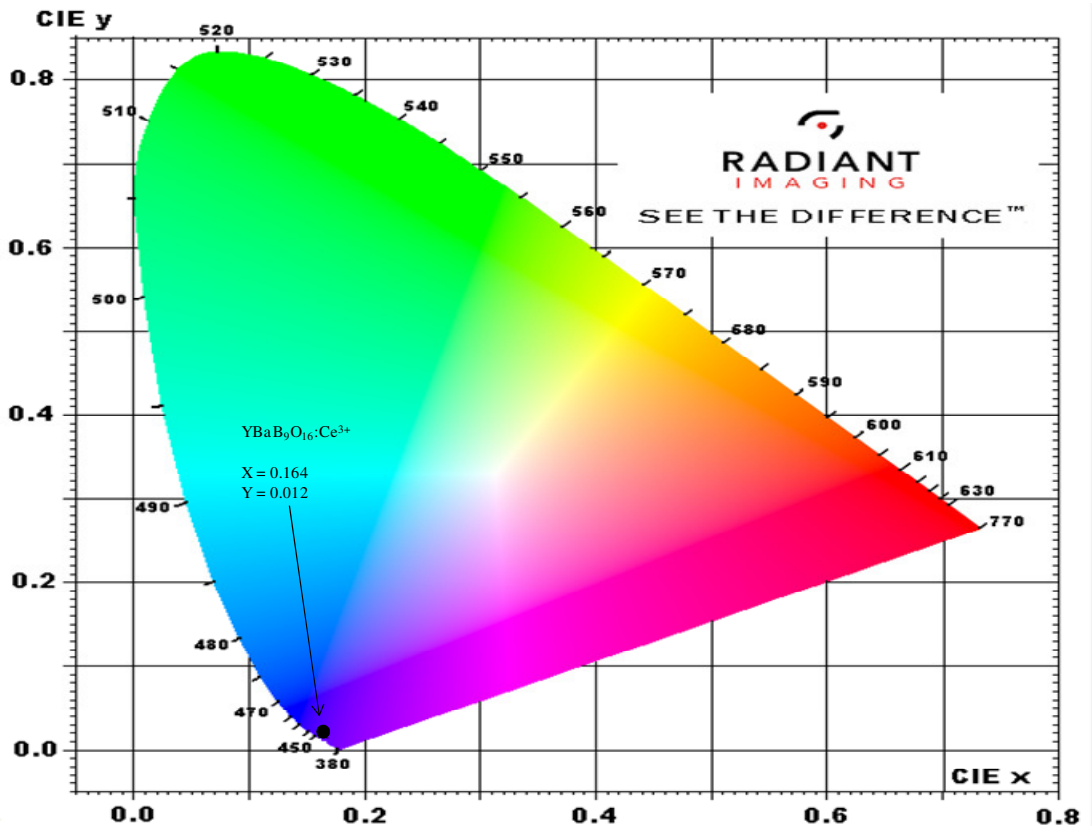

Figure-3
CIE coordinates of $YBaB_9O_{16}$: Ce^{3+}

CIE Co-ordinates: Figure-3 Represent CIE coordinates of $YBaB_9O_{16}$: Ce^{3+} was measured as (*x=0.164, y=0.012*). The location of coordinate has been marked in Figure-3 with a red circle. The CIE coordinate of $YBaB_9O_{16}$: Ce^{3+} is in near blue region.

Conclusion

The blue emitting phosphor Ce^{3+} doped $YBaB_9O_{16}$ phosphor was successfully synthesized by re-crystallization method. The luminescence properties in term of excitation and emission spectra $YBaB_9O_{16}$ properties show emission in blue region. The color chromaticity coordinate for $YBaB_9O_{16}$: Ce^{3+} was found to be x=0.164, y=0.012.

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