LUMINESCENCE PROPERTIES OF $SRAL_2B_2O_7:EU^{3+}$ PHOSPHOR FOR GREEN LIGHTING TECHNOLOGY

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Abstract

SrAl2B2O7: Eu3+ phosphors were synthesized by the combustion method. The prepared phosphor characterized through XRD technique for phase purity and studied for luminescence. The phosphors can be efficiently excited by 395nm and shows red emission at 615 nm due to 5D0→7F2 transition. Concentration quenching occurs at the 0.5 mole % of Eu3+ ions. Photoluminescence results suggest that this phosphor may be applicable in red emitting phosphor for an application in environmental friendly based lighting technology.

Keywords: Borate, Solid state lighting, Combustion method.

1. Introduction

For the past several years, aluminates based phosphor materials have been one of the widely used candidates for solid state lighting because of their high thermal stability , good chemical stability, low cast and outstanding luminescence properties [1-3]. The development of aluminates based phosphors has shown to be a special attention due to their outstanding application in environmental friendly light emitting devices in last some decade. Conventional methods for fabrication of WLED consist of combination of a blue emitting InGaN chip with $Y_3Al_5O_{12}:Ce^{3+}$ phosphor [4,5]. In recent years, trivalent and divalent rare earth ions doped inorganic phosphors paid much attention because of their potential applications in environmental friendly light emitting diodes [6-8]. White light emitting diodes are consider as the third generation of solid state lighting technology due to their advantages over traditional light technology such as superior color uniformity, low energy consumption (less CO_2 exhaustion), environment friendliness, long lifetime and high CRI value [9-11]. The paper presents the synthesis of $SrAl_2B_2O_7: Eu^{3+}$ phosphor prepared by combustion method and studied its luminescent properties for solid state lighting.

2. Experimental Procedure

$SrAl_2B_2O_7: Eu^{3+}$ phosphor were prepared by combustion synthesis. The combustion synthesis was carried out at 600°C. The starting raw materials were $Al(NO_3)_2.4H_2O$, $SrNO_3$(A.R.) , H_3BO_3, Eu_2O_3 and urea (NH_2CONH_2). Urea was used as fuel. Eu_2O_3 converted into the nitrate form by mixing of appropriate amount of dilute nitric acid. All the ingredients were mixed according to stochometric ratio in agate mortar and a pasty solution was formed, the solution is then transferred to silica crucible and kept inside a muffle furnace, which is maintained at a constant temperature 600°C. A flame with the foamy powder was formed, and that powder was collected and analysed by X-ray powder diffraction (XRD) and photoluminescence (PL) measurement.

3. Photoluminescence properties

Fig 1 shows the excitation spectrum of $SrAl_2B_2O_7: Eu^{3+}$ monitored at 614nm. The excitation spectrum shows three characteristic

bands which are located at 364nm, 384nm and 395 nm, due to intra-configurational 4f–4f transitions of Eu^{3+} ions. Fig. 2 illustrates the emission spectra of $SrAl_2B_2O_7$: Eu^{3+} phosphors. Emission spectra consist three emission peaks located at about 580 nm, 593nm , 614 nm are assigned to transitions of $^5D_0 \rightarrow {}^7F_0$, $^5D_0 \rightarrow {}^7F_1$, $^5D_0 \rightarrow {}^7F_2$ respectively[12]. The highest emission intensity observed at 614 nm , which suggest that the Eu^{3+} ions occupies a center of symmetry in $SrAl_2B_2O_7$ host [13]. From fig.3. it is observed that the emission intensity increased with the increasing concentration of Eu^{3+} and maximum emission intensity observed at 0.5 mole%. Beyond 0.5 mole% the emission intensity gradually decreases with further increase of concentration of Eu^{3+} due to concentration quenching effect [14]. Photoluminescence results suggest that the phosphor may have potential applications in the field of solid state lighting.

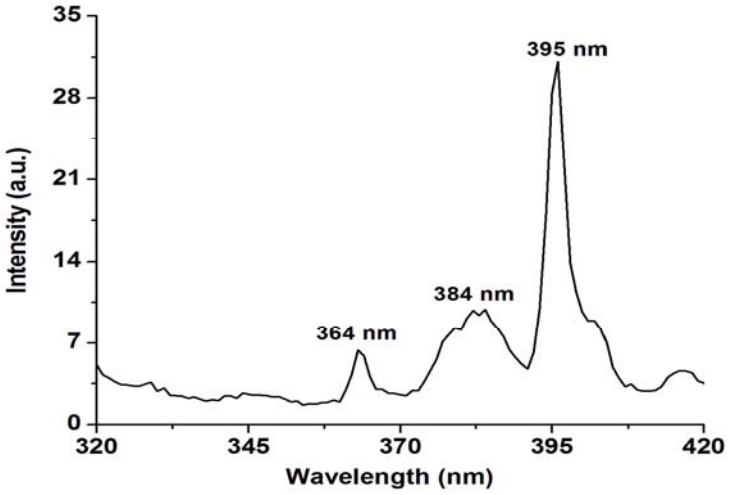

Fig.1. Excitation spectrum of $SrAl_2B_2O_7$: Eu^{3+} phosphor (λem= 614 nm).

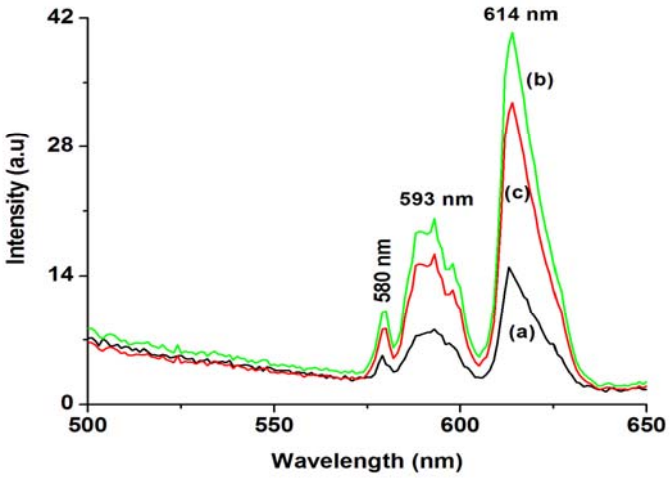

Fig 2. Emission spectrum of $SrAl_2B_2O_7$: Eu^{3+} phosphor (λex= 395nm), Where (a) Eu=0.2 mole% (b) Eu= 0.5 mole% (c) Eu= 1 mole%

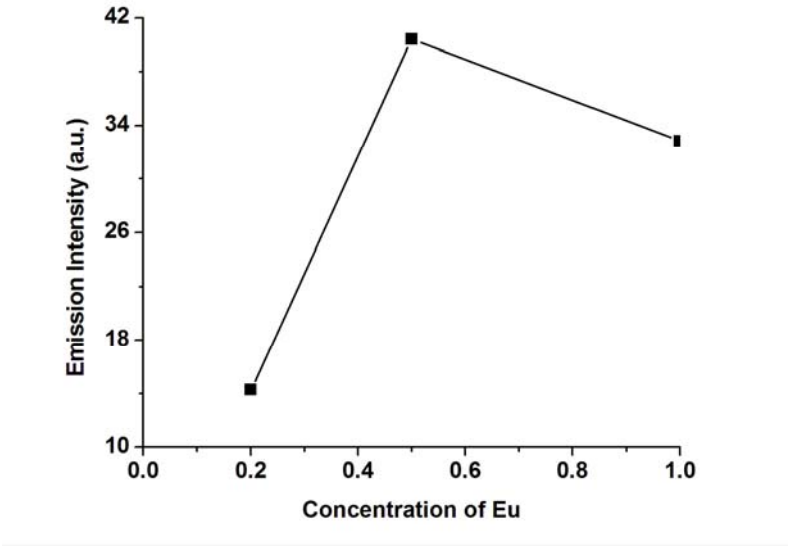

Fig. 3. Effect of concentration of doped Eu^{3+} on relative emission intensity at 614nm for $SrAl_2B_2O_7$ phosphor

4. Conclusions

Trivalent europium doped SrAl2B2O7 phosphors were synthesized by combustion method. The strongest emission wavelength of SrAl2B2O7: Eu3+ is at 614nm for 395 nm excitation attributed to 5D0→7F2 transition of Eu3+ ions. The concentration quenching occurs when Eu3+ concentration reached 0.5 mol %. The prepared phosphors could find application in ecofriendly lighting technology.

5. Referencs

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