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Luminescence Studies of Eu Doped AY_2O_4 (A=Ca, Ba) Phosphor

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Abstract— *The rare-earth Eu^{3+} doped and CaY_2O_4 and BaY_2O_4 red phosphor synthesized by solid state reaction method. The PLE and PL were characterized by Spectrofluorophotometer. The excitation spectra of synthesized phosphor at 613 nm monitoring were composed of a broadband and a series of sharp peaks, the strongest excitation peak at 254 nm. The main emission spectra of samples under 254nm excitation is Eu^{3+} ions $^5D_0 \rightarrow {}^7F_2$ electric dipole transition with a strong red light, so that the phosphors may be a better candidate for red component for white light generation in display and lamps.*

1. INTRODUCTION

Application of novel insulator materials in various optoelectronic devices is rapidly growing. Knowledge about electronic properties of these compounds in various forms (bulk, thin film, nanoparticles) is highly desirable in order to benefit fully of their new or improved performance for a particular application. In plasma displays (PDP) MgO films play two important roles. Firstly this layer protects dielectric materials as well as phosphors, which convert VUV radition into visible light, from erosion caused by bombarding of energetic Xe and Ne ions. Secondly, the MgO film is a source of secondary electrons, thereby directly determining the firing voltage (FV) of gas discharge in PDP cells. Earlier studies have shown that the FV of simple alkali earth oxides (BaO, electron affinity χ~0.6 eV) is lower than that of MgO (χ~0.8 eV).

However, the hygroscopisity of BaO do not facilitate its use in real devices. Good alternative to simple oxides can be ternary Ba compounds, which due their spinell structure are expected to be radiation resistant and chemically more inert. There is not much information available on the electronic properties of such compounds, which motivated us to carry out present study of Eu3+ activated CaY_2O_4 and BaY_2O_4.

2. EXPERIMENTAL

Powder samples were prepared by firing stoichiometric mixtures of $CaCO_3$, $BaCO_3$, Y_2O_3 as raw materials and Eu_2O_3 as activator at 1200°C for 2 h. The photoluminescence spectra were obtained by using a spectrofluorophotometer with an 80-W Xe lamp and 0.25-m monochromators. Slit widths were 0.05 mm for emission and 1.56 mm for excitation.

In this work Eu^{3+} activated CaY_2O_4 and BaY_2O_4 were synthesized by solid state reaction and their luminescent properties under UV excitation were investigated.

3. RESULTS AND DISCUSSION

3.1 PLE Study

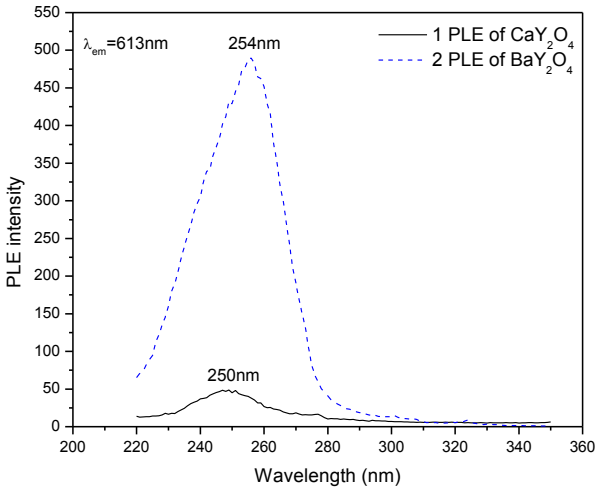

Fig. 1: PLE spectra of Eu (0.1%) doped AY_2O_4 Phosphor monitored at 613nm.

The emission spectrum of Eu^{3+} site in CaY_2O_4 and BaY_2O_4 shows maximum intensity at 613 nm and 633nm corresponding to $^5D_0 \rightarrow {}^7F_2$ transition, and the transition of $^5D_0 \rightarrow {}^7F_1$ around 595nm is observed with low intensity in both phosphors.

The excitation spectrum monitored at 613 nm radiation has a broad band at about 254 nm of BaY_2O_4 and the excitation spectrum has a broad band at about 250 nm of CaY_2O_4 with low intensity than BaY_2O_4 as shown in the

figure 1. Both excitation bands correspond to the [Eu^{3+} - O^{2-}] charge-transfer transitions. It is known that the position of the [Eu^{3+} - O^{2-}] charge transfer transition is more or less fixed in octahedral VI coordination but moves to lower energy with increasing Eu-O distance.

3.2 PL Study

Figure 2 shows emission spectra of CaY_2O_4:Eu^{3+} (1%) and BaY_2O_4:Eu^{3+} (1%), in the 585 - 650 nm region under 254-nm excitation. This result is in good agreement with the results reported by Byung-yoon Park et al., The 613nm peak is assigned to ED which is stronger than MD transition at 595nm.

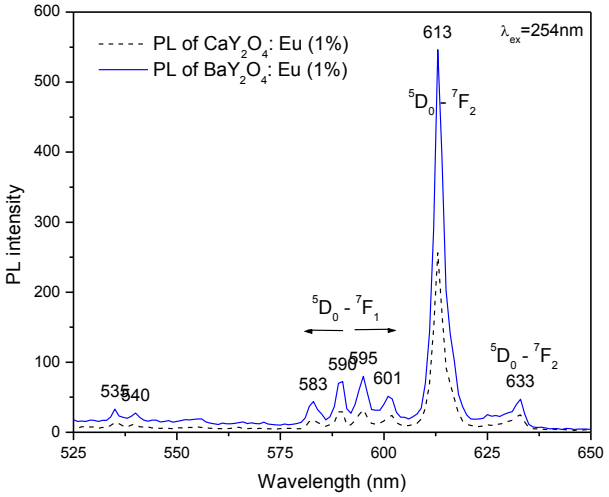

Fig. 2: PL spectra of Eu (1%) doped AY_2O_4 phosphor under 254nm excitation

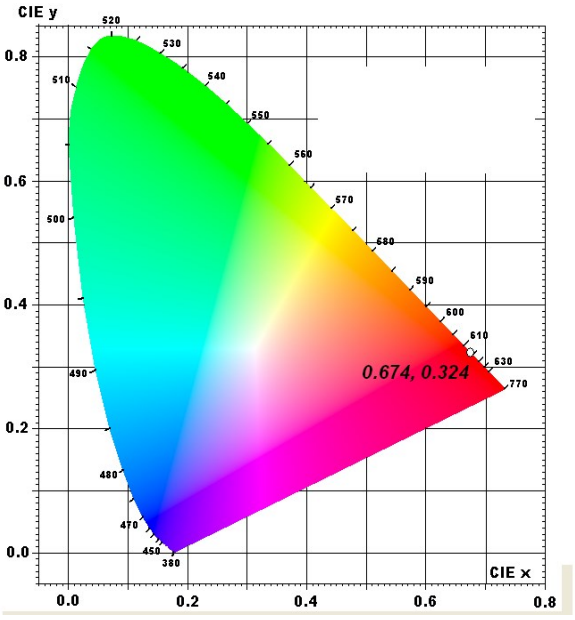

Fig. 3: CIE co-ordinates of Eu (1%) doped AY_2O_4 phosphor depicted on 1931 chart

3.3 CIE Study

The CIE co-ordinates calculated by the Spectrophotometric method using the spectral energy distribution of the CaY_2O_4 and BaY_2O_4:Eu^{3+}(1%) samples is shown in figure 3. The color co-ordinates x=0.624 and y=0.324 showing red emission.

4. CONCLUSIONS

The emission spectrum of Eu^{3+} site in CaY_2O_4 and BaY_2O_4 shows maximum intensity at 613 nm and 633nm corresponding to $^5D_0 \rightarrow {}^7F_2$ transition. However when the Ca is replaced with Ba the intensity of 613nm is doubled apart from other emissions in CaY_2O_4 and BaY_2O_4. This may be due the presence of Ba ion whose atomic radius is nearly same as Eu ion in the crystal matrix.

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