

Characterization techniques and PL study of Eu ,Mn doped BaY₂O₄ phosphors

Sk. Erfan and B. Subba Rao

Department of Physics, VSR & NVR College, Tenali-522 201, India

Abstract

The rare-earth Eu³⁺ doped and BaY₂O₄ red phosphor synthesized by solid state reaction method. The PLE, PL and XRD were characterized. 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 Eu³⁺ ions ⁵D₀→⁷F₂ 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 radiation 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 $\chi \sim 0.6$ eV) is lower than that of MgO ($\chi \sim 0.8$ eV).

However, the hygroscopicity 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 BaY₂O₄.

2. Experimental

Powder samples were prepared by firing stoichiometric mixtures of BaCO₃, Y₂O₃ as raw materials and Eu₂O₃ 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 Eu³⁺ activated BaY₂O₄ was synthesized by solid state reaction and their luminescent properties under UV excitation were investigated.

3. Results and discussion

3.1 PLE study

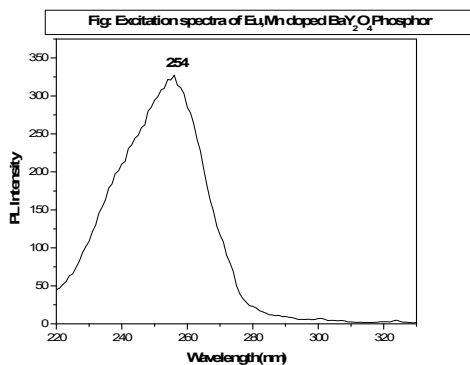


Fig.1 PLE spectra of Eu (2%),Mn(2%) doped BaY₂O₄ Phosphor monitored at 613nm.

The emission spectrum of Eu³⁺ site in BaY₂O₄ shows maximum intensity at 595nm and 613nm corresponding to ⁵D₀→⁷F₂ transition, and the transition of ⁵D₀→⁷F₁ around 595nm is observed with low intensity in this phosphor.

The excitation spectrum monitored at 613 nm radiation has a broad band at about 254 nm of BaY₂O₄. It is known that the position of the [Eu³⁺ - O²⁻] 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 BaY₂O₄:Eu³⁺(2%),Mn(2%) 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.

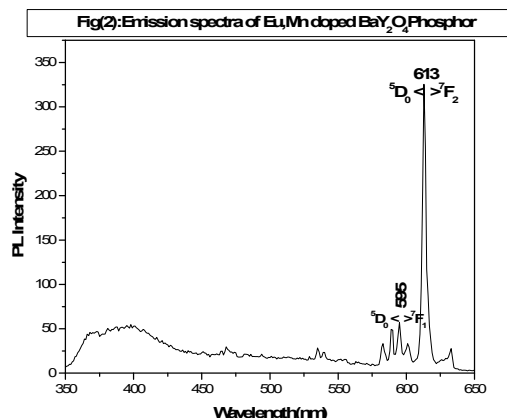


Fig.2 PL spectra of Eu (2%),Mn(2%) doped BaY₂O₄ phosphor under 254nm excitation

3.3 CIE study

The CIE co-ordinates calculated by the Spectrophotometric method using the spectral energy distribution of the BaY₂O₄ Eu³⁺(2%), Mn(2%) samples is shown in figure 3. The color co-ordinates x=0.624 and y=0.324 showing red emission.

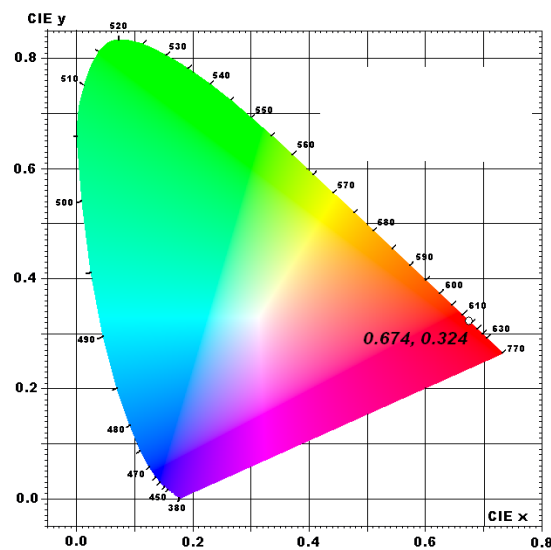
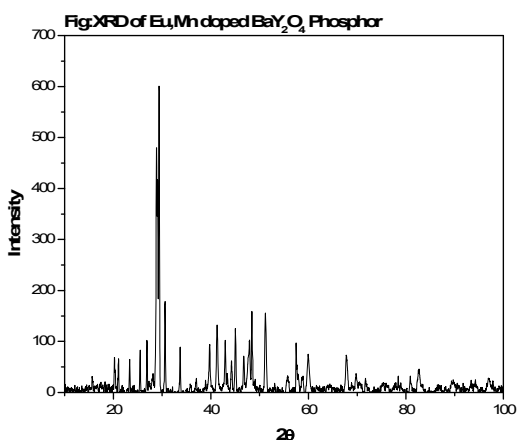


Fig.3 CIE co-ordinates of Eu(2%),Mn(2%)doped BaY₂O₄ phosphor depicted on 1931 chart

XRD:

XRD Pattern of Eu doped CaY_2O_4 phosphor is shown in figure-4. The crystallite size is calculated using Scherrer's formula $d = K \cdot \lambda / \beta \cos \theta$, Where 'K' is Scherrer constant (0.94). The crystal size of BaY_2O_4 : Eu(3+), Mn phosphor is around 90 nm.



Conclusions:

The emission spectrum of Eu^{3+} site in BaY_2O_4 shows maximum intensity at 613 nm corresponding to ${}^5\text{D}_0 \rightarrow {}^7\text{F}_2$ transition. Not only that the crystal size of BaY_2O_4 – Eu, Mn doped phosphor is found to be 90 nm.

References

- [1] S.J. Park, C.-H. Park, B.-Y. Yu, H.-S. Bae, C.-H. Kim and C.-H. Pyun, *J. Electrochem. Soc.*, 146(10), 3903 (1999)
- [2] H. E. Hoefdraad, *J. Solid State Chem.*, 15, 175 (1975)
- [3] H. T. Hintzen, H. A. M. van Hal, C. Langereis, and C.J. M. Denissen, *J. Less-Common Met.*, 155, 291 (1989)
- [4] G. Blasse, and B. C. Grabmaier, *Luminescent Materials*, p. 17, Springer-Verlag, Berlin (1994)

- [5] T. J. Vink, A. R. Balkenende, R. G. F. A. Verbeek, H. A. M. van Hal, and S. T. de Zwart, *Appl. Phys. Lett.* 80, 2216 (2002)
- [6] T.I. Savikhina, I.A. Meriloo, *Trudy Inst. Fiz. Akad. Nauk Est. SSR* 49, 146 (1979)
- [7] A.I. Kuznetsov, V.N. Abramov, N.S. Roose, T.I. Savikhina, *JETP Letters* 28, 602 (1978)
- [8] I.N. Ogorodnikov, V.A. Pustovarov, M. Kirm, A.V. Kruzhalov, L.I. Isaenko, *Phys. Sol. State* 43, 1454 (2001) and *Engg. 2* (2209) 012046
- [9] B.S. Chkrabarty, K.V.R. Murthy, TR, Joshi, *Turkish Journal of Physics* 26, 2000, 193-198.
- [10] K V R, Murthy, *Recent Research in Science and Technology* 4 (8), 2013
- [11] M. C Parmar, K V R Murthy and M. R Rao. *Indian Journal of Engineering and Material Sciences*, Vol.16, June 2009, PP.185-187
- [12] Rahul Ghildiyal, Pallavi Page and K V R Murthy, *Journal of Luminescence*, Volume 124, Issue 2, June 2007, Pages 217-220.
- [13] D. Tawde, M. Srinivas, K V R Murthy, *physica status solidi (a)* 2008 (4), 803-807.
- [14] Pallavi Page, R Ghildiyal and K V R Murthy, (2008) *MRB*, 43 (2), pp. 353-360. *Sk. Erfan et. al. / Int. J. Luminescence and Applications*, ISSN: 2277-6362, Vol. 5, No. 2, June 2015 263
- [15] K V R Murth, *IJLA*, 2011 Vol.1 (I), ISSN 2277 – 6362, pp 34-37. [16] K.V. R Murthy, A.S. Sai Prasad and M. R. Rao, *Physics Procedia* 29 (2012) 70 – 75.
- [17] Pallavi Page, R Ghildiyal K V R Murthy, *MRB*, Vol.41, 10, (2006), 1854-1860.
- [18] Pallavi Page, K V R Murthy, *Philosophical Magazine Letters*, Vol.90, No.9, Sept2010, 653–662.
- [19] K V R Murthy, *Shaping the Future with green chemistry* (2014), 2-4, ISBN: 978-93-82570-34-9.
- [20] K V R Murthy, *LEDs-EL Phosphors*, *Proceedings of NSDM-14*, 5-13, ISBN:978-93-82570