THE EXPERIMENT
INTERNATIONAL JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN-2319-2119

RESEARCH ARTICLE

P.Sujitha et al, The *Experiment, 2013 Vol. 15(3), 1072-1076*

SYNTHESIS PHOTOLUMINESCENCE STUDIES OF Y_2O_3 PHOSPHOR DOPED WITH TB,EU AND GD

ABSTRACT

Present paper reports the synthesis and characterization of Tb, Eu and Gd activated Y_2O_3 phosphor. This phosphor was prepared by solid state reaction method and characterized by Photoluminescence, XRD and SEM techniques. PL excitation peaks for Y_2O_3 Phosphor doped with Eu, Gd & Tb were observed at 252,268 and 304 nm, whereas the emission spectra of Y_2O_3 Phosphor doped with Eu, Gd & Tb shows peaks around 485,544,552,595,613 and 632nm. The phase formation is determined by X-Ray Diffraction(XRD) and it is around 20nm.The morphology is also observed.

KEYWORDS Photoluminescence(PL),Thermoluminescence(TL),X-Ray Diffraction(XRD),Solid State Reaction(SSR)

1.INTRODUCTION

Phosphor can be found in broad range of the everyday applications such as cathode ray tubes(CRT) used in medical imaging, projection television(PTVs),Fluorescent lights(FL), graphics, electro-luminescent panels(EL) and field emission display(FED)[1-6]. These materials provide high luminescence due to the electronic transition mainly due to the 4f→ 4f transition of the activator ions. In a recent communication, preliminary results have been reported on the synthesis, characterization and optical spectroscopy of nanosized doped Y2O3 prepared by a combustion method [12], a well-known oxide phosphor material which shows improved quantum efficiency when prepared in a nano structured form.

2.EXPERIMENTAL

The phosphor sample was prepared by solid state diffusion reaction method. The phosphor Y_2O_3 is doped with Eu_2O_3, Tb_4O_7, Gd_2O_3. The prepared Y_2O_3: Eu,Gd,Tb phosphor is weighed and grounded into a fine powder using agate mortar and pestle about an hour. The grounded mixture was placed in an alumina crucible and heated from room temperature to 1200^0c in a muffle furnace with a heating rate of 5^0C/min. After reaching 1200^0c the phosphor heated for 3hours and the furnace was allowed to cool to room temperature along with the samples.

3.CHARACTERIZATIONS

The characterizations of prepared phosphors are done using Photoluminescence (PL), XRD, and SEM . The photoluminescence spectra were recorded at room temperature using spectroflurophotometermeter (SHIMADZU, RF5301PC) xenon lamp as excitation source. . Using XRD technique the phase and crystallite size is found. The surface morphology and the particle sizes of the phosphors are observed from SEM

4.RESULTS AND DISCUSSIONS

(1).Photoluminescence study

FigI(A),(B) and (C) are the photoluminescence emissions of Y_2O_3:Eu(1.0%), Gd(1.0%), Tb(1.0%) when excited with 254nm excitation for various regions of visible spectrum. All the emissions observed in Y_2O_3: Eu(1.0%),Gd(1.0%),Tb(1.0%) for 254nm excitation is presented in table1.

THE EXPERIMENT
INTERNATIONAL JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN-2319-2119

RESEARCH ARTICLE

P.Sujitha et al, The *Experiment, 2013 Vol. 15(3), 1072-1076*

When the phosphor Y_2O_3: Eu(1.0%),Gd(1.0%),Tb(1.0%) is excited with 254nm the sharp Eu^{3+} and Tb^{3+} emission peaks are seen at 468,536,582,589, 595,600,613,633 with an intensity around 54,50,36,60, 66,41,390,36au are present.

When the phosphor is excited with 268nm the sharp Eu^{3+} and Tb^{3+} emission peaks are seen at 85,489,493,545,552,584,589,595,613,633 with an intensity around 94,67,65, 148, 106, 23, 24,27,132,13a.u are present.It is interesting to note when the phosphor Y_2O_3: Eu(1.0%),Gd(1.0%),Tb(1.0%) is excited with 254 the emission the red is dominated at 613nm emission with 390au intensity is present. The red domination from Eu^{3+} emission is found at 613nm which is due to the allowed transition $^5D_0 \rightarrow {}^7F_2$ with electric dipole of energy 2.0225ev.

Y_2O_3: Eu(1.0%),Gd(1.0%),Tb(1.0%) is excited with 268 the emission the red is dominated at 545nm emission with 148au intensity is present. The green domination from Tb^{3+} emission is found at 545nm which is due to the allowed transition $^5D_1 \rightarrow {}^7F_1$.The allowed transitions of the Gd^{3+}, Tb^{3+} and Eu^{3+} with different emission wavelengths and intensities are shown in table 1. They are due to the transitions,

- Blue emission at 467nm is due to transition $^5D_2 \rightarrow {}^7F_0$ with energy 2.6572ev.
- Green emission at 535nm is due to transition $^5D_1 \rightarrow {}^7F_1$ with energy 2.3002ev.
- Yellow emission 589nm is due the transition $^5D_0 \rightarrow {}^7F_1$ with magnetic dipole of energy 2.1376ev.
- Red emission is 613nm is due to the transition $^5D_0 \rightarrow {}^7F_2$ with electric dipole of energy 2.0225ev.
- Deep red emission is 632nm is due to transition $^5D_0 \rightarrow {}^7F_3$ with electric dipole of energy 1.9617ev.

(2).X-Ray Diffraction(XRD)

Fig.II is the XRD of Y_2O_3: Eu(1.0%),Gd(1.0%),Tb(1.0%) The calculated crystallite size using Scherer's formula $d = K.\lambda / \beta \cos\theta$, where 'K' is the Scherer's constant (0.94), 'λ' the wavelength of the X-ray (1.5418 Å), 'β' the full-width at half maxima (FWHM) (0.0076), 'θ' the Bragg angle of the highest peak is 16.70^0, $\cos\theta$, = 0.9578 ,the crystallite size is around **20.11**nm.

(3).Scanning Electron Micrograph(SEM)

Fig.III(A and) are the SEM micrographs of Y_2O_3: Eu(1.0%),Gd(1.0%),Tb(1.0%) with magnification of 150K for different locations. From the Scanning Electron Micrograph of Y_2O_3: Eu(1.0%),Gd(1.0%),Tb(1.0%) it is found the particles are shapeless with various sizes from 40-200nm with agglomerated clusters are found. From the SEM micrograph the calculated average basal diameter of 60nm.

5.Figures and Tables

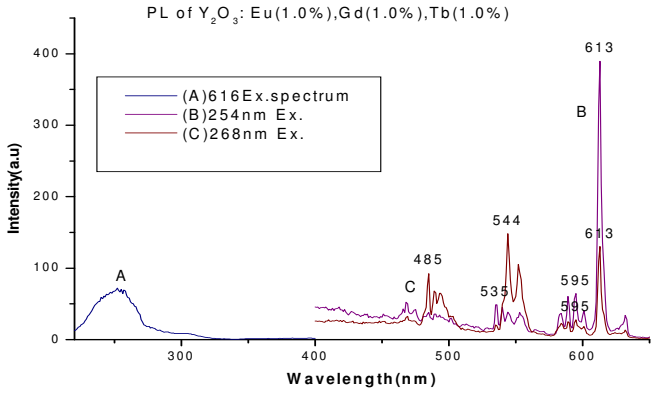


Fig. I(A): Emission of Y_2O_3: Eu(1.0%),Gd(1.0%),Tb(1.0%)

THE EXPERIMENT
INTERNATIONAL JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN-2319-2119

RESEARCH ARTICLE

P.Sujitha et al, The *Experiment, 2013 Vol. 15(3), 1072-1076*

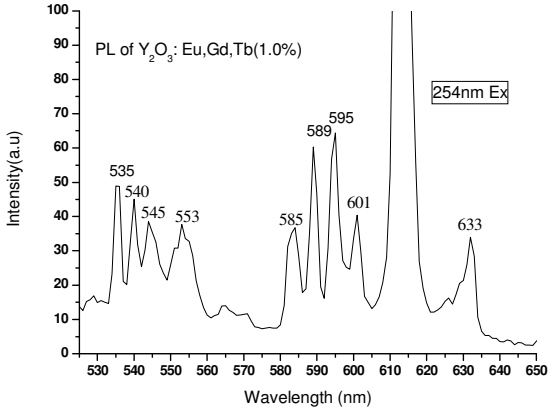


Fig. I(B): Emission of Y_2O_3: Eu(1.0%),Gd(1.0%),Tb(1.0%)

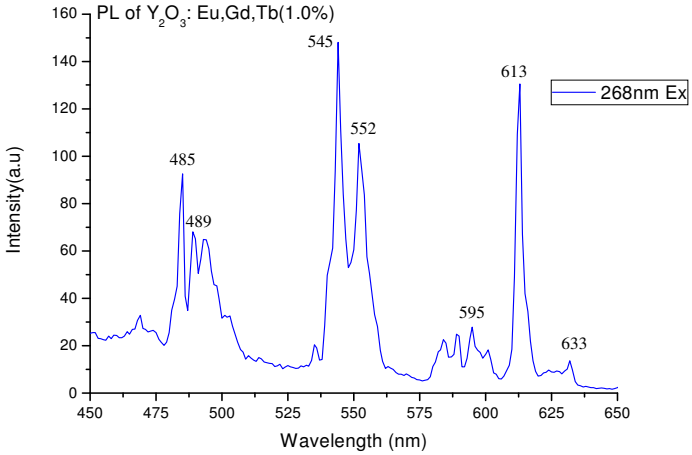


Fig. I(C): Emission of Y_2O_3: Eu(1.0%),Gd(1.0%),Tb(1.0%)

Sr.No.	**Excitation Wavelength (nm)**	**Emission Wavelengths (nm)**	**Intensities (a.u.)**
01.	254	468,536,582,589, 595,600,613,633	54,50,36,60, 66,41,390,36
02.	268	485,489,493,545,552, 584,589,595,613,633	94,67,65,148,106, 23,24,27,132,13

Table 1: Intensities and emissions of Y_2O_3: Eu(1.0%),Gd(1.0%),Tb(1.0%)

THE EXPERIMENT
INTERNATIONAL JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN-2319-2119

RESEARCH ARTICLE

P.Sujitha et al, The *Experiment, 2013 Vol. 15(3), 1072-1076*

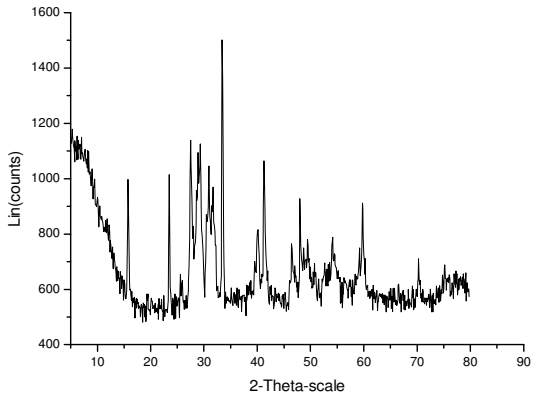
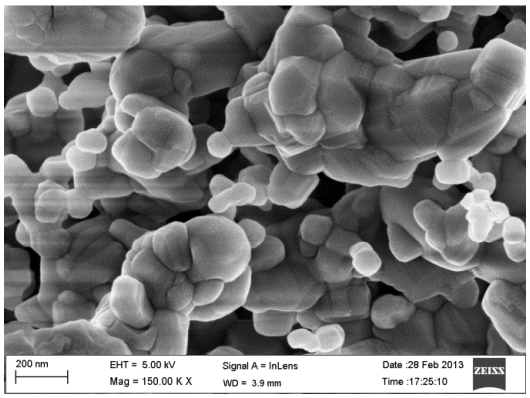


Fig.II: XRD of Y_2O_3: Eu(1.0%),Gd(1.0%),Tb(1.0%)



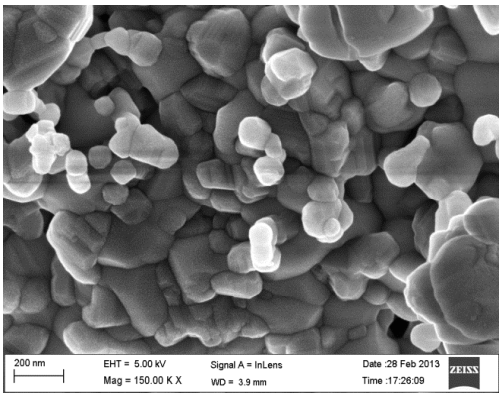


Fig.III(A) Fig.III(B)

Fig.III (A and B) are the SEM of Y_2O_3: Eu(1.0%),Gd(1.0%),Tb(1.0%)

6.CONCLUSIONS

It is interesting to note that the blue, green and red [R:132,B:94, G:149] emissions are seen with nearly equal ratio. From XRD we conclude that the phosphor is in single phase.Glowing nano particles are seen which is due the impinging electron beam leads to generate red light from the phosphor under SEM study. which conclude us the present phosphor Y_2O_3: Eu(1.0%), Gd(1.0%), Tb(1.0%) may be a good candidate for Compact Fluorescent Lamps {CFLs}. Further studies are going on.

THE EXPERIMENT
INTERNATIONAL JOURNAL OF SCIENCE AND TECHNOLOGY

ISSN-2319-2119

RESEARCH ARTICLE

P.Sujitha et al, The *Experiment, 2013 Vol. 15(3), 1072-1076*

7.REFERENCES

1. G. Blasse et.al, Luminescent Materials, Springer-Verlag, Berlin (Germany) 1994
2. W.M. Yen et.al, Inorganic Phosphors,CRC Press.Boca Raton, FL (USA) 2004
3. Wang,Y H, Wang,Z.Y,Zhang,P.Y,Hong,Z.L,Fan,X.P,Mater.Lett.,58,3308, (2004)
4. Feldmann C, Jüstel T, Ronda C R, Schmidt P J. Adv. Funct. Mater.13, 511, (2003)
5. Danielson E et al., J. Mol. Struct., 470, 229, (1998)
6. Danielson E et al., Science, 279, 837, (1998)
7. Okada,S. et al., Solid State Ionics, 175, 593, (2004)
8. Hinatsu Y, Wakeshima M, Edelstein N, Craig I, J. Solid State Chem., 144,20,(1999)
9. Ropp, R.C., Luminescence and the Solid State, Elsevier, Amsterdam, (1991)
10. Xiao, X., Yan, B., Journal of Physics and Chemistry of Solids, 69, 1665–1668, (2008)

P.Sujitha[*] B. Subba Rao[1] and K.V.R.Murthy[2]

[*,1]Department of Physics, VSR & NVR College, Tenali-522 201.
[2]Display Materials Laboratory, Applied Physics Department, Faculty of Technology & Engineering, M.S. University of Baroda, Vadodara – 390 001.