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Photoluminescence Properties of Gd_2sio_5: CE (1.5%) and EU(X) Phosphors

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Abstract*: This paper reports that the preparation and photoluminescence studies of host Gd_2SiO_5:Ce (1.5 mol%) and Eu(X) where X = (0.2, 0.5, 1.0, 1.5 and 2.0 mol%) Powder samples were prepared by firing stoichiometric mixtures of raw material and Eu_2O_3 as activator at 1200 ^oC for 2 hours. The photoluminescence spectra were obtained by using a spectro fluorophoto meter with an 80-W Xe lamp and 0.25-m mono chromators. Slit widths were 0.05 mm for emission and 1.56 mm for excitation. The synthesized phosphor excitation spectrum monitoring at 400nm, 440nm and 615nm this gives series of sharp peaks, the strongest. The main emission spectrum observed at 254nm,275nm,314nm,347nm and 690nm excitation is gives the wavelength range from 366 to 628 peaks with high intensities and some low intensities because of existence of Ce and Eu^{3+}, so that the phosphors may be a better candidate for red component for white light generation in display and lamp. The excitation spectrum monitored at 615 nm radiation has a broad band at about 254-300nm of with good intensity.

Keywords: Photoluminescence, wavelength, phosphor, doping, host lattice.

I. INTRODUCTION

Recently various red phosphors materials have been actively investigated to improve their luminescent properties and to meet the development of different display and luminescence devices. Inorganic compounds doped with rare earth ions form an important class of phosphors as they possess a few interesting characteristics such as excellent chemical stability, high luminescence efficiency, and flexible emission colors with different activators. As new red luminescent materials of host of Gd_2SiO_5: Ce (1.5%) and Eu^{3+} (X) where (X=0.2, 0.5, 1.0, 1.5 and 2.0 mol %) the rare-earth in Gd_2SiO_5:Ce(1.5%) blue and red phosphor is synthesized by standard solid state reaction method. The synthesized phosphor excitation spectrum monitoring at 400nm, 440nm and 615nm this gives series of sharp peaks, the strongest. The main emission spectrum observed at 254nm,275nm,314nm,347nm and 690nm excitation is gives the wavelength range from 366 to 628 peaks with high intensities and some low intensities because of existence of Ce and Eu^{3+}, so that the phosphors may be a better candidate for red component for white light generation in display and lamp.

II. EXPERIMENTAL

The samples were prepared by solid state reaction method at high temperature. Gd_2SiO_5:Ce(1.5%) and Eu^{3+}(X) where (X = 0.2, 0.5,1.0,1.5 and 2.0 mol %) were initially prepared by mixing of stoichiometric amounts of starting materials Gadolinium(III) oxide (Gd_2O_3) Silicon dioxide (SiO_2) Cerium oxide (CeO_2) and Europium oxide (Eu_2O_3) (A.R.) All the compounds was weighed, added in appropriate proportions synthesized in order to analyze the co-dopant nature i.e. the effect of concentration and its emission lines in the host phosphor. Europium oxide Eu_2O_3 is used as activator ion at different concentration (0.2, 0.5, 1.0, 1.5, and 2.0 mol %) and grounded into a fine powder using agate mortar and pestle about an hour. The grounded phosphors were placed in an alumina crucible and heated in air atmosphere at 1200°C for 2 hours in a muffle furnace the phosphor were characterized by the photoluminescence spectra were obtained by using a spectrofluorophotometer with an 80-W Xe lamp and 0.25-m mono chromators. Slit widths were 0.05 mm for emission and 1.56 mm for excitation.

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III.RESULTS AND DISCUSSIONS

A. *Photoluminescence Study*

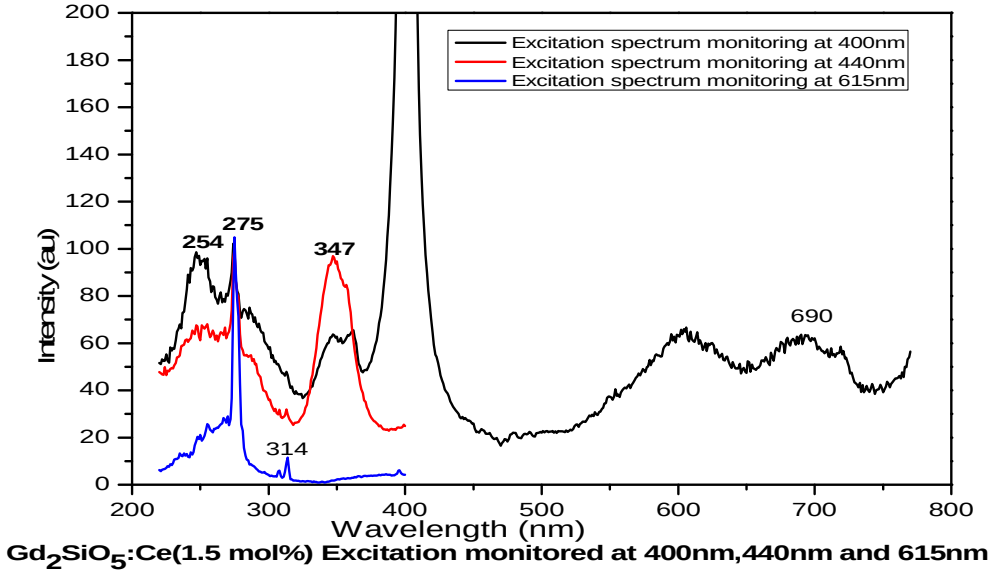

Fig.1 shows that Excitation of Gd_2SiO_5: Ce (1.5%) monitored at 400nm, 440nm and 615nm

The fig.1 shows the host materials excitation spectrum of Gd_2SiO_5: Ce (1.5%) monitored at 400nm, 440nm and 615nm . the main emission peaks observed at 254nm, 275nm, 314nm, 347nm and 615nm.

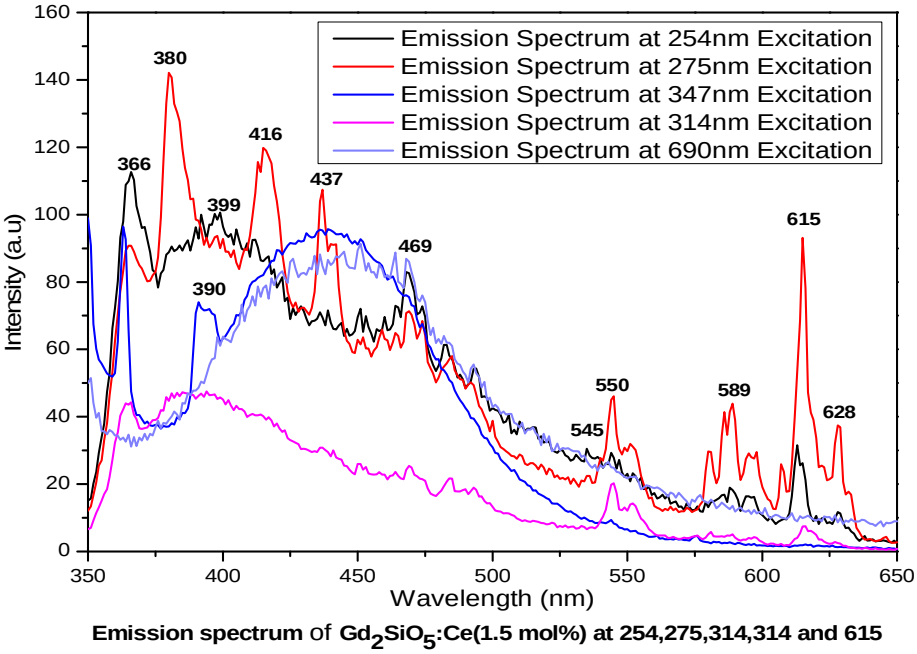

Fig.1 shows that Emission spectrum of Gd2SiO5: Ce (1.5%) at 254nm,275nm, 314nm,347nm and 690nm Excitations

Fig.2.is shows that the emission spectrum Gd2SiO5: Ce (1.5%) at 254nm, 275nm, 314nm, 347nm and 690nm Excitations. At 254nm the peaks are from 366nm to 628nm that is UV to red region. the same sample emissions peaks are 366nm,380nm, 390nm,399nm, 416nm, 437nm, 459nm, 454nm, 550nm, 580nm, 615nm and 628nm.

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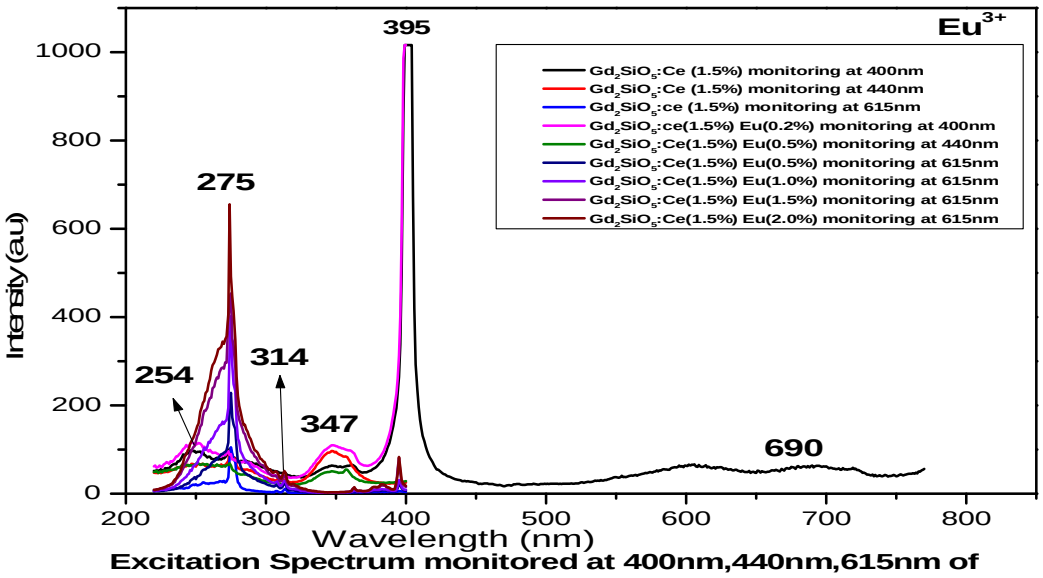


Excitation Spectrum monitored at 400nm,440nm,615nm of Gd_2SiO_5:Ce(1.5%)Eu(0.2, 0.5,1.0, 1.5,2.0%)

Fig.3. is Excitation spectrum of Gd_2SiO_5: Ce (1.5%) Eu (0.2, 0.5, 1.0, 1.5 and 2.0 mol %) monitored at 400nm, 440nm and 615nm

Fig.3 is the Gd2SiO5: Ce (1.5%) material is doped with Eu (0.2, 0.5, 1.0, 1.5 and 2.0 mol %) Eu is activated as activator the main emission peaks are as follows 254nm, 275nm, 314nm, 347nm, 395nm and 690nm.

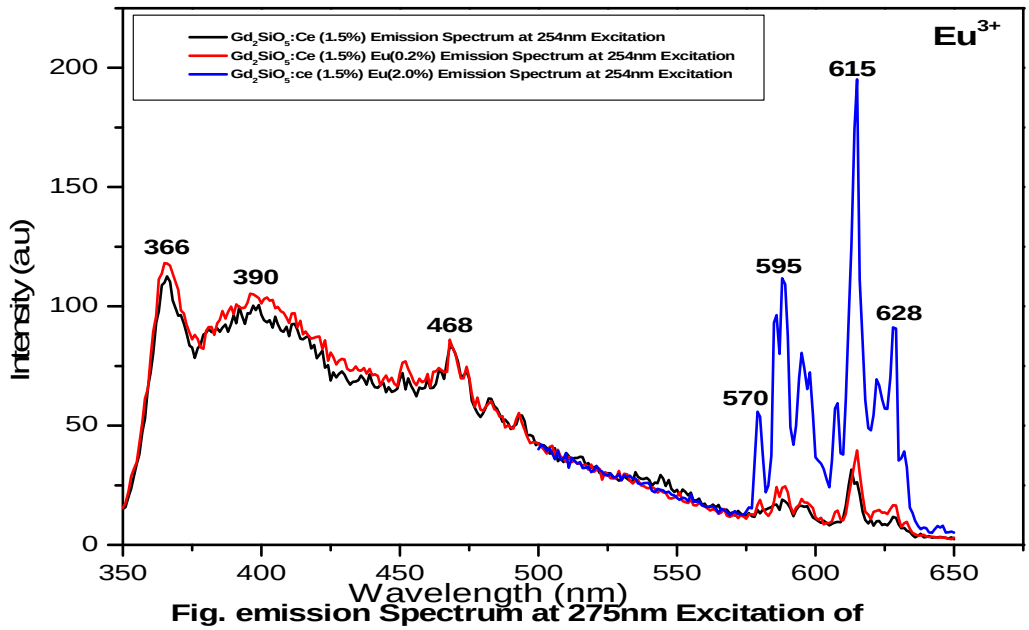


Fig. emission Spectrum at 275nm Excitation of Gd_2SiO_5:Ce(1.5%)Eu(0.2% and 2.0%)

Fig.4. is Emission spectrum of Gd_2SiO_5 : Ce (1.5%) and Eu (0.2and 2.0 mol %)

Fig4. the emission spectrum of Gd2SiO5: Ce (1.5%) and the base with Eu (0.2 and 2.0 mol %) phosphor have only 254nm excitation the emission peaks are 366nm, 390nm, 468nm, 570nm, 595nm, 615nm, 628nm but here the 615nm with high intensity is of Eu3 transition.

Peak Wavelength (nm)	Intensities (a.u) under 254nm excitation of Gd_2 SiO_5: Ce (1.5%) Eu(x)		
	Ce(1.5%)	Ce(1.5%)Eu(0.2%)	Ce(1.5%)Eu(2.0%)
366	111	121	25
399	99	20	30
469	82	86	25
545	30	34	54
595	28	30	77
615	30	34	188
628	25	25	89

Table1.Emission spectrum wavelength and intensities of Gd_2SiO_5 : Ce (1.5%) and Eu (0.2and 2.0 mol %)

The emission wavelength and intensities are tabulated in table1. Form this table at 615nm wavelength with high intensity it is in the red region.

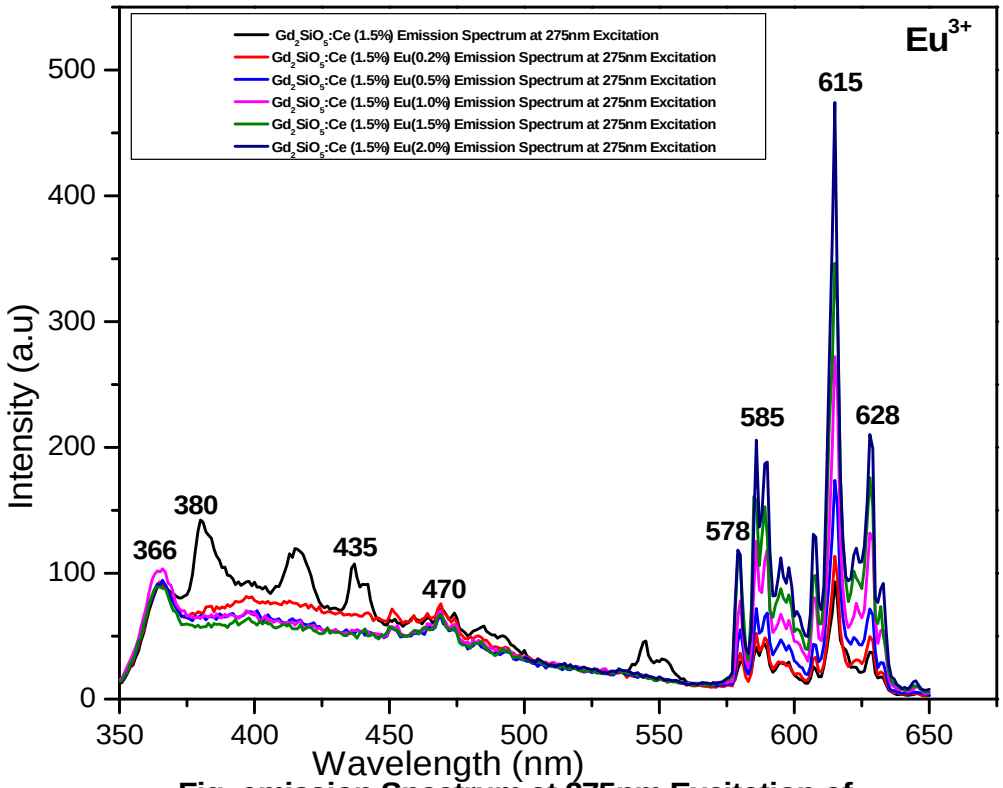


Fig. emission Spectrum at 275nm Excitation of Gd_2SiO_5:Ce(1.5%)Eu(0.2, 0.5, 1.0,1.5 and 2.0%)

Fig.5. Emission spectrum of Gd_2SiO_5 : Ce (1.5%) and Eu (0.2, 0.5, 1.0, 1.5 and 2.0 mol %)at 27nm excitation

Fig.5 is the emission spectrum of Gd2SiO5: Ce (1.5%) and the base with Eu (0.2, 0.5, 1.0, 1.5 and 2.0 mol %) phosphor is excited with 275nm the wavelength ranges from 366 to 628 with different intensities. Here it is note that the starting wavelengths from 366 to 570 with less intensity and from 575 to 628 with high intensities this is due existence of Eu3+ in the host material.

Peak Wavelength (nm)	Intensities (a.u) under 275nm excitation of Gd_2 SiO_5: Ce (1.5%) Eu(x)					
	Ce(1.5%)	Ce(1.5%) Eu(0.2%)	Ce(1.5%) Eu(0.5%)	Ce(1.5%) Eu(1.0%)	Ce(1.5%) Eu(1.5%)	Ce(1.5%) Eu(2.0%)
366	25	121	93	101	87	83
380	141	70	72	75	58	80
435	106	65	58	60	59	56
470	30	86	66	67	66	68
578	42	45	54	78	110	117
585	42	40	70	128	161	202
615	93	34	173	272	344	468
628	36	30	68	131	173	205

Table2.Emission spectrum wavelength and intensities of Gd_2SiO_5 : Ce (1.5%) and Eu (0.2, 0.5,1.0, 1.5and 2.0 mol %)

From the above table is the wavelength and intensities of emission peaks with different intensities of Gd2SiO5: Ce (1.5%) and the base with Eu (0.2 and 2.0 mol %) phosphor here 615nm with good intensity. With effect the emission peaks are like 366nm, 445nm, 490nm, 512nm, 545nm, 585nm, 615nm and 628nm range of blue to red phosphor so these peaks showed that the phosphor exhibited strong emission peak with good intensity because of Eu3+ corresponding to 5D0 → 7F2 (613 nm) red emission and weak 5D0 → 7F1 (585 nm) orange emission. The excitation spectra monitored at 545 nm show broad band from 220 to 300 nm ascribed to O–Eu charge-transfer band centered at about 269 nm, and the other peaks in the range of 300–400 nm originated from f–f transitions of Eu3+ ions. The major peak with good intensity of host in the Ce(1.5 mol%) and Eu(1.0 mol%) this samples are very much useful for red phosphors.

A. XRD:

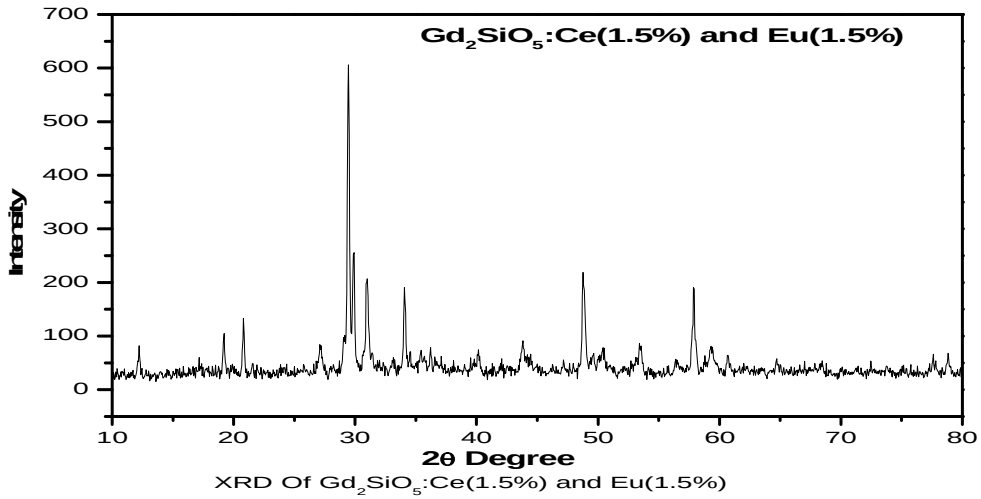


Fig.6. Emission spectrum of Gd_2SiO_5 : Ce (1.5%) and Eu (0.2, 0.5, 1.0, 1.5 and 2.0 mol %)at 27nm excitation

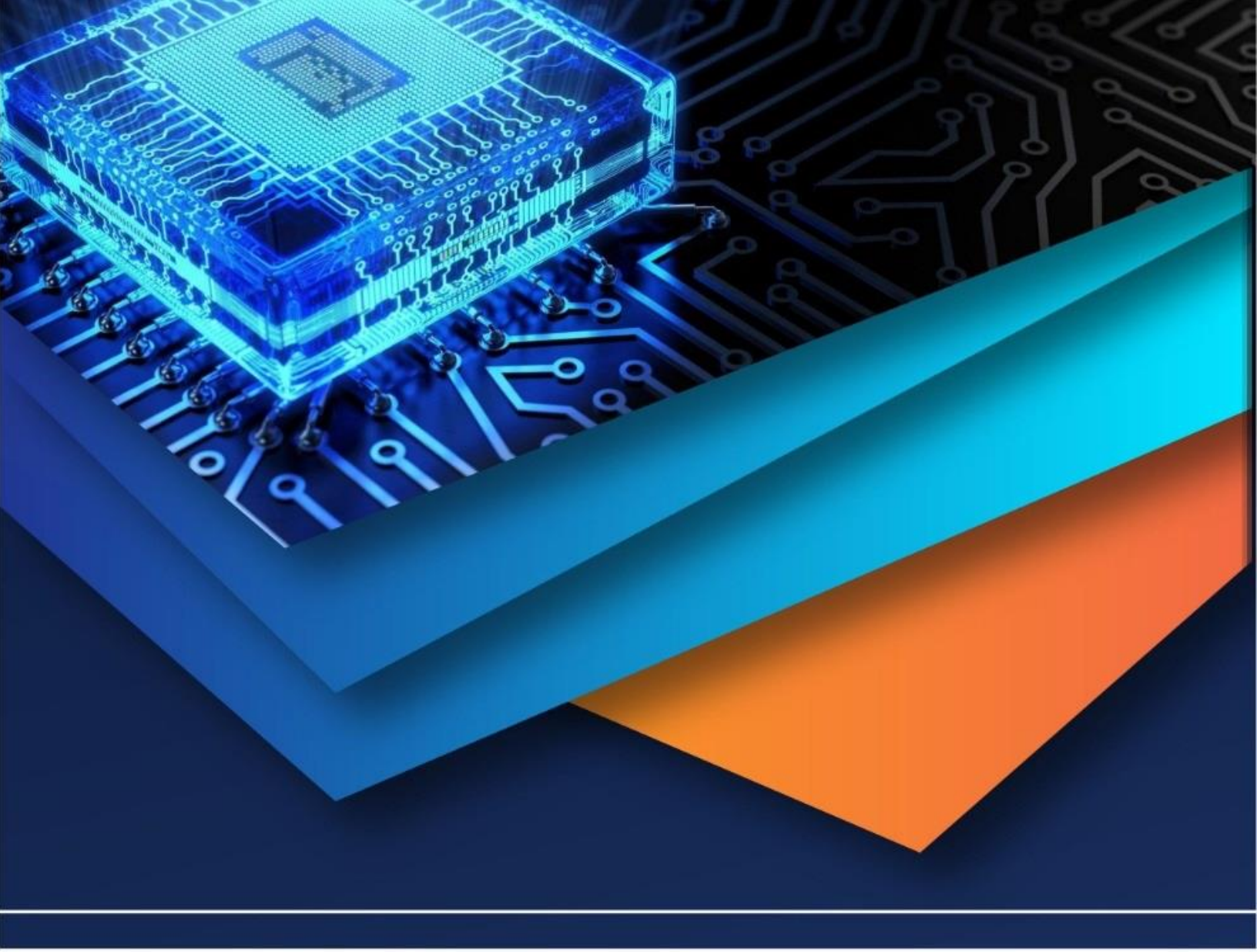
The above figure is xrd of the Gd_2SiO_5: Ce(1.5%) and Eu(1.5%) The calculated crystallite size for the highest intensity peak, using Scherer's formula, d =K.λ/ β Cosθ, where 'K' is the Scherer's constant (0.94), 'λ' the wavelength of the X-ray (1.5418 Å), 'β' the full-width at half maxima (FWHM) (0.282), 'θ' the Bragg angle of the highest peak is 30.98°, Cosθ = 0.857. The calculated crystallite size is around 29.25nm.

IV. CONCLUSIONS

The pure Gd_2SiO_5 phosphor and co-dopants of Ce and Eu in Gd_2SiO_5 phosphor were synthesized via high temperature solid state reaction. The characteristic of the Gd_2SiO_5 phase was quenched when the Eu concentration increases. It is conclude that this may be useful for The emission spectrum of Eu^{3+} site shows maximum intensity at 615 nm and 628nm corresponding to $^5D_0 \rightarrow {}^7F_2$ transition. From the XRD studies the co-dopants of Ce and Eu in Gd_2SiO_5 phosphor samples are in single phase. From the PL studies, it is concluded that the co-dopants phosphor under 254nm and 275nm excitation are very much use full to producing green and red light with good intensity for all practical display devices in particular compact fluorescent lamps.

REFERENCES

[1] H. Yokota, M. Yoshida, H. Ishibashi, T. Yano, H. Yamamoto, S. Kikkawa, J. Alloys Compd. 495 (2010) 162–166.
[2] T. Kamae, Y. Fukazawa, N. Isobe, M. Kokubun, A. Kubota, S. Osone, T. Takahashi, N. Tsuchida, H. Ishibashi, Nuclear Instrum. Method A 490 (2002) 456–464.
[3] M. Kobayashi, M. Ieiri, K. Kondo, T. Miura, H. Noumi, M. Numajiri, Y. Oki, T. Suzuki, M. Takasaki, K. Tanaka, Y. Yamanoi, M. Ishii, Nuclear Instrum. Method A 330 (1993) 115–120
[4] K.V.R. Murthy et al, Journal of Lumin., Vol.124, Issue 2, (2007), Pages 217-220.
[5] Phosphor Hand book, second edition edited by William M. Yen, Shigeo Shionoya, Hajime Yamamoto.Yen, W.M., and Weber, M.J., InorganiPhosphors (Compositions, Preparations and optical Properties, CRC press, Boca Ration, 2004.
[6] Murthy, K.V.R. et al, MRB, Vol.41, 10, (2006),1854-1860.
[7] Murthy, K.V.R. et al, MRB, Vol.41, 10, (2006),1854-1860.
[8] Shinoya S,. Yen WM. Phosphor Handbook,Laser and Optical Science and Technology Series, CRC Press, Boca Raton, 1999
[9] Y. hinatsu, M. Wakeshima, N. Edelstein, I.Craig, Journal of Solid State Chemistry, 144, (1999),P 20-24.
[10] R.Sankar, G.V.subba Rao, Journl of electrochemical society, 147, (2000), 2773-2779
[11] Feldmann C, Jüstel T, Ronda C R, Schmidt P J. Adv. Funct. Mater 2003, 13: 511.
[12] Danielson E, et al X-ray powder structure of Sr2CeO4: J. Mol. Struct., 1998, 470: 229.
[13] K.V.R. Murthy et al, Journal of Lumin., Vol.124, Issue 2, (2007), Pages 217-220.
[14] Ropp, R.C.,Luminescence and the Solid State,Elsevier, Amsterdam,Volume-12 ,(1991)
[15] R.P. Rao, D.J. Devine, J. Lumin. 87–89(2000) 1260–1263.
[16] Murthy, K.V.R., et al Philosophical Magazine Letters, Vol.90, No.9, Sept2010, 653–662.
[17] R. L. Kohale and S. J. Dhoble, Luminescence, (2012), DOI 10.1002/bio.2411.
[18] K. N.Shinde,S.J.Dhoble,J.Opt.Ect.andAdv. Mat.13 (2011)
[19] R.P. Rao and D.J. Devine RE-activated lanthanide phosphate phosphors for PDP Applications, Journal of Luminescence 87-89 (2000) 1260-1263.
[20] Murthy, K.V.R. Luminescence associated with Eu^{3+} in two host lattices (2010) Philosophical Magazine Letters, 90 (9), pp. 653-662.



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