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Research Article

# THE EFFECT OF FLUX ON PHOTOLUMINESCENCE PROPERTIES OF SM<sup>3+</sup>DOPED SR<sub>2</sub>CEO<sub>4</sub> PHOSPHOR

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#### ABSTRACT

The effect of flux on photoluminescence properties of Strontium cerium oxide doped Sm<sup>3+</sup> phosphor was studied. The Strontium cerium oxide doped Sm<sup>3+</sup> phosphor was synthesized by conventional solid state reaction method at temperature 1200°C for 4h. The powder samples were characterized by X-ray diffraction (XRD), Scanning Electron microscope (SEM) and Fourier transforms infrared spectroscopy (FTIR) spectrum. The X-Ray diffraction pattern reveals the crystallite size and the structure is orthorhombic. Photoluminescence excitation and emission spectra of Sr<sub>2</sub>CeO<sub>4</sub>:Sm<sup>3+</sup> (0.5mol %) without and with different fluxes like as Citric acid, Glycin and Urea were recorded at room temperature. The color co-ordinates (CIE-1913chromaticity diagram) for the Sr<sub>2</sub>CeO<sub>4</sub>:Sm<sup>3+</sup> (0.5mol %) with different fluxes were x = 0.542 and y = 0.334 (without flux), x=0.577 and y=0.336 (with different fluxes). This phosphor has a good potential for applications in display devices.

Keywords: Photoluminescence, Conventional Solid state reaction method, Samarium (Sm<sup>3+</sup>), Different fluxes.

#### 1. INTRODUCTION

Phosphate based inorganic compounds doped with rare earth ions form an important family of phosphors for solid state lighting applications. White light-emitting diodes (W-LEDs) offer benefits such as high luminous efficiency, low energy consumption, long lifetime and environment friendliness. They are tipped to be the next generation solid state lighting, in the replacement of conventional incandescent and fluorescent lamps which are Hg pollutants, frangible and consume high energy [1]. In the recent years, research on the phosphors used for white LEDs has become a hot topic and gained maturity. A large number of papers have been published about the successful synthesis and luminescence of rare earth phosphors with the orientation of exploring novel phosphors suitable for solid state lighting [2]. The research for oxide phosphors has been increasing due to their applications in many fields, such as cathode ray tubes (CRTs), light-emitting diodes (LEDs) and field emission displays (FEDs). Rare earth applications in the field of display devices is still a hot topic and much of the research around the globe is continuing to improve the phosphor efficiency and to enhance the luminescence properties of the phosphor with discovery of blue light emitting Sr<sub>2</sub>CeO<sub>4</sub> by combinatorial chemistry method prescribed in 1998 by Danielson [3]. Sr<sub>2</sub>CeO<sub>4</sub> consist of infinite edge-shearing CeO<sub>6</sub> octahedral chains separated by Sr atoms. The luminescence originates from a ligandto metal Ce<sup>4+</sup> charge transfer. The broad emission band is suitable for the doping of rare earth ions in pursuing new luminescent materials and some research work has been carried out by traditional solid-state reaction [4, 5], namely the metal oxides are used as precursors and the reaction reagents have to be calcinations at very high temperature for a long time. Sr<sub>2</sub>CeO<sub>4</sub> exhibiting the emission peak at  $\sim$ 480 nm upon the excitation at  $\sim$ 280 nm, is considered as a potential blue emitting phosphor [6]. The blue phosphors are very few and if a suitable blue phosphor is found then it can be added to the well studied red and green combination for white light emission from the phosphor [7]. If blue phosphor Sr<sub>2</sub>CeO<sub>4</sub> is doped with trivalent rare earths europium and

samarium emit in the red region of the visible spectra. The rare earth materials exhibit excellent sharp-emission luminescence properties with suitable sensitization and effectively used in designing of white light emitting materials. Solid state lighting have a very bright future in various lighting applications because of their high energy efficiency and cost effectiveness compared to incandescent bulbs [8]. Recently, various phosphor 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 [9].

In this paper, we presented the conventional solid state reaction method for the preparation of samarium (0.5mol %) doped  $Sr_2CeO_4$  phosphor at 1200°C temperature. The effect of flux on calcinations temperature and different fluxes were adding of doping ions on the structural, morphology and luminescent properties were investigated. The obtained phosphors were characterized by different techniques.

#### 2. EXPERIMENTAL

Analytical grade Strontium nitrate  $[Sr(NO_3)_2]$ , Cerium oxide (CeO<sub>2</sub>) and Samarium oxide (Sm<sub>2</sub>O<sub>3</sub>) of assay 99.9% were used as starting materials. All the phosphor samples were prepared via solid state reaction method (SSR). Firstly, un-doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor was prepared by weighing, mixing inorganic salts, Strontium nitrate [Sr(NO<sub>3</sub>)<sub>2</sub>], Cerium oxide [CeO<sub>2</sub>] in 2:1 molar ratio. It was ground into fine powder using agate mortar and pestle for about an hour. Different fluxes like Urea (NH<sub>2</sub>CONH<sub>2</sub>) (Qualigens fine chemicals; A division of GLAXO pharmaceuticals, Mumbai- 400030, Product No. 22585, Assay (99.9%), Glycine (NH<sub>2</sub>CH<sub>2</sub>COOH) (Made in Germany; E. Merck, Darmstadt. Assay (99.95%) and Citric acid (C6H8O7) (Qualigens fine chemicals-Mumbai) were added with 10wt% and stirred for 5min. The samples were fired at 1200°C for 3 hours with a heating rate of 5°C/min in a muffle furnace by keeping in an alumina crucible closed with lid.

To identify the crystal phase, X-ray diffraction (XRD) analysis was carried out with a powder X-ray diffractometer (Angle Dispersive X-ray diffraction Indus beam line-II, (ADXRD BL-12), Raja Raman Centre for Advanced Technology (RRCAT), Indore, India. The electron source size at this port is approximately 0.5mm

(H) x 0.5 mm (v). The beam acceptance of the beam line is 2mrad (H) x 0.2mrad (V). The microstructures of the samples were studied using a scanning electron microscope (SEM) (XL 30 CP Philips). The scanning continues time was 10s, and  $2\theta$  range is from 15 to  $60^{\circ}$ . The Fourier Transform Infrared (FTIR) spectra were recorded in an FTIR spectrometer (IR Affinity 1) in the range from 500 to 4000 cm<sup>-1</sup>. The photoluminescence (PL) emission and excitation spectra were recorded with a spectrofluorophotometer (SHIMADZU, RF-5301 PC) equipped with a Xenon lamp as excitation source [10, 11]. All the spectra were recorded at room temperature. Emission and excitation spectra were recorded using a spectral slit width of 1.5nm. The Commission International de l' Eclairage (CIE-1931 chromaticity diagram) color co-ordinates were calculated by the spectrophotometric method using the spectral energy distribution. The chromatic color coordinates (x, y) of prepared materials was calculated with colour calculator version 2, software from Radiant Imaging.

# RESULTS AND DISCUSSION Physical properties

After heating at 1200°C and cooling to room temperature in the furnace, the samples appears in light cream colour as well as very smooth and looks like pulpy as shown in the below fig.1. All the samples were again ground to make in to fine powder.



Fig. 1: Right side top:  $Sr_2CeO_4$ :  $Sm^{3+}$  with Urea as flux, Left side top:  $Sr_2CeO_4$ :  $Sm^{3+}$  with Glycin as Flux, Right side bottom:  $Sr_2CeO_4$ :  $Sm^{3+}$  with Citric acid as flux, Left side bottom:  $Sr_2CeO_4$ :  $Sm^{3+}$ (0.5%), Center: un-doped  $Sr_2CeO_4$ 

#### 3.2. Crystal structure properties

The crystalline structure of the powders was analyzed by X-ray powder diffraction (XRD). The present XRD phosphors were done on (Angle Dispersive X-ray diffraction (ADXRD BL-12), Raja Ramanna Centre for Advanced Technology (RRCAT), at Indore, India. Fig. 2 represents the typical X-ray diffraction (XRD) pattern of  $\text{Sm}^{3+}$  (0.5mol %) doped  $\text{Sr}_2\text{CeO}_4$  phosphor without flux and with different fluxes were prepared via the conventional Solid state reaction method. The X-ray diffraction patterns of Sm<sup>3+</sup> (0.5mol %) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor sample were well consistent with the data indicated in JCPDS card No. 50-0115 and structure of Sr<sub>2</sub>CeO<sub>4</sub> phosphor is orthorhombic. The crystallite size of the sample was determined from the XRD pattern parameters according to the Scherrer's equation  $D_c = k\lambda/k$  $\beta {\rm cos} \theta,$  where  $D_{\rm c}$  is the average crystallite size, k' is the Scherrer's constant equal to 0.94,  $\lambda$ ' is the wavelength of the X-ray (0.8592 Å),  $\beta$ ' is the full-width at half maxima (FWHM) and  $\theta$ ' is the Bragg angle (diffraction angle) of the XRD peak [12]. The calculated average crystallite size of the Sm<sup>3+</sup> (0.5mol %) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor without flux and with different fluxes were added to the  $\text{Sm}^{3+}$  (0.5mol %) doped  $\text{Sr}_2\text{CeO}_4$  phosphor presented in table 1. The table 1 shows that, when  $\text{Sm}^{3+}$  (0.5mol %) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor without flux and with different fluxes the crystallite size is slightly increases and there is no change in crystal structure and mostly in single phase.



Fig. 2: XRD pattern of Sm<sup>3+</sup> (0.5mol %) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor without flux and with different fluxes

**Table 1: Crystallite size of samples** 

Name of the Sample	Crystallite size		
$\mathrm{Sm}^{3+}$ (0.5mol%) doped $\mathrm{Sr}_{2}\mathrm{CeO}_{4}$	19.04mm		
phosphor without flux	10.041111		
$\mathrm{Sm}^{3+}$ (0.5mol%) doped $\mathrm{Sr}_{2}\mathrm{CeO}_{4}$	18.14nm		
phosphor with Urea as flux			
$\mathrm{Sm}^{3+}$ (0.5mol%) doped $\mathrm{Sr}_{2}\mathrm{CeO}_{4}$	18.16nm		
phosphor with glycin as flux			
$\mathrm{Sm}^{3+}$ (0.5mol%) doped $\mathrm{Sr}_2\mathrm{CeO}_4$	18 19nm		
phosphor with Citric acid as flux	10.171111		

#### 3.3. Photoluminescence properties

Strontium Cerate phosphors has been synthesized by many researchers since last 15 years. In the present work, photoluminescence properties deals with synthesis of strontium cerate phosphor doped with  $\text{Sm}^{3+}$  (0.5mol %) in open air as well as synthesized using different fluxes Citric acid, Glycin and Urea were added.

Figs. 3.1, 3.2, 3.3 and 3.4 are the photoluminescence excitation and emission spectrum of  $\text{Sm}^{3+}(0.5 \text{mol}\%)$ doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor prepared with Citric acid, Glycin and Urea as flux under different excitation wavelengths. Fig.3.1 represents the conventional solid state reaction derived from the excitation and emission spectrum of Sm<sup>3+</sup>(0.5mol%) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor without flux was calcinated at 1200°C for 4h. Fig.3.2, 3.3 & 3.4 shows the excitation and emission spectrum of  $Sm^{3+}(0.5mol\%)$  doped  $Sr_2CeO_4$  phosphor with different fluxes Citric acid, Glycin and Urea were added and calcinated at 1200°C for 4h, from the excitation spectra it is observed that broad spectra from 220 to 350 nm and centered located at 254 nm. The effect of flux on trivalent samarium doping and to see the effect of the same on the emission characteristics of the host, photoluminescence spectra were recorded at room temperature for the  $\text{Sm}^{3+}(0.5 \text{mol}\%)$  doped  $\text{Sr}_2\text{CeO}_4$ phosphor with different fluxes. The broad band could be assigned to the legend to-metal charge transfer from O<sup>2-</sup> to  $Ce^{4+}$ . From the emission spectrum of  $Sm^{3+}(0.5mol\%)$ doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor under 254, 275 and 340nm excitations. These spectral features are characteristic of intra-configurationally f-f transitions of the RE ions. Because tetravalent cerium in Sr<sub>2</sub>CeO<sub>4</sub> has no 4f electrons, emissions are due to the presence of Sm<sup>3+</sup> having five 4f electrons. But on increasing the samarium concentration, the sharp lines of the samarium emission appear prominently and the Ce<sup>4+</sup>- O<sup>2-</sup> CT transitions of the host decreases relatively. The narrow lines are assigned to the transitions from the between  ${}^{4}G_{5/2}$  excited state to the lower  ${}^{6}H_{I}$  (J = 5/2, 7/2 and 9/2) energy

levels of the ground multiplets of Sm<sup>3+</sup> ions. According to the selection rules [13-16] magnetic dipole transitions that obey J = 0 and  $\pm 1$  (J = total angular momentum) are allowed for Sm<sup>3+</sup> in a site with inversion symmetry. The emission spectra of Sm<sup>3+</sup>(0.5mol%) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor sample were peaking at the 387nm but when doped with samarium, the emission spectra are dominated by the red  ${}^{4}G_{5/2} \rightarrow {}^{6}H_{7/2}$  transition centre red at 609nm. When the phosphor is excited with 275nm, a good blue emission peaking at 469, 568, 609nm and less intensity red emission at 653nm are observed. The main emission 469nm is not smooth one; many kinks are there

however 568, 609 and 653nm are spiky peaks. The 469nm peak is attributed to Ce<sup>4+</sup> and the other peaks at 568, 609 and 653nm are then basic Sm<sup>3+</sup> emissions in Sr<sub>2</sub>CeO<sub>4</sub> phosphors. The kinks on the basic Ce<sup>4+</sup> emission from 350 - 550nm are due to the five un-paired electrons of Sm<sup>3+</sup> ion and the emissions at 568, 609 and 653nm are the basic Sm<sup>3+</sup> emissions which are attributed to the following transitions  ${}^{4}G_{5/2} \rightarrow {}^{6}H_{5/2}$ ,  ${}^{4}G_{5/2} \rightarrow {}^{6}H_{7/2}$  and  ${}^{4}G_{5/2} \rightarrow {}^{6}H_{9/2}$  respectively. Table 2 represents the different excitations and intensity of emission wavelengths of Sm<sup>3+</sup>(0.5mol%) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor with different fluxes.



Fig. 3.1: Excitation and Emission spectrum of  $\text{Sm}^{3+}(0.5 \text{mol}\%)$  doped  $\text{Sr}_2\text{CeO}_4$  phosphor without flux under different excitation wavelengths



Fig. 3.2: Excitation and Emission spectrum of  $\text{Sm}^{3+}(0.5 \text{mol}\%)$  doped  $\text{Sr}_2\text{CeO}_4$  phosphor with Citric acid as flux under different excitation wavelengths



Fig. 3.3: Excitation and Emission spectrum of  $\text{Sm}^{3+}(0.5 \text{mol}\%)$  doped  $\text{Sr}_2\text{CeO}_4$  phosphor with Glycin as flux under different excitation wavelengths



Fig. 3.4: Excitation and Emission spectrum of Sm<sup>3+</sup>(0.5mol%) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor with Urea as flux under different excitation wavelengths

#### 3.4. SEM Study

Scanning electron microscopy (SEM) was performed to determine particle morphology, crystallite size, as well as homogeneity at nanometer scale. Fig. 4 represents the SEM images of  $\text{Sm}^{3+}(0.5\text{mol}\%)$  doped  $\text{Sr}_2\text{CeO}_4$  phosphor without flux and with different fluxes in various magnifications in this phosphors under the study of morphology micrographs. The examined SEM micrographs shows that the  $\text{Sm}^{3+}(0.5\text{mol}\%)$  doped  $\text{Sr}_2\text{CeO}_4$  phosphor without flux and with different fluxes in various magnifications in this phosphors under the study of morphology micrographs. The examined SEM micrographs shows that the  $\text{Sm}^{3+}(0.5\text{mol}\%)$  doped  $\text{Sr}_2\text{CeO}_4$  phosphor without flux and with different fluxes phosphor samples originated from the solid microcrystalline structure with some agglomeration and irregular shapes between the grains and it can be seen clearly that the structure of synthesized phosphor has

different sizes and irregular shapes of bunching of flowers with different resolutions. It is also found the average Bessel sizes of the  $\text{Sm}^{3+}(0.5 \text{mol}\%)$  doped  $\text{Sr}_2\text{CeO}_4$  phosphor without flux and with different fluxes reveals the reduction of the particles size from 10-2µm. The grains appeared agglomerated owing to the high-temperature solid-state synthesis. These phosphors can be very easily employed in lighting display technology and various coating display illuminating applications [17, 18]. The overall SEM studies concluding us the phosphors can be grounded mechanically and sieved to get uniform size to use as phosphors in the devices like Compact Fluorescent Lamps (CFL) and Fluorescent Lamps [FL].

Name of the Sample	λ <sub>em</sub> (nm)	Intensity of emission wavelength under excitation wavelength		
		$\lambda_{ex} = 254$ nm	$\lambda_{ex} = 275 nm$	$\lambda_{ex} = 340$ nm
Sm (0,5%) doped $Sr_2CeO_4$ without flux	469	355	334	229
	568	132	132	76
	609	190	190	98
	653	46	46	23
Sm (0,5%) doped $Sr_2CeO_4$ with citric acid as flux -	469	369	357	238
	568	146	146	78
	609	186	186	103
	653	42	42	21
Sm (0,5%) doped $Sr_2CeO_4$ with Glycin as flux -	469	355	337	237
	568	139	139	87
	609	200	200	103
	653	42	42	22
Sm (0,5%) doped $Sr_2CeO_4$ with Urea as flux -	469	331	331	229
	568	138	138	73
	609	197	197	93
	653	42	42	22

Table 2: Emission intensity under excitation wavelength



Fig. 4: SEM images of Sm<sup>3+</sup>(0.5mol%) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor without flux and different fluxes

#### 3.5. FTIR Study

FTIR spectrum is one of the most common spectroscopic techniques used by organic and inorganic compounds. The FTIR technique is to count the absorption of various infrared radiations by the target material, to develop an IR spectrum that can recognize functional groups and molecular structure in the sample. The Fourier Transform Infrared (FTIR) spectra were recorded within the wave number range 4000 to 500 cm<sup>-1</sup> on (IR Affinity-1) FTIR spectrometer instrument. Fig. 5 represents the FTIR spectrum of Sm<sup>3+</sup>(0.5mol%) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor without flux and different fluxes. From the FTIR spectrum, it is observed that all most all peaks of Sm<sup>3+</sup>(0.5mol%) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor without flux and different fluxes are same, with variation in intensity. The peak at

3559 cm<sup>-1</sup> is assigned to H-O-H stretching vibration of crystal water or lattice water with medium intensity. The sample might have absorbed moisture from the atmosphere. Sometimes the presence of H-O-H bond may be degrading the phosphor luminescence. The absorption peaks at 2959 cm<sup>-1</sup>, 1559 cm<sup>-1</sup> were assigned to stretching characteristics of SrCO<sub>3</sub>. The absorption peaks at 1445-507cm<sup>-1</sup> is assigned to lattice water band with medium intensity sometime in the other laboratory due to the delay in measurements the phosphors under study might have absorbed water molecules from the atmosphere as well as from CO<sub>2</sub> gas. However all the absorptions that are observed in the FTIR spectrums of  $Sm^{3+}(0.5mol\%)$  doped  $Sr_2CeO_4$  phosphor without flux and different fluxes in the present phosphors are the standard and allowed ones.



Fig. 5: FTIR of Sm<sup>3+</sup>(0.5mol%) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor without flux and different fluxes

#### 3.6. CIE Co-ordinates

In order to further improve the CIE color coordinates and achieve good quality white light emission, the attributed luminescence color of the sample has been characterized by the CIE-1931 chromaticity diagram. Generally, monochromatic sources ( $\Delta\lambda$ -0) are located on the perimeter of the chromaticity diagram. The color location moves towards the center of the chromaticity diagram, when the spectral bandwidth of a source gets broader. Hence, for red light emission, the coordinates are located near the center of the chromaticity diagram (x = 0.649, y = 0.303). Fig. 6 shows the CIE Coordinates of Sm<sup>3+</sup>(0.5mol%) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor without flux and different fluxes were presented in CIE-1931 chromaticity diagram [19-20]. From the fig. 6 it is observed that the CIE-1931 chromaticity diagram Co-ordinates emission spectrum of Sm<sup>3+</sup>(0.5mol%) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor without flux and different fluxes phosphors at points (A). X=0.542 and Y=0.334 (without flux),(B).X=0.577 and Y=0.336 (with different fluxes) which indicates to red color ( $\lambda_{em}$ = 568,609nm) under 254,275 and 340nm excitation wavelengths.



Fig. 6: CIE Co-ordinates of Sm<sup>3+</sup> (0.5mol%) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor without flux and different fluxes

### 4. CONCLUSION

In summary, novel Sm<sup>3+</sup>(0.5mol%) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor without flux and different fluxes was successfully synthesized by conventional solid state reaction method. The XRD study confirms that the  $Sm^{3+}(0.5mol\%)$  doped  $Sr_2CeO_4$  phosphor without flux and different fluxes compound has orthorhombic structure at room temperature. The effect of flux on calcinations temperature, and different fluxes were adding of doping ions on the structural, morphology and luminescent properties were investigated. The average crystallite size of the trivalent Samarium doped with Sr<sub>2</sub>CeO<sub>4</sub> phosphor without flux and different fluxes are 18.04-18.19nm slightly increases and there is no change in crystal structure and mostly in single phase. The effect of flux on trivalent samarium doping and to see the effect of the same on the emission characteristics of the host, photoluminescence spectra were recorded at room temperature for the  $\text{Sm}^{3+}(0.5 \text{mol}\%)$  doped  $Sr_2CeO_4$  phosphor with different fluxes. The broad band could be assigned to the legend to-metal charge transfer from  $O^{2-}$  to  $Ce^{4+}$ . From the emission spectrum of  $\text{Sm}^{3+}(0.5 \text{mol}\%)$  doped  $\text{Sr}_2\text{CeO}_4$  phosphor under 254, 275 and 340nm excitations. The emissions at 568, 609

and 653nm are the basic Sm<sup>3+</sup> emissions which are attributed to the following transitions  ${}^{4}G_{5/2} \rightarrow {}^{6}H_{5/2}$ ,  ${}^{4}G_{5/2} \rightarrow {}^{6}H_{7/2}$  and  ${}^{4}G_{5/2} \rightarrow {}^{6}H_{9/2}$  respectively. From the repots, the average Bessel sizes of the Sm<sup>3+</sup>(0.5mol%) doped Sr<sub>2</sub>CeO<sub>4</sub> phosphor without flux and with different fluxes reveals the reduction of the size particles from 10-2µm. The grains appeared agglomerated owing to the high-temperature solid-state synthesis. From the FTIR spectrum, it is observed that almost all peaks of  $Sm^{3+}(0.5mol\%)$  doped  $Sr_2CeO_4$  phosphor without flux and different fluxes are same, with variation in intensity. The peak at 3559 cm<sup>-1</sup> is assigned to H-O-H stretching vibration of crystal water or lattice water with medium intensity. The absorption peaks at 2959 cm<sup>-1</sup>, 1559 cm<sup>-1</sup> were assigned to stretching characteristics of SrCO<sub>3</sub>. The absorption peaks at 1445-507cm<sup>-1</sup> is assigned to lattice water band with medium intensity sometime in the other laboratory due to the delay in measurements the phosphors under study might have absorbed water molecules from the atmosphere as well as from CO<sub>2</sub> gas. The CIE-1931 chromaticity diagram Co-ordinates emission spectrum of  $\text{Sm}^{3+}(0.5 \text{mol}\%)$  doped  $\text{Sr}_2\text{CeO}_4$ phosphor without flux and different fluxes phosphors at points (A).X=0.542 and Y=0.334 (without flux),

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(B).X=0.577 and Y=0.336 (with different fluxes) which indicates to red color ( $\lambda_{em}$ = 568,609nm) under 254, 275 and 340nm excitation wavelengths. The overall studies concluding us the phosphors can be ground mechanically and sieved to get uniform size to use as phosphors in the devices like Compact Fluorescent Lamps (CFL), SSL technological applications in the LED devices and Fluorescent Lamps [FL].

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#### **Conflict** of interest

None declared

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None declared

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