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Synthesis and Photoluminescence behavior of Eu doped $SrLa_2Al_2SiO_9$ Phosphor

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Abstract

The present paper reports the synthesis and Photoluminescence (PL) studies of the SrLa2Al2SiO9 phosphor doped with Eu for different concentrations 0.1, 1.0, 1.5, 2.0 mole percentages respectively. The phosphor was synthesized using the standard solid state reaction technique and ground using mortar and pestle, fired at 1200oC for 3 hour with heating rate of 5oC/min in a muffle furnace. The powder phosphors were characterized by X-ray diffraction and Scanning electron microscopy. The Photoluminescence (PL) excitation spectra were recorded for different Eu concentrations monitoring at 616 nm, and shows different peaks at 269 and 395nm. The Photoluminescence (PL) emission of Eu doped SrLa2Al2SiO9 phosphor was recorded for different Eu concentrations, and show peaks at 364, 468, 489, 498, 515, 540, 556, 580, 588, 597, 615 and 626 nm with good intensity, these are mainly due to Eu3+ electron transitions.

Keywords: Photoluminescence [PL], Rare Earth ions [RE ions], XRD, Solid State Reaction [SSR].

1.INTRODUCTION:

$SrAl_2SiO_9$:Eu has been good commercial green 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.

The useful applications of rare earth element compounds, especially lanthanide phosphate doped inorganic materials, have been touched upon broadly. Over the past a few years, they have been applied in many fields, such as optical display panels, cathode ray tubes, optoelectronic, sensitive device, electronic and plasma display panels due to their special chemical and physical properties.

2. MATERIALS AND METHODS

Analytically pure and used without any further purification. The phosphor $SrLa_2Al_2SiO_9$ doped with Eu for different concentrations 0.1, 1.0, 1.5, 2.0 mole percentages, prepared using solid state synthesis method. Stoichiometric proportions of raw materials namely, $SrCO_3$, Al_2O_3 SiO_2, Lanthanum Oxide (La_2O_3) and Europium Oxide (Eu_2O_3) of assay 99.9% were used as starting materials and grinded in an agate motor and pestle, mixed and compressed into a alumina crucible and heated at 1200^{o}C for 3 hours with heating rate of 5^{o}C/min in the muffle furnace. The prepared samples were again grounded in to powder for taking the characteristic measurements. All the phosphor samples were characterized by X-ray diffraction (Synchrotron Beam Indus -II), SEM and the Photoluminescence (PL) emission and excitation spectra were measured by Spectrofluorophotometer (SHIMADZU, RF-5301 PC) using 150 watts Xenon lamp as excitation source. The emission and excitation slit were kept at 1.5 nm, recorded at room temperature.

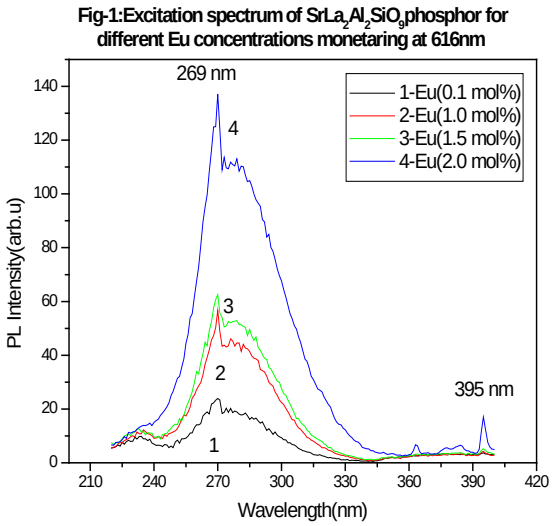
3. RESULTS AND DISCUSSION

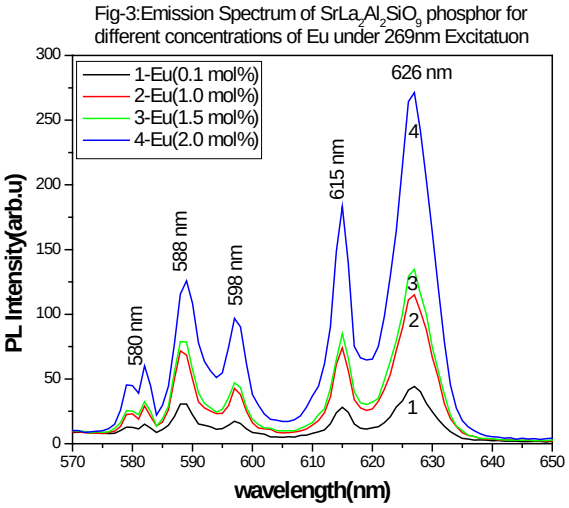
3.1 Photoluminescence Study

Fig.1 is the excitation spectra of $SrLa_2Al_2SiO_9$ phosphor doped with Eu for different concentrations 0.1, 1.0, 1.5, 2.0 mole percentages respectively. The phosphor $SrLa_2Al_2SiO_9$: Eu when monitored at 616nm. From fig.1, it is confirmed that the excitation spectra consists of two absorption maxima at 269 and 395nm. Fig.2 and 3 are the emission spectra of $SrLa_2Al_2SiO_9$ doped with Eu(0.1, 1.0, 1.5, 2.0 mol %) phosphor under excitations at 269nm wavelengths. The phosphor shows the PL peaks at 364, 468, 489, 498, 515, 540, 556, 580, 588, 597, 615 and 626 nm with good intensity,

S.No	Sample name	Eu Conc. ol %	P L Intensity(arb u)		
			269 nm Ex		
			λ_{emi} (nm)	λ_{emi}(nm)	λ_{emi}(nm)
			588nm	615nm	626nm
1	$SrLa_2Al_2SiO_9$: Eu	0.1	31	28	43
2		1.0	70	71	114
3		1.5	79	83	132
4		2.0	123	182	267

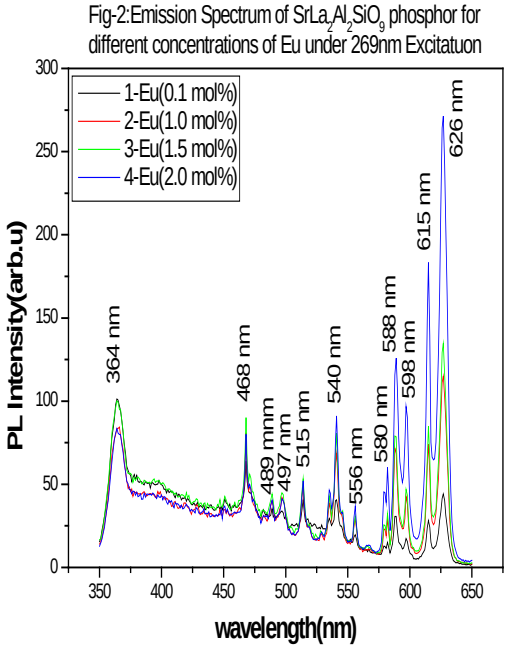
Table-1: Photolumeniscence Intensity of different emission peaks with Eu Concentrations

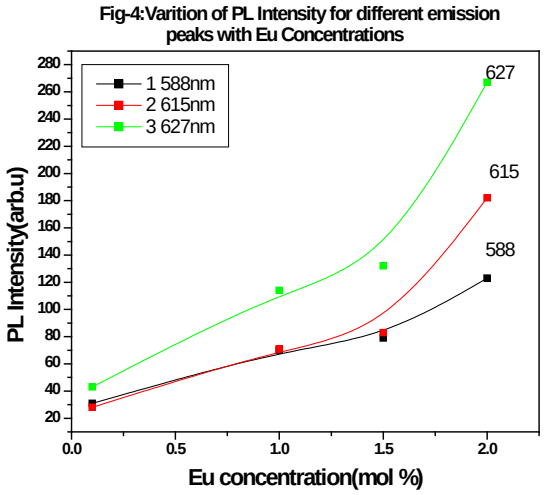




3.2 SEM Study

The particle morphological investigation of Eu doped $SrLa_2Al_2SiO_9$ was carried out by scanning electron microscopy (SEM). The typical SEM image is shown in Fig.5, 6 with different magnifications. From SEM images are reveals that the particles size and shape is irregular and size varies from 1-5µm with highly agglomerated particles are present in the phosphor.





Wavelength (nm)	*Transitions*
468	$^5D_2 \rightarrow {}^7F_0$
489	$^5D_2 \rightarrow {}^7F_2$
497	$^5D_2 \rightarrow {}^7F_2$
515	$^5D_2 \rightarrow {}^7F_3$
540	$^5D_1 \rightarrow {}^7F_1$
556	$^5D_1 \rightarrow {}^7F_2$
580	$^5D_0 \rightarrow {}^7F_0$
588	$^5D_0 \rightarrow {}^7F_1$
597	$^5D_0 \rightarrow {}^7F_1$
615	$^5D_0 \rightarrow {}^7F_2$
626	$^5D_0 \rightarrow {}^7F_3$

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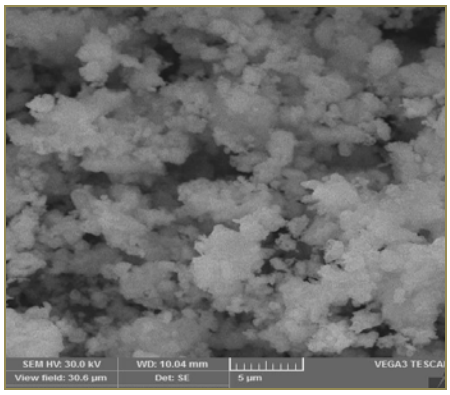


Fig.5. SEM Image of $SrLa_2Al_2SiO_9$: Eu, Tb, Ce

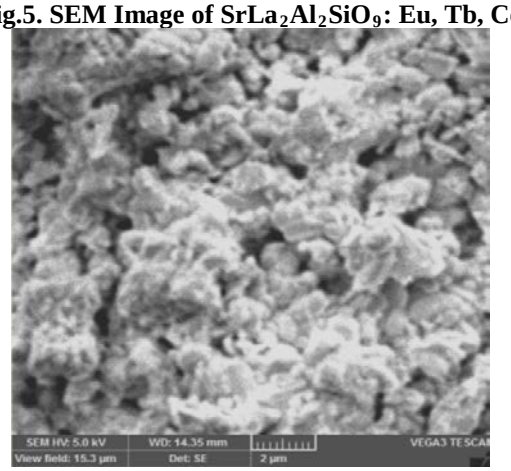
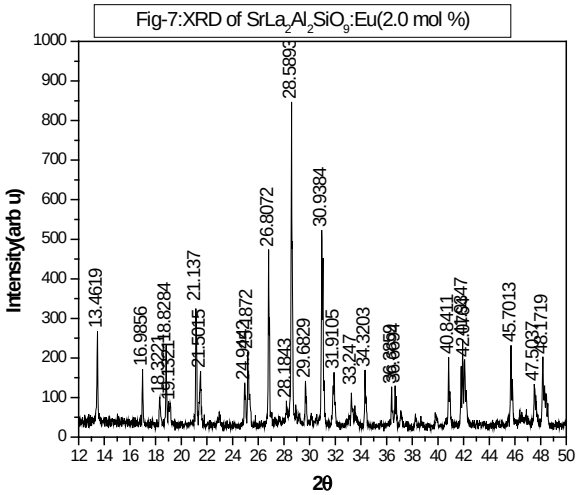


Fig.6. SEM Image of $SrLa_2Al_2SiO_9$: Eu,

3.3 X-ray Diffractometry (XRD): Figure -7 is the XRD of the phosphors. From XRD it is normally concluded the phosphor may not be in single phase. This may be due to Al-Si might not have diffused properly into the crystal matrix due to less calcinations temperature (1200^oC).



Conclusions:

The emission peaks observed in **$SrLa_2Al_2SiO_9$**: Eu when excited with 254nm at 364, 468(Blue), 489, 498, 515, 540, 556, 580, 588, 597(Yellow), 615 and 626 nm(red) with good intensity, these are mainly due to Eu^{3+} electron transitions are observed. The obtained results on **$SrLa_2Al_2SiO_9$: Eu** is suitable for white light source using UV light as the primary excitation.

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