International Journal of Luminescence and applications
Vol6 (4) January, 2017, **ISSN 2277 – 6362**

Synthesis and characterization properties of $Al_2Sr_2La_2O_8$: Dy phosphor

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Abstract *- $Al_2Sr_2La_2O_8$ doped with Dysprosium ion was synthesized by solid state reaction under air atmosphere. Its characterization was systematically analyzed by SEM, X-ray diffraction (XRD) and photoluminescence spectra (PL). Photoluminescence emission spectra having excitations 627nm at around 254, 270nm revealed that Dy ions were present in trivalent oxidation states. The emission peaks are found at 363, 400, 469nm (red) and 540, 586, 626nm (Green) are observed. Scanning Electron Microscopy (SEM) was implemented to investigate the surface morphology of present phosphor. The obtained results on $Al_2Sr_2La_2O_8$: Dy is suitable for white light source using UV light as the primary excitation.*

1. INTRODUCTION

Aluminate compounds haven been utilized as host materials of lamp phosphors for many years, thanks to their relatively low material cost, and reasonable stability in lamp application. The development of the first synthesized aluminates phosphor can be traced back to 1970. In the 1980's rare-earth-activated aluminate phosphors were practically used in (BAM:Dy) fluorescent lamps. This was the first application of rare-earth-activated aluminates in tri band fluorescent lamps and represented a landmark in this history of fluorescent lamp development.

2. EXPERIMENTAL

To prepare Aluminum, Strontium Lanthanate (ASL) doped with various concentrations of Europium, consists of heating stoichiometric amounts of reactants at 1000 °C for 2 h in a muffle furnace. The Dy^{3+} activated ASL phosphor was prepared via high temperature modified solid state diffusion. The starting materials were as follows: Aluminum Oxide, strontium carbonate , Lanthanum Oxide and the molar ratio of rare earth Dysprosium oxide Dy_2O_3 (National Chemicals, Baroda, 99.999%) was used to prepare the phosphor .The mixture of reagents was ground together to obtain a homogeneous powder in acetone base. After being ground thoroughly in stoichiometric ratios by using an agate mortar, to ensure the best homogeneity and reactivity, powder was transferred to alumina crucible, and then heated in a muffle furnace at 1200 °C for 2 hr. The phosphor material was cooled to room temperature naturally. All samples were found out to be white who are studied for photoluminescence. PL spectra were recorded at room temperature using spectrofluorophotometer.

3. RESULTS AND DISCUSSION

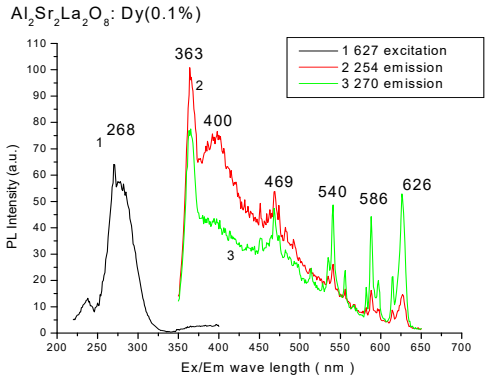

Figure 1 PL of ASL:Dy excited with 254nm.

The PL peaks are observed at 363, 400, 469, 540 586 and 626nm with different intensities. However the red emission intensity at 626nm dominates all other emissions followed by 540, 469 and 586nm. All the observed peaks are allowed transitions of

Dysprosium when excited with 254nm. The observed some main peaks and other small peaks are basically the allowed transitions of Dysprosium in +3 state. They are due to:

1. 467nm emitted peak is due to $^5D_2 \rightarrow {}^7F_0$ transition of Europium and is due to magnetic dipole (MD) with energy 2.657 eV.
2. 515nm emitted peak is due to $^5D_2 \rightarrow {}^7F_3$ transition of Europium and is due to electric dipole with energy 2.429 eV.
3. 540nm emitted peak is due to $^5D_1 \rightarrow {}^7F_1$ transition of Europium and is due to electric dipole with energy 2.307 eV.
4. 555nm emitted peak is due to $^5D_1 \rightarrow {}^7F_2$ transition of Europium and is due to electric dipole with energy 2.228 eV.
5. 588nm emitted peak is due to $^5D_0 \rightarrow {}^7F_1$ transition of Europium and is due to magnetic dipole. with energy 2.118 eV
6. 615nm emitted peak is due to $^5D_0 \rightarrow {}^7F_2$ transition of Europium and is due to electric dipole with energy 2.015 eV and is due to electric dipole.
7. 626nm emitted peak is due to $^5D_0 \rightarrow {}^7F_3$ transition of Europium and is due to electric dipole with energy 1.985 eV and is due to electric dipole.
8. 626nm emitted peak is due to $^5D_0 \rightarrow {}^7F_3$ transition of Europium and is due to electric dipole with energy 1.985 eV and is due to electric dipole.

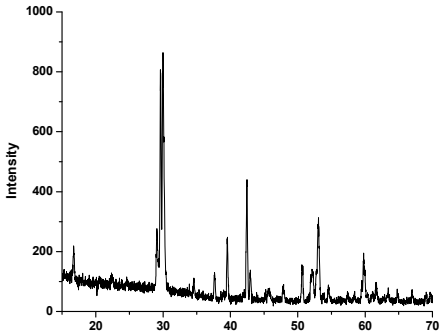

Fig.: 2 XRD of ASL: Eu 0.5

Fig. 2 is XRD of ASL:Dy(0.5%).

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) (0.29^0), 'θ' the Bragg angle of the peak highest intensity is 29.0^0, $\cos\theta = 0.9660$ and for 0.5% Eu doped ASLis around 29.33 nm.

The morphological investigation of Eu doped ASL was carried out by scanning electron microscopy (SEM). The typical SEM image is shown in Fig. 3. SEM image reveals that the particles size and shape is irregular and size varies from 2-5µm.

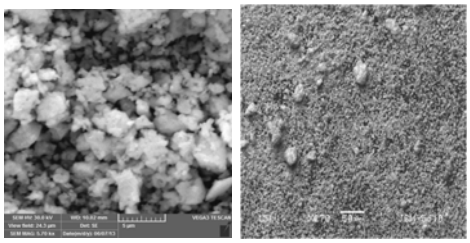

Fig.3: SEM of ASL: Dy

CONCLUSIONS

1. The emission peaks observed in $Al_2Sr_2La_2O_8$: Dy when excited with 254nm 540, 586, 626 (green) and 363, 400, 469nm (red) are observed.
2. The obtained results on $Al_2Sr_2La_2O_8$: Dy is suitable for white light source using UV light as the primary excitation.

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