SYNTHESIS AND PL CHARECTERISATION OF Alq_3: Eu ORGANIC PHOSPHOR

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Abstract

Europium doped alumium-8-hydroxyquinoline metal complex is prepared by simple precipitation route in order to reduce the cost and time of synthesized material. It is characterized by XRD. X-ray Diffractogram of Eu doped Alq_3 complex displays well defined X-ray diffraction lines, confirming its crystalline nature. SEM analysis is done which confirms the formation of micro size crystal structure. Photo luminescence spectra of Alq_3: Eu reveals intensity in green region. The synthesized Eu doped Alq_3 organic phosphor is promising material for optical or optoelectronic applications.

Keywords: phosphor, Alq_3, Xrd, SEM, Photoluminescence, and Eu doped Alq_3

1 Introduction

Now a days Organic light-emitting diodes (OLEDs) constitute a rapidly developing field. Many believe that they represent the future of flat panel display technology. The main focus of OLED research is to address these issues. Two types of compounds: conjugated organic polymers, such as poly (1, 4-phenylenevinylene) (PPV) and molecular species such as aluminum tris-(8-hydroxyquinolate) (Alq_3) are used frequently. Organic have attracted tremendous interests for application in functional nanoscale electronic and optoelectronic devices, the crystallinity and molecular arrangement of which have a great influence on the performance of these devices. [1–4] However, compared with the overwhelming majority of inorganic nonmaterial, only a few successful preparations of organic one-dimensional (1D) nonmaterial such as nanowires and nanotubes are reported. [3, 5–7]

Since the first efficient low-voltage-driven organic light-emitting diodes (OLEDs) based on tris(8-hydroxyquinoline)aluminum(Alq_3) were reported [8]. Alq_3 has become a important prototypical electron transport and emitting material for OLED devices because of its excellent stability and electro-luminescence properties. Therefore lumophores based on Aluminum metallo-8-hydroxyquinolate prepared from wet Chemical method and co-doped with Eu^{2+} rare earth elements are prepared and characterization of the material by X-Ray diffraction spectrographic is carried out. Alumium-8-hydroxyquinoline and co-doped materials with varying concentrations of dopants are synthesized by simple wet Chemical route in order to reduce the cost and time of synthesized material. In the synthesis technique when Eu metal is added which contribute an electron, withdrawing constituent at the 5-position in 8-hydroxyquinoline, increasing the solubility of the corresponding metal quinolate complexes in non polar solvents.

2 Experimental

Alq_3 was prepared as follows: firstly take 25 ml double distilled water and 25 ml acetic acid in beaker. Dissolve 5 gm of 8-hydroxyquinoline in a mixture of double distilled water, acetic acid and stir it still the orange transparent solution was obtained say solution I.

Take 5gm Al $(NO_3)_3.9H_2O$ and dissolve in double distilled water. Stir it till clear solution was obtained say solution II. Mix the solution I and II and stir for 10 min and add N_4OH solution by drop by drop to this mixture

of solution with continuous stirring. Filter the yellow green precipitate and wash the precipitate with double distilled water for 8 to 10 times. Place the precipitate for drying 40-50^{o}C. The other derivative of 8-hydroxyquinoline metal complex is prepared by Simple precipitation method same as Alq_3. Aluminum nitrate is replaced by Europium oxide. For the preparation of Alq_3 host lattice, aluminum nitrate and 8-hydroxyquinoline as raw materials and for Alq_3: Eu, Europium oxide is used as other material mixed in an appropriate molar ratio. The synthesis chemical reactions as follows

$$Al(NO_3)_3 .9H_2O + (C_9H_7NO) \rightarrow Al(C_9H_7NO)_3 + 9H_2O + 3(NO_2) \uparrow$$

$$Al(NO_3)_3.9H_2O + EuO_3 + 5(C_9H_7NO) \qquad [Al(C_9H_7NO)_3:Eu] + 9H_2O + 3(NO_2)$$

3 Result and discussion

1. XRD OF Alq_3: Eu

Diffraction data has historically provided information regarding the structures of crystalline solids. Such data can be used to determine molecular structures, ranging from Simple to complex, since the relative atomic positions of atoms can be determined. X-ray Diffraction provides important evidence and indirect proof of atoms. The Symmetry of the diffraction patterns corresponds to the symmetry of the atomic packing. It is the simplest way to determine the inter atomic lattice spacing that exists. The intensity of the diffracted beams also depends on the arrangement and atomic number of the atoms in the repeating motif, called the unit cell. Thus, the intensities of diffracted spots calculated for trial atomic positions can be compared with the experimental diffraction intensities to obtain the positions of the atoms themselves. The XRD pattern did not indicate presence of the constituents like nitrates, ammonia and other likely phases. This result indicates the final product formed is in crystalline and homogeneous form.

The synthesized complex have been characterized by XRD on the 'Expert pro' Automated power Diffractometer system company name Analytical, Netherland taken at 'SAIF' Punjab University, Chandigarh. Further investigation on the grain size of this complex by SEM is carried out.

2. SEM OF Alq_3: Eu

Further investigation of the grain size of this Alq_3: Eu complex by SEM is carried out. SEM is carried on instrument JSM-6390. Fig.2 represents crystalline structure predicted by XRD is confirmed by SEM. In given microphotographs crystalline structure is ranged between 5 to 50µm. Width of the crystal is measured as 2.8µm to 3.94µm.Hence given complex is found to be a microstructure.

3) PL properties of Alq_3: Eu

Figure 3 shows the photo luminescence (PL) excitation spectrum of Alq_3:Eu having excitation wavelength is 44onm, 437nm,442nm,439nm. The prominent PL excitation peak of Alq_3: Eu is observed at 440nm. The PL emission spectra of prepared Alq_3: Eu powder shows the prominent shoulder at 502nm with higher intensity, 504nm, 507nm, and 500nm with decreasing intensity in green region. Hence the emission peak reveals that prepared phosphors is not only suitable for organic light emitting diode but also for photoluminescence liquid crystal display (PLLCD) and solid state lighting application as their no significant change in the emission peaks but there is an increase in the intensity.

3 Conclusion

Alq_3: Eu^{2+} hybrid organic phosphor is synthesized by the precipitation wet chemical method. Phosphor is characterized by XRD spectrograph. X-ray spectrograph of Eu doped Alq_3 complex displays well defined X-ray diffraction lines, confirming its crystalline nature and its grain size. Further investigation on the particle size of this complex by SEM is carried out. SEM confirms crystalline structure organic micro phosphor Alq_3:Eu^{2+} .Photo luminescence excitation spectra observed at 440nm blue region whereas emission spectra reveals at 502nm in the green region. So Alq_3:Eu^{2+} organic phosphor is suitable in the green region for PLLCD and OLED, nano rods, nano wires and solid state lighting application devices.

4 References

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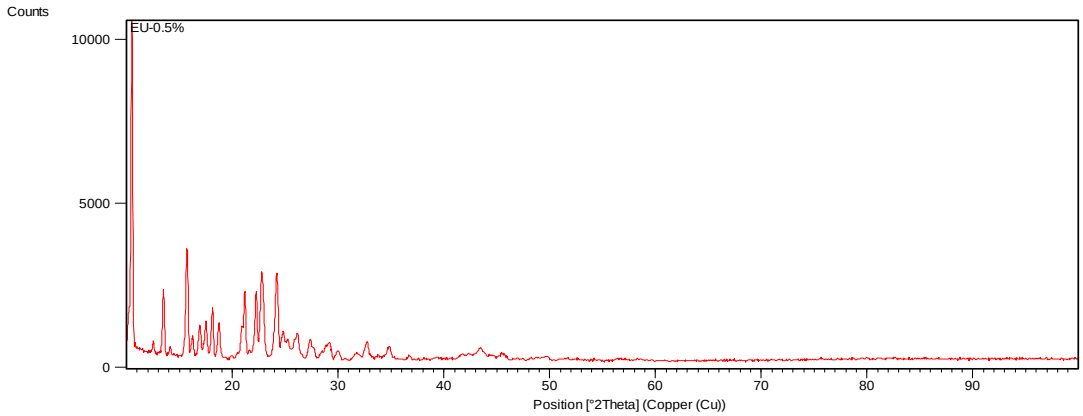

Fig. 1: XRD OF Alq_3: Eu

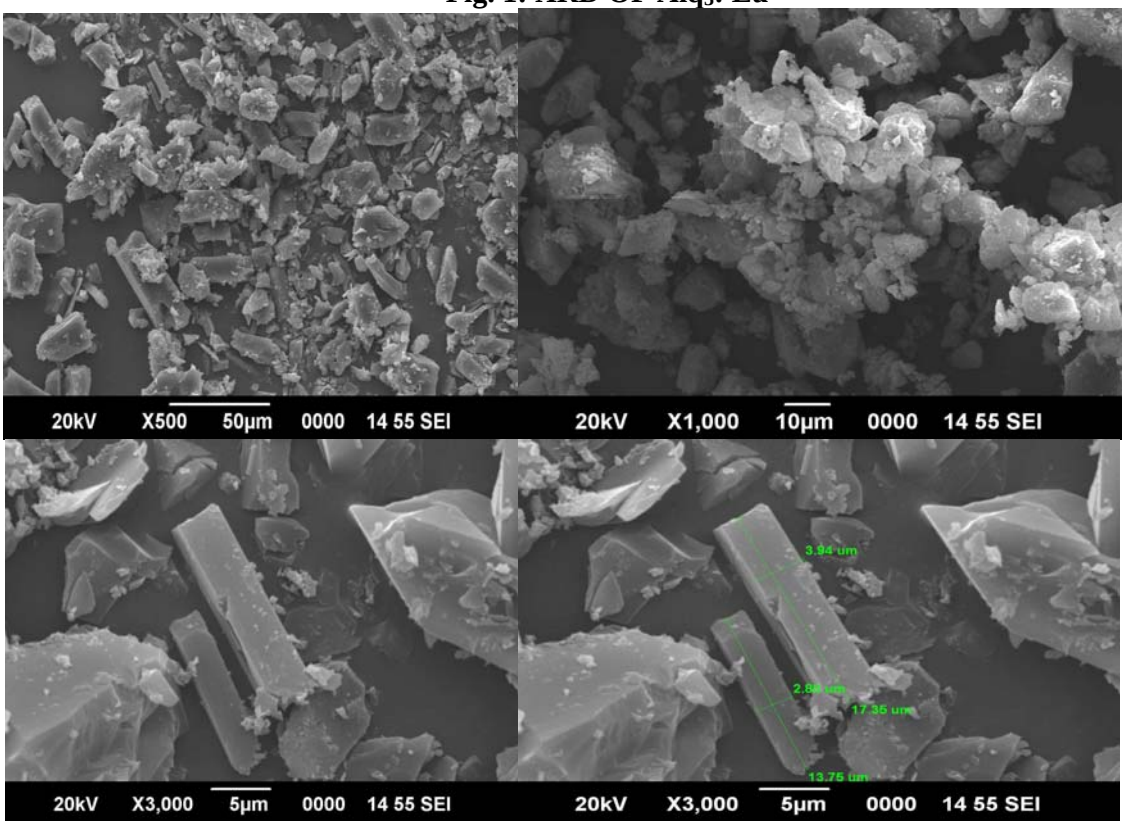

Fig. 2: SEM OF Alq_3: Eu

Fig 3: Excitation spectrum: Alq3: Eu

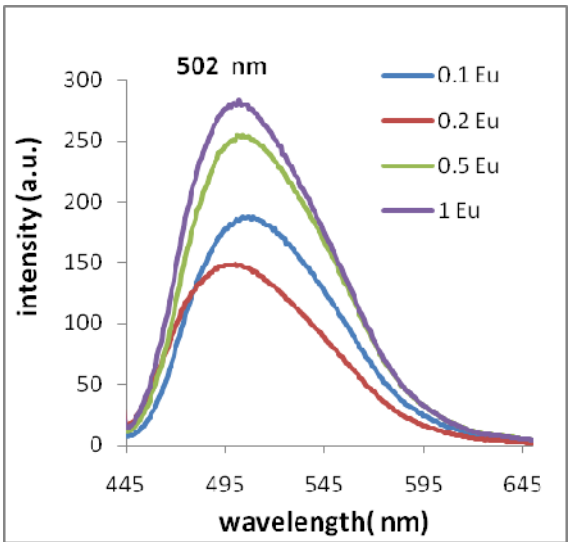

Fig 4: Emission spectrum: Alq_3: Eu