Synthesis of Zn Doped Alq_3 Blue Oled Organic Nano Phosphor

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Abstract:
Zinc doped alumium-8-hydroxyquinoline metal complex has been synthesized by simple precipitation route in order to reduce the cost and time of synthesized material. It is characterized by XRD. X-ray Diffractogram of Zn doped Alq_3 complex displays well defined X-ray diffraction lines, confirming its crystalline nature. The X-ray diffraction data analysis is done which confirms the formation of nano size crystal structure. The synthesized Zn doped Alq_3 organic nanophospor is promising material for optical or optoelectronic applications.

Keywords: nano phosphor, Alq_3, Xrd, Zn 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 optoelectronicdevices, 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 nanomaterials, only a few successful preparations of organic one-dimensional (1D) nanomaterials 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)aluminium(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 Aluminium metallo-8-hydroxyquinolate prepared from wet Chemical method and co-doped with Zn^{2+} alkaline earth elements are prepared and characterization of the material by X-Ray diffraction spectrographic is done. 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 Zn 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 produces an intense green-emission at the excitation around 365-450 nm wavelength (i.e. Blue OLED excitation wavelength).

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 4.3069 gm 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^oC. The other derivative of 8-hydroxyquinoline metal complex is prepared by Simple precipitation method same as Alq$_3$. Aluminum nitrate is replaced by nitrates of those metals. For the preparation of Alq$_3$ host lattice, aluminum nitrate and 8-hydroxyquinoline as raw materials and for Alq$_3$: Zn, zinc nitrate is used as other material mixed in an appropriate molar ratio. The synthesis chemical reactions as follows

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

$$Al\ (NO_3)_3.9H_2O + Zn\ (NO_3)_2 + 3(C_9H_7NO) \rightarrow Al\ Zn\ (C_9H_7NO)_3 + 9H_2O + 5(NO_2) \uparrow$$

3 Result and discussion

1) XRD OF Alq$_3$: Zn: 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 whether the final product formed is in crystalline and homogeneous form or not. The particle size is calculated and reported in this paper.

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.

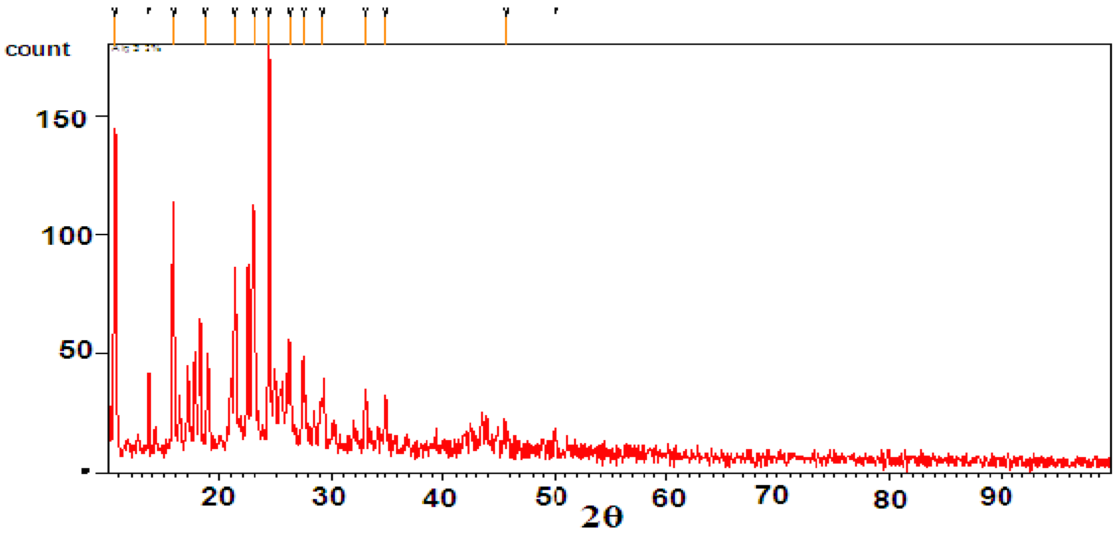

Fig. 1: XRD OF Alq_3: Zn

2) Measurement Conditions for particle size of Alq_3: Zn

Table1: Peak List

Pos. [°2Th.]	Height [cts]	FWHM [°2Th.]	d-spacing [Å]	Rel. Int. [%]
10.6407	112.21	0.4896	8.30745	76.21
13.5890	35.27	0.4896	6.51093	23.95
15.8802	42.50	0.9792	5.57631	28.87
18.6699	10.07	1.9584	4.74889	6.84
21.2674	54.91	0.4896	4.17440	37.29
22.9983	86.07	0.4896	3.86398	58.45
24.4429	147.25	0.4896	3.63879	100.00
26.4039	36.23	0.4896	3.37283	24.60
27.5981	29.44	0.4896	3.22953	19.99
29.1810	23.09	0.4896	3.05785	15.68
32.9208	24.20	0.4896	2.71852	16.44
35.0353	15.22	0.4896	2.55914	10.34
45.7130	3.89	0.4896	1.98314	2.64
50.0138	8.64	0.4896	1.82221	5.87

3) Calculation of xrd peaks

The calculations is carried out by Scherer's formula

$D = 0.9 * \lambda/\beta \cos(\theta)$ (λ=1.54A)

To calculate the first peak

$2\theta = 10.6407$; $\theta = 5.3203$

$\beta = 0.4896*3.14/180$

$\beta = 8.5408*10$^-3(in radian)

$D_1 = 0.9*1.5406*10^{-10}/8.5408*10$^-3*COS (5.32035)

$D_1 = 16.30$ nm

To calculate the second peak

$2\theta = 24.4429$; $\theta = 12.22145$

$\beta = 0.4896*3.14/180$

$\beta = 8.5408*10$^-3(in radian)

D2 = $0.9*1.5406*10^{-10}/8.5408*10$^-3*COS (12.22145)

D=16.61 nm

Similarly calculations for all other peaks are found to be 16.57 nm, 16.52 nm, 16.35 nm, 16.68 nm. Average grain size of crystallites is calculated as 16.51nm. Further investigation on the grain size of this complex by SEM should be carried out.

3 Conclusion

Alq_3: Zn^{2+} hybrid organic complex has been synthesized by the precipitation wet chemical method and characterized by XRD spectrograph. X-ray spectrograph of Zn doped Alq_3 complex displays well defined X-ray diffraction lines, confirming its crystalline nature and grain size is calculated to be 16.51nm in the nano range. Further investigation on the particle size of this complex by SEM should be carried out. Hence the organic nanophosphor i.e. Alq_3:Zn^{2+} is suitable for PLLCD and OLED, nanorods, nanowires and solid state lighting application devices.

4 References

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