Synthesis and Electroluminescence characterization of annealed Znq2 particles with CTAB

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Abstract: The high luminescence Zinc (II)-bis (8-hydroxyquinoline) Znq2 nano particles were synthesized by simple precipitation method using Cetyl trimethyl ammonium Bromide (CTAB) as cationic surfactant. The synthesized Znq2 was annealed at 200°C in air for 3 hours. The crystalline nature of Znq2 nano particles was confirmed by X-ray powder diffraction (XRD). The morphology and the presence of Znq2 nano particles were analyzed and confirmed using SEM and EDAX. The functional groups of these nano particles were analyzed and assigned using FTIR studies. The optical property of Znq2 was confirmed by UV-vis spectrum. The band gap of Znq2 is calculated. The luminescence behavior of synthesized Znq2 nano particles were confirmed by photoluminescence studies for OLED applications as emission and electron transport layers.

Keywords: Znq2, nano particles, CTAB, SEM, UV-vis, FT-IR.

1. Introduction and Experimental method

Organic light emitting diodes (OLEDs) have been attracted great interest for thin film flat-panel display and solid state lighting device application [1, 2]. A significant part of organic molecules and conjugated polymer materials show broad emission spectra, however, the availability of pure emission color is important for full color display. Blue, green and red light-emitting materials with standard color and high efficiency are necessary for full color displays. Since the first OLEDs with Zn complexes reported in 1993, synthesis of novel zinc complexes as active materials for OLEDs. The electroluminescent performance of zinc complexes Znq2 as the emitter is just comparable with that of Alq3. However, in many instances, the electron-transporting mobility of zinc complexes goes beyond that of Alq3. So zinc complexes may be potential candidates to enhance the electron-transporting properties for OLEDs. [3-5]. Znq2 used as an emissive transport material (ETM) because of their excellent electron transport properties; this is due to the better π-π overlap of molecular orbitals of the zinc derivatives. In this article, a systematic investigation has been carried out to synthesize Znq2 particles by a simple precipitation method. As a result, this study sets out to evaluate the structure, optical and thermal properties of zng2 particles. Surface modification of the particles has been carried out using ionic surfactant of Cetyl trimethyl ammonium Bromide (CTAB) with annealing.

http://www.sphinxsai.com/framesphinxsaichemtech.htm
1.1. Experimental method

Initially 4.3175 g of zinc acetate was dissolved in 100 mL of water and stirred magnetically for about 1 hr. at room temperature. In this solution, 0.03435 g of CTAB dissolved in 20 mL of water was added. The 8Hq solution was separately prepared by dissolving 5.442 g of 8Hq in mixed solvent of Ammonia (0.04 mL) and water (100 mL) and then it was added drop by drop to the above solution. Yellow precipitates were formed immediately and they were stirred at room temperature for 1 hr. The precipitates were filtered, rinsed with distilled water. The precipitates were then dried at room temperature and calcined at 200°C for 3 hr.

2. Result and Discussion

2.1. Structure and morphology analysis

The XRD patterns of the Znq2: CTAB annealed at 200°C sample is shown in Fig.1. The diffraction peaks can be indexed to be Znq2 (JCPDS card no. 48-2116). [6].

![Fig.1. XRD pattern of Znq2: CTAB](image1)

The SEM image of the Znq2: CTAB particles are shown in Fig. 2. The SEM image of the particles apparently exhibits granular Znq2 nano structures. The diameter of the granular nano structures are in the range of 70-80 nm and also in the diameter range of 1.247 μm.

![Fig.2. SEM image of Znq2: CTAB](image2)

2.2. FTIR spectroscopic analysis of Znq2:CTAB

The FTIR spectrum of Znq2 nano particles is recorded in the range of 4000–400 cm\(^{-1}\) employing a BRUKER 66 V FTIR spectrometer using KBr pellet technique is shown in Fig.3. The vibrations at 1604 cm\(^{-1}\), 1575 cm\(^{-1}\) and 1322 cm\(^{-1}\) were assigned to the quinoline group of Znq2. The bands at 1496 cm\(^{-1}\) and 1461 cm\(^{-1}\) should correspond to both the pyridyl and phenyl groups in Znq2. The peaks at 730 cm\(^{-1}\) and 601 cm\(^{-1}\) were associated with in-plane ring deformation. The O-H vibration bands were detected at 2653–3207 cm\(^{-1}\) [7, 8].

![Fig.3. FT-IR spectrum of znq2: CTAB](image3)

![Fig.4. (a) Optical absorption and (b) photoluminescence spectra of Znq2: CTAB](image4)
2.3. Optical Absorption and photoluminescence characterization

The optical absorption of the Znq2 particles in the wavelength region 200-800 nm was carried out using double beam CARY 5E UV-vis spectrophotometer and the spectrum obtained is shown in Fig.4 (a). The absorption spectrum shows maximum peak at 243 nm with a shoulder at 405 nm. The band gap of the material was calculated from the optical absorption curve which revealed the band gap of the complex be 5.11 eV [9]. The Fig.4. (b). shows the photoluminescence (PL) emission spectrum of Znq2 particles by excitation wavelength of 385 nm. The prominent PL emission peak is observed at 539 nm in green region. It shows that Znq2: CTAB not only suitable for organic light emitting diode (OLED) but also for photoluminescent liquid crystal display [10].

2.4. Conclusion

Simple precipitation method has been presented to synthesize Znq2 particles with CTAB. The properties of Znq2 particles were studied by XRD, SEM, FTIR, UV-vis and PL analysis. Our investigations indicated that the CTAB assisted Znq2 particles are the best, in terms of size, morphology, structure and optical properties. Znq2: CTAB can be used as the novel electroluminescence material for OLED applications.

3. References

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