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Synthesis of ZnSe nanocrystals and Photoluminescence studies at different wavelengths.

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ABSTRACT

In this work, an experimental method to obtain ZnSe nanocrystals in co-precipitation method. The nanocrystals obtained using simple procedure based on the precipitations of ZnSe in aqueous solution in the presence of hydrazine hydrate as stabilizer and ammonia at room temperature. The structural characterization of powder X-Ray diffraction shows the particle were obtained in nanorange as well crystallite structure and morphological structure shoes the spherical shape crystal structure formation. The photoluminescence properties were determined by excitation and emission spectroscopes at different excitation range. The FTIR examined the vibrational peaks of ZnSe nanocrystals.

INTRODUCTION

In the past few years, II-VI semiconductors have been promising hopefuls for laser diode and optoelectronic devices working in laser blue range. The semiconductors have been broadly utilized for the principal fundamental properties and electronic applications, for example, sensors, Bio medical labelling sensors, Emitting diodes, transistors etc[1-4]. Various Chalcogenides shown their interest in quantum confinement region because of its applications in optical properties with less photo degradation rates[5]. The gap of Zinc related semiconducting materials are exceptionally productive producers in blue to green range. Various semiconductors have been prepared as ZnO, ZnS, CdS, CdSe as because of the stability of ZnO nanostructured are excessively used in most of the nanotechnological applications[6-9]. For fabrication of short wavelength devices ZnSe shows the strong potential material which exhibits tunable blue Uv luminescence. Various methods have been used for the synthesis of ZnSe nanoparticles as aqueous and organometallic method, water soluble route [10-13].

METHODOLOGY PROPOSED

Particularly, at the normal room temperature response, an aqueous arrangement of 5millimolar selenium powder(99% pure) and 30 millimolar of Na_2S are broken down into 100 millilitres of distilled water to get an aqueous solution of sodium selenosulphate. With the persistently stirring for 9 hours the solution is stilled for 12 hours after that the clear solution is observed which is further filtered and kept aside. 0.1 molar of zinc acetate

solution is prepared in 100millilitres of distilled water. Now the prepared sodium selenosulphate is added to zinc acetate solution and hydrazine hydrate is added as stabilizer, ammonia is added and NaOH is additionally included to alter the pH level. Further accelerates were isolated by centrifuge and washed. The particles were kept in oven at 100^0 C for 5 hours to get powder test.

RESULTS AND DISCUSSION

Fig. 1 demonstrated the X-ray diffraction pattern for Zinc selenide nanoparticles. The diffraction peaks at angle (2θ) of 23.43, 29.57, 32.90, 41.31, 43.54, 45.23, 51.58, 56.08, 58.94, 61.42 and 64.92 corresponding to (111), (111), (200), (110), (103), (220), (311), (222), (201), (202) and (203) planes respectively for hexagonal spinel structure of ZnSe (JCPD Card No. 89-2840) has been observed [14]. The size measure D(crystallite size) was determined utilizing the scherrer formula i.e. $D= 0.9\lambda/\beta\cos\theta$,Where λ is the wavelength of utilized radiation, β is the full width half maximum (FWHM) of diffracted peaks and θ is the Bragg angle. The crystallite structure was observed to be around 14.64 nanometers. In any case, the other peaks at 23.43° and 29.57° are identified with selenium, and formation of ZnSe nanocrystals. The sharp crest extensive suggests that both the nanocrystals in low or high nanometer range are collected together.

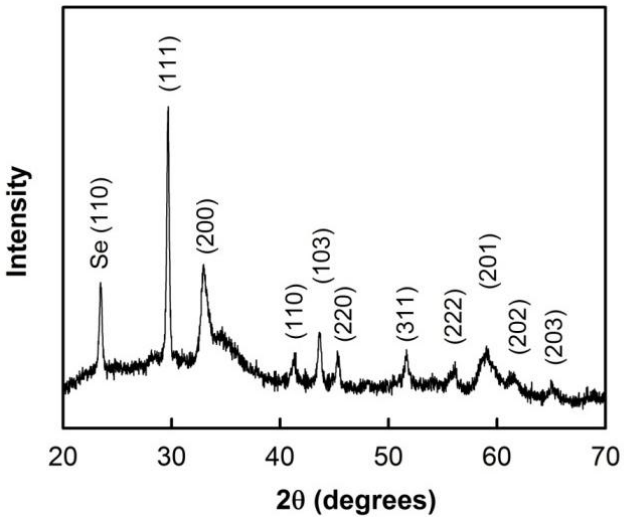

Fig 1 XRD spectra of ZnSe nanocrystals

TEM estimations were performed to analyse about the morphology of the nanocrystals. The crystals were observed to be almost spherically in structure. The normal particle size was estimated surmised from TEM micrographs is around 20 nanometers. Here the molecule estimate(20nm) from TEM examination firmly coordinated with the molecule measure determined from De sherrer formula. Factors for example, nucleation and development, recrystallization, agglomeration and ageing forms have effectly affects the particle size and its structure [15-17]. FT-IR spectrum of the corresponding sample is shown in Fig. 3. The characteristic major

peaks appearing at 487 are characterized at ZnSe stretching mode , 556, 594, 636, 665, 690 cm^{-1} belong to Zn-Se vibrations.

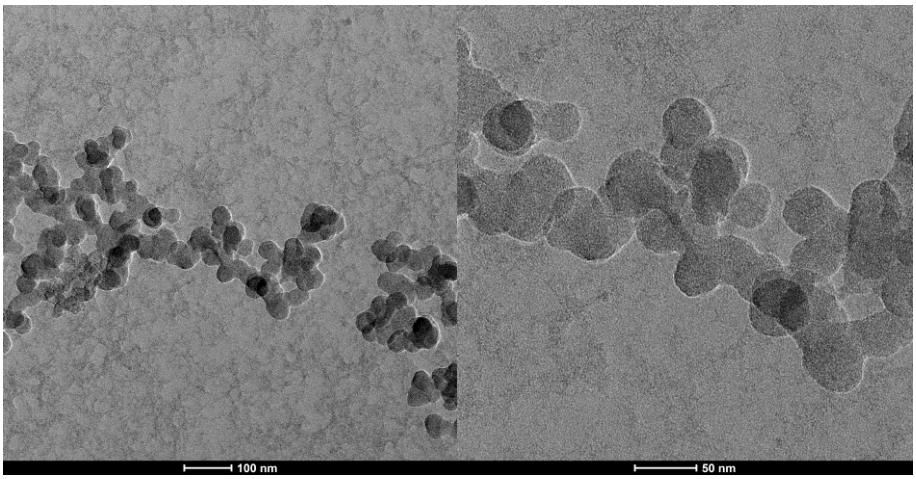

Fig 2 TEM images of ZnSe nanocrystals.

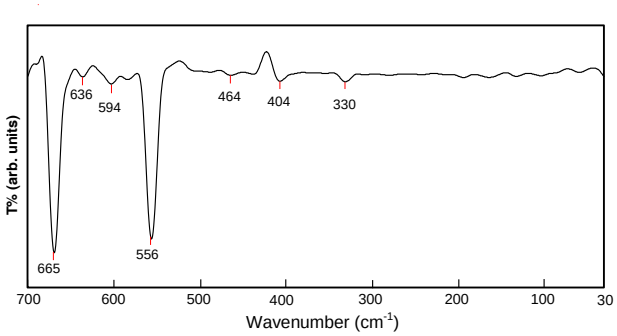

Fig 3 FTIR spectra of ZnSe nanocrystals

Fig 4 shows the luminescence spectra of Zinc Selenide nanocrystals. It is observed that the absorption spectra exhibits at different wavelengths like Fig 4(a) represents the exhibition of strong peak 431 nm at excitation energy of 360 nm. In fig 4(b) there is increase in absorption as the exhibition wavelength shifted to 423 nm the excitation energy at 380 nm. In fig 4(c) there is again shifted in peak to 421 nm at the excitation wavelength of 400 nm. In fig 4(d) luminescence spectra exhibits the strong peak with higher intensity at 422 nm at excitation energy of 410 nm.

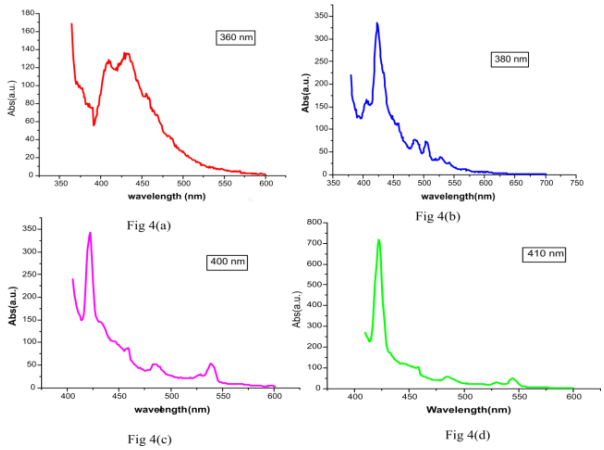

Fig 4(a) Fig 4(b) Fig 4(c) Fig 4(d)

Fig 4(a) shows the emission spectra at 360 nm, 4(b) shows the emission spectra at 380 nm, 4(c) shows the emission spectra at 400 nm 4(d) shows the emission spectra at 410nm

CONCLUSIONS

Zinc Selenide nanoparticles were prepared by co-precipitation method. According to X-Ray diffraction study showed the hexagonal crystal structure with crystallite size 14nm. Transmission Electron microscopy images confirms the spherical shape of nanocrystals FTIR results showed the bonding on the surface of ZnSe nanoparticles. At the different excitation energy, the strong peak is observed at 422 nm at excitation of 410 nm.

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