

OPTICAL STUDIES OF CDS NANOPARTICLES **PREPARED BY CBD METHOD**

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Abstract : Extensive studies are done on semiconductor nano-particles because of their wide applications in opto-electronic devices. Semiconductor nano- crystallites electronic devices have wide variety of optical applications with the advance of science and technology. CdS are grown into ammonia matrix and synthesized by chemical route. Growth of Nano-structured CdS is confirmed by the XRD study. Optical properties of Nano-structured CdS are studied by XRD, SEM, TEM, UV and PL. Average particle size is found to be 2.5nm from SEM the study which is conformed by XRD study. Peaks of photoluminescence (PL) Emission Spectra are found around 295.5nm and 365nm at room temperature. Optical absorption studies were done with the help of a UV-VIS Spectrophotometer, which showed a strong absorbance at wavelength 230nm. X-ray fluorescence study also confirmed presence of Cd & S in the nano structured films.

Keywords: Nanoparticle, XRD, XRF, SEM, TEM, PL, UV.

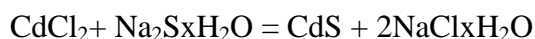
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1 Introduction:

In recent years, semiconductors like CdS nano structured material have their high potential applications in opto-electronic devices. With decrease in the particle size, their physical and electrical properties vary. CdS has a wide band gap, compared to II-VI semiconductor materials having band gap of 2.42eV at room temperature. CdS nano crystals are being extensively used in various fields such as photovoltaic cells, luminescence devices, sensors, optical fibres, etc. Several techniques have been employed to prepare CdS nano particles. Among these one of the method is CBD (Chemical Bath Deposition) method which is cost effective and may be the cheapest. In our study, we are trying to characterize the properties of CdS with different concentrations with the help of instruments like XRD, SEM, TEM, PL, UV-VIS, and XRF.

2 Experimental: CdS nano-particles are synthesized by CBD method using different concentrations of ammonia solution as a matrix. Different concentrations of Cadmium Chloride (CdCl_2) and Sodium Sulphide Flakes ($\text{Na}_2\text{S} \times \text{H}_2\text{O}$) are taken (A). Ammonia (NH_3) solution (25%) is mixed with deionised water (B). A and B are mixed and stirred upto 80°C .

Aqueous solutions of CdCl_2 with $\text{Na}_2\text{S} \times \text{H}_2\text{O}$ are mixed in 100ml of distilled water. Then ammonia solution of 100ml is added to the solution and stirred. They are stirred at 100 rpm in a magnetic stirrer for four hours. The temperature was kept constant at 80°C for four hours. The solution was kept overnight inside a dark chamber for complete dissolution and found to be transparent. The solutions thus obtained are filtered. The residue obtained in the filter paper are washed with distilled water and allowed to dry in air. XRD of clear solution deposited in glass plate is taken to ascertain the formation of nano structured CdS. The chemical reaction is as follows:



3 Results and Discussions

3.1 XRD Study

In order to check whether CdS made by CBD method has undergone structural change in nano scale, XRD study has been made. The X-Ray Diffraction pattern of CdS nano particles at different concentrations are analyzed with the help of Philips X'pert Pro diffractometer at

operating voltage 40kV and current 35mA are shown below the figure 1. It shows the nano structured crystalline CdS. The highest intensity peaks are found at 2Θ values of 26.894° , 44.291° and 52.30° referring to diffraction in (111) planes along with two another lower intensity peaks at (220) and (311) planes. The broadening of peaks is observed and the particle size is calculated using Scherer's formula,

$$D=0.094\lambda/\Delta\theta\cos\Theta$$

3.2 Optical Absorbance Study:

The optical absorbance studies of CdS are done at room temperature with the help of UV-Visible absorption spectrometer Shimadzu UV-2600, to investigate the optical properties and energy structures of CdS nano crystalline semiconductors. The peak of absorbance showed in the range of wavelength at around 230 nm in fig2.

3.3 Photo luminescence Studies:

The photoluminescence study are done with the help of Fluorescence Jasco Specfluorometer FP-8300. The peak of PL spectra are found at around 295.5nm and 365nm. The maximum peak is found at 0.03M as shown in

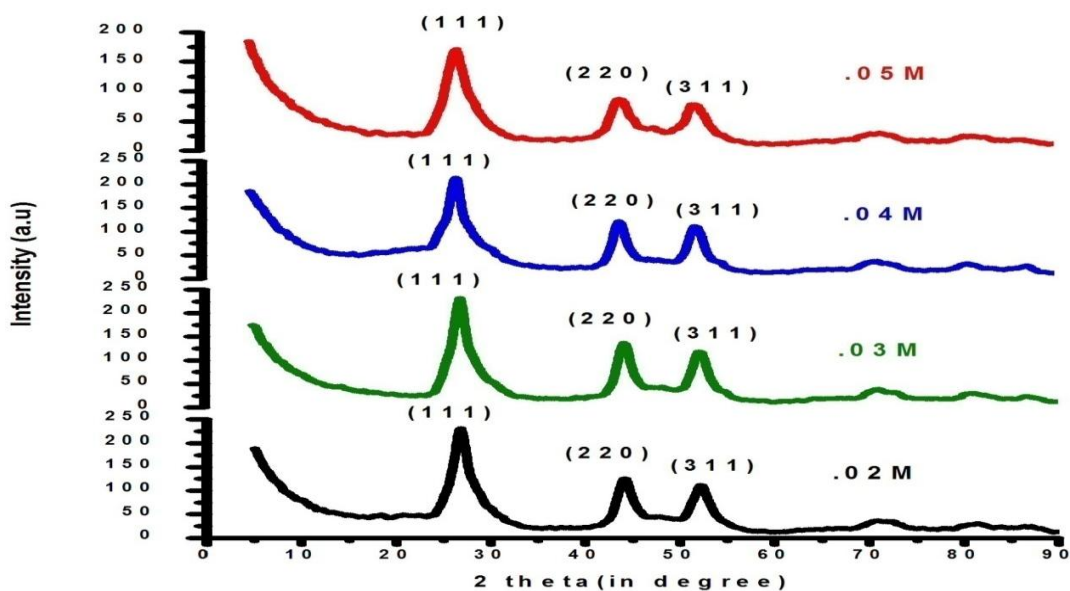


fig3.

Fig 1. XRD study of CdS at different concentrations

3.4 TEM Analysis: The TEM studies of CdS were done with the help of TEM (JEOL-100 CX) is shown in fig4. It is seen that the particle size obtained from the diffraction pattern satisfied well with that of the value obtained from XRD studies.

3.5 SEM Analysis: A convenient method to study the surface morphology of nano crystalline structure is Scanning Electron Microscope. SEM analysis of CdS are done with the help of SEM Carl Zeiss Sigma VP is shown in fig5. The surface morphology of CdS nano crystalline structure thus obtained from SEM analysis shows that the crystal is hexagonal .

3.6 XRF Analysis: CdS thin films are scanned with the help of Axios X-Ray Fluorescence Spectrometer at operating voltage 50kV & 20mA. The peaks of Cd and S are shown in fig6 (a) and Fig (b).

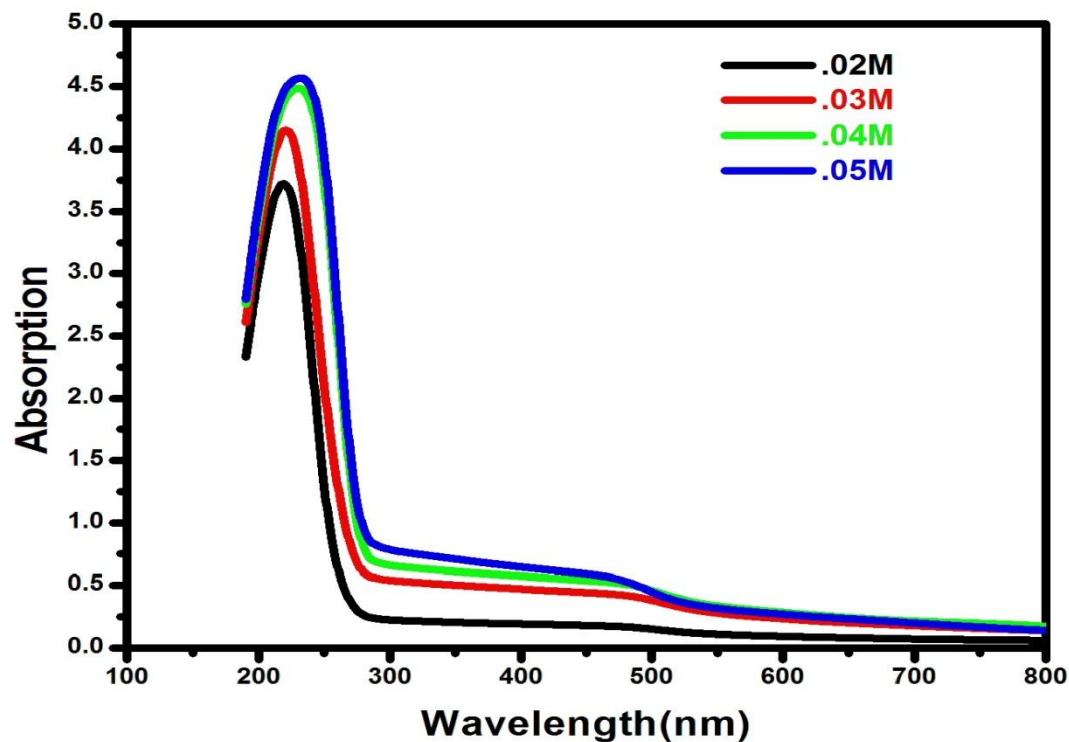


Fig2. UV-VIS spectra of CdS at different concentrations

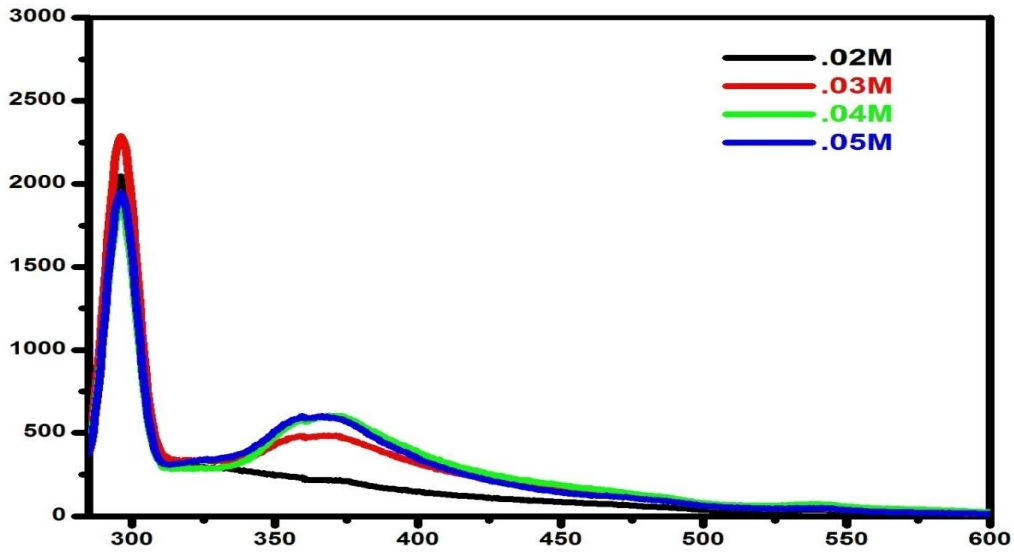


Fig3. PL spectra of CdS at different concentrations

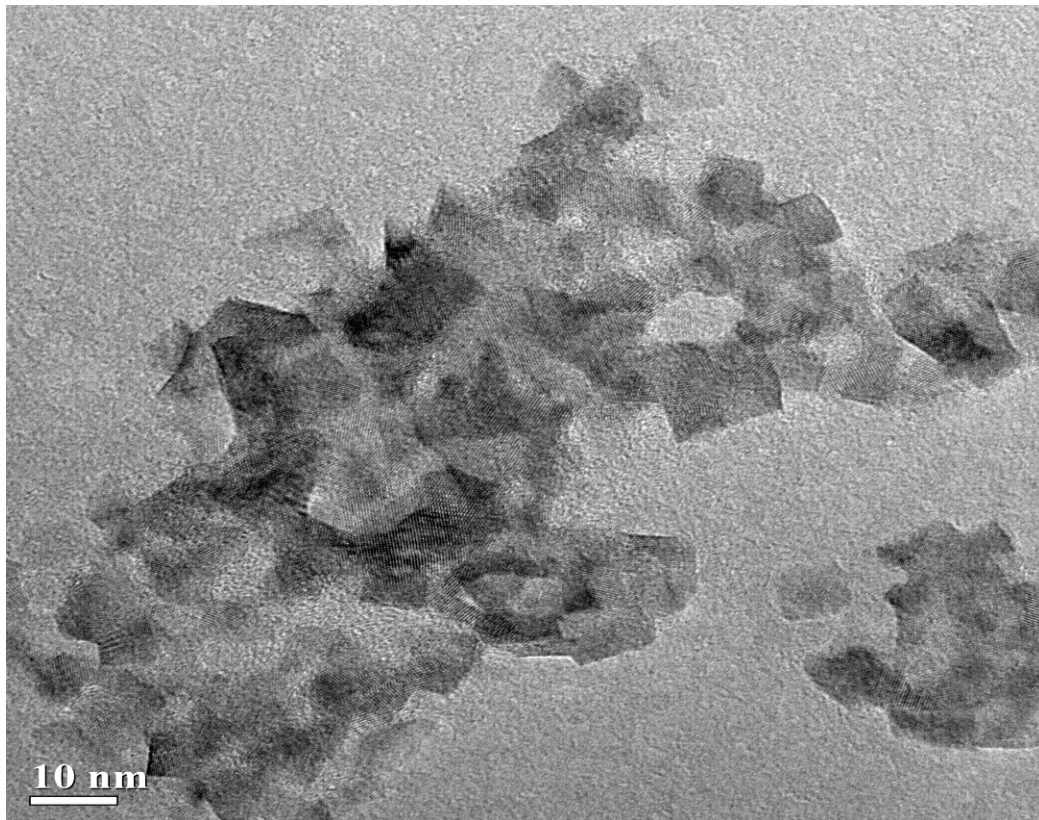


Fig4. TEM analysis of CdS

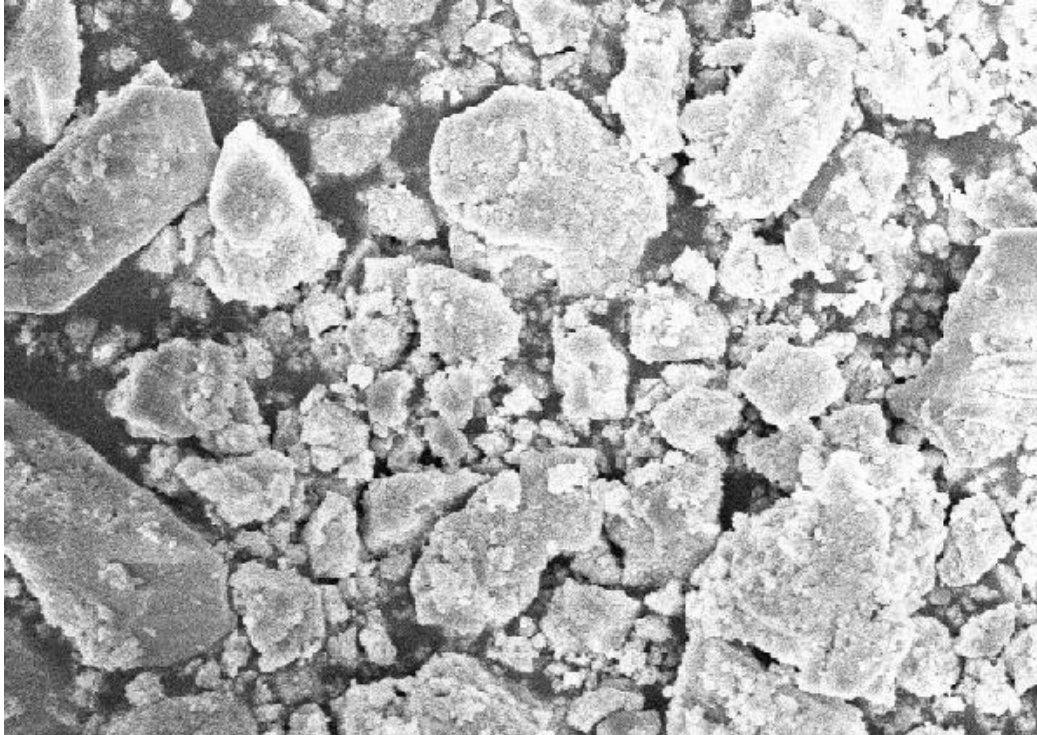


Fig5. SEM analysis of CdS

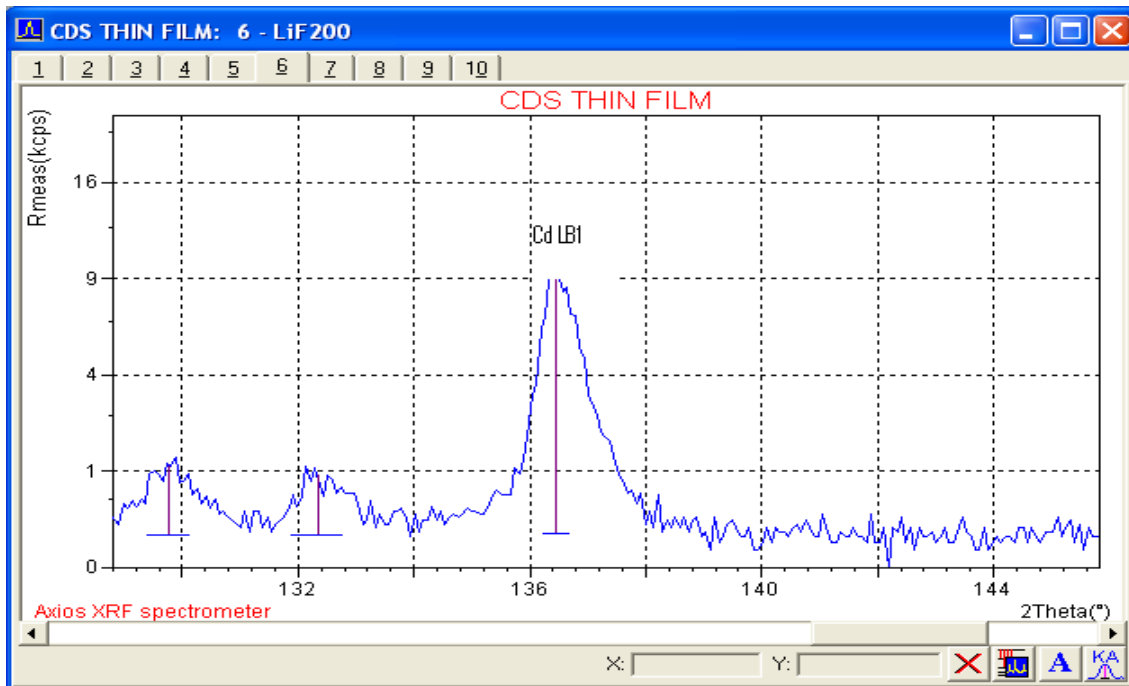


Fig6 (a) XRF studies of CdS

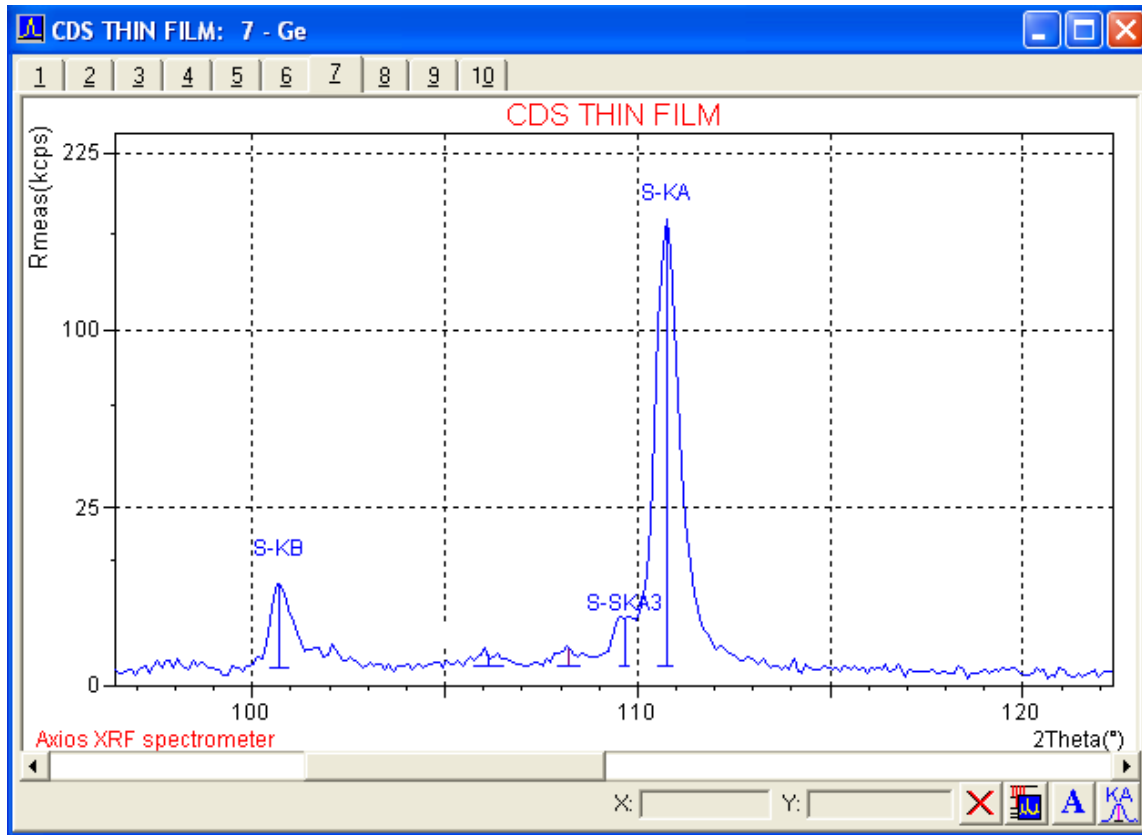


Fig6 (b) XRF studies of CdS

4 Conclusion: CdS have been synthesized by chemical bath deposition method and optical properties are characterized. From TEM study average particle size of CdS nano particle is found to be 2.5nm which is confirmed by XRD study. Hexagonal phase is observed in SEM analysis. Photo luminescence peaks are observed at wavelength 295.5nm and 365nm. The UV absorption spectra show increase of absorbance from 3.5 to 4.5 with the increase in molarity of nano structured material and band gap thus obtained from analysis is found to be 4.25eV.

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