Preparation and Characterization of CdO Nanoparticles by Precipitation Method

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Abstract— Cadmium oxide nanoparticles were prepared using modified precipitation method using cadmium chloride and ethanol solution. The particle size of CdO nanoparticles is found to be 41nm using x-ray diffrometer. UV visible found absorption peak appeared at 300nm. This absorption band of CdO nanoparticle has been shows a blue shift due to quantum confinement. Photoluminescence (PL) spectrum shows band edge emission at 396nm and green emission at 548nm. Green emissions arise from the oxygen vacancy of cdo material because of photo generated hole in valance band with an electron in conduction band.

Key words: Cadmium oxide nanoparticles, UV, XRD & PL

I. INTRODUCTION

The synthesis of binary chalcogenides of group II-VI semiconductor in a nanopowder form has been a rapidly growing area of research due to their important optical, physical and chemical properties. These II-VI semiconductor nanoparticles are presently of great interest for their physical applications such as zero dimensional quantum confined materials and for their applications in optoelectronics13. Semiconductor nanoparticles belong to state of matter in the transition region between molecules and solids12.The physical and chemical properties of these nanomaterials are found to be size dependent. Large scale synthesis of semiconductor nanoparticles such as solid powder is critically important not only for the study of their physical properties but also for industrial applications in the area of catalysis, photo catalysis and microelectronics10.Cadmium oxide is attracting tremendous attention due to its interesting properties like direct band gap of2.3 eV. It is widely used in the applications like the preparation of cadmium-coated baths and Manufacture of paint pigments

In the present paper, synthesis and characterization of cadmium oxide and cadmium sulphide nano-particles has been studied.

II. MATERIALS AND METHODS

A. Experimental Description:

To prepare CdO nanoparticles by taking 0.3g of cadmium chloride powder of 99.99% purity (alfa aesear) which was dissolved in 50ml of ethanol and solution is stirred at room temperature. After stirring process sodium hydroxide solution was added to solution to maintain the PH10 and stirred for half an hour.

Subsequently, the solution was kept for 5hours for the deposition of the cdo nanoparticles. The particles were collected in a petty dish and dried at 100C for 2hours, keeping material in a hot air oven for 2hours. The Brownish CdO nanoparticles are collected, grained and preserved in an air tight container.

III. RESULT AND DISCUSSION

A. X-Ray Diffraction Structural Analysis:

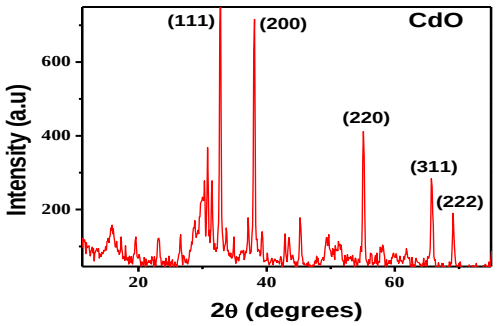

Fig. 1: shows the XRD for Cadmium Oxide Nanoparticles

The XRD pattern CdO nanoparticles are shown in fig.1, the diffraction peaks are absorbed at 2theta values. The prominent peaks have been utilized to estimate the grain size of sample with the help of Scherer equation,

Grain size $D = \frac{K\lambda}{\beta \cos\theta}$

The grain size estimated using the relative intensity peak (100) for CdO Nanoparticles was found to be 41 nm and increase in sharpness of XRD peaks indicates that particles are in crystalline nature. The (111), (200), (220), (311) and (222) reflections are clearly seen and closely match the reference patterns for CdO (Joint Committee for Powder Diffraction Studies (JCPDS) File No. 05-0640).

B. UV-Visible Spectroscopy:

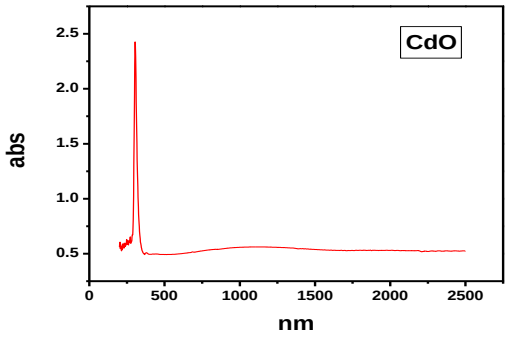

Fig. 2: shows an absorption peak for CdO Nanoparticles

The UV–visible absorption spectra of CdO Nanoparticles are shown in Fig.2 although the wavelength of our spectrometer is limited by the light source, the absorption band of the CdO Nanoparticles have been shows a blue shift due to the quantum confinement of the exciton present in the sample compare with bulk CdO particles. This optical phenomenon indicates that these Nanoparticles show the quantum size effect. The maximum absorption peak

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appeared at around 300 nm and its band gap value is around 4.1eV.The Band gap were calculated for bulk materials is around 2.3eV and for Nanomaterials is around 3.4eV.

C. Fourier Transform Infrared Spectroscopy Study:

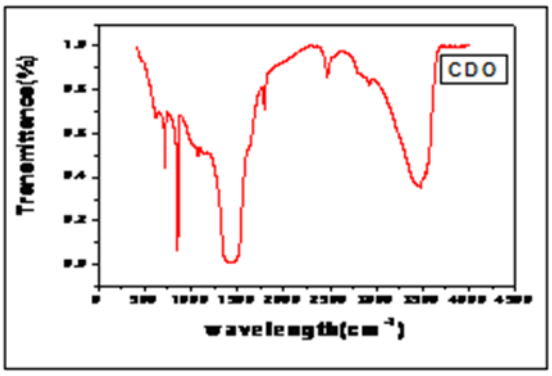

Fig. 3: shows the Transmittance for CdO Nanoparticles

In figure.3 the peak at 1270 cm^{-1} and comparatively two small peaks corresponds in the presence of Cadmium and oxygen in the sample. In the FTIR spectrum the strong absorption in the range of 1270 to 1641 cm^{-1} and the other couple of peaks in the range of 553 and 666 cm^{-1}. The week absorption at 1641 is also found in the FTIR spectrum. The above Cadmium reacting with oxygen in the air during the time of preparing CdO NPs. From the FTIR spectrum it is confirmed that presence of Cadmium and oxygen in the range between 1641 to 1270 cm^{-1} respectively.

D. Photoluminescence Study:

The room temperature Photoluminescence spectra of CdO Nanoparticles calcined at 400ºC are shown in figure.4

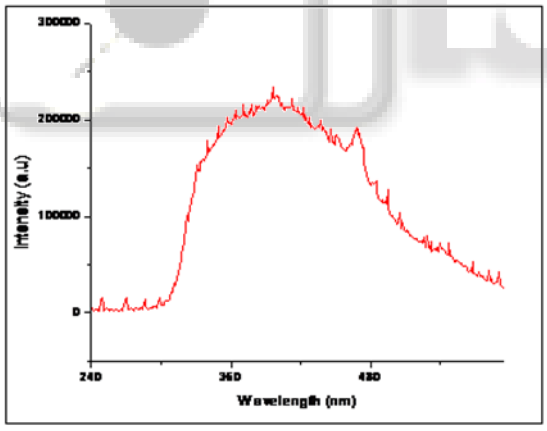

Fig. 4: shows the absorption spectra CdO Nanoparticles

A broad and maximum emission peak appeared at around 400 nm and its band gap value is around 3.1 eV .The peak at 396nm corresponds to the band edge emission. The peak at 468nm is due to artifact. The peak at 548nm arises from the oxygen vacancy of CdO materials because of recombination of a Photo generated hole in valence band with an electron in conduction Band.

IV. Conclusion

The Cadmium oxide Nanoparticles were prepared by Modified precipitation Method along with different concentrations. The Characterization Techniques of X-Ray Diffraction and optical Studies such as UV-Visible Spectroscopy, Fourier Transform Infrared Spectroscopy and Photoluminescence. The XRD used to find conform the CdO Nanoparticles to the Structure and Particle size of 41 nm. The UV-Visible used to find the CdO Nanoparticles band gap energy of 4.1eV and absorption spectra. FTIR used to conform the functional groups is present in the CdO Nanoparticles. PL (Photoluminescence) used to study the Optical properties.

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