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Synthesis and Characterization of Undoped and Copper Doped CdS Nanoparticles

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Abstract

In the present work, CdS nanoparticles were synthesised by Simple Chemical method. The effect of the doping concentration on the optical properties of CdS nanoparticles has been investigated. The samples were characterized by X-Ray diffraction (XRD), UV-Visible spectroscopy and Fourier Transform Infrared Spectroscopy (FTIR). The XRD studies indicate that the samples prepared were hexagonal in nature. The Absorption spectra show absorption edge in UV region. Increase in doping agent concentration leads to an increase in the optical transmission and increases the size of the particles as the band gap decreases..

Keywords: Nanocrystals, Polyvinyl alcohol, composites, photoluminescence, electroluminescence.

1.0 INTRODUCTION

The semiconductor nanoparticles exhibit structural, optical, electronic, Luminescence and photo-conducting properties very different from their bulk properties[1]. It is also attractive because of their possible application in solar cell, photo-detector, Laser, LED, high density magnetic

information storage and many others in semi conducting industries [2]. An attempt has been made here to investigate the optical properties of doped and undoped nanocrystalline CdS with Cu.

2.0 EXPERIMENTAL

Cadmium Sulphide(CdS) nanoparticles were grown by Inexpensive Chemical route using PVA as a capping agent. For the undoped CdS nanoparticles, the 0.5M solution of $CdSO_4$ was prepared by dissolving $CdSO_4$ in distilled water. The matrix solution was prepared by adding it to an aqueous solution of PVA with constant stirring at room temperature. The pH of the solution was maintained by adding ammonium buffer Solution to turn above matrix solution to metallic complex solution. The thiourea as S^{2-} ion source was then added to the above metallic complex solution to form colloidal solution of CdS nanoparticles. For Cu doping, $CuSO_4$ solution of (0.005 M) was mixed with the host $CdSO_4$ solution (0.5M) solution prior to deposition and similar steps were followed to have final CdS : Cu matrix solution.

3.0 RESULTS AND DISCUSSIONS

XRD shows hexagonal CdS nanoparticles with size in a few nanometers range. Significant peaks were obtained at 2θ angles 26°, 29°, 32°, 36°,44°, 51.5°, 61.5° corresponds to the reflections at (002), (101), (200),102), (110), (112), (202) planes.

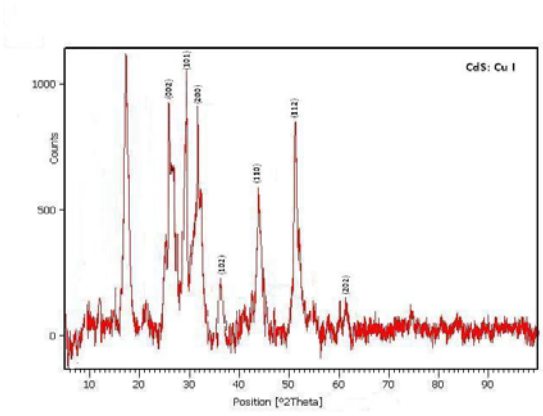

Figure 1: XRD of CdS: Cu nanoparticles

Optical absorption studies show that absorption edge shifts towards longer wavelengths by increasing loading of Cu doping indicating increase in crystal size. Large blue shift is observed in both CdS and Cu doped CdS samples with respect to bulk CdS. This indicates a clear quantum confinement in PVA capped CdS nanostructures. C.M. Janet et al also reported that, the size of CdS nanocrystal becomes smaller than the exciton radius a remarkable quantum size effect leads to a size dependent increase in the band gap and a blue shift in the absorption onset [3].

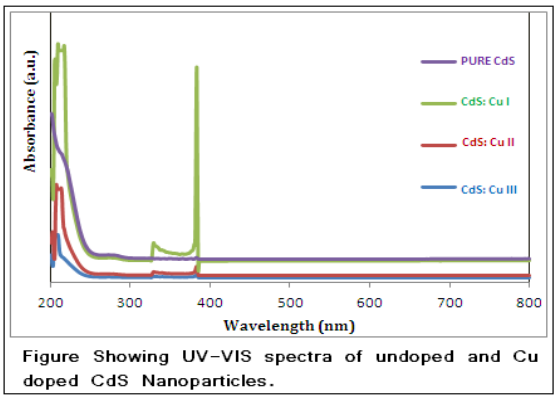

Figure 2. Absorption spectra of CdS:Cu nanoparticles

In FTIR spectrum, the peak at 3431 cm^{-1} is assigned to O-H stretching of absorbed water on the surface of the sample and the peak at 1438 cm^{-1} is attributed to bending vibrations of Poly Vinyl Alcohol used in the process. The C-O stretching vibration of absorbed PVA molecule gives its intense peak at 1025 cm^{-1}. In addition to surface coverage of CdS by PVA, presence of trace amount of template ligand namely PVA is also evident , its ring C-H vibration occurs at about 3074 cm^{-1} which is a very weak peak. The FT-IR spectra for CdCuS sample is shown in figure 3(a) and figure 3(b).

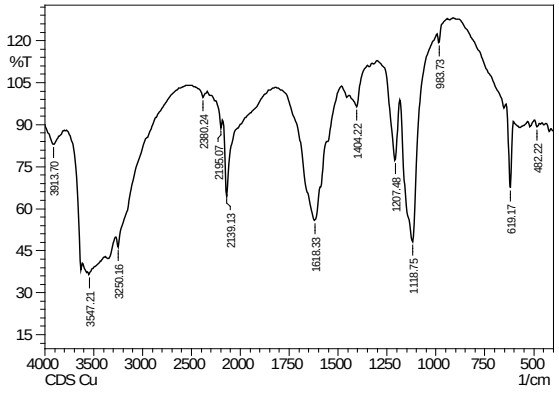

Figure 3(a): FTIR spectra for CdS: Cu sample I.

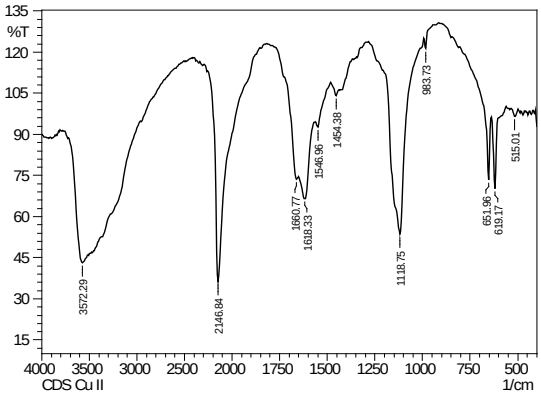

Figure 3(b): FTIR spectra for CdS: Cu sample II.

4.0 CONCLUSION

The investigations have shown that synthesis of CdS:Cu nanoparticles using cost effective chemical route.The sharp absorption edge in UV revealed better applications of CdS in luminescence devices.

References:

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