

SYNTHESIS AND CHARACTERIZATION OF CU DOPED CDS NANOPARTICLES BY USING CO-PRECIPIATION METHOD

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Abstract : Semiconductor nanoparticles active in the visible region of the solar spectrum have received much attention due to their optical and electronic properties. Cu doped CdS nanoparticle were synthesized in aqueous solution by simple chemical co-precipitation method. Different molar percentage of Cu is doped in CdS nanoparticles during synthesis. The optical property of as synthesized Cu doped CdS nanoparticle were investigated by the UV-Vis spectroscopy in the range of 200- 900nm. The band gap of CdS:Cu nanoparticles was determined to be around 2.25 eV. X-ray diffraction measurements showed that the nanoparticles have the structure of cubic phase and average crystallite size of the particles was also calculated using Scherrer's formula.

Keywords: CDS:CU, CHEMICALSYNTHESIS, CO-PRECIPIATION, X-RAYDIFFRACTION, UV-Vis SPECTROSCOPY.

I. INTRODUCTION

Nanoparticles have attracted great interest in recent years because of their unique chemical, physical, optical, electrical properties which are different from those of either the bulk materials or single atom. Cadmium sulphide nanomaterial are most widely studied binary chalcogenide material belonging to the II-VI group. CdS material have been realized in the form of nanoparticles, nanowires, nanorods, nanobelts etc [1, 2]. However, due to the ease of preparation and versatile properties of nanoparticles most of the studies were focused on CdS nanoparticles. Here, in the present investigation we present the influence of Cu dopant concentration on the crystal structure and the optical properties of CdS:Cu nanoparticles synthesized by chemical co-precipitation method. Although many researchers have synthesized CdS:Cu nanoparticles, yet there is large scope in studying the doping effect on the optical properties of this material [4, 5]. In the present work, the effect of Cu doping on their structural and optical properties was studied.

II. RESEARCH METHODOLOGY

2.1 Experimental Work

Experimental

Materials

CdS:Cu have been prepared by chemical co-precipitation method. All the chemicals, cupric acetate ($\text{Cu}(\text{CH}_3\text{COOH})_2 \cdot 2\text{H}_2\text{O}$), cadmium chloride ($\text{CdCl}_2 \cdot 2\text{H}_2\text{O}$), thiourea ($\text{CH}_4\text{N}_2\text{S}$), NaOH, were analytical grade and were used further purification.

Experimental procedure

In a typical synthesis 0.1M $\text{CdCl}_2 \cdot 2\text{H}_2\text{O}$ was added in 50ml distilled water and stirred to obtain a clear solution. Cupric acetate was dissolved at the molar percentage of 0.5%, 1% and 2% for three separate reactions. In the next step, thiourea (0.1M) was dissolved in the same solution. Then 1M NaOH was prepared separately in 20ml distilled water. 20ml NaOH solution was added drop by drop in previous solution till pH reached greater than 11 and the whole solution was stirred for 1 hour. Then the solution was centrifuged at 2000-3500 rpm for half hour. The resultant semi-solid mass was washed 3 times with distilled water to remove the impurities and unreacted precursors. Then this semi-solid mass was taken in petry dish and dried in an oven at 80-100 °C for 2-3 hour to obtain yellow coloured powder.

Characterization

Structural properties of as synthesized powder samples were studied by X-ray diffraction technique. The samples were optically characterized by UV-Vis spectroscopy in the range of 200-900 nm after dispersing them in ethanol.

III. RESULTS AND DISCUSSIONS

Figure 3.1 shows the X-ray diffraction results of as synthesized Cu doped CdS nanoparticles. XRD measurements showed that the nanoparticles have the mixture cubic and hexagonal phases of Cu doped CdS matching with JCPDS card numbers JCPDS data card # 21-629 and JCPDS data card # 41-1049, respectively. The band gap of Cu:CdS nanoparticles has been determined from the UV-Visible spectroscopy graphs (Figure 1 and Figure 2). The band gap of Cu doped CdS nanoparticle after calculation was found to be 2.21 eV, 2.23 eV and 2.27 eV for 0.5%, 1% and 2% Cu doped CdS nanoparticles samples respectively.

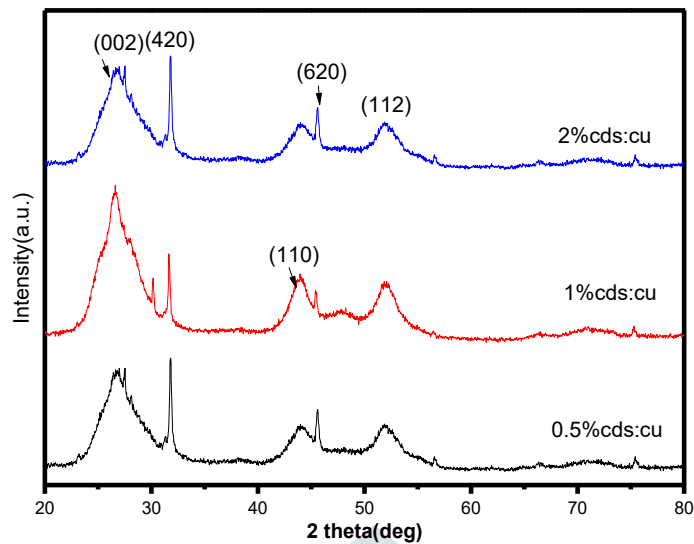


Figure 3.1- X-ray diffractograms of Cu doped CdS nanoparticles

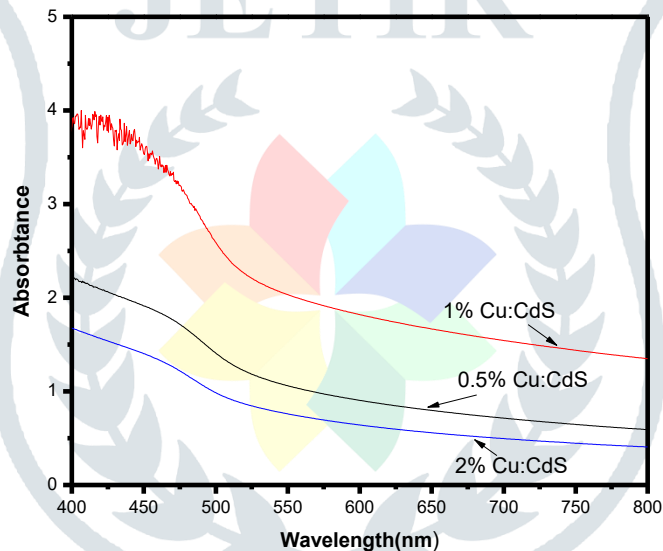


Figure 3.2- UV-visible spectra of Cu doped CdS nanoparticles

IV. CONCLUSIONS

Cu doped CdS nanoparticles have been prepared using coprecipitation technique. It can be concluded that as doping of Cu increases the band gap of nanoparticle increases.

V. ACKNOWLEDGMENT

We are thankful to the P.G.K. Mandal, Pune, and Dr. G. R. Pathade, Principal Haribhai V. Desai College, Pune for allowing us to carry out this work. We also thankful to Chemistry Department for providing us permission for using laboratory equipments.

VI. REFERENCES

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