Synthesis and Characterization Studies of CdS Nanoparticles

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Abstract – In the present work, a systematic study has been carried out to understand the synthesis, structural, surface morphological and optical properties of CdS nanoparticles. In this work, Cadmium Sulphide nanoparticle was successfully synthesized by sol-gel method at room temperatureusing cadmium nitrate and thiourea as the precursor solutions. The prepared nanoparticles were characterized by X-Ray Diffraction method (XRD), Scanning Electron Microscopy (SEM), Energy Dispersive X – ray Analysis (EDAX) and UV – Visible spectroscopy. The XRD analysis shows that the particles have crystallites with hexagonal structure along (1 0 1) plane. The grain size was found to be in the range 43.50nm. The SEM micrograph of CdS nanoparticles post annealed at 300°c reveals the uniform cloud like structure.The UV visible spectrum shows that the band gap of CdS nanoparticle is about 3.0eV.

Keywords: Sol - gel method; CdS nanoparticle; XRD; SEM.

1. INTRODUCTION

Semiconductor nanoparticles (quantum dots) have been investigated over the past years due to their specific optic, electronic and catalytic properties. These properties emerge from the high surface-to-volume ratio present in nanoparticles. Cadmium chalcogenides are well studied materials [1, 2] due to, among other interesting properties, their well-established relationship between the optical absorption and their size. Due to high stability, excellent physical, chemical and structural properties, availability, ease of preparation and handling, CdS nanomaterials can be exploited in various fields of life. In photonics, due to its photoconducting and electrical properties can be used in sensors, photodetectors, optical filters, and all optical switches[3–7]. It exhibits high photosensitivity and its band gap appears in the visible spectrum[8], enabling it to be useful for many commercial and potential applications in photovoltaics, as hetero-junction solar cells and thin film solar cells. In this work, cadmium sulfide nanoparticles were synthesized using sol-gel process; this method is not time consuming and can be developed at room temperature.

2. EXPERIMENTAL PROCEDURE

2.1 Synthesis

To prepare CdS nanoparticle, cadmium nitrate which was dissolved in 100 ml of distilled water and the solution was stirred for 30 min at room temperature.After 30 min stirring process, 2 ml of ammonia solution was introduced and then the solution was stirred for an hour at room temperature.The process was then followed by addition of thioureaprecursor into the solution.Soon after the introduction of thiourea the entire solution changed into deep yellow.

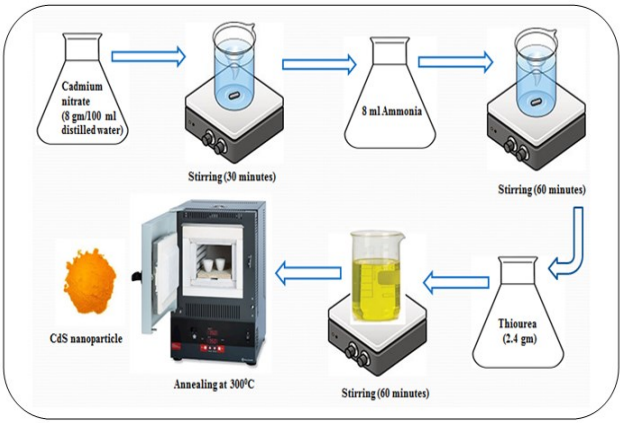

Figure 1: Mechanism used for the preparation of CdS nanoparticle

The particles are then collected in a petri dish and dried by keeping the material in a hot air oven for 3 hours with the temperature of 300°C.Then the free standing powder was collected and preserved in an air tight container. The simple mechanism to prepare CdS nanoparticle was shown in Figure 1.

3. RESULTS AND DISCUSSION

3.1 Structural Analysis

For the prepared CdS nanoparticles X – Ray diffraction (XRD) pattern was obtained using X'PERT PRO X – ray diffractometer, which was operated at 40 KV and 30 mA with