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Synthesis and Characterization of Cadmium selenide nanoparticles

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Abstract

In this paper we give the simple and less hazardous route for synthesis of CdSe nanoparticles. We are using co-prepitation method for synthesis of CdSe nanoparticles we are getting nanoparticles by doing calcination process at 400°C.The synthesized CdSe nanoparticles have been characterized by Optical Microscope and X-ray diffraction. The uniqueness of Hexagonal (Wurtzite) CdSe was revealed by the X-ray diffraction peaks.

Keywords

CdSe(cadmium selenide) nanoparticles, hexagonal, thioglycerol, XRD(X-ray differaction).

Introduction

"Nanotechnology related to design, characterisation, production and application of different structure, devices and systems by controlling the shape and size in the nanometre scale" [1].Nanotechnology is emerging branch because it can be applied in wide area, having verities of application.Nanotechnology is the scientific convergence of physics, biology, chemistry, materials science and engineering at nanoscale. As nanoparticles present in nanoscale they are having high surface to volume ratio, because of high surface to volume ratio they are showing good optical, electrical, chemical properties and good mechanical stability. Nanoparticles are very important and useful as they are in nano size acquired novel property as compared to bulk materials. For given functions by control at atomic and molecular level we are able to build up specific nanostructure and devices. Due to potential application in biomedical, optical and electronic of the nanoparticles they attract several researchers.

Cadmium selenide is an inorganic compound with the formula CdSe. That is classified as II-VIsemicondutor of the n-type. CdSe-derived nanoparticles with sizes below 10 nm exhibit a property known as quantum confinement. Quantum confinement results when the electrons in a material are confined to a very small volume. Quantum confinement is size dependent, meaning the properties of CdSe nanoparticles are tuneable based on their size.[2] Crystal structure of CdSe in three forms Wurtzite(hexagonal), sphalerite(cubic), rock salt(cubic).The sphalerite CdSe structure is unstable and converts to the wurtzite form upon moderate heating. The transition starts at about 130 °C, and at 700 °C it completes within a day. The rock-salt structure is only observed under high pressure.[3] . The CdSe nanoparticles are used in many applications like use in solar cell, thin films, photoresistors, light emitting diodes, biofluorescent tagging and so on. Cadmium selenide nanoparticles are synthesized by various techniques like Sol-gel method, Hydro-thermal method by several researchers. Now the present work has prepared the CdSe nanoparticles by co-precipitation method and to characterize the nanoparticles by Optical Microscope and XRD (X-ray diffraction). Different other methods was used to prepared CdSe nanoparticles but these convential methods usually produce large particles, irregular size and low specific surface area.

Methods and Materials

The starting materials used in co-precipitation method were Cadmium oxide (CdO), Selenium Dioxide (SeO_2), Ammonia (NH_3), Thioglycerol as a capping agent. In this work CdSe nanoparticles were prepared using co-precipitation method.

Experimental procedure

In this process CdSe nanoparticles was prepared by dissolving CdO and SeO_2 in 2:1 ratio. The solution was prepared by dissolving 0.66gm CdO and 1.1096gm SeO_2 in 10ml distilled water.
This solution was taken in a 100ml beaker and kept above the magnetic stirrer and allowed to stir for 2 hours at room temperature at 350- 400 RPM.

Then two drop of thioglycerol was added in the solution, thioglycerol act as capping agent, so that nanoparticles formed remain in nanoscale. Now Ammonia was slowly added to it using funnel drop by drop under constant stirring condition. Adding Ammonia till the PH reached to 11 and maintain on that PH only. Under constant stirring condition the whole process was carried out.

After adding Ammonia the mixture which was allowed to stir for 2 hours percipitate was formed. CdSe get settled at the bottom of the beaker. Then the percipitate separate carefully from beaker. The whole precipitate was washed thoroughly with help of double distilled water, to make precipitate free from impurities or foreign elements.

The resulting precipitate was centrifuge in centrifugation machine for 5 min. Put the sample in hot air oven at 50°C for 3 hours for complete drying .Now the sample of CdSe was dried, grind the sample by mortar. The CdSe nanoparticles were obtained via controlled calcination process using muffle furnance for 15 hours at 400°C. we will obtain very fine nanoparticles if we increase calcination time.

Figure 1 CdSe nanoparticles

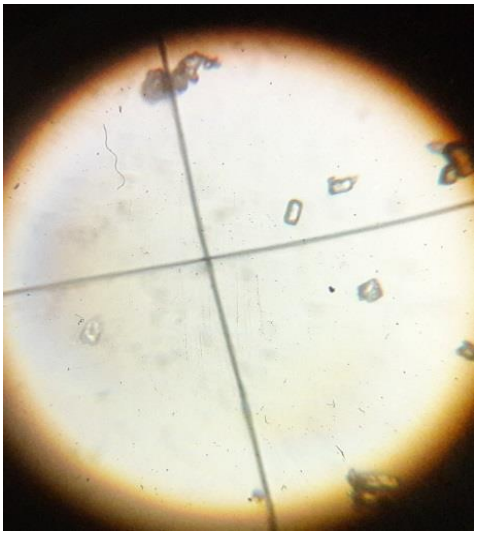

Figure2 CdSe nanoparticles shown in Optical Microscope

Characterization

CdSe nanoparticles were characterized by Optical Microscope and X-ray diffraction

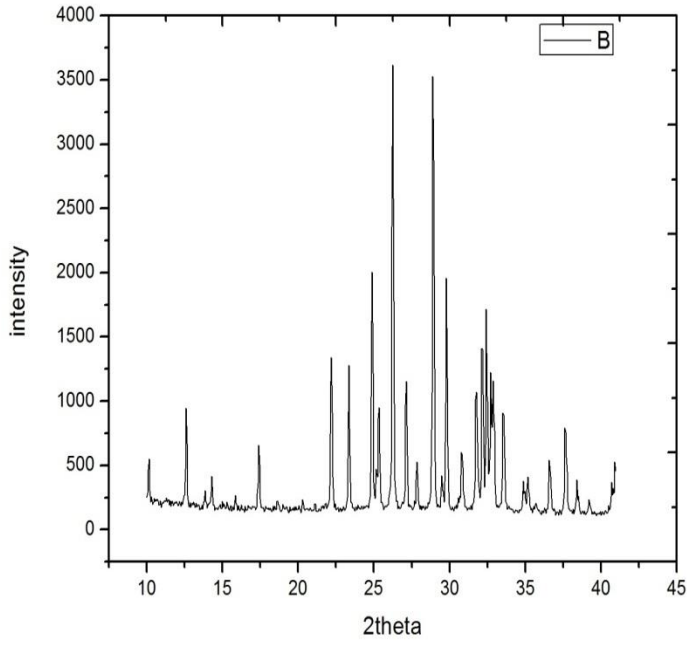

Figure3 Powder X-ray diffraction of CdSe nanoparticles.

Result and Discussion

Synthesized CdSe sampleX-ray diffraction (XRD) pattern shown in Figure 1.The position of several differaction peak shown in XRD data analysis (Table 1) are match well with the standard powder diffraction data (a = 4.299 Å and c = 7.010 Å). Due to diffraction form the several peaks of CdSe nanoparticles have been obtained (002), (101), (102), (103), (202), (211), (114) planes of Hexagonal (Wurtzite) CdSe which are very good similarity with hexagonal (P6mc) structure Joint Committee on Powder Diffraction Standards) JCPDS pdf # 77.2307 (a = 4.299 Å and c = 7.010 Å).[4] Due to presence of other phase in the sample some additional peaks are also observed in the XRD pattern. Under the present conditions pure and single phase CdSe has not been successfully obtained.[5]

Crystalline Phase	2θ (observed)	2θ (reference)
CdSe	25.3361 (002)	25.391 (002)
CdSe	27.1345 (101)	27.097 (101)
CdSe	35.1772 (102)	35.136 (102)
CdSe	45.8176 (103)	45.810 (103)
CdSe	55.8585 (202)	55.879 (202)
CdSe	67.8477 (211)	67.880 (211)
CdSe	69.0965 (114)	69.099 (114)

Table1 2θ (observed) and 2θ (reference)value of CdSe nanoparticles.

Crystalline Phase	(Å) (observed)	Lattice parameters (Å)[8]
	a =4.2914 *c* =7.0014	*a* =4.299 *c* =7.010
CdSe	-	-
CdSe	-	-
CdSe	-	-
CdSe	-	-
CdSe	-	-
CdSe	-	-

Table2 Reference and observed lattice parameters of CdSe nanoparticles.

Reference

1. X.G. Peng, L. Manna, W.D. Yang, J. Wickham, E. Scher, A. Kadavanich, A.P. Alivisatos, Nature 404, 59, 2000.
2. Nanotechnology Structures - Quantum Confinement.
3. Lev Isaakovich Berger, Semiconductor materials, CRC Press. 202,1996.
4. Pdf 77.2307 JCPDS:- Stevenson. A.W., Barneaz, Actacrystallogr.,Sec.B: Structure science 40, 530,1984.
5. Rahul Jain &Vinay Kumar Verma, "Synthesis and Characterization of CdSe Nano-particles from Novel Cadmium Complex of Selenolate Precursor", Phosphorus, Sulfur, and Silicon,pp. 1749–1754, 2015.