University Research Resource Journal
ISSN : 2581-3730
JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR
Volume 6, Issue 1 (January to March, 2023)

Green Synthesis and Characterization of CdSe Nanoparticles

JV'n Deepika1, JV'n Nayan Mishra2*
1 Research Scholar, 2 Assistant Professor
Department of Science and Technology, Faculty of Education and Methodology,
Jayoti Vidyapeeth Women's University, Jaipur Rajasthan.
*Corresponding Author Email :- dyadav969436@gmail.com

Acknowledgement to Idea Originator :

I would like to express my sincere gratitude to Advisor & CEO JV'n Mr. Vedant Garg, and Registrar JV'n Dr. Hema Bafila Jayoti Vidyapeeth Women's University, Jaipur. This research report has been prepared by JV'n Deepika of Jayoti Vidyapeeth Women's University, Jaipur (Rajasthan). I would like to thank the mentor for the support, suggestions and insights, all of which have contributed to this research: JV'n Dr. Nayan Mishra, Department of Physics, Jayoti Vidyapeeth Women's University, Jaipur (Rajasthan).

Abstract :

In this work, I am giving the simple and less hazardous route for Synthesis of CdSe. Biosynthesis of highly effective QDs has been investigated. The crystallographic properties of CdSe system were investigated by XRD pattern. The Optical Characterization indicates narrow peak width with band gap ranging in between 2.30eV to 2.56eV. Quantum confinement effect was shown by all synthesized CdSe nano particles. Due to Quantum confinement effect, band gap of thin film increases as compare to bulk. Self assemble CdSe Semiconductor nanocrystals vary in colour from green-yellow to orange-red and luminescence from blue to yellow , where shorter wavelength, higher energy, electronic transition corresponds to smaller grain sizes. Aloevera plant extract was used as caping agent. The mechanism of formation of CdSe nanoparticles were investigated on the basis of experimental results.

Keywords : XRD Pattern, QDs, Quantum confinement, Optical Characterization.

Introduction :

Over the past several decades Nanoparticles have attracted enormous attention due to their unique size dependent physical and optical properties. The major interest in II-IV group materials has been mainly due to their tunable optical properties which can be altered by controlling size, morphology and composition. Inappropriate chemical passivation leads to compromise in quantum dots quality and which further leads to poor technological orientation. The two main operators cause the properties of the material at nanoscale being unique : Quantum effect and Surface. On the surface of QDs there are some voids, which are responsible for creating traps for charge carriers and excitons, due to which reduction of Quantum Yield can be seen. To avoid these traps and to improve Quantum Yield of QDs, perfect passivation is crucial. Among all the semiconductor nanocrystals quantum dots colloidal CdSe are of great interest for both fundamental studies and technological applications due to their interesting size dependent properties.

University Research Resource Journal
ISSN : 2581-3730
JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR
Volume 6, Issue 1 (January to March, 2023)

Solar cell, Light emitting diode, gas sensors, single electron transistor are the most important application of CdSe semiconductors. CdSe quantum dots (QDs) have attracted interest in the fields of optoelectronics and biomedical imaging due to their wide absorption cross sections and narrow emission bands. . CdSe NPs exist in three structural forms : a haxagonal wurtziete structure, a cubic zinc blende (sphalirite) structure and the rock salt. Bulk CdSe has the haxagonal structure. Cubic exist in thin layer of CdSe. In this work, CdSe Nanocrystals are prepared by chemical methods of template synthesis or controlled precipitation in solution using surfactants as stabilizers.

Materials & Methods :

Self-assembled semiconductor CdSe crystals were synthesized from Cd and Se precursor. Selenium precursor was prepared from a stock solution of sodium sulphite (Na2SO3). For this I took 1g of Selenium metallic powder and 3g of Na2SO3 and mixed them at 80°C for 24 hours to form a clear solution. CdSe was prepared by cadmium nitrate [Cd(NO3)2] and selenium solution as precursor. For preparation of CdSe crystal, I took (o.75g) cadmium nitrate [Cd(NO3)2] at 27°C and then after setting the 9.8 pH, I added 1mL selenium solution by further added 2-drops of Hydrazine Hydrate. After that I added 5mL Aloevera plant extract as capping agent. After drying the solution I got CdSe nanocrystals.

To examine the size distribution of CdSe the thin grazing angle attachment of XRD 6000 (Shimadzu, Japan), X-ray diffraction pattern were recorded by using CuKa X-rays at an angle of incidence of 0.5°. A solar slit placed before the scintillation detector in the right goniometer geometry and the beam divergence was restricted with the help of a 0.15nm slit on the source side. For the scan range of 20°-60° which was covered in 1°/minute had drive axis 2? with step size of 0.02°±0.003A° was the instrument propagation error in the d-value. The data obtained from the analysis of experimental results of X-ray diffraction was also affected due to instrument related broadening and strain includes effects. The optical absorption of the nanocrystals was studied by using a dual beam UV-vis spectrometer (UVPC 1601, shimadzu) with spectral bandwidth of 2nm.

Results & Discussion :

Structural Characterization

The x-ray pattern for CdSe QDs having different particle size is represented in figure 1. Figure 1 also represents the broadness of diffraction peaks of samples increase gradually with decrease in size of particle. Three different peaks are observed in all five samples close to 2? value of 49.9°, 42.03°, 25.3° corresponding to (311), (220), (111) crystal lattice of cadmium selenide (CdSe) by varying the molarities of marcaptoethanol in the reaction matrix, the grain size of CdSe can be turned around 6.5 ± 1nm. Since the smaller size nanocrystal can reduce excess free energy by changing its lattice structure, so the value of lattice parameters varies from standard with smaller grain size. The information obtained from XRD and Rietveld refinement given in the table1 A & B

S.N.	Sample Name	Grain Size (nm)	2θ (Degree)	FWHM	d-values (Å) Obsr.	Miller Plane (hkl)	Lattice paramete A°	Phase assignment
1	CdSe nano	~6.5	25.3	1.560	3.446	(111)	6.2	(Cubic)
			42.03	1.282	2.134	(220)		(Cubic)
			49.93	1.348	1.827	(311)		(Cubic)

University Research Resource Journal
ISSN : 2581-3730
JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR
Volume 6, Issue 1 (January to March, 2023)

Table-1

A. XRD peak positions for nano CdSe sample

B. Rietveld analysis table for XRD patterns.

Samples	Phase assign	Chi2. Fact.	G. of Fitting	Spacer group	Refine parameter	Lattic Para. Å	Size nm	d-Val. Å
CdSe nano	Cubic	1.1	1.1	F -43m	14	6.134	2.1	3.55

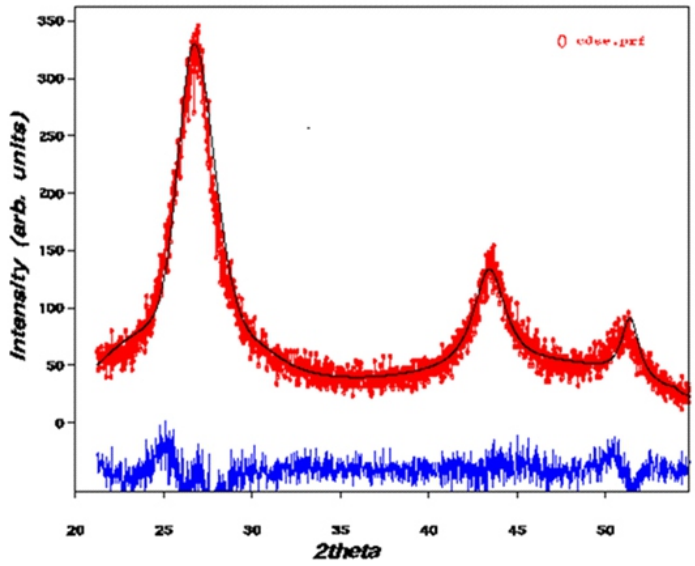

Figure-1 X-Ray Diffraction Pattern of CdSe nanocrystals

We employed the Rietveld-refinement (fullprof) analysis for the accurate particle size distribution and phase analysis and for that the diffraction peaks in x-ray diffraction pattern of samples are broadened. Figure 1 is the result of bulk CdSe by using simplest mathematical model. It is clear from figure 1 that all the peaks reproduce well both in shape and intensity. The aim of this experiment was to obtain structural data and phase analysis.

Optical Characterization

For nano CdSe sample, the fundamental absorption edge is 590 nm,. The binding energy increase on decreasing particle size due to strong overlap between holes and electrons. This increase confinement energy of hole and electron is responsible for excitonic absorption in nanoparticles at room temperature. Steady increase in spectral absorption peak values with elapsed time duration, referred as red shift, which indicates the growth in quantum dots.

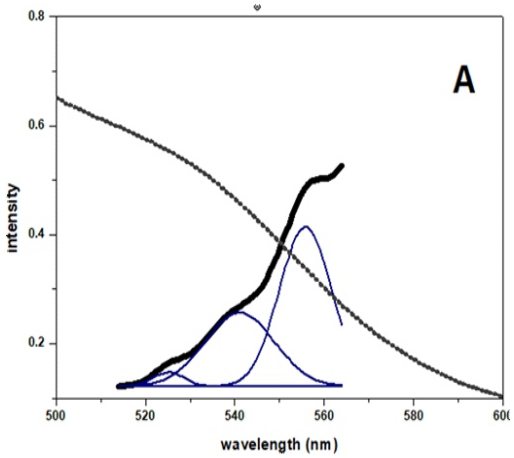

Figure 2 Optical Absorption & PLE spectroscopy of CdSe nanocrystals.

University Research Resource Journal
ISSN : 2581-3730
JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR
Volume 6, Issue 1 (January to March, 2023)

Conclusion :

In summary, CdSe QDs were prepared through chemical route. I have successfully designed the synthesis procedure of CdSe quantum dots with a caping agent. In future, this study of CdSe quantum dots helps in biological applications. The knowledge of their potential effects should be prioritised as the globe quickly adapts to this new technology wave. To prevent nanoparticles from emerging as the new threat of the twenty-first century, this is crucial. The identification of its hazards may be necessary for this new technology to be long-term sustainable. Particle size of CdSe nanocrystals was around 10 nm.

Reference :

1. D. Kaushik, M. Sharma, R. R. Singh, D. K. Gupta and R. K. Pandey, Mater. Lett. 60 2994 (2006).
2. B. O. Dabbousi, J. Rodriguez-Viejo, F. V. Mikulec, J. R. Heine, H. Mattoussi, R. Ober, K. F. Jensen, M. Bawendi, J. Phys. Chem. B., 101 9463 (1997).
3. P X.eng, M. C. Schlamp, A.Kadavanich, A. P.Alivisatos, J. Am. Chem. Soc 119 7019 (1997).
4. Hines M. A. and P.Guyot. Sionnest, J. Phy. Chem. 100 468 (1996).
5. A. R.Kortan, R. Hull, R. L. Opila, M. G. Bawendi, M. L. Steigerwald, P. J. Carroll and L. E. Brus, J. Am. Chem. Soc 112 1327A (1990)
6. M. Sharma, D. Gupta, D. Kaushik, A. B. Sharma, and R. K. Pandey, J. Nanosci. Nanotech., 8 1 (2008).
7. R. B. Little, M. A. El-Sayed, G. W. Bryant and S.Burke, J. Chem. Phys., 114 (4) 1813 (2001).
8. J.Rockenberger, L.Troger, A. Rogach, M.Tischer, M. Grundmann, A. Eychmyeller and H.Weller, J. Chem. Phys., 108 7807 (1998).