

# Synthesis, Characterization & Potential Medico-applications of Cadmium Based Nanocrystals

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## Abstract

**Background:** Homoeopathy is a system of medicine which works on the principle of "Similia Similibus Curentur" (Let Like be Treated by Like). This system of holistic healing was founded by Dr. C.F. Samuel Hahnemann a German physician and cherished in the minds of Dr. Herring, Dr. Kent, Dr. Boeninghausen, Dr. Farrington and many others to attain the present status. Advanced homoeopathy is based on quantum confinement of material in serial dilution process. Homeopathic medicines are prepared from animals, plants as well as minerals with the process of potentisation and dynamization.

**Aim:** To analyse the mechanism of conversion of Sulphide of Cadmium into quantum dot & its applicability in homeopathy.

**Results:** The optical absorption property of the CdS nanoparticles studied using UV-Vis-NIR spectrophotometer is found in the range of 300-100 nm. CdS nanoparticles show absorption peak at 462 nm. The average particle size of the CdS nanoparticles calculated using Scherer formula is 20 nm.

**Conclusion:** CdS showed excellent emission properties make them as an outstanding Using material for their practical applications in medical devices, fluorescence drug particle and other medical applications. The great advantages of using homoeo-nanoparticles.

**Keywords:** Nanotechnology • Homoeopathy • SEM • Particle Size • Nanoparticle tracking analysis

## Introduction

II-VI group nanocrystals have aroused great scientific and technological attention due to their possible application as biological active materials [1], quantum dot lasers [2], luminescent devices [3], photo-detectors [4], chemical sensors [5] etc. Cd based homeo-nanomedicine refer to those materials whose dimension lie in the nanometre range. Their electronic state lies between the bulk materials and molecular. Nanocrystalline materials possess distinct behaviour from bulk material because of the large surface to volume ratio & confinement of electrons within a low dimension leads to changes in physical and electronic properties of the material.

In the recent years, II-VI nanocrystalline semiconductor materials have been under intense research due to their exciting unique properties, which are absent in bulk materials since nanoparticles have a wide number of surface atoms than that of bulk [6-9] Cadmium chalcogenides have been under intense investigation for their size dependent optical absorption properties and core/shell nanoparticles of CdS showed excellent emission properties makes them as an outstanding material for their practical applications in optoelectronics and photonics [10-12].

This remedy is indicated mostly in cases that present symptoms of severe gastritis or gastro-enteritis. Primarily, it is the mucus membrane of the

stomach that is irritated and they react with forceful vomiting. The vomit may be brownish and even black in color and may look like coffee grounds. This is because the slow oozing of blood from the mucosa of the stomach and the blood stays there for sometimes before it is ejected. The cases that need Cadmium Sulphate give the impression that something really serious is going on not only because of the intensity of the pains but primarily because of the type and effect of vomiting. The pt. is prostrated from the exertion of vomiting, wants to lie down quietly and doesn't want any interference.

The nausea is so excessive that vomiting is excited even by something nearly touching the lips. CdS is helpful in diseases like apoplexy, boils, chilblains, cholera infantum, corneal opacity, eye disorders, facial paralysis, indigestion, meningitis, nasal polyps, ozaena, and yellow fever [13]. Cadmium is found in nature in intimate association with zinc which it nearly resembles in action, but cadmium acts more powerfully.

Homoeopathy means treating disease with remedies on the basis of doctrine of signature prescribed in simple, small doses. Homoeopathic medicines are prepared by the process of potentization which negate the toxic effects of crude drug substance and boost its dynamic and curative property which include trituration and succession [14]. Homoeopathic dilutions are made by the process in which substance is diluted with alcohol or distilled water and then shaken vigorously and called as dynamization. Potencies are usually labelled with alphabets and numbers like, 1M, 30C, 200C, 50 LM. As per the conventional medicine, all homoeopathic medicines are placebo which gives only psychological relief to patients [15]. With advancement of nanoscience and nanotechnology new research paths were opened and aimed to investigate the possible nanoparticles present in homeopathic medicines.

## Materials and Methods

In this homeopathic medicine or nanomedicine controlled chemical reaction between appropriate precursors in an aqueous or non-aqueous medium is exploited. Precipitation of the nano particles may occur via homo or heterogeneous nucleation as the ionic product exceeds the solubility product. Once the nuclei are formed, growth may proceed by diffusion. The reaction

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parameters such as reactant activity, temperature, pH and the presence of catalyst can be controlled to obtain a desired growth rate and particle size [13,16].

## Experimental techniques

X-ray diffraction patterns were recorded in the thin film grazing angle mode of XRD6000 (SHIMADZU, JAPAN) powder diffractometer, using  $\text{CuK}\alpha$  line. Beam divergence was restricted with the help of 0.15 mm slit on the source side. Drive axis was  $2\theta$  for scan range between  $20^\circ$ – $60^\circ$  covered in  $10^\circ/\text{minute}$  with step size of  $0.020^\circ$ . The instrument propagation error in the d-value was  $\pm 0.003 \text{ \AA}$ .

UV-1601 spectrophotometer was used to measure the extent to which the samples transmit light of different wavelengths. The instrument automatically records a graph of absorbance vs. wavelength within spectral range of 190 to 1100 nm. SEM characterization was carried out using Techni 20G2 Transmission Electron Microscope operated at 200 kV. Applying axial tilt and selecting a small portion of the brightest diffraction ring acquired the bright and dark field images [17-19].

## Results and Discussion

Cadmium sulfide exhibits a wurzite structure (hexagonal symmetry) or rocksalt structure (cubic symmetry). However, Cadmium sulfide crystals most commonly stabilize with the wurzite structure (hexagonal symmetry), whereas the crystals exhibit the rock salt phase (cubic symmetry) at high pressure.

The growth of Cadmium sulfide (cubic symmetry) quantum dots was monitored *in situ* using absorption and luminescence spectroscopy. The optical absorption spectra as well as photo luminescence spectra of Cadmium sulfide sample grown without capping agent and following homeopathic medicine were studied and results have shown in insets of Figure 1.

The Cd based homeopathic nanocrystal sample showed continuous red shift in the absorption onset with dilutions. On the other hand, the potentized samples exhibited an initial red shift till 30X dilution of growth and beyond which the onset remained practically invariant. Our observations evidently suggest that the particle size decreases continuously with dilution in the homeopathic preparation method.

The red dotted curve in Figure 2 represents the observed X-Ray diffraction pattern from the Homeopathic Cd based nanocrystal sample. All the observed diffraction peaks could be readily indexed as cubic structure of Cadmium sulfide. A systematic increase in the broadening of the diffraction peak with increasing dilution of particles indicated a concomitant decrease in particle size.

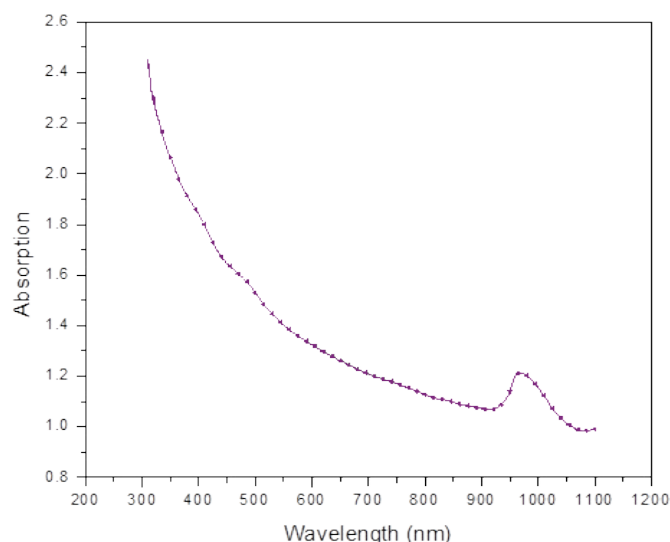


Figure 1. Optical absorption of cadmium sulfide nanocrystals.

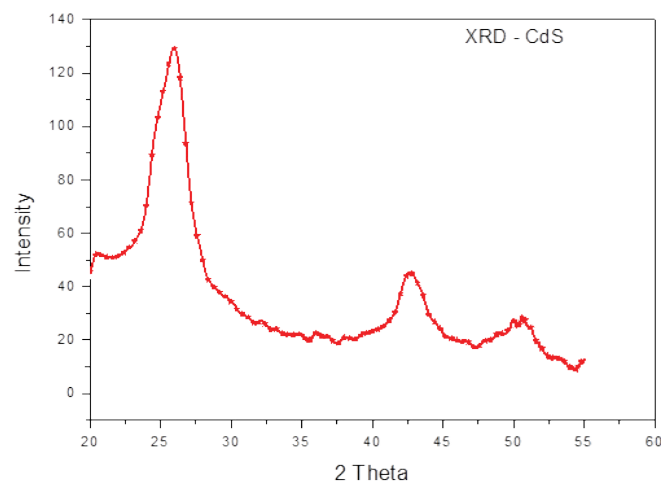


Figure 2. XRD of cadmium sulfide nanocrystals.

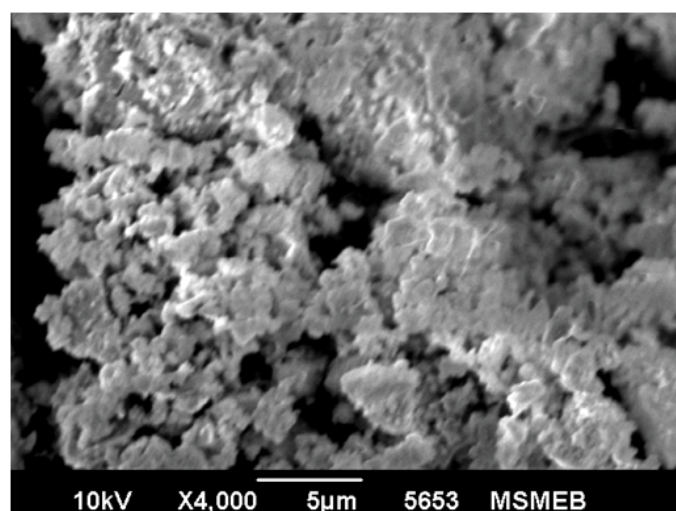


Figure 3. SEM micrographs of nanoparticles of cadmium sulfide.

Detailed surface morphological characterization and particle size analysis of homeopathic cadmium sulfide nanoparticles samples were also performed using scanning electron microscopy. Figure 3 shows collection of SEM image of as homeopathically synthesised Cadmium sulfide Nanocrystals sample. The SEM image revealed a reasonable homogeneous average cluster size of  $\sim 4 \mu\text{m}$  ( $\pm 0.56 \mu\text{m}$ ). The corresponding size distribution has been shown as the histogram. The average particle size obtained from the histogram is in good agreement with the results obtained from broadening of X-ray diffraction peak.

## Conclusion

Recently advanced empirical studies demonstrate the presence of Cd and original source of nanoparticles in the ultra-high dilutions of several advanced homeopathic medicines. Recent research studies have also demonstrated the efficacy of the photo therapy in inducing the ablation of the cancer cells through laser activated bio-nanoparticle photosensitizers.

The resultant research findings on what nano-homeopathic remedies are (highly reactive nanoparticles) and how they interact with the complex living systems could significantly advance the field as a valuable form of homeopathic Nano medicine. The homeopathic nano structures were also characterized using XRD, SEM and UV-vis. The results revealed that nano-homeopathic remedies are homogeneous, spherical in shape,  $\sim 90 \pm 20 \text{ nm}$  in size & good opto-electronic activity for treatment.

## Conflict of Interest

No potential conflict of interest was reported by the authors.

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