ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Synthesis and Characterization of CDS Nanoparticles from *Mimosa Pudica* Plant Extract.

Shaik Raziya [1], Bokka Durga[1], Rajamahanti Santhoshi Ganesh[1], Boddeti Govind[2], and Nowduri Annapurna[1]*.

[1]Department of Engineering Chemistry, AUCE(A), Andhra University, Visakhapatnam-530 003, Andhra Pradesh, India.
[2]Department of HSS, Raghu Institute of Technology, Visakhapatnam-530 003, Andhra Pradesh, India.

ABSTRACT

Cadmium sulfide is one of the most promising materials for solar cells and of great interest for their practical applications in electronics and photonics. The physical and chemical properties of these nanoparticles are found to be size dependent. The present work describes preparation of CdS nanoparticles using Mimosa pudica plant extract as a stabilizing and capping agent which assisted the formation of nanoparticles. The synthesiszed Nanoparticles were characterized using UV–VIS spectrophotometry, Transmission electron microscopy , Energy Dispersive X- Ray Spectroscopy , X- Ray Diffraction (XRD) Spectrometer and Fourier Transform Infra- Red Spectroscopy (FTIR) analysis. The crystalline sizes of cadmium sulfide crystals are estimated from the peaks of XRD. The optical properties of the samples are estimated by UV Visible spectroscopy. The absorption spectrum is studied by FTIR. Scanning Electron Microscopy (SEM) is used to carry out the structural characterization of the nanoparticles. Transmission electron microscopy followed by selected area electron diffraction pattern analysis indicated the formation of polydispersed, crystalline, CdS. EDS analysis confirmed the presence of Cd and S in nanosphere.

Keywords: Mimosa Pudica , CdS Nanoparticles, Biosynthesis , SEM , TEM, Microbial activity.

Corresponding author

ISSN: 0975-8585

INTRODUCTION

Nanoparticles are ultrafine particles with their size ranging from 1-100 nm. Nanoparticles have attracted considerable attention due to their unusual and fascinating properties, with various applications, over their bulk counterparts [1,2]. Nanotechnology is mainly concerned with synthesis of nanoparticles of variable sizes, shapes, chemical compositions and controlled dispersity and their potential use for human benefits. The synthesis of metal nanoparticles have been widely discussed in the literature due to small sizes, larger surface area and unique physical and chemical properties which have many potential applications [3-5]. Among the semiconductor nanomaterials CdS, ZnS, CdSe, ZnSe etc are proved to be versatile materials because of their applications in optoelectronic devices due to large variation in the band gap as a function of particle size. Cadmium Sulfide (CdS) is one of the most important II-VI group elements possessing size tunable optical transitions in solar cell, optoelectronics and wider range of applications [6,7]. Semiconductor nanoparticles such as PbS and CdS have attracted considerable due to their unique properties from that of their bulk materials [8]. Cadmium Sulfide (CdS) is traditionally used as yellow pigment called ' aurora yellow '. The search for cadmium for industrial applications revealed that it occurs as Sulfide in the grenockite mineral, a companion to Sphalerite (ZnS). CdS exhibits many remarkable characteristics including good thermal, mechanical and size- dependent optical properties, which has potential applications in lasers, light - emitting diodes and optical devices (Ji et al 2006 , Karunakaran and Senthivelam 2005). Cadmium Sulfide is photo chemically active and photosensitize biochemical oxidation- reduction reactions. CdS is one of the most well-known Visible light- driven semiconductors due to its narrow band gap. In literature , the CdS nanoparticles are synthesized from a) Physical evaporation , b) Hydrothermal synthesis , c) Electrodeposition , d) Physical Vapor Deposition (PVD), e) Pulsed Laser Deposition ,f) Laser Ablation Method , g) Solvothermal Method, h) Template Synthesize and many other methods so far reported [9-16].

Various physical, chemical and biological methods have been employed to synthesize nanomaterials. Green synthesis provides advancement over chemical and physical method as it is cost effective , environment friendly, easily scaled up for large scale synthesis and in this method there is no need to use high pressure , energy , temperature and toxic chemicals. The biological methods for the synthesis of nanomaterials include the extract from plant , bacterial, fungal species , and so forth. The synthesis of nanoparticle using various plants and their extracts can be favorable over other biological synthesis methods which involves complex procedures of maintaining microbial cultures and hence plant mediated biologically synthesis is hiking importance due to its simplicity and eco- friendliness .

M. Pudica is a medicinal herbal plant. It belongs to Fabaceae family. It is a creeping annual or perennial herb and as the compound leaves fold inward and droop when touched and re-opens within minutes later.

The M. Pudica has grabbed the attention of researchers worldwide for its pharmacological activities such as anti- diabetic, anti- toxin, anti- oxidant and wound healing activity. In view of its medicinal importance and lack of literature reports on the synthesis of cadmium silfide nanoparticles using mimosa pudica plant extract, an attempt was made to synthesis and characterize cds nanoparticles using mimosa pudica plant extract as stabilizing or capping agent.

MATERIALS AND METHODS

All chemicals were of analytical grade and purchased from Merck (India) and were used without further purification. The culture media were purchased from Hi- media (India), De-ionized water was employed for preparing all the solutions and regents.

2MLH Magnetic stirrer REMI, X- Ray Diffraction (XRDC) Spectrometer - Make Pan analytical (Model No : X'PERT PRO), Scanning Electron Microscopy (SEM), JEOL- JSM (Model No :66iOLV), UV- Visible Spectrophotometer UV- Shimadzu (Model No: UV 2450 Double Beam), Energy Dispersive X- Ray Spectroscopy (EDS)(Oxford Institute), Transmission Electron Microscopy (TEM).

ISSN: 0975-8585

EXPERIMENTAL:

Preparation of Mimosa Pudica Extract:

100 grams of dried plant material was washed several times with de-ionized water to remove all the diet and soil. The material was dried and chopped into small pieces, crushed and powdered using mechanical grinder. 10 g of plant powder was weighed ; 150 ml of double distilled water ; 10 ml of solvent was added to a 250ml beaker and boiled until the volume reduces to half. The extract was filtered using Whatman No .1 filter paper and supernatant was collected and stored for further use.

Cadmium Sulfide Nanoparticles Synthesis :

5ml of M. Pudica extract was added into 50 ml Cadmium Chloride (0.1 M) solution. Sodium Sulfide (50ml, 0.1M) dissolved in de-ionized water was added drop wise into the solution of Cadmium Chloride kept under magnetic stirring. The contents was later on placed on to a rotatory orbital shaker operating at 200rpm, 30 ^{0} C for 12 hours in dark solution. The formation of the particle was monitored by sampling an aliquot (3ml) of the mixture after 12 hours, followed by measurement of the UV- Vis spectra using a spectrophotometer. In order to find the absorption maximum optical density of the content from wavelength 250- 700 nm.

RESULTS AND DISCUSSION

UV - Visible Spectral Studies :

The visual study of CdS Nanoparticles production from the M. Pudica plant was confirmed by UV-Shimadzu Model No: 2450 Double Beam Spectrophotometer by recording the absorbance from 250- 700 nm. The color change from light orange to thick yellow is observed and a typical absorption peak is observed at 379.0nm as shown in fig 1.

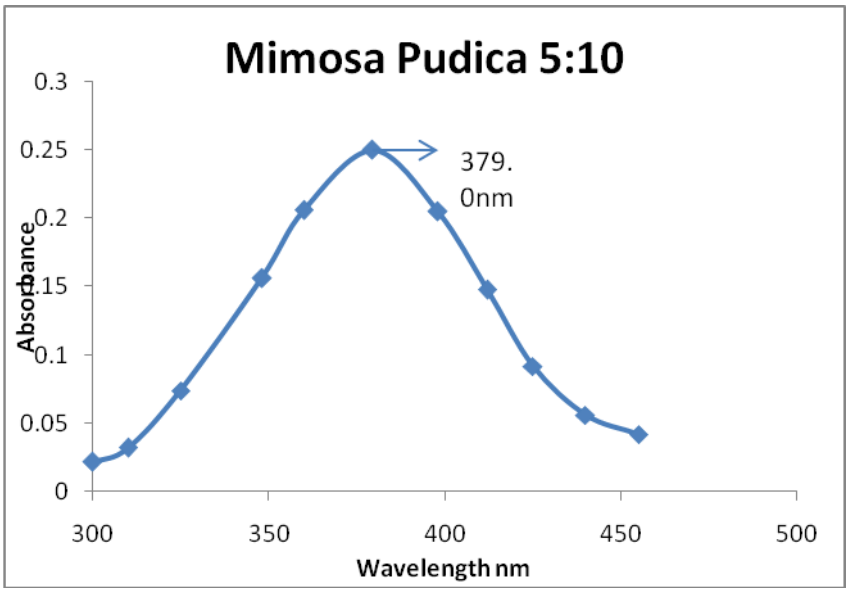

Figure- 1

X- Ray Diffraction (XRD) Spectrometer:

The crystalline nature of CdS nanoparticles was confirmed by the analysis of XRD pattern as shown in fig 2. The XRD spectrum showed seven distinct diffraction peaks at 11.527, 24.783, 26.860, 44.120, 51.774, 52.193, 72.544. the average crystallite size calculated using Scherrer formula from the highest peak of 26. 860 is found to be 5. 66829nm.

ISSN: 0975-8585

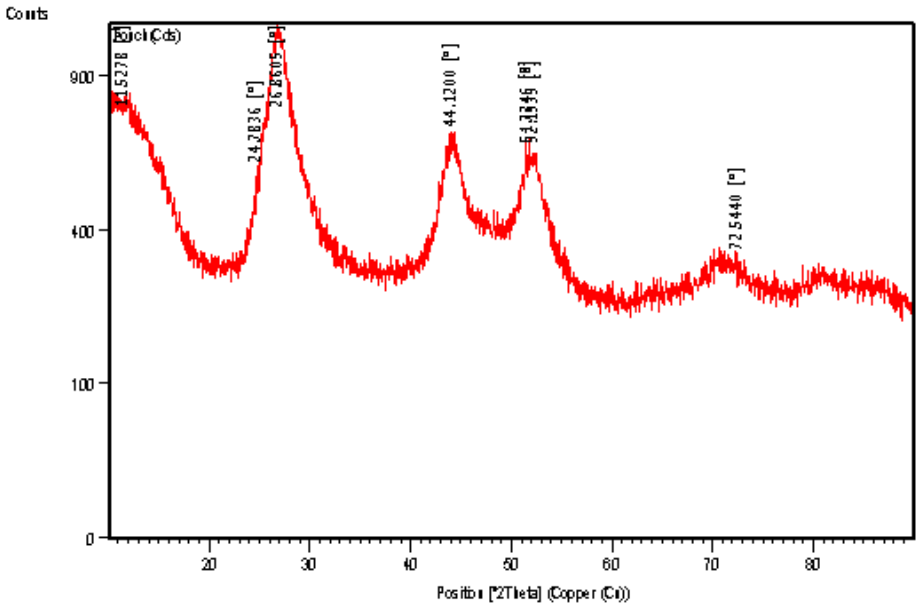

Figure-2

Scanning Electron Microscopy (SEM):

The figure depicts the SEM images obtained from drop coated films of CdS nanoparticles synthesized from 5 ml of sample on the grid , extra solution was removed using a blotting paper and then the film on the SEM grid were allowed to dry by putting a mercury lamp for 5 min. It is clear that the particles are crystalline in nature as shown in fig 3.

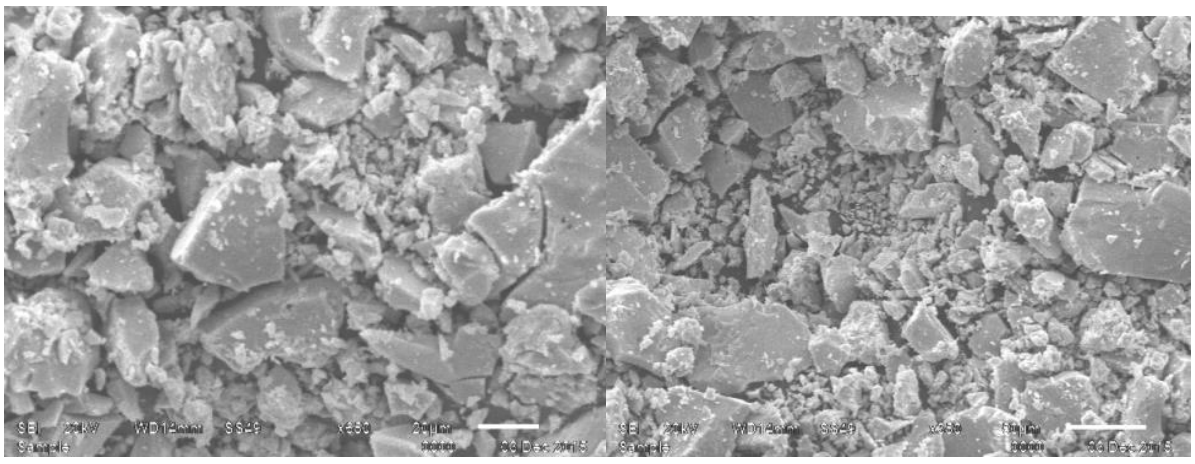

Figure- 3

Energy Dispersive X- Ray Spectroscopy :

Further analysis of the CdS particles by Energy Dispersive Spectroscopy confirmed that the presence of signal characteristics of elemental Cd and S. Other peaks in the figure 4 corresponds to Carbon, Oxygen, Sulphur were due to sputter coating of glass substrate on the EDS stage and were not considered in elemental analysis of Cd and S fig 4.

ISSN: 0975-8585

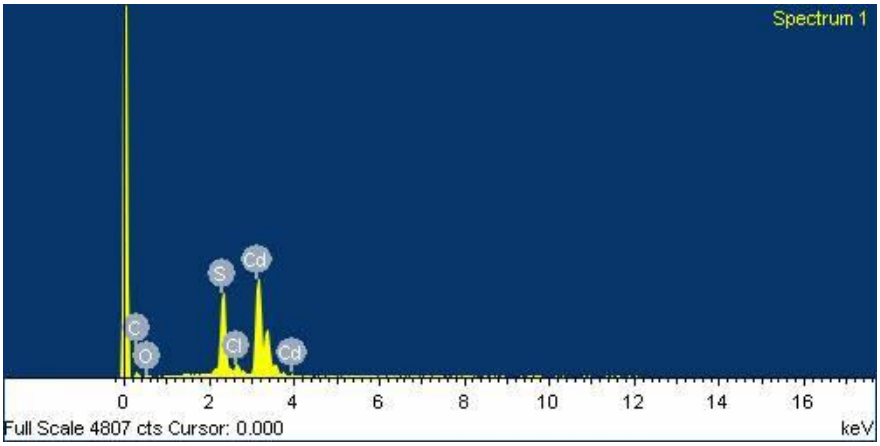

Figure- 4

Transmission Electron Microscope (TEM):

TEM was performed to elucidate the morphology as well as size of the biosynthesized CdS nanoparticles on a JEOL voltage at 80 KV. Colloidal solution CdS nanoparticles , in double distilled water , was ultrasonicated for 15 min and then coated onto ultraclean carbon coated copper grid for analysis . It is clear from the TEM image in figure that the particle shape is spherical, and the bar marker in the figure 5 is 20nm.

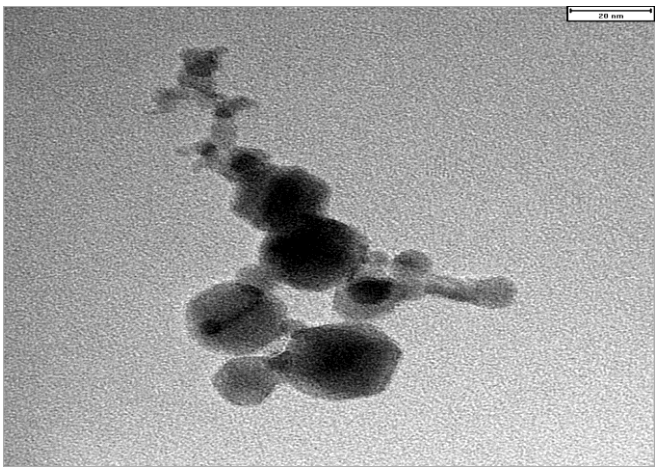

Figure- 5

Fourier Transform Infra- Red Spectroscopy (FTIR) analysis:

FTIR is used to study the purity and composition of the synthesized products. The FT-IR Characterization is utilized to discover the particles and their practical gatherings present in the combined Cadmium Sulfide nanoparticles. The dried CdS nanoparticles mixed with KBr were characterized with Fourier transform infrared spectrometer furnished with SHIMADZU IR Prestige - 21 Intron magnifying lens utilizing transmittance modes working at a determination of 4 cm-1. The FTIR spectra could be clarified by different peaks in fig 6, 7 as: The absorption peak at 3, 420. 7 cm $^{-1}$ could be attributed to the OH group of the plant material. The strong absorption band at 1619.25 cm^{-1} was assigned C= C stretching's of the particles. The weak absorption band at 1442 - 1357 can be attribute to C= O stretching's. The broad peak at 1152 could be assigned to the ester group present in the extract. The sharp peak at 1112 are of C-H bending vibrations with CdS formation at 603. 21.

ISSN: 0975-8585

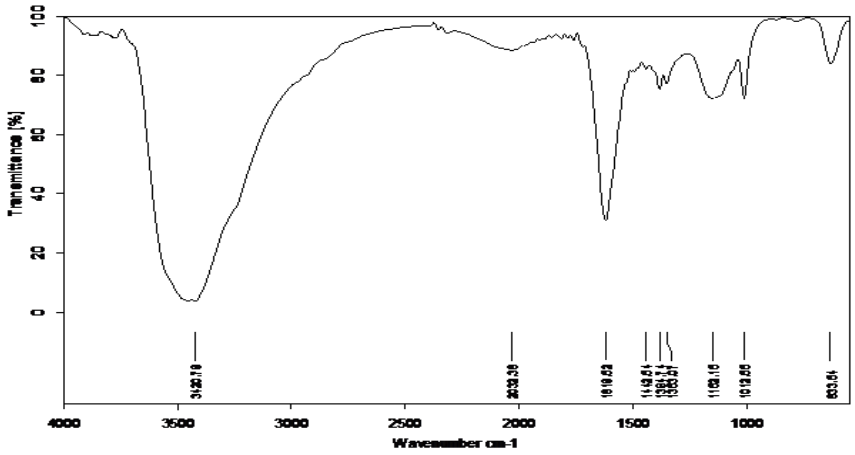

figure 6: solid IR of M.P

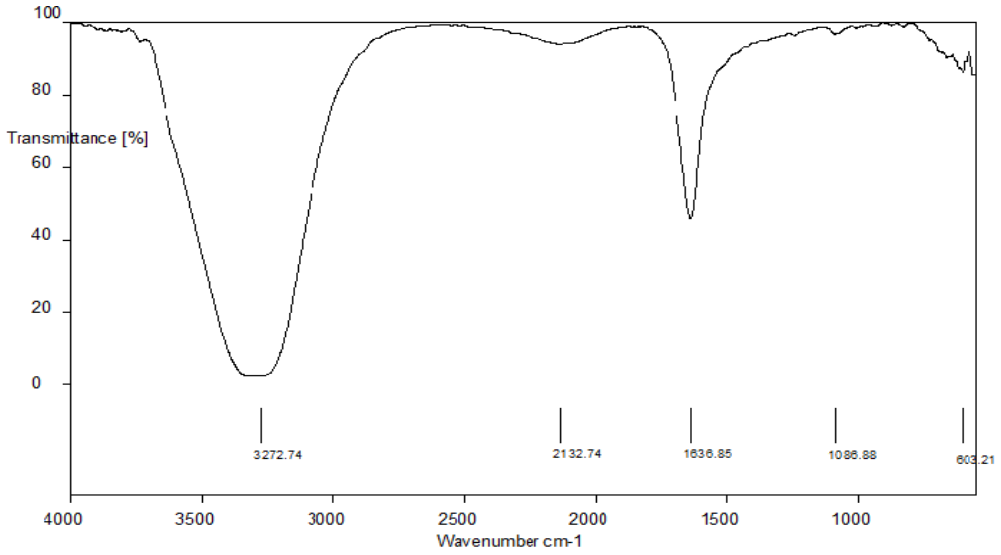

Figure 7: plant extract of M.P

ANTI MICROBIAL STUDIES OF CdS NANOPARTICLES

The antimicrobial movement of green incorporated CdS nanoparticles from plant separate and of their particular CdS NPs containing arrangement was dissected against Gram positive bacterial strain like Staphylococcus aureus. The antifungal studies were completed in parasitic strain like Aspergillus niger secured from Corpuscle research focus. Container - plate strategy was taken after for testing antimicrobial action against green combined CdS NPs and their plant separate.

Anti-bacterial Activity :-

Procedure:- Anti-bacterial activity of the given extracts were performed by using cup plate method; Against a test organism Staphylococcus aurues.

Standard Antibiotic:-Amikacin-10µg/ml prepared in sterile water.

Nutrient agar medium was sterilized by moist heat sterilization using an autoclave (121 ^{0}C: 15-20 lb for 20 min's). 60 sterile petri plates were used for the assay to get triplicate values. Molten agar medium was

ISSN: 0975-8585

inoculated with microbial suspension and poured in to the plates (temperature of the medium for inoculation is 35-40 ^{0} C.)After solidification of the medium, cups were made aseptically using a stainless borer. 50µl of sample of the extracts and an antibiotic solution of 50 µl were placed in the cups and the plates were kept in refrigerator for diffusion for a period of one hour. The plates were then kept in the incubator for one day at 37 ^{0} C .The inhibition zone diameters were then recorded and the diameters were compared against those obtained for the standard antibiotic as shown in fig 8,9.(Amikacin - 10 µg/ml prepared in sterile water).

Figure- 8

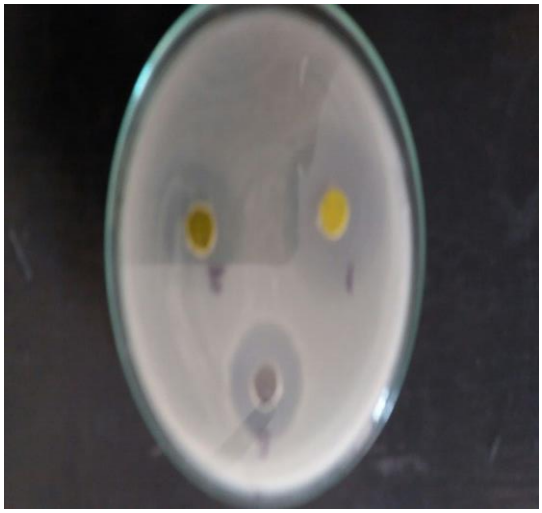

Figure- 9

Anti- Fungal :

Potato dextrose agar medium was disinfected by damp warmth cleansing utilizing an autoclave [121 0 C; 15-20 lb for 20 min's]. 60 sterile petri plates were utilized for the examine to get triplicate values. Liquid agar medium was immunized with microbial suspension and poured(temperature of the medium for immunization is 35- 400 C). After hardening of the medium, containers were made aseptically utilizing a stainless borer. 50µl of the specimen of the concentrates and an anti-microbial arrangement of 50µl were put in the mugs and the plates were kept in icebox for dissemination for a time of 60 minutes. The plates were then kept at room temperature for 3 days. The hindrance zone distances across were then recorded and the measurements were looked at against those got for the standard antibiotics shown in fig 10, 11 (Fluconazole-20 µg ml disintegrated in methanol).

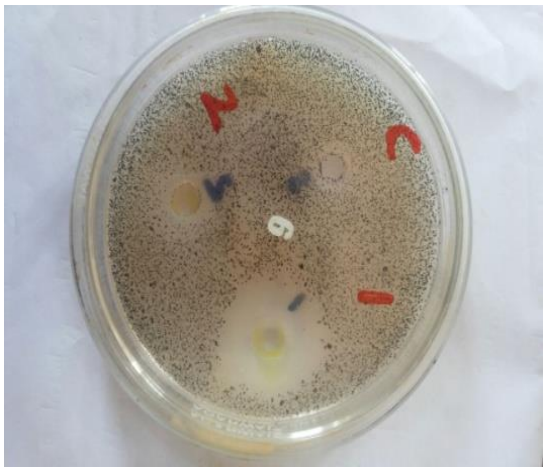

Figure- 10

Figure- 11

ISSN: 0975-8585

CONCLUSION

The work incorporates a study on the synthesis of CdS nanoparticles was carried out by green method using Mimosa Pudica plant extract which acts as a capping agent or stabilizing agent to reduce CdS metal to nanosize particles and its characterization. This route is rapid, simple without any hazardous chemicals as reducing or stabilizing agents and a cost effective and simple method of synthesis of CdS Nanoparticles.

REFERENCES

[1] Daniel M C and Astruc D. Gold nanoparticles :assembly , supramolecular chemistry , quantum -size related properties and applications towards biology , catalysis , and nanotechnology . Chem Rev. 2004 ; 104 : 293- 346.

[2] Kato H. In Vitro assays : tracking nanoparticles inside cells. Nat Nanotechnolo. 2011; 6; 139-140.

[3] Papp S, Patakfalvi R , Dekany I " Metal nanoparticle formation on Layer Silicate Iamerae ". Colloid Polym Sci , (2008) , 286, pp. 3- 14.

[4] Seoudi R, Said RA, " Studies on the effect of the capping materials on the spherical gold nanoparticles catalytic activity ". WJNSE, (2011), 1. 11, pp. 1- 51 - 61.

[5] Foglia S, Suber L, Righini . M. "Size tailoring of CdS nanoparticles by different collodial chemical techniques ". Colloids Surf. (2001), 177 (1). pp. 3- 12.

[6] Kamat , P. V. J. Phys. Chem, C; 2008, 112 , 187337-53.

[7] Alivisators . A. P; Science, 1996, 271 , 933-937.

[8] Kandasamy K, Harkesh B Singh and Kulshrehta SK , J. Chem. Soc; Vol . 121 (2009) 293-296.

[9] Pan , A ; Yang , H; Liu , R ; Yu , R; Zou , B; Wang , Z: Color- Tunable Photoluminescence of Alloyed $CdS_X Se_{1-x}$ Nanobelts . Journal of the American Chemical Society 2005, 127 , 15692- 15693.

[10] So, W ;-W ; Jang , J.-S ; Rhee , Y. - W ; Kim , K . -J ; Moon , S. -J ; Preparation of Nanosized Crystalline CdS Particles by the Hydrothermal Treatment . Journal of Colloid and Interface Science 2001, 237, 136- 141.

[11] Xiao, J; Peng , T; Dai , K; Zan , L; Peng , Z: Hydrothermal Synthesis , Characterization and its Photoactivity of CdS/ Rectorite Nanocomposites . Journal of Solid State Chemistry 2007, 180, 3188-3195.

[12] Mammadov , M. N; Aliyev , A. S ; Elrouby , M: Electrodeposition of Cadmium Sulfide. International Journal of Thin Films Science and Technology 2012 , 1, 43-53.

[13] Lin, Y. F ; Song , J, Ding, Y; Lu, S. Y; Wang , Z. L: Piezoelectric Nanogenerator Using CdS Nanowires. Applied Physics Letters 2008, 92.

[14] Mahdavi , S. M; Irajizad , A ; Azarian , A Tilak , R. M: Optical and Structural Properties of Copper Doped CdS Thin Films Prepared by Pulsed Laser Deposition . Scientia Iranica 2008 , 15, 360- 365.

[15] Anikin, K. V; Melnik , N. N; Simakin , A. V; ShafeevG. A; Voronov, V. V; Vitukhnovsky , A . G; Formation of ZnSe and CdS Quantum Dots Via Laser Ablation in Liquids . Chemical Physics Letters 2002, 366, 357-360.

[16] Ckakarvathi , S. K ; Kumar, V ; Kumar , S: Galvanic - Fabrication of CdS Microstructures Using Nuclear Track Filter Membranes . Journal of Materials Science 2005 , 40 , 503- 504.