



ISSN: 2617-2070 (Print) ; 2617-2070 (Online)
Journal of Advanced Sciences and Engineering Technologies
Available online at: <http://jaset.isnra.org/>

Journal of Advanced
Sciences and Eng.
Technologies

JASET

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Keywords

CdS nanoparticles

Sol-Gel method

Liver enzymes

ARTICLE INFO

Article history:

Received 01 October 2019

Accepted 10- December -2019

Available online 23– January 2020

DOI:

<http://dx.doi.org/10.32441/jaset.03.01.03>

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Sol-Gel Synthesis, Characterization, and Effect of CdS nanoparticles on activity of liver Enzymes

A B S T R A C T

This paper describes the synthesis of CdS nanoparticles by sol-gel route using organic molecules as gelatin media. At 70°C the CdS nanoparticles are formed with particle size 75.28nm. The nanoparticles are characterized by XRD, SEM, AFM and FTIR. The effect of nanoparticles on activity of liver enzymes (GPT and GOT) is also studied by using different concentration of NPs. It is found that the activity of GPT and GOT enzymes increases with decreases in nano particles concentrations and decreases in inhibition percentage. The greater activation of nano was demonstrated at concentration (10⁻¹ M).

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1. Introduction

Cadmium sulphide was an-significant semiconductor matter, with energies band gap of 2.5 eV at room temperature. Cadmium sulphide nanoparticle was used in different application this as gas sensor, solar cell, photochemical catalysis, detectors for laser and biological labels. Preparation of Cadmium sulphide nanoparticle could be done by fresh chemical reaction, microwave heating [1,2], sol-gel method [3], more of the researcher prepared Cadmium sulphide nanoparticles in the existence of unlike surface material and cover agents [4,5,6]. Cadmium sulfide thin film have attract increasing interest, in new year's because of its widely direct band gap energies, electrical properties, optical and stability, different ways, that as chemical vapor deposition, spray pyrolysis and sputtering, and successive ionic coat adsorption and reaction had use for depositing Cadmium sulfide films. The efficiency of Cadmium sulfide semiconductor film is amended by change it's optical and electrical properties by doping with some elements that as copper, Erbium ,and Gallium [7]. Organic material carrying function collection had been use as fixed stabilizer for the solution compilation of CdS nanomaterial's with numerous monarchy. For example, polyester constraint with a thiol edge association was used us covalently attach stabilizers for the elaboration of stable Cadmium sulfide nanoclusters in tetrahydrofuran (THF), dimethyl form amide (DMF) and, that was further use for the elaboration for homogeneous scuttle of Cadmium sulfide particles. The electron transfer between quantum dots Cadmium sulfide and titanium dioxide was due to the different energy levels of the different conduction and valence bands this transports, occupy place if an exacted was generated by the absorbed of an incident photon [8]. Farhan

and et al [9] prepared hematite NPs by sol-gel method at different temperatures and its photo activity for degradation of dyes. Enzymes are giant macromolecules which catalyst biochemical reactions. The difference between those enzymes possesses catalytic activity. The part of the enzyme tertiary structure, which is responsible for the catalytic activity is called the 'active site' of the enzyme the active site is usually a hydrophilic cleft or cavity containing an array of amino acid side chains. Which bind the substrate and carry out the enzymatic reaction. A liver enzymes are a protein that helps to speed up a chemical reaction in the liver Aspartate aminotransferase (GOT) and alanine aminotransferase (GPT) are enzymes found mainly in the liver, but also found in red blood cells, heart cells, muscle tissue and other organs, such as the pancreas and kidneys. GPT having the function of transferring amino group from alpha-amino acid (alanine) to alpha- keto acids (α -ketoglutarate), therefore; named transaminase[10,11]. The transamination reaction is an important in intermediary metabolism due to synthesis and degradation of amino acids. The keto acids formed by the reaction are ultimately oxidized by the tricarboxylic acid cycle to provide a source of energy [12].

2. Materials and Methods

The synthesis consists of the reaction of Cd and S compounds in the presence of organic molecule. Cadmium chloride, sodium sulfide and thioglycerol. Analytical grade purity was of each reagent consumed and was obtaining by Merck chemical Reagent Co. LTD. Technical grade (Sigma ,Aldrich) ethanol full and distillation wet with using of prepared for Nano crystal's with sol-gel in a typical synthesis aqueous solution of cadmium chloride, thioglycerol (TG), thioglycerol was addition drops to aquatic settling and (1mol)

of sodium sulphide settling was injection drops with drops over settling down stirring. End the admixture is reflex by stirring at 6 hour for 70°C. The solid was isolated throughout settling with centrifuge (3500 rpm) of 15 minute for were cleaned sometimes by acetone into getting rid. CdS nanoparticle was collecting as yellow powder, dried of four hour and aged of 72 time.

2.1 Effect of nanoparticles on GPT and GOT enzyme activity

1-Preparation different concentration of nanoparticles (1×10^{-1} , 1×10^{-2} , 1×10^{-3} , 1×10^{-4} , 1×10^{-5} M) in deionized water .

2- Preparation of working reagent : mix 8 ml of reagent (R1) with 2 ml of reagent (R2) the working reagent is stable for 30 days at 2-8 °C.

3- Six test tubes were used to put in each one mix (1000µl) from working Reagent (GPT enzyme) with (100µl) nanoparticles and (100µl) serum and incubate at 37 °C for one minute . Then the change in absorbance per minute (Δ O.D/min.) was measured at $\lambda = 340$ nm.

4 -A control solution was prepared by mixing (1000 µl) GPT enzyme with (100 µl) serum and deionized water (100 µl) and incubate at 37°C for 1minute. Then the change in absorbance per minute. (Δ O.D / min.) was measured during 3 minute .The inhibitor percentage was calculated by comparing the activity with and without the nano and under the same conditions. According to the equation [13] .

$$\% \text{Inhibition} = 100 - \frac{\text{the activity in the presence of nano}}{\text{the activity in the absence of nano (control)}} \times 100$$

The enzyme GPT & GOT activity was measured in human serum by using this equation : GPT activity (unite / litter) = Δ O.D / min. x 1745 .

3. Results and Discussion

3.1 Microscopic Analysis (SEM)

The SEM products for their synthesized nano-crystallized chemical shows their surface morphology's or volume for nanocrystalline. Observation of cadmium sulphide nanocrystals were performed for used SEM figure (1) showed the surface morphologies for nanostructured prepared at temperature 70°C the picture shows the particles are not completely spherical in shape. The opposition, correlating by nano cadmium sulphide sample can be un-spheres geometries for nanocrystalline, and SEM topographical observation. The figure has aggregate into formation clusters similar results were obtained by Srinivasa et al [14]. There are been reported several methods for the synthesis of CdS nanoparticles. Yuan-chang and Tsai-wen Lung [15] synthesized size-quantities CdS using a facile hydrothermal growth method. [16] prepared CdS nanoparticles with- average grain size of about 12 nm .Zhu et al. [17] produced CdS nanoparticles with 5-10 nm by microwave irradiation method.

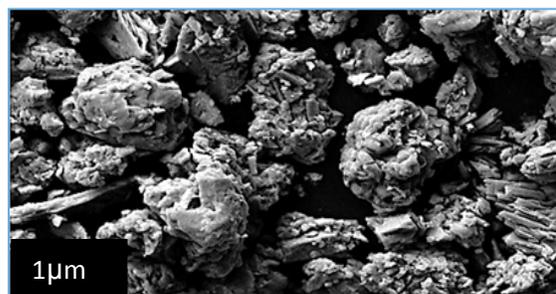


Fig. 1 Electron photographs of CdS nanoparticle (SEM) .

3.2 Atomic Forces Microscopies (AFM)

AFM picture showed in figure (2) of CdS, the surface of CdS exhibited uniformity, it was observed to have smaller grains, non – uniform grain size and random orientation with less of crystallized. The deeper layers of atoms were subjects into higher interatomic power of products a compacted molecules, whereas for that atomic near there surface

were subjects into a weaker interatomic. The drastic change in surface roughness is in conformity with the analysis of the growth of the structure. CdS Nanoparticle is spherical in shape having an average diameter of (75.28nm). The 3-dimensional (3D) AFM image of nanoparticle material had an irregular distributed CdS nanoparticle over in surface could seem by root mean square roughness for (0.784 nm).

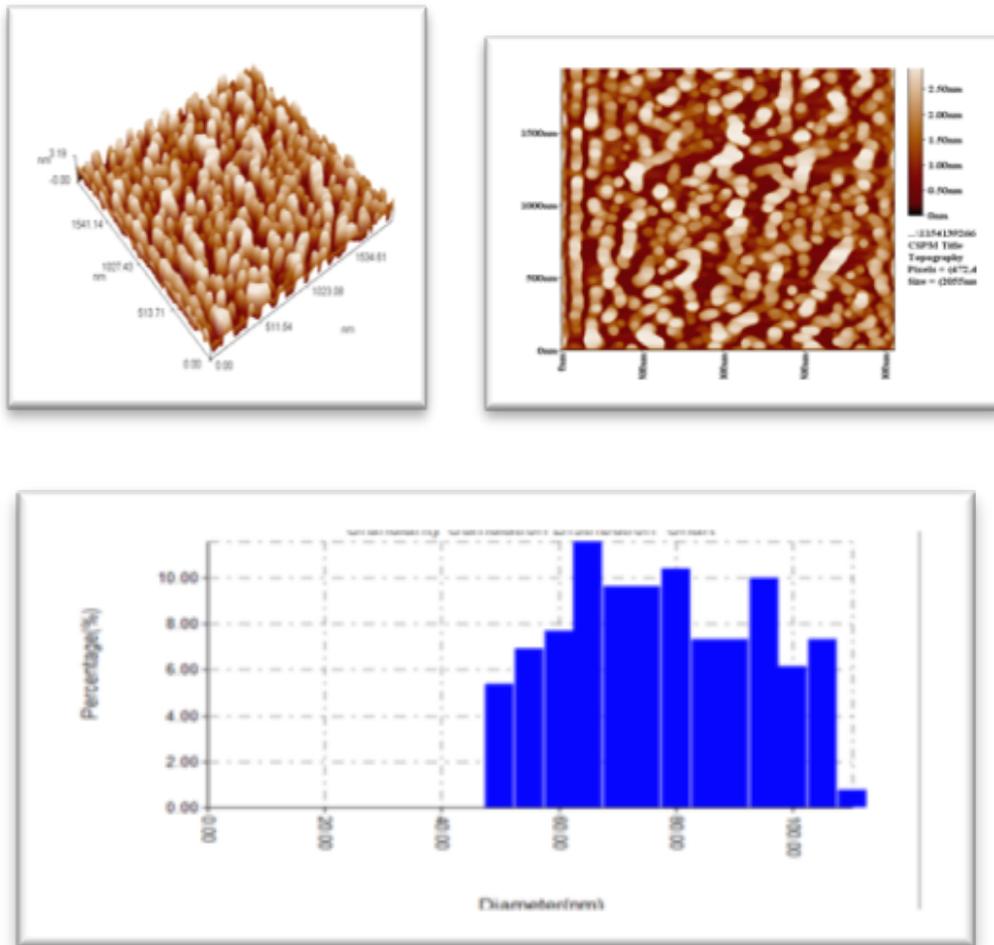


Fig. 2 AFM image of as prepared CdS nanoparticles

3.3 XRD diffraction

Figure (3) X-ray diffraction shows of chemically synthesized nano cadmium sulphide. The figure could have been assigning to hexagonal CdS phases the

standard data by comparing with JCPDS. The six main diffraction peaks at $2\theta=24.45^\circ$, 26.3° , 36.37° , 43.67° and 51.84° are corresponding to (100), (002), (101), (112), (102) and (110) planes respectively, the figure shows the formation of cadmium

sulphide nanocrystalline clearly suggested little particles size of hexagonal phase ,X-ray peak intensities were weak. The X-ray bonds shifted to larger diffraction by decreasing crystalline size suggesting lattice

contraction identical products find into results Tripathi et al [18] used the

Scherer equation. The crystal size for that specimens was finding equal 19.13 nm .

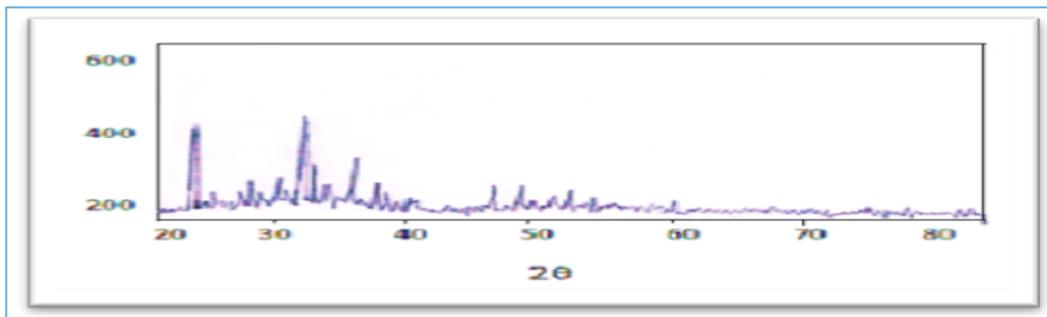


Fig. 3 The XRD pattern of CdS nanostructure obtained from sol-gel process

3.4 FTIR analysis

Infrared spectra CdS crystallite was taken between the ranges of 400 to 4000 cm^{-1} for CdS at temperature 70°C . Figure (4) shows the infrared spectra of sample by sol-gel method ,the larger energies range their band with 3558 cm^{-1} and 1649 cm^{-1} into spectrum were lead to their stretch , bend vibration for there (O-H) groups for absorption wet over there surface for

cadmium sulphide nanoparticle. The middle power bond with 877 and 675 cm^{-1} have been assigned us CdS band ,that product indicates there that nanocrystalline was synthesized with sol-gel way. Similar results reported the infrared spectral for properties of cadmium sulphide nanocrystal which have be synthesized with chemistry growth method. The (S) groups rule us a bound sitting of (Cd) ion for prepared cadmium sulphide nanocrystals.

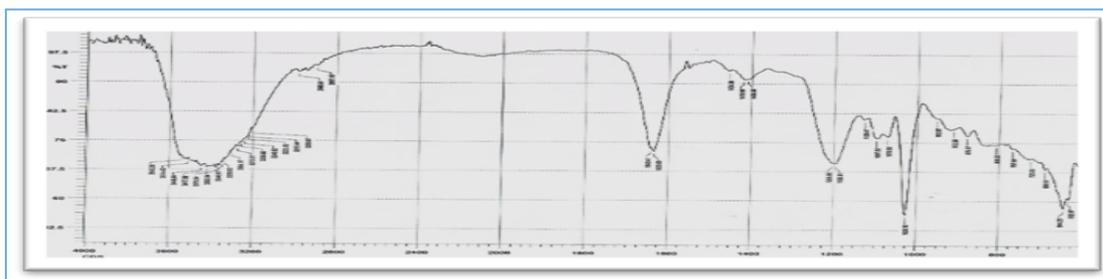


Fig. 4 FTIR Spectra for CdS nanoparticles synthesized by sol-gel method.

The effect of CdS nanoparticles on GPT and GOT enzyme Activity

The effect of nano (CdS) of serum GPT and GOT enzymes activity was investigated in this study, the biochemical tests revealed that

nanoparticles caused inhibitory effects on GPT and GOT enzymes. The relationship between nanoparticles concentration versus the activity of enzymes as shown in figure (5) and figure (6) for GPT and GOT respectively. These results observed that any increase in nano

concentrations caused decreases in activation of enzymes and increases in inhibition percentage. Figure (7) and figure (8) for GPT and GOT enzymes respectively. The greater inhibition of nano was demonstrated at concentration (10^{-1} M). The enzyme plays an important role in amino acid metabolism and in the urea tricarboxylic acid cycles (19). We suggested that nano molecule changes the active sides of amino acids on GPT and GOT enzymes, due to decreasing affinity of active sides of enzymes or the change in the stereo structure of the enzymes in the presence of nano caused to inhibit the enzymes. The results of our study are in agreement with previous studies of same enzyme (20).

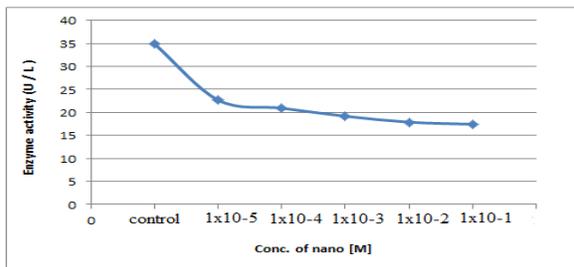


Fig . 5 Effect of different concentration of nanoparticles on the activity of GPT enzyme in human serum.

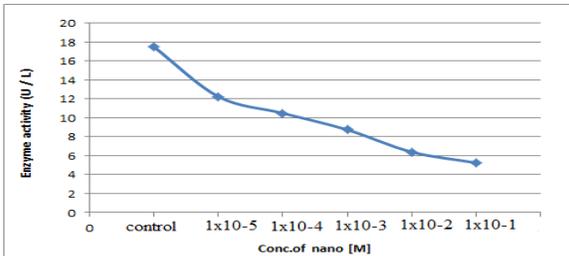


Fig . 6 Effect of different concentration of nanoparticles on the activity of GOT enzyme in human serum.

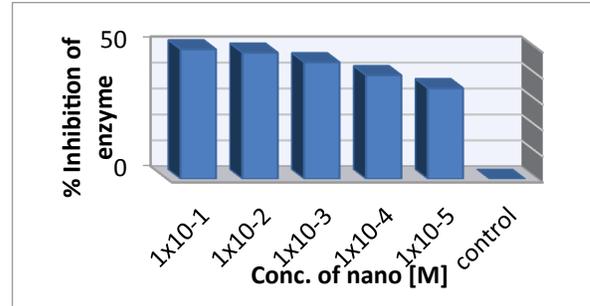


Fig . 7 % Inhibition of GPT enzyme with different concentration of nanoparticles.

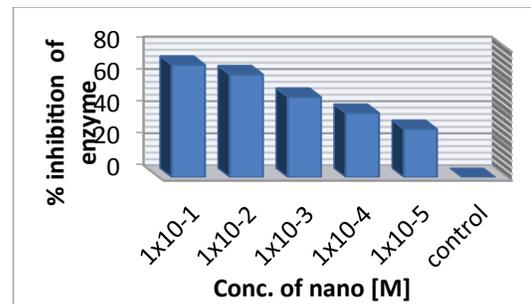


Fig .8 % Inhibition of GOT enzyme with different concentration of nanoparticles .

Recently Xing-Jiu Huang and et al. (21) presented a comprehensive review of research activities that concentrate on GOT and GPT detection techniques due to their clinical importance. (22)Y.M.Jeon and et al. were examined the liver tissue damage induced by nano sized-TiO₂ in mouse the biochemical parameters of liver namely GOT, GPT and Alkaline phosphates enhanced approximately 18% ,35% and 69 % by exposure to nano sized-TiO₂ respectively. The GPT activity is greater more than GOT activity due to GPT sensitive to nanoparticles more than GOT enzyme.

4. Conclusion

Successfully prepared of CdS nanoparticles using organic molecules by sol-gel method. In

XRD and AFM analysis the particle size of produced CdS was approximately 75.28 nm . The SEM analysis illustrates that the particles morphology are not completely spherical in shape, the FTIR spectrum of CdS NPs the middle power bond with 877 and 675 cm^{-1} have been assigned us CdS band.Nanoparticles (CdS) caused inhibitory effects on liver enzymes. The greater inhibition of nano was demonstrated at concentration (10^{-1}M).Inhibitor percentage of GPT enzyme exhibits (50%) lower than GOT enzyme (70.02%).

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