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Microwave-assisted synthesis of silver doped with cadmium sulphide using capping agent

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ABSTRACT

Silver doped Cadmium Sulphide nanoparticles were synthesized at room temperature using Microwave assisted method with various molecular ratio. The size of nanometer particles nearly 5nm were controlled by using poly vinyl alcohol as a capping agent. The nanoparticles size and morphology was studied by using FTIR, Scanning electron microscope, Transmission electron microscope, Energy Dispersion X-ray analysis and XRD.

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KEYWORDS

Microwave-Assisted;
Capping agent;
Molecular ratio;
Silver doped with Cadmium
Sulphide.

INTRODUCTION

The development of uniform nano meter sized particles has been intensively pursued because of their technological and fundamental scientific importance^[1,2]. These Nano particulates materials often exhibit very interesting electrical, optical, magnetic, and chemical properties, which cannot be achieved by their bulk counter parts³⁻⁴. Synthesis, chemical physical properties of metal nanoparticles are currently of considerable interest because of their potential application in commercial industries. Owing to the small size of the building block and high surface - volume ratio, these material are expected to demonstrate unique properties.

Synthesis of Nano material has gained importance in the field of synthetic technology, In this work has follow Wet chemical route, because of its faster, cleaner and cost effectiveness than all other methods.

In the present work various molar concentration of

Silver-Cadmium Sulphide nanoparticles were synthesized using PVA as a capping agent. It play important role to control the size of particles and has characterized for their size by using X-ray diffraction. The morphology of sample were determined by Scanning electron microscope, FT-IR, EDAX and Transmission electron microscope. On the observation of XRD to assume the size of nanoparticles, it shows between 1-10 nm.

EXPERIMENT

Calculated amount of various molecular ratio of cadmium acetate(X) and silver nitrate(Y) were dissolved in a beaker containing 50ml of de-ionized water and 50 ml of methanol. The above mixture was kept in a magnetic stirrer for stirring, in the mixture a magnetic pallet was added and simultaneously weighted composition of sodium sulphide (Z) dissolved in 50 ml of deionized water and 50 ml of methanol along with

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0.5 gm. of poly vinyl alcohol (PVA) after complete mixing is taken in a burette and contents of the burette were added in to the mixture drop by drop. The stirring were continued for almost half an hour until the fine precipitate of silver doped cadmium sulphide nanoparticle was obtain. And then the mixture was placed in domestic microwave oven for 3-5 mints. The precipitate were then filtered off and washed several times with methanol

TABLE 1 : Gives detail about Molecular ratio of chemical in this synthesis

S. No.	Sample Code	X gm. Of Cd(COOH) ₂	Y gm. Of AgNO ₃	Z gm. Of Na ₂ S
1.	S1	7.1	1.3	1.6
2.	S2	6.3	1.9	1.8
3.	S3	6.4	2.2	1.4
4.	S4	6.5	2.3	1.2
5.	S5	6.1	1.9	2.0

in order to get purity of the sample. Various composition of NP's prepared with different molecular ratio.

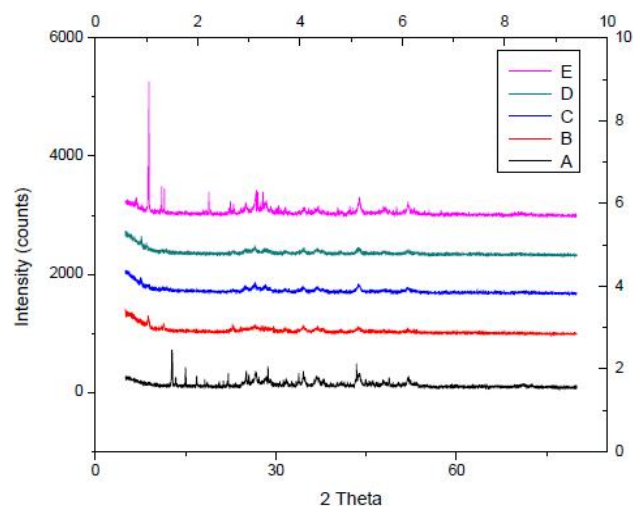
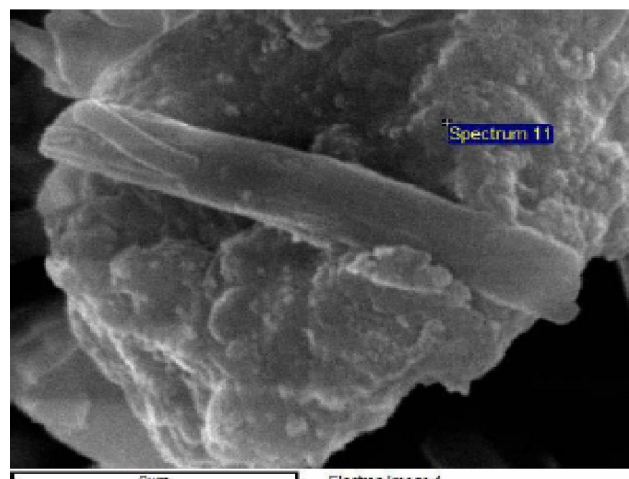


Figure 1 : Indicates the nanoparticles size between 1-10 nanometer



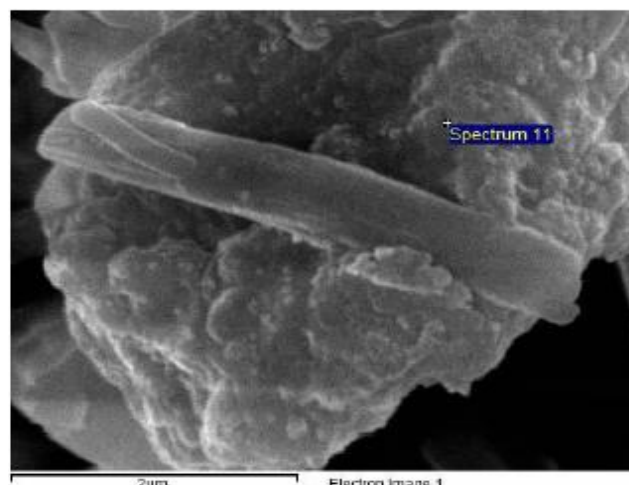
(a)



(b)



(c)



(d)

Figure 2 : a, b, c and d shows the morphology of NP's.

Molecular ratio table was shown below.

All the green colored Ag doped CdS powders obtained were subjected to x-ray diffraction using X-ray diffractometer. Surface morphology of the samples has been studied using scanning electron microscope

(SEM), transmitted electron microscope (TEM) with EDAX is carried out for the elemental analysis of prepared samples and FTIR spectrum of the nanoparticles were recorded.

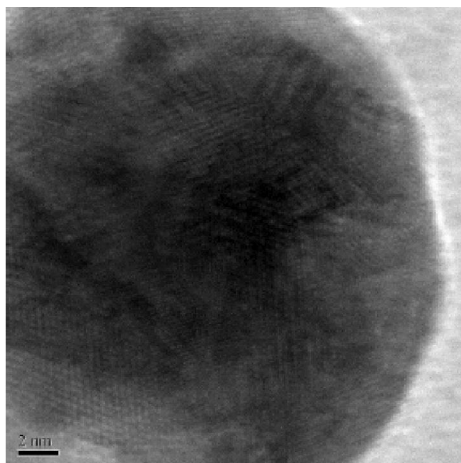
RESULT AND DISCUSSION

X-ray diffraction analysis

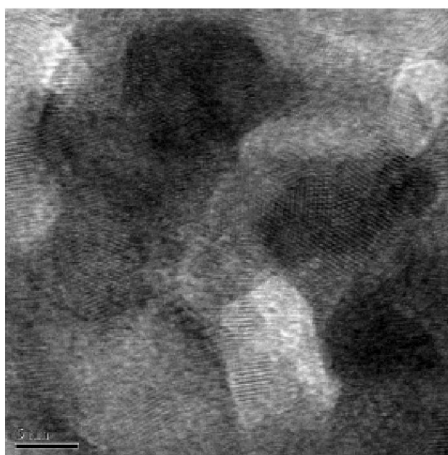
X-ray diffraction pattern of silver doped cadmium sulphide nanoparticles with various compositions shows line broadening of diffraction peaks gives an indication that the synthesized particles are in nanometer's size. The presence silver doped cadmium sulphide nanoparticles in the formation of Bragg's peaks at 2θ values of 12.64, 11.22, and 26.50. The mean diameter of NP's was calculated from the Scherrer formula $d=0.94\lambda/\beta \cos \theta$, where d is the mean diameter, λ is the wave length of X-ray radiation source of the particle size between 1-10 nm and it can be calculated using Debye-Scherre formula. From XRD data, observed. Ag doped CdS denotes different 2θ were 12.640, 11.22, 26.50 and β is the angular full width at half maximum of the XRD peak at half maximum of the XRD peak at diffraction angle θ . The mean diameter was determined to be 1-10nm.

SEM and TEM analysis

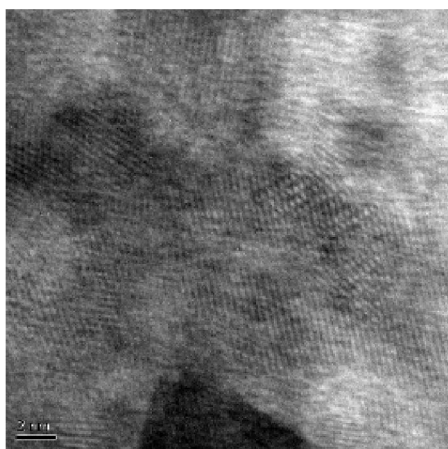
The SEM and TEM analysis was explained the morphology and grain size of nano particles. The shape and size of silver doped cadmium sulphide is entirely different from un doped cadmium sulphide. From the



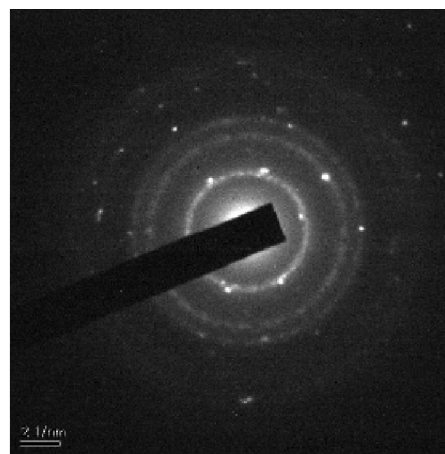
(e)



(f)



(g)



(h)

Figure 2 : e, f and g shows the morphology and Surface activity of NP's

Figure 2 : h. indicates the morphology and unit cell arrangement of NP's

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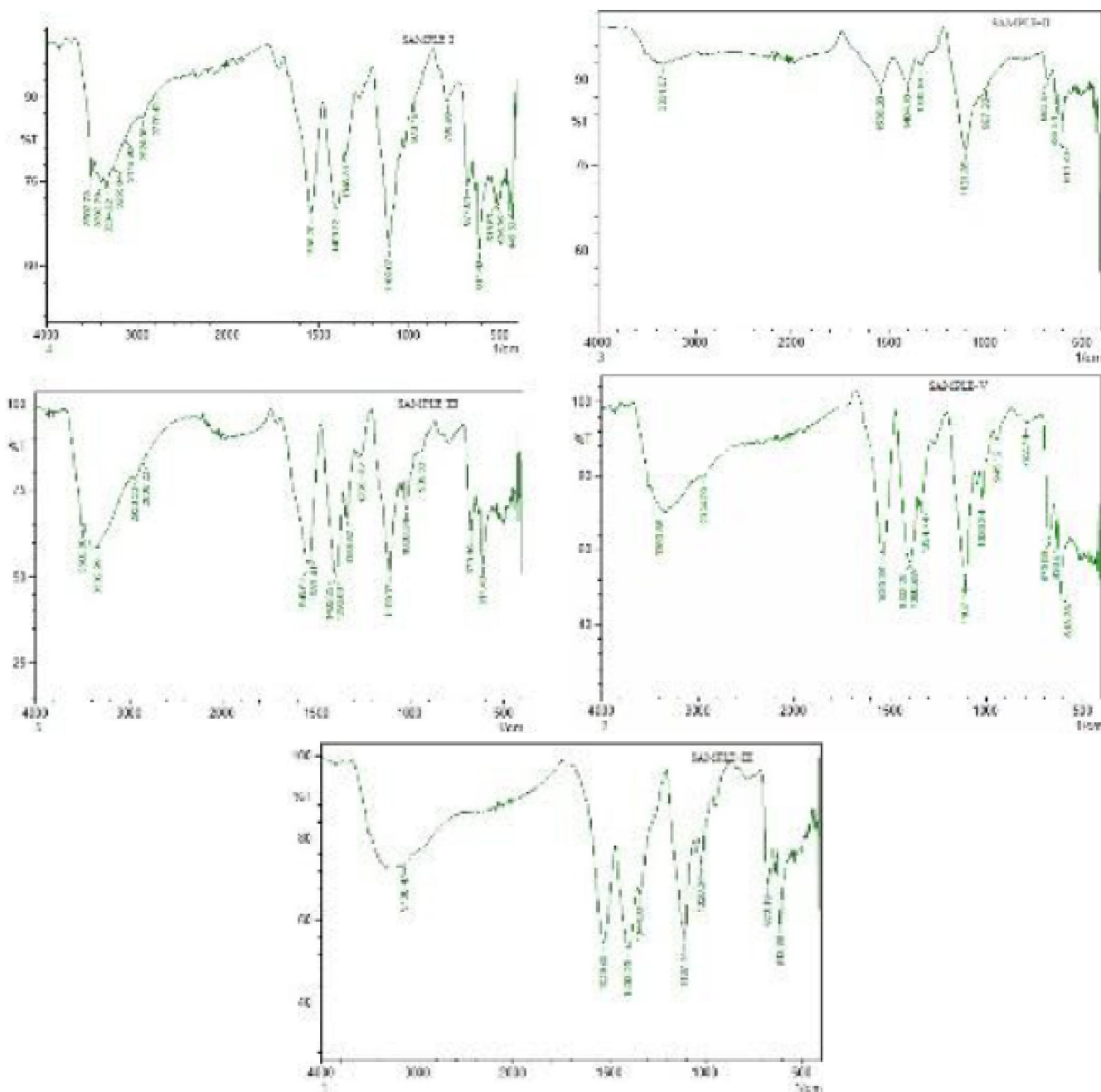


Figure 3 : Shows the nanoparticle with different size

Figure indicates the size between 1-10 nm and morphology was globular in shape, which was entirely different from undoped cadmium sulphide.

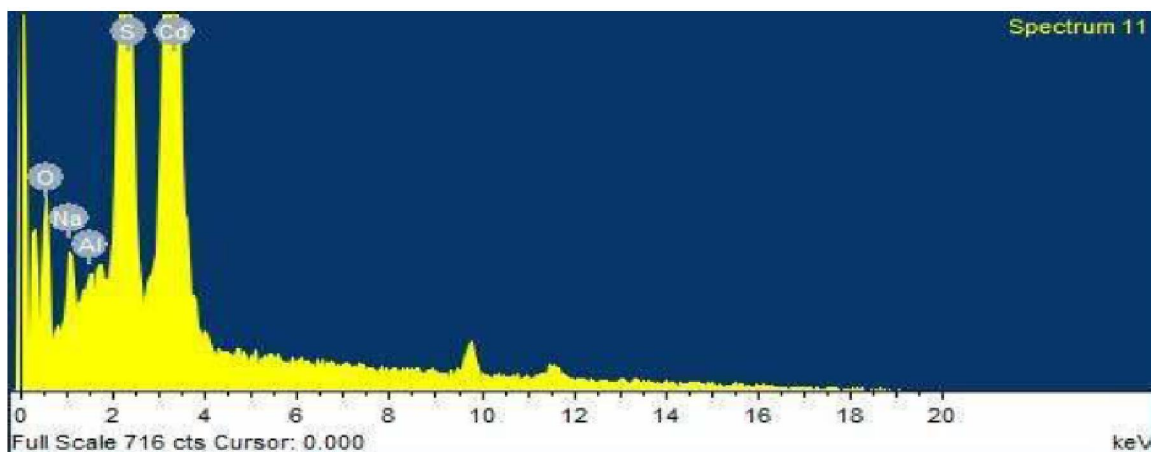
FTIR analysis

The Figure 3 Shows the IR spectrum of silver doped cadmium sulphide confirmed peaks at 3128 cm^{-1} to 3140 cm^{-1} was assigned to O-H stretching of absorbed water on the surface of CdS. The stretching vibrational peak at 663 to 613 cm^{-1} indicates the presence of cadmium sulphide. The major peak at 1614, 1402, 623

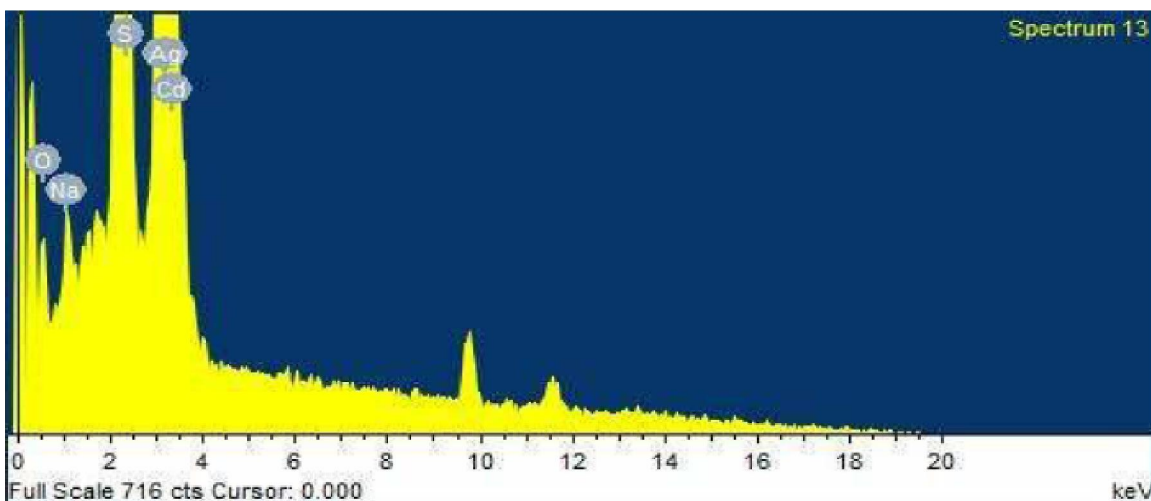
were due to the presence of different bands of silver doped cadmium sulphide nanoparticles.

EDAX analysis

The EDAX stands for Energy dispersive X-ray analysis. The EDAX technique were used for elemental analysis or chemical characterization of a sample. From the Figure 4.a and 4.b. shows clearly presence of silver(Ag),Cadmium (Cd) and Sulphide(S). The technique was helped to confirmed the particles presence in this analysis.



(a)



(b)

Figure 4 : a and b EDAX diagram of Ag-CdS

CONCLUSION

The present study indicates that the wet chemical method can be successfully employed for the preparation of silver doped cadmium sulphide nanoparticles. The X-ray diffraction measurement confirms the structure and particle size of the sample was 1-10nm. The scanning electron microscope and transmitted electron microscope image clearly indicates the formation of nano particles with globular shape. Analysis of EDAX confirms that the sample with clear peaks of Cadmium (Cd), Sulphur(S) and Silver (Ag) is around the nominal composition. FTIR shows clearly about the effect of capping agent presents in the mixture. The wet chemical method of synthesis of Ag-CdS NP's using poly vinyl chloride as capping agent with various molecular ratio reported in this work is simple and feasible for production of nano sized particles.

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