© 2018 IJSRST | Volume 4 | Issue 5 | Print ISSN: 2395-6011 | Online ISSN: 2395-602X
Themed Section: Science and Technology

Optical and Structural Properties of Pure and Bio-ZnS Using Cucumis Sativus Leaf Extract

B. Anand*[1], A.Muthuvel[2], V. Mohana[3], P. Selvarani[1], B.Lakshmi[1]

[1]Department of Physics, Government Arts and Sciences College, C. Mutlur, Chidambaram, Tamil Nadu, India

[2]PG Research Department of physics TBML College, Poraiyar, Tamil Nadu, India

[3]Annamalai University, Annamalai nagar, Tamil Nadu, India

ABSTRACT

The developments of green synthesis route through biological method for the synthesis of nanoparticles using plants have received attention in the recent times as it is environment friendly and economical method. This present work reported Pure and biosynthesized ZnS nanoparticles using cucumis sativus leaf extract. The biosynthesized ZnS nanoparticles were characterized by using different analysis techniques. The nanoparticles optical absorption and structural properties of Pure and biosynthesized ZnS studied by UV-Visible spectroscopy (UV-Vis) and X-Ray diffraction (XRD), surface morphology formation were investigated using Scanning Electron Microscopy (SEM) and average grain size also calculated and different functional group of Pure and biosynthesized ZnS Fourier transform infrared spectroscopy (FT-IR).

Keywords: ZnS, Bio-ZnS, cucumis sativus, SEM, FT-IR

I. INTRODUCTION

Nanomaterials have wide-ranging applications and implications in a variety of areas, including physics, chemistry, electronics, optics, materials science and biomedical sciences [1]. Semiconductor nanomaterials like CdS, ZnS, CdSe emerged as important materials for the applications in optoelectronics devices, sensors, lasers, and biotechnology [2]. ZnS is one of the promising semiconductor materials in II-VI group because of their wide band gap energy 3.72 eV [3]. There are various chemical based methods available for the synthesis of ZnS nanomaterials, chemical bath deposition [4] spray pyrolyis, vacuum evaporation and pulsed laser deposition, but there is a growing concern towards use of these chemicals as they are reported to be very toxic for the environment, and also not cost effective, Due to these problems, various eco-friendly approaches for the synthesis of ZnS nanoparticles are being adopted. This has prompted researchers to seek the use of biological systems to produce ZnS nanoparticles in an ecofriendly way [5] recently; Syzygium aromaticum reported the biosynthesis of ZnS nanoparticle [6-8]. Cucumis sativus L. belonging to Cucurbitaceous family is commonly known as Cucumber It is found wildly in the Himalayan regions and also cultivated throughout India. Traditionally, this plant is used for headaches; the seeds are cooling and diuretic, the fruit juice of this plant is used as a nutritive and as a demulcent in anti-acne lotions. [9] This is the first work on synthesis of ZnS-NPs using an ecofriendly, non-toxic aqueous extract of Cucumis sativus aqueous leaf extract, the biosynthesized ZnS nanoparticles were characterized by using different analysis techniques UV- visble, XRD, SEM, FT-IR

II. MATERIALS AND METHODS

2.1. Plant Extract

Zinc sulphate (99.9 %) was procured from Sigma Aldrich Chemicals, Bangalore, India. All other regents used in the reaction were of analytical grade with maximum purity. Deionized water was used throughout the experiment. The fresh leaf of Cucumis sativus (Figure1) was obtained from mutlur at Chidambaram, Tamil Nadu, India

2.2. Preparation of leaf extracts

The fresh leaves of Cucumis sativus leaf, without any infection, were collected and 50g of the leaves were weighed and washed running tab water followed deionized water five times for removing soil and dusts. Washed material treated shadow dried, open air dried at room temperature more than ten days and grinder used to crush powder form of dried plant Cucumis sativus leaf. The leaves broth solution was prepared by taking 25 g of coursed powder was treated in a 250 mL Erlenmeyer flask along with 100 ml of deionized water and then boiling the mixture at 85 °C for 20 min. After boiling, the solution was filtered through Whatman No.1 filter paper. The filtered extract was stored in the refrigerator for further experiments as reducing agent and stabilizer.

Figure 1. Photograph of Cucumis sativus leaf

2.3. Biosynthesis of ZnS nanoparticles

Biosynthesis of ZnS used from Cucumis sativus leaf extract, zinc sulphate obtained from merck industries in analytical grade used for without purification, 15.0 g zinc sulphate was dissolved in 100 ml deionized water and 15 ml of Cucumis sativus leaf extract was treated in 20 min stirred. Than 15 ml of stirred extract was added drop by drop in 80 ml (1 mM) of aqueous ZnS solution were kept from continuous stirring at 2 hours. The formation of nanocolloid solution was formed at result and dried for 60ºC at 5 hours.

2.4 Characterization Techniques

The optical absorption spectra of the samples were recorded by UV-1650 PC SHIMADZU spectrometer. Using X pert PRO diffractometer with a Cu Ka radiation (Ka = 1.5406 Å) the X-ray diffraction (XRD) patterns of the powdered samples were recorded. During the recording of the diffractogram, a narrow slit of 0.1 mm was used with a scanning speed of 0.02/s. The size and morphology of the nanoparticles were analyzed using Scanning Electron Microscopy (SEM; JEOL-JSM-5610 LV). Fluorescence measurements were performed on a RF-5301 PC spectrophotometer. The functional groups were determined by a SHIMADZU8400 Fourier-transform infrared spectrometer in which the IR spectra were recorded in transition mode by diluting the milled powders in KBr and the wavelength between 4000 and 400 cm^{-1} was used to assess the presence of functional groups in pure and Bio-ZnS.

III. RESULTS AND DISCUSSION

3.1 UV-Visible

The optical properties of Pure and Bio-ZnS nanoparticles are examined through UV–visible spectra from Figure 2. The optical absorbance range from 400 - 800 nm. The samples have sharp absorption edges in the UV region. The observed absorption edge increases from 327 to 348 nm with incorporation of Zns atoms while Bio-ZnS results in absorption peak tending toward larger wavelengths [10]. Then the maximum absorbance of Cucumis sativus leaf extract ZnS nanoparticles colloid solution was fall in at 348 nm It is found that the absorption

edge shifts toward longer wavelength in compared to the peak value of pure (327 nm)

The band gap values were calculated from absorption data using the following equation 1.

$$E_g=\frac{1240.8}{\lambda}\text{……..1}$$

Where Eg is the optical band gap, and λ is the wavelength corresponding to the relevant absorbance/transmission [11]. The estimated energy gap for the pure ZnS is 3.79 eV, it is decreased to 3.56 eV for the biosynthesized ZnS nanoparticles using Cucumis sativus leaf extract (Figure 3)

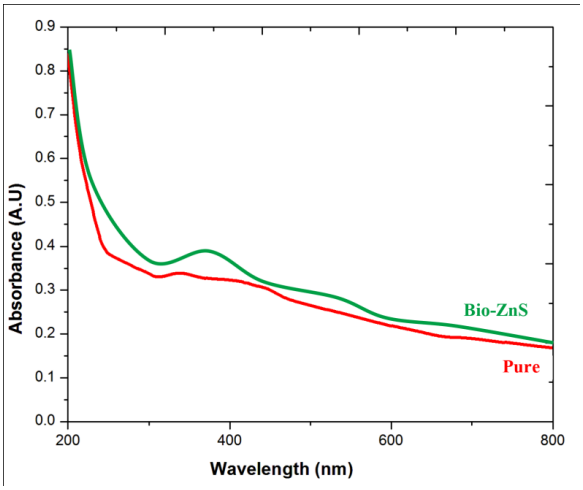

Figure.2. UV-Visible absorption spectrum of pure and Bio-ZnS nanoparticles

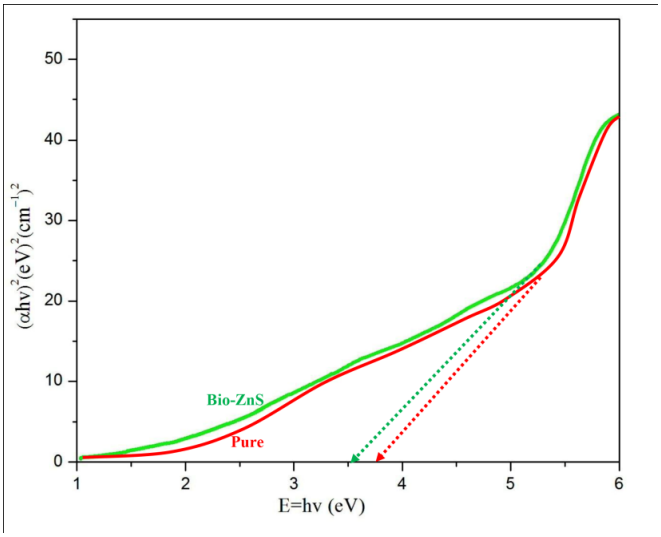

Figure 3. band gap energy of pure and Bio-ZnS nanoparticles

3.2. X-Ray Diffraction Study

XRD was used for analyzing the crystal information of biosynthesized ZnS nanoparticles. Figure 4 shows the wide angle X-ray diffraction pattern of Pure and Bio-ZnS nanoparticles using Cucumis sativus leaf extract. The diffraction peaks at 28.34°, 47.42° and 56.13° are assigned to (111), (220) and (311) planes of the zinc blende cubic phase of ZnS which are in good agreement with the literature values [JCPDS NO: 5-0566]. No extra diffraction peaks of other phases are detected, indicating the phase purity of ZnS nanoparticles. The average crystallite size of the biosynthesized ZnS nanoparticles was calculated to be 38 nm when compare to the Pure 50 nm using Debye-Scherrer equation 2 [12]

$$D_{XRD}=\frac{K\lambda}{\beta\cos\theta}\text{ …….. 2}$$

Where D is the crystallite size of zinc sulphide nanosheets, λ represents wavelength of x-ray source 0.1541 nm used in XRD, β is the full width at half maximum of the diffraction peak, k is the Scherrer constant with value from 0.9 to 1 and θ is the Bragg angle.

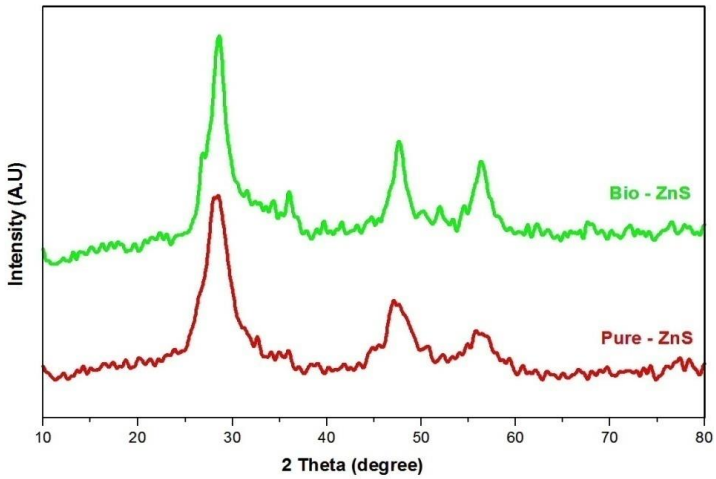

Figure 4. X-ray diffraction pattern of Pure and Bio-ZnS nanoparticles

3.3. Scanning Electron Microscopy (SEM)

The determination of particle size in colloidal solution can be made using dynamic light scattering technique. Particle size distribution with intensity of the Pure and Bio-ZnS nanoparticles is observed shown in

(Figure.5-6). These two images show the crystallites with small agglomeration and form aggregates. The figure 6 clearly shows the different particle size and zinc blend and spherical microstructure on the surface and estimate size is about 38 nm which dictates moderate distribution of the biosynthesized ZnS nanoparticles. The observed nanoparticles size is high compared to XRD analysis,

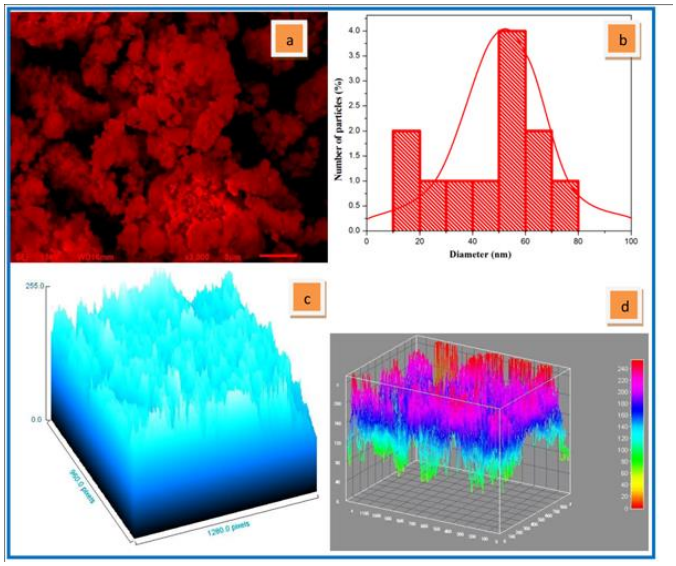

Figure. 5. a) SEM image b) size distribution histograms c) Surface occupancy plot and d) Surface profile analysis in pure ZnS nanoparticles

3.4. FT-IR Study

In order to further confirm the formation of ZnS nanoparticles and investigate the interactions between bio-molecules and ZnS nanoparticles, FTIR spectrum of Pure and biosynthesized ZnS nanoparctiles was recorded. As shown in Figure 7. Range from 4000-400 cm^{-1} wave numbers. The peak 1524 cm^{-1} is C=C aromatic of Pure ZnS, the 2850 cm^{-1} correspond to C—H asymmetric, C-H Vibration at 594.62 cm^{-1} according to this stretching ZnS nanoparticles [13]. a small peak present at 1,517 cm^{-1} corresponds to N–O asymmetric stretch nitro compounds and a strong peak observed at 1,120 cm^{-1} represent C–H wag (–CH_2X) alkyl haloides, and a strong peak observed at 4,70 cm^{-1} the biosynthesized Zns corresponds to C–Br stretch alkyl halides, alkenyl C-H stretch 3,010 cm^{-1}

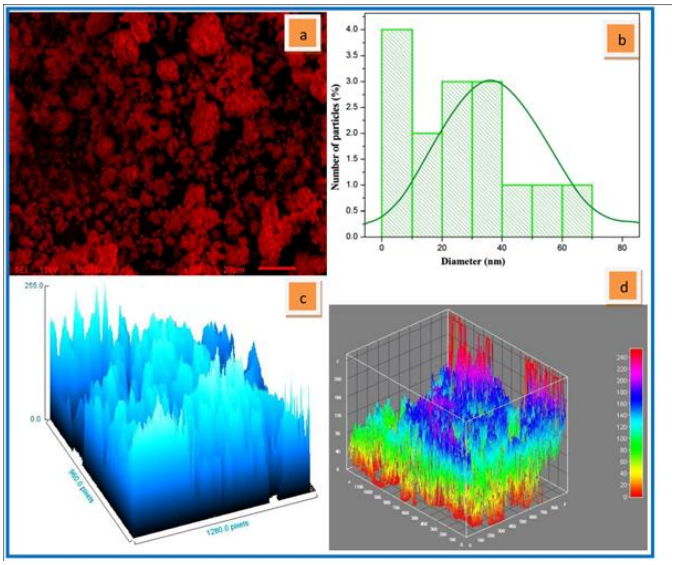

Figure 6. a) SEM image b) size distribution histograms c) Surface occupancy plot and d) Surface profile analysis in Bio-ZnS nanoparticles

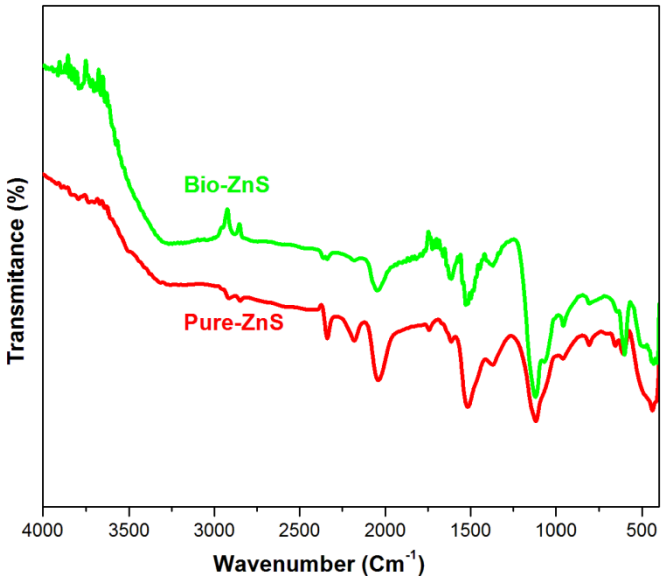

Figure 7. FT-IR spectrum of Pure and Bio-ZnS nanoparticles

IV. CONCLUSION

Biosynthesized ZnS nanoparticles using Cucumis sativus leaf extract in first time we reported, characterization of ZnS nanoparticles were analyzed by using XRD, SEM, UV-Visible and FT-IR.

Biosynthesized ZnS nanoparticles using Cucumis sativus leaf extract are cubic zinc blende structure and average grain size was calculated ~ 38 nm using XRD analysis. Surface morphology of biosynthesized ZnS nanoparticles was found different zinc blende shapes of surface, the absorbance at 348 nm and different functional group of Cucumis sativus leaf extract were found by using UV-Visible and FTIR spectrum

V. REFERENCES

[1]. J. Chen, B. Hu, and J. Zhi, Optical and photocatalytic properties of Corymbia citriodora leaf extract synthesized ZnS nanoparticles, Physica E: Low-dimensional Systems and Nanostructures, 79, 103-106, 2016.

[2]. N. Soltani, A. Dehzangi, A. Kharazmi, E. Saion, WMM. Yunus, BY. Majlis, Structural, Optical and Electrical Properties Of Zns Nanoparticles Affecting By Organic Coating. Chalcogenide Letters.11, 79-90, 2014

[3]. D. E. Ortíz-Ramos, L. A. Gonzalez, and R. Ramirez-Bon, p-Type transparent Cu doped ZnS thin films by the chemical bath deposition method, Materials Letters, 124, 267-270, 2014.

[4]. S. Tec-Yam, J. Rojas, V. Rejón, and A. I. Oliva, High quality antireflective ZnS thin films prepared by chemical bath deposition, Materials Chemistry and Physics, 136, 2-3, 386-393, 2012.

[5]. G. Vitor, T. C. Palma, B. Vieira, J. P. Lourenço, R. J. Barros, and M. C. Costa, Corrigendum to 'Start-up, adjustment and long-term performance of a two-stage bioremediation process, treating real acid mine drainage, coupled with biosynthesis of ZnS nanoparticles and ZnS/TiO 2 nanocomposites, Minerals Engineering, 89, 18, 2016.

[6]. I. Cock, Antimicrobial Activity of Syzygium australe and Syzygium leuhmannii Leaf Methanolic Extracts, Pharmacognosy Communications, 2, 71-77, 2012.

[7]. U. S. Senapati and D. Sarkar, Structural, spectral and electrical properties of green synthesized ZnS nanoparticles using Elaeocarpus floribundus leaf extract, Journal of Materials Science: Materials in Electronics, 26, 8, 5783-5791, 2015.

[8]. U. S. Senapati and D. Sarkar, Synthesis and characterization of biopolymer protected zinc sulphide nanoparticles, Superlattices and Microstructures, 85, 4, 722-733, 2015.

[9]. D. Kumar, S. Kumar, J. Singh, Narender, Rashmi, B. D. Vashistha, and N. Singh, Free Radical Scavenging and Analgesic Activities of Cucumis sativus L. Fruit Extract, Journal of Young Pharmacists, 2, 4, 365-368, 2010.

[10]. M. Jayandran, M. Haneefa, and V. Balasubramanian, Green synthesis and characterization of Manganese nanoparticles using natural plant extracts and its evaluation of antimicrobial activity, Journal of Applied Pharmaceutical Science, 105-110, 2015.

[11]. H.-I. Chen and H.-Y. Chang, Synthesis of nanocrystalline cerium oxide particles by the precipitation method, Ceramics International, 31, 6, 795-802, 2005.

[12]. T. Cui and et al., ChemInform Abstract: Crystal Structures and Properties of Nitrogen Oxides under High Pressure, ChemInform, 47,11, 2016.

[13]. M. Sathishkumar, M. Saroja, M. Venkatachalam, G. Parthasarathy, and A. T. Rajamanickam, Biosynthesis and Characterization of Zinc Sulphide Nanoparticles Using Leaf Extracts of Tridaxprocumbens, Oriental Journal of Chemistry, 33, 2, 903-909, 2017.