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Short Communication

Synthesis and Characterization of Copper Sulphide Nanoparticle By Using Capping Agent CTAB

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ABSTRACT

Various Nano composites were synthesized using different technique like sol-gel, electro polishing etc. In some cases by oxidation or sulfidation treatment also a core shell nanostructure could be generated. Copper sulphide Nano composites exhibited sharp optical absorption peaks which arose because of their structural characteristics. Copper sulphide diameter of 30-40 nm, was grown using sol-gel techniques.

Keywords: Synthesis, Nano composites, Copper Sulphide.

INTRODUCTION

Nano composites are materials in which a phase with Nano scale dimensions is dispersed within a matrix. These matrixes have acquired significance because of interesting physical properties exhibited by them. Various techniques have been used to synthesize these materials. We have synthesized CuS Nano composites using sol-gel technique. By suitable oxidation of the composite a core shell nanostructure was developed in them. Materials exhibited interesting electrical and optical properties.

MATERIALS AND METHODS

Copper chloride ($CuCl_2$, H_2O), Sodium thiosulphate ($Na_2S_2O_3$,$5H_20$) ,Double distilled water and Acetone.

Synthesis: Copper sulphide nanoparticles were synthesized by simple sol-gel technique. The reactants were taken in presence of CTAB which acts as capping agent and also avoids agglomeration. As the concentration of CuS depends on the concentration of reactants so equal amount of $CuCl_2$ (0.3 M) and sodium thiosulphate (0.3 M) are used for the synthesis.CTAB was added slowly with constant stirring to the $CuCl_2$ solution within a 250ml beaker. Solution was stirred for 3.5 h with magnetic stirrer. Sodium thiosulphate solution was added dropwise to the above solution at 80^0C for the formation of Nano crystalline CuS. Final solution was stirred for 24h. Stirred solution then filtered and washed several time with double distilled water, followed by acetone and dried at 60^0C.

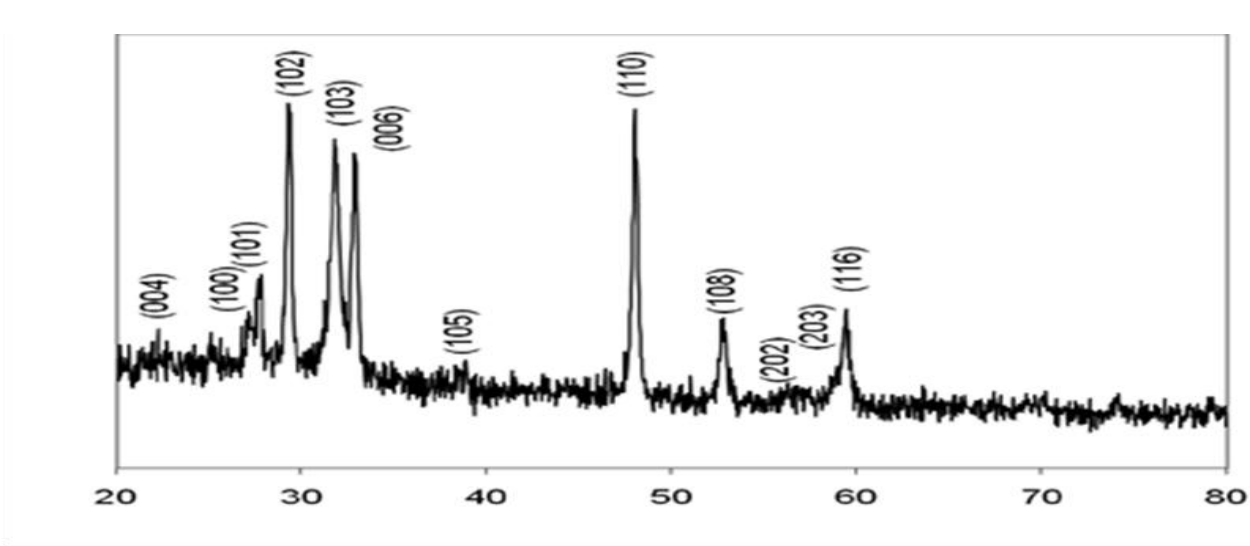
$CuCl_2$, H_2O solution prepared
↓
Solution stirred for 3.5 h with magnetic stirrer
↓
$Na_2S_2O_3,5H_2O$ added in presence of capping agent CTAB
↓
Solution kept for 24h in stirring condition at 80^0C
↓
Filtered, washed by double distilled water
↓
Dried at 60^0C by acetone

RESULTS AND DISCUSSION

XRD Analysis: According to the shell reaction feature identified, powder X ray diffraction (XRD) of this sample (Fig 1) revealed the presence of two crystal structures: one is tetragonal and the other is monoclinic. The vertical lines indicate the positions and intensities of XRD peaks of powder CuS. The intensity shows the corresponding XRD patterns at higher resolution.Diffraction peaks can be closely matched with the monoclinic and tetragonal structures. Among these two structural phases, the monoclinic phase seems to be more abundant based on the XRD data.[1],[2].The size of nano particle is calculated by Scherrer formula.

$$D = (K.\lambda)/(\beta.\text{Cos}\ \theta)$$

Where λ is the X-ray wavelength, K is a dimensionless shape factor, β is the line broadening at half the maximum intensity and θ is the Diffracted angle.



2Θ in degree

Fig1:Intensity vs Angle(degree),X.R.D Graph

FTIR Spectroscopy: The intensity peak in fig.2 at 3440cm^{-1} correspond to bond N-H, O-H of alkanes, amide, alcohol and H-bonded to phenols. Peaks at 2950, 2930 and at 2809 indicates the presence of

strectching vibrations of C-H. The peak at 1640 indicate C=C, C=O stretching vibrations of alkenes and amides. The peak at 1031 indicates C-O, C-N stretching vibrations and it coreesponds to presence of alcholos, carboxylic acid and aliphatic amines in the extract.Peaks apepeared at the position 450, 530 and 595 corrsponds to streaching vibration of C-F, C-Br, C-Cl bond.So we can assumed that both alkaloides and phenolos which are water soluable acts as a capping agent as well as stbilising agent[3,4].

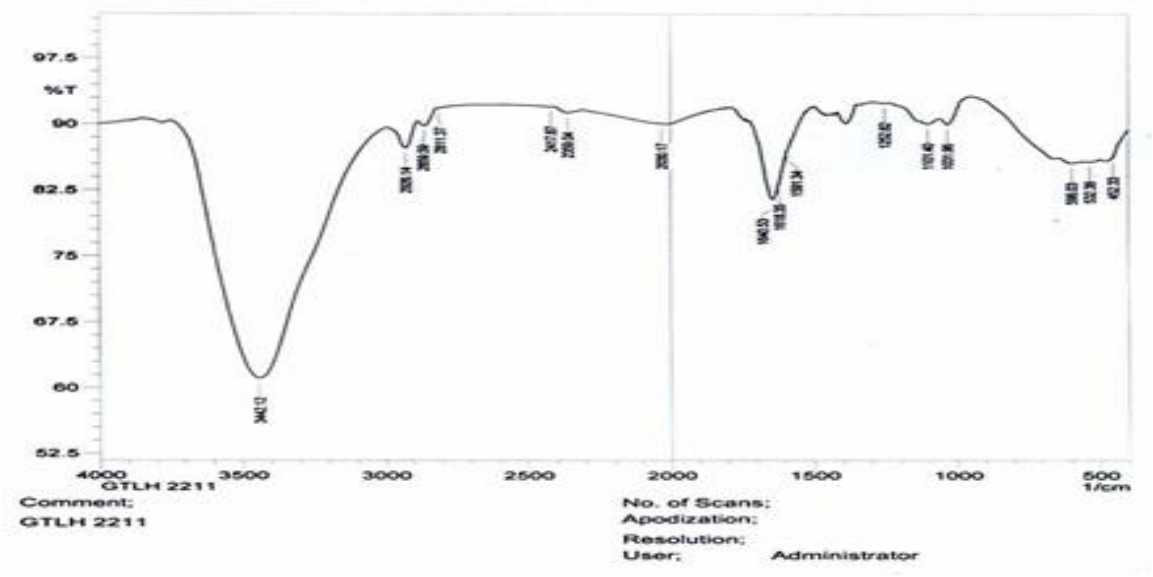


Fig 2.Intensity vs wave number graph(FTIR)

UV Spectroscopy: Due to free electron of metal nano particle resonance absorption band (Fig.3) appears when as free electrons are combined with light wave.sharp peak appears at 470 nm which is called characteristics wavelength of CuS nano particle.It signifies that presence of CuS nanoparticle. It signifies blue shift from the energy gap of bulk CuS, confirming the effect of quantum size confinement.The peak absorption can be assigned to the overlapping d–d transition of Cu^{2+}ion in the sample.Blue shift in absorption spectrum occurs due to weak crystal bonding. Thus, the lowest excited state of the d electrons is shifted and the d–d transition is shifted to the blue region.[5,6].

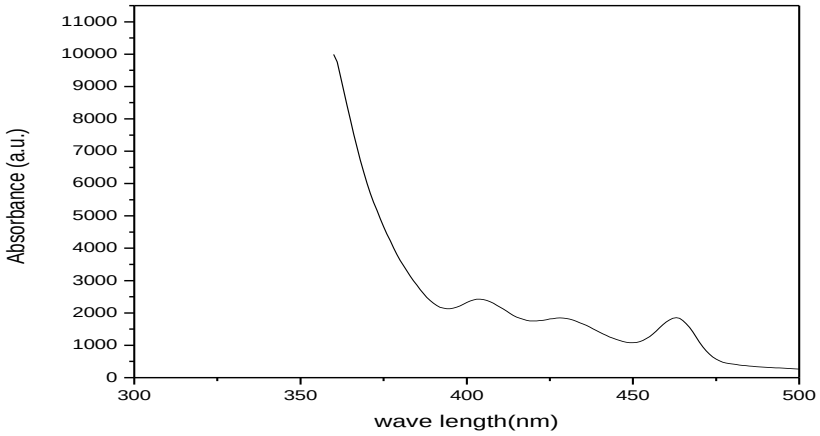


Fig 3.Absorbance vs wavelength graph(U.V)

PLSpectroscopy: Fig 4 shows the PL spectrum from the as synthesized CuS nanoparticles (excitation at 360 nm)at room temperature .The PL spectrum of the CuS nanoparticles shows a peak centered at 450nm which is shorter than submicron CuS, indicating a CuS nanocrystals obtain in this work in quantum size[7,8].

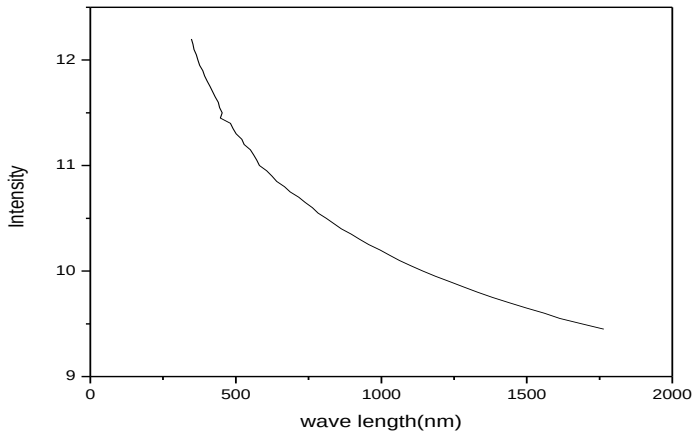


Figure 4.Intensity vs wavelength graph (P.L)

APPLICATIONS

Due to the above properties of CuS nanoparticles it can be used in large scale in the field of optoelectronics.

CONCLUSIONS

In this work we are able to show to prepare by low cost ,safe and easy hydrothermal method.The molar concentration ratio of the reactents were found to be significant parameters for preparation of CuS nanoparticle.CTAB acts as stabilisation agent.U.V spectroscopy shows that band gap of CuS nanoparticle ranges from 1.3 ev to 1.7 ev. Due to this property CuS can be used as optoelectronic devices.This sample can also be used for medical and pharmaceutical applications in large scale.The treatment based on CuS nanoparticle is important and it will be focused for future.

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