Fabrication and Description of Copper Sulfide Nanostructures

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ABSTRACT

Covelite (CuS) has been investigated for its structural, compositional, electrical, and luminous characteristics utilising copper acetate and thiourea in the presence of mixed solvents (water-butanol and water-cyclohexanol). The X-ray diffraction (XRD) pattern of the Copper Sulfide samples revealed the hexagonal structure, which is the result of various mixed solvents. Through the use of energy dispersive X-ray (EDX) and Fourier Transform Infrared (FT-IR) examinations, bond and atomic weight % were determined. The Copper Sulfide particle morphologies for water-butanol and water-cyclohexanol were found to be rod- and flake-shaped, respectively, using a scanning electron microscope (SEM). Copper sulfide nanostructures band gap energies were determined using the optical band energy curve and UV–Vis absorption spectra. The sulphur vacancy flaws were the cause of the UV and visible emission bands seen in the PL spectra. The electrochemical characteristics of the water-cyclohexanol helped Copper Sulfide sample are better than those of the water-butanol assisted Copper Sulfide sample, according to the CV investigation. The proportion of cango red (CR) dye degradation in the mixed solvent-assisted Copper sulfide samples was calculated based on the catalysts' efficiency.

INTRODUCTION

Copper sulfide linked to environmental issues, hazardous wastes and toxic water contaminants have received a lot of attention. The significance of organic dyes for the textile and other sectors is also highly pertinent. Catalyst approaches provide several benefits over traditional methods, including faster oxidation and the absence of polycyclic product production. Due to light absorption from semiconductor materials, the band gap energy has been equivalent to or more, which might cause free radicals to oxidize the system's surface. But these days, Copper sulfide is the main topic because of its link to energy storage and biological applications including antibacterial and anticancer treatment. Chalcoginide nanostructure semiconductors, including ZnS, CdS, NiS, CoS, and CuS, may find use in gas sensors, LEDs, photovoltaic cells, photocatalysis, and other applications. CuS nanostructures, one of the chalcoginides, are p-type semiconductor materials that are very beneficial in photothermal, photoconductive, and optoelectronic applications due to their low band gap of 2.2 eV at ambient temperature. This results from the interaction between photon-atom molecules and light absorption during the optical absorption process. The development of transition metal oxides with various morphologies as optoelectronic materials has sparked new interest, and reports of a recently discovered class of nanomaterials with intriguing photophysical characteristics are fostering the emergence of a new generation of nanomaterials for use in photonics and microelectronics technology. Therefore, it should be crucial to create a mixed solvents approach that works well for synthesising nanomaterials with predictable size and shape in the nanoscale range. The hydro/solvothermal synthesis of 1 and 3-D CuS nanostructures utilising copper acetate and thiouria in the presence of mixed solvents (water-butanol and water-cyclohexanol) has not yet been reported. Additionally, CuS nanostructures' optical absorption, photocatalytic, electrochemical, and luminescent qualities.

Copper Sulfied nanostructure preparation

Without requiring further purification, all of the chemical reagents were commercially available and had AR purity. In 80 millilitres of water-butanol, 1.82 g of thiourea and 1.59 g of copper acetate were dissolved. First, 80 millilitres of water-butanol were used to dissolve the copper salt. Next, thiouria was added and the mixture was stirred for 30 minutes. The resulting Cu-Tu complex solution was quickly moved into a 100 mL Teflon-lined stainless steel autoclave and kept at 180 °C for.

Analysing structures

The XRD examination determined the Copper sulfide samples' crystal structure and phase purity. Copper sulfide samples were aided by the various combined solvents' XRD signals. Strong and crisp diffraction peaks are seen in XRD patterns, indicating that the Copper sulfide samples have excellent crystalline structure. The Copper Sulfide samples' (JCPDS No. 65-3556) hexagonal structure was revealed by the XRD pattern, and this structure closely matches the copper sulfide nanostructure study from earlier.

CONCLUSION

To sum up, the hydro/solvothermal technique was effective in synthesizing Copper Sulfide nano rod and nanoflakes. The Copper sulfide samples with excellent purity and crystallinity were shown to have a hexagonal structure by the XRD patterns. The FT-IR investigations revealed the Cusingle bondS bond's molecular structure. The morphology of the water-butanol and water-cyclohexanol aided CuS samples was shown by the HR-SEM to be rod and flake shaped. TEM scans show that the nanorods' typical width is between 40 and 72 nm, while their average length is also shown.

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