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Opto-Electrical Properties Studies Of Cu_2S Thin Film Prepared By Chemical Bath Deposition Method

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Abstract: Nanocrystalline Cu_2S thin film has been successfully synthesized by chemical bath deposition (CBD) method. The film was deposited on glass substrates at 50^OC for 30 min. The Cu_2S thin film was characterized using UV-Vis spectroscopy and I-V characteristics. This prepared Cu_2S thin film shows good absorbance in visible range. Cu_2S thin film shows 2.3eV band gap was found by optical Study. The current voltage characteristics measure under dark and illumination condition at room temperature. The Cu_2S thin film shows the good response under illumination condition.

Keyword: CBD, visible, band gap, illumination etc.

I. INTRODUCTION

Four kinds of copper sulfides of different chemical compositions were chemically deposited and examined for their optical and electrical characteristics found in literature survey [1]. The copper sulfide is an important semiconductor material and unique physical and chemical properties. The copper sulfides are used in various applications such as solar cells, light emitting diodes, defrosting windows, and optoelectronics. Due to this, Cu_2S thin films have been used in air-glass tabular solar collectors as absorber coating in photoelectron and photovoltaic applications. Cu_2S thin films are used in solid junction solar cells, that have many applications as, it is a direct conversion device [2-4]. Cu_2S thin films have transmittance in infrared region, low reflectance in the visible region and hierarchical petal like nanostructures [5, 6]. Different methods have been employed to deposit Cu_2S thin films, among these; electrochemical deposition, Spray pyrolysis, Hydrothermal method. Such as, it involves relatively simple and inexpensive equipment, the deposition occurs closer to equilibrium than in many high temperature methods and inter element diffusion is not a problem, the toxic gaseous precursors are not used. In comparison with electrochemical, the chemical bath deposition (CBD) method is very simple and because of its electric nature, the process can be controlled. In the present investigation we have synthesized Cu_2S thin films by CBD technique [7-10].

II. EXPERIMENTAL

Copper sulfides thin films were prepared on glass substrate by Chemical bath deposition (CBD) technique. The bath contains 0.02M $CuSO_4$ and 0.05 Thiourea as sources of Cu and S ions. These reactions, however, are inconvenient for film depositions, and for that purpose copper ions are usually complexes by a suitable complexing agent, such as triethanolamine, citric acid, or EDTA. The 2-3drops of Triethaloamine (TEA) and 4ml of ammonia as complexing agents. Solutions were prepared in double distilled water. The pH in all the baths was 10-12 adjusted by diluted ammonia. The temperature of the baths was maintained at 50^0 C for 30 min. The substrates used were standard microscope glass slides [9]. The glass substrates were first ultrasonically cleaned, the soaked for a few minutes in chromic acid and acetone. Films were grown in the baths for about 30 min after precipitation began, then taken out, rinsed with distilled water, dried in air, and preserved for investigation.

The optical measurements were studied in the range of 300 to 900 nm using UV-VIS spectrophotometer (Hitachi model U-2900). Electrical measurements of CZTS thin film were performed by monitoring current–voltage (I–V) characteristic curves [LAB equipment model 24 (2004)].

III. RESULTS AND DISCUSSION

The UV-Vis absorption and band gap spectra of copper sulfide film. The absorption spectra range from 300 to 900 nm shows in fig.1. The optical properties have studied to reveal the information about the light absorption and band gap of the material [9].

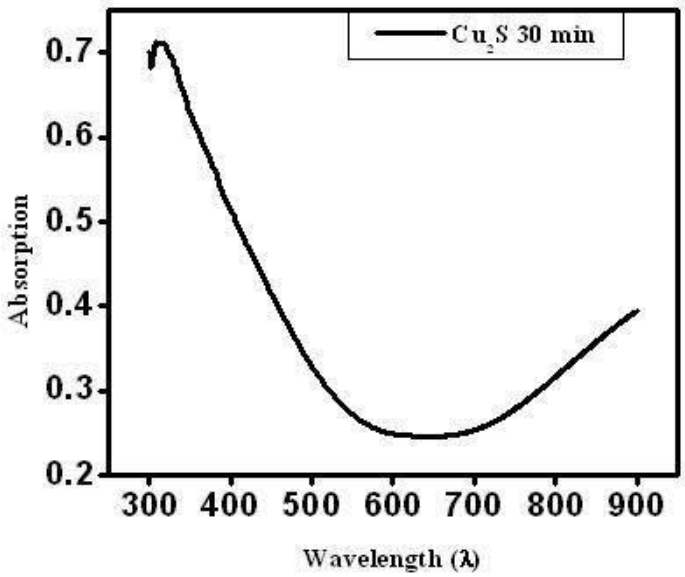

Fig. 1. Absorption of Cu_2S thin film

The absorption in the shorter wavelength region is probably due to inter band transitions from the valence toward the conduction band, while absorption in the higher wavelength may attribute to free carriers [9]. From absorption we calculate the band gap of Cu_2S thin film was 2.3eV.

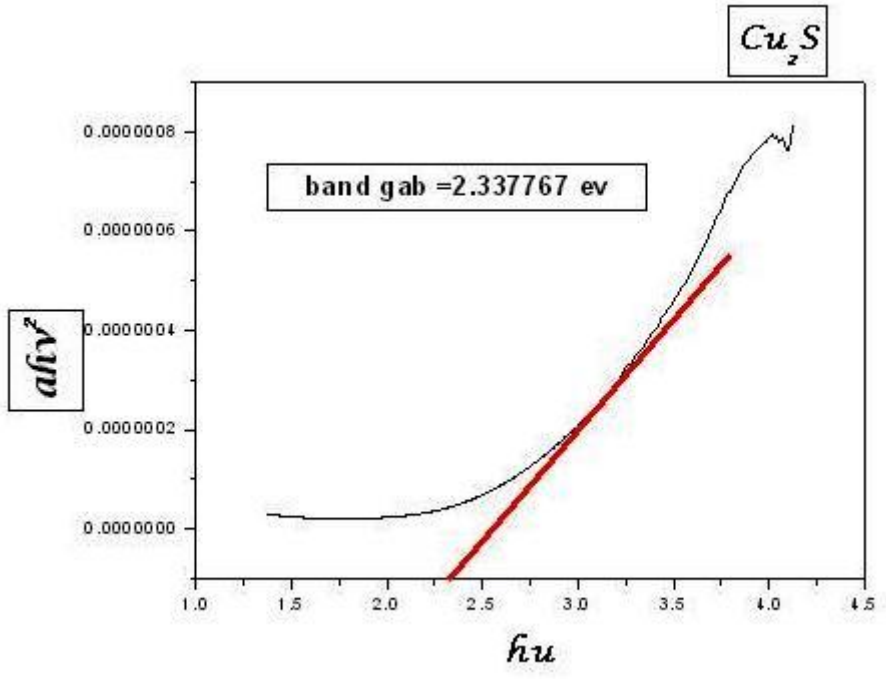

Fig. 2. Band gap of Cu_2S thin film

I-V characteristic curves of the thin film have used for the electrical characterization of the samples at room temperature. Fig3. Represent the I-V characteristic curves in dark and under illumination of light of Cu_2S thin film prepared by CBD method. Cu_2S thin film current has increased under illumination with an increase in number of free charge carriers [7].

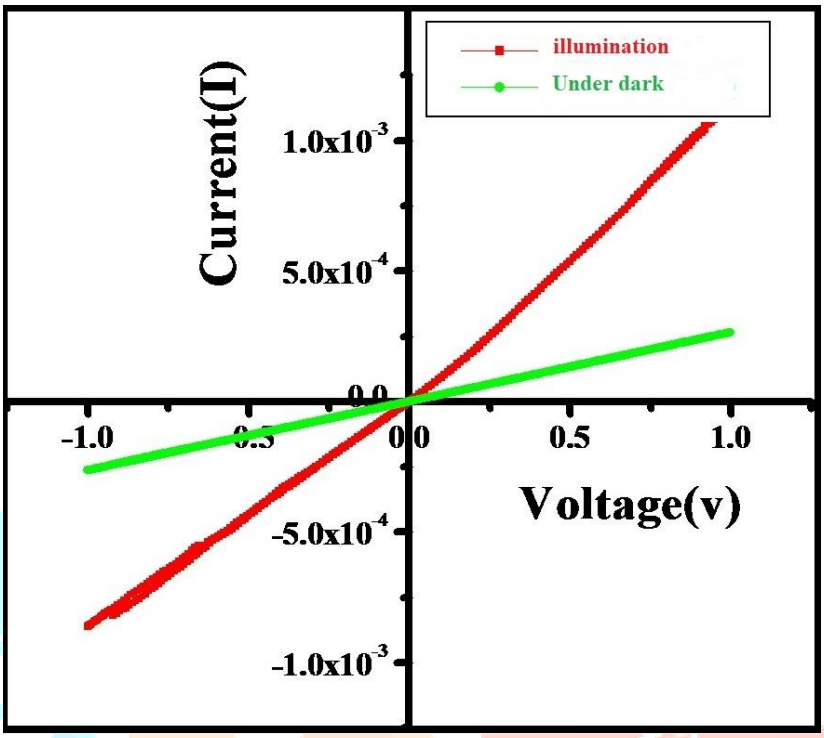

Fig.3. I-V characteristics of Cu_2S thin film.

IV. CONCLUSION

The Cu_2S thin film deposited by chemical bath deposition on glass substrate. The film was prepared at 50^{O}C for 30 min. The film shows good absorbance in visible range and the band gap of Cu_2S thin film was 2.3eV calculated by optical properties. The resistivity shows Cu_2S thin film was semiconductor nature. I–V studies reflected good photo-response of Cu_2S thin film under illumination. The optical and electrical properties revealed that the Cu_2S thin film can be suitably optoelectronics application.

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