Impact Factor – 6.625 | Special Issue - 218 | January 2020 | ISSN – 2348-7143

INTERNATIONAL RESEARCH FELLOWS ASSOCIATION'S

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Multidisciplinary International E-Research Journal

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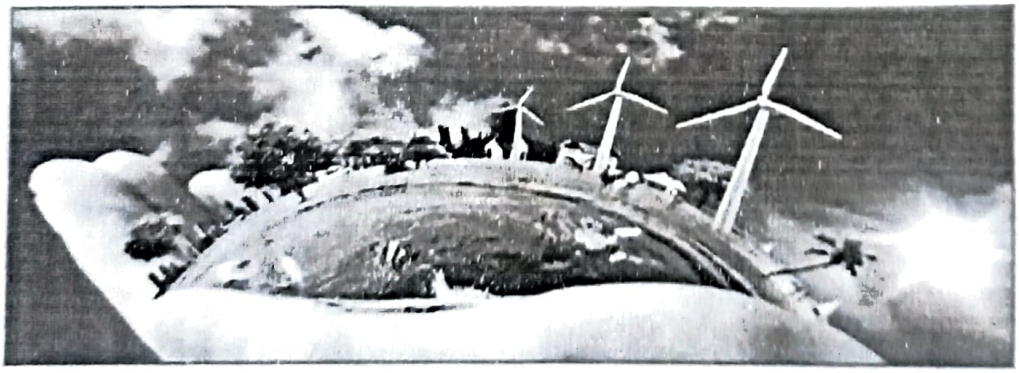
NATURAL RESOURCES MANAGEMENT AND SUSTAINABLE DEVELOPMENT



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ISSN : 2348-7143
January 2020
RESEARCH JOURNEY International Multidisciplinary E-Research Journal
Impact Factor (SJIF) - 6.625 | Special Issue 218 : Natural Resources Management and Sustainable Development

Effect of deposition time on growth of cadmium sulfide (CdS) thin film for photovoltaic application

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Abstract:

Cadmium sulphide (CdS) thin films are widely used as a buffer layer in thin film solar cell (TFSC). In this work chemical bath deposition (CBD) method is employed to grow CdS thin films. The effect of different deposition time on various properties of CdS thin films are extensively studied. CdS films grown on glass substrates by using CBD method are adhered well to the substrate and showed good optical properties. Optical and morphological properties are studied with the help of UV-Vis absorption spectroscopy and scanning electron microscopy (SEM), respectively. The optical absorption spectra were recorded in the wavelength range of 300-700 nm. Band gap of the films were calculated from Tauc plot. It is observed that band-gap of the CdS thin films decreases with increase in the deposition time. SEM shows uniform, compact deposition over the substrate with granular morphology. Increase in particle size is observed for sample deposited at higher deposition time.

Key Words: CdS thin films, chemical bath deposition, complexing agent.

1.0 Introduction:

Semiconductor thin film has attracted much attention due to their applications in microelectronics, optoelectronics, nonlinear optics, photocatalysis and energy conversion industries [1]. Cadmium sulfide (CdS) is a direct band gap (2.42 eV) II-VI group metal chalcogenide semiconductor material. CdS is a best material showing strong light absorption in visible region [2]. CdS thin films have proven applications in various areas such as photodetector [3], thin film field effect transistor [4], sensors [5], light emitting diode [6] and optoelectronic devices [7]. Moreover, thin films of CdS are piezoelectric and used as transducers operating at frequencies in the GHz region [8]. Research is extensively carried out on CdS thin film as in order to improve the optoelectronic properties as it is a promising material and has a wide application as a buffer layer thin film solar cell [9]. CdS shows a promising candidate for the formation of heterostructure in CIS, CIGS thin film solar cell [10-11].

Various deposition methods such as atomic layer deposition [12], magnetron sputtering [13], spray pyrolysis [14], metal organic vapor phase epitaxy [15], molecular beam epitaxy [16], vacuum evaporation [17] are used to grow CdS thin film. Among these methods, chemical bath deposition (CBD) is mostly favored because it is one of the low cost methods as the others are expensive and need high purity chemicals along with sophisticated equipment also. Simple equipment's like water bath with temperature indicator, magnetic stirrer with solution beakers are used in this method. The starting chemicals are commonly available and are cheap. With this method, a large number of depositions of thin films can be done with number of cycles. Any insoluble surface of any shape can be a suitable substrate for deposition. The low temperature deposition avoids oxidation and corrosion of metallic substrates. Moreover CBD yields adherent, uniform deposition with good reproducility. The growth of thin film is strongly dependent on growth condition such as deposition duration, concentration of precursors, temperature, etc. Improvement in the above growth parameters can lead to provide pathways to develop high efficiency solar cells.

In the present work CdS thin films are deposited by using CBD method in aqueous solution. The effect of deposition duration on optical and morphological properties of CdS thin film is studied extensively.

2.0 Experimental Details:

2.1 Materials:

All chemicals Cadmium sulphate ($CdSO_4$), Ammonium chloride (NH_4Cl), Thiourea (CH_4N_2S) and Ammonia solution were AR grade and used as received. Double distilled water is used as solvent.

2.2 Experimental procedure:

The major advantage of CBD is that it requires only solution containers and substrate mounting devices. For the preparation of CdS thin film using the chemical bath

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