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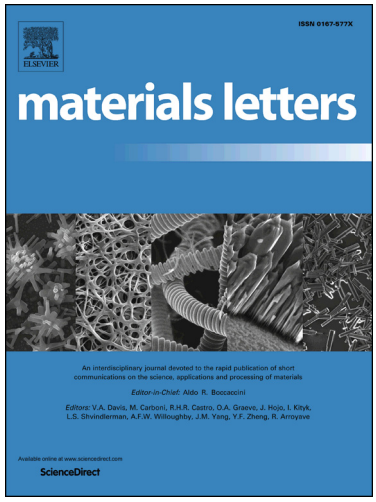

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Investigations on Hot-wall deposited Cadmium Sulphide buffer layer for thin film solar cell

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Abstract:

Cadmium Sulphide (CdS) thin films were deposited on to well-cleaned soda lime glass substrates using hot wall deposition technique at room temperature. The structure of CdS thin films was found to be hexagonal with <002> orientation and after annealing the film crystallized to <002>, <101>, <102>, <112> directions. Raman Spectroscopy confirmed the hexagonal structure with a shift at 312 cm^{-1}. SAED pattern from the Transmission electron microscopy also confirmed the formation of hexagonal CdS. X-ray Photoelectron Spectroscopy confirmed the formation of CdS with relevant at% of Cd and S. Field emission scanning electron microscopy images revealed smooth surface of the thin film with distinctive grains. Atomic force microscopy results showed a surface roughness of 4.47 nm. Transmission spectra of the films were studied and the transparency was found to be above 80%. The optical band gap was found to be around 2.4eV in accordance with the reported values. The results show that device quality buffer layers can be deposited using hot-wall deposition.

Keywords: Cadmium Sulphide, Buffer layer, Thin film solar cell, Vacuum deposition, Film Uniformity, Optical films

1. Introduction :

Cadmium sulfide (CdS) is an important II-IV semiconductor which is used in variety of applications in electro-optics, infrared devices and mainly as intermediate layer in solar cells such as Cadmium Telluride (CdTe), Copper Indium Diselinide (CIS), Copper Indium Gallium Selenide (CIGS), and of late in Copper Zinc Tin Sulphide (CZTS) [1][2]. CdS is a non-stoichiometric n-type semiconductor with direct band gap energy of 2.42 eV (bulk CdS). The band gap of CdS is in the visible region of the electromagnetic spectrum, leading to high photosensitivity of CdS in this region[3].

CdS films have been prepared using several methods, such as chemical-bath deposition (CBD) [4], electrodeposition [5], spray pyrolysis [6] and closed space vapor transport (CSVT) [7]. Among the various techniques, CBD is considered to be a very slow process but, the simplified method helps in obtaining better alignment of the crystallites with enhanced grain structure [4]. CBD formed CdS acts as a better passivation layer to the underlying absorber layer by withstanding the bombardment of high energetic vapor species during the subsequent