Effect of Seed Layer on Opto-Electronic Properties of CdS Thin Film

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Among different methods used to grow CdS films, chemical bath deposition (CBD) and electrochemical deposition (ED) are two of the most commonly used techniques. A novel method of growing chemical bath deposited CdS thin films (CBD-CdS) by using electrodeposited CdS (ED-CdS) as a seed layer is reported and compared with conventional ED-CdS and CBD-CdS films in this work. Conventional ED-CdS films were deposited for a duration of 60 min under potentiostatic conditions of -600 mV against the Ag/AgCl electrode at a bath temperature of 60 °C in a reaction solution of 0.05 mol dm^{-3} cadmium chloride, 0.05 mol dm^{-3} sodium thiosulfate and diluted H_2SO_4. Conventional CBD-CdS films were grown using 0.001 mol dm^{-3} cadmium sulfate, 0.002 mol dm^{-3} thiourea and 1.1 ml of ammonia solution for a period of 60 min. The seed-assisted CBD-CdS films (ED/CBD-CdS) were grown by depositing CBD-CdS on top on an ED-CdS layer deposited for 3 min under the same conditions mentioned above. When compared, the ED/CBD-CdS system showed superior I_{SC} (19.4 µA) performance in PEC cell (CdS/0.1 mol dm^{-3} $Na_2S_2O_3$/Pt) compared to other two systems due to its homogeneity, enhanced majority carrier concentration, high surface roughness, and improved inter-particle connections. The ED/CBD-CdS system also showed a significant improvement in V_{OC} (198 mV) over CBD-CdS (169 mV) and ED-CdS (168 mV) systems potentially due to higher flat band potential. Additionally, comparatively high E_g value of 2.45 eV was obtained for the ED/CBD-CdS due to lower disorder value of ED/CBD-CdS system. These results suggest that the novel method of CdS deposition, seed assisted CBD-CdS thin films demonstrate better opto-electronic properties compared to both ED-CdS and CBD-CdS films alone.

Keywords: CdS, Chemical bath deposition, Electrodeposition, Seed