

Low-Surface Roughness and High Optical Quality CdS Thin Film Grown by Modified Chemical Surface Deposition Method

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Abstract : We report on deposition of smooth, pinhole-free, low-surface roughness ($< 4\text{nm}$) and high optical quality cadmium sulfide (CdS) thin films on glass substrates using our new method based on chemical surface deposition principle. In this method, cadmium acetate and thiourea are used as reactants under special growth conditions for deposition of CdS films. X-ray diffraction (XRD) measurements were used to examine the crystal structure properties of the deposited CdS films. In addition, UV-vis transmittance and low-temperature (4K) photoluminescence (PL) measurements were performed for quantifying optical properties of the deposited films. Interestingly, we found that XRD pattern of the deposited films has dramatically changed when the growth temperature was raised during the reaction. Namely, the XRD measurements reveal a structural change of CdS film from Cubic to Hexagonal phase upon increase in the growth temperature from $75\text{ }^{\circ}\text{C}$ to $200\text{ }^{\circ}\text{C}$. Furthermore, the deposited films show high optical quality as confirmed from observation of both sharp edge in the transmittance spectra and strong PL intensity at room temperature. Also, we found a strong effect of the growth conditions on the optical band gap of the deposited films; where remarkable red-shift in the absorption edge with temperature is clearly seen in both transmission and PL spectra. Such tuning of both optical band gap and crystal structure of the deposited CdS films; can be utilized for tuning the electronic bands alignments between CdS and other light harvesting materials, like CuInGaSe or CdTe, for potential improvement in the efficiency of all-solution processed solar cells devices based on these heterostructures.

Keywords : thin film, CdS, new method, optical properties

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