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TX-100 assisted CBD-Cds thin films

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Among various deposition methods of CdS thin films, chemical bath deposition (CBD) stands out owing to its simplicity and low-cost of fabrication to produce high quality thin films. Triton X 100 (TX-100) is a nonionic surfactant which is widely used as a detergent. In this work CdS thin films were fabricated using the CBD method in the presence of TX-100 (CBD/TX100-CdS). The performances of the fabricated samples were then compared with films deposited without TX-100, using conventional CBD method (CBD-CdS). CBD/TX100-CdS was deposited on thoroughly cleaned fluorine-doped tin oxide (FTO) coated conducting glass substrates using 0.001 M $CdSO_4$, 0.002 M $CS(NH_2)_2$, 1.1 ml of NH_4OH solution and 0.647 mg cm^{-3} of TX-100 in a reaction vessel for one hour. For CBD-CdS, same steps were followed with the use of same chemicals except TX-100. Both TX-100 treated and untreated CdS thin films were fabricated under bath temperatures of 40, 60 and 80 ˚C. Later, all the samples were air annealed at 300 ˚C for one hour. The fabricated samples were characterized using GIXRD, SEM, UV-visible spectroscopy, Mott-Schottky and photo electrochemical (PEC) cell. GIXRD results reveal that the deposited films are hexagonal in phase. Transmittance in the range 300-800 nm was found to be higher for CBD/TX100-CdS compared to CBD-CdS samples. The SEM images indicate all the CBD/TX100-CdS has smaller cluster sizes compared to CBD-CdS samples, which leads to higher band gap values obtained from UV-visible spectroscopy for CBD/TX100-CdS. PEC cell measurements yield that both I_{SC} and V_{OC} values for CBD/TX100-CdS are higher compared to CBD-CdS, while CBD/TX100-CdS fabricated at 60 ˚C bath shows the best $I_{SC} \times V_{OC}$ product. These impressive I_{SC} values observed for CBD/TX100-CdS samples can be due to higher surface roughness of CBD/TX100-CdS, as a result of its smaller cluster sizes. Additionally, the flat band potential calculations from Mott-Schottky measurements also reveal that the deposited CBD/TX100-CdS films have higher flat band potential compared to CBD-CdS. All these results confirm that the optical and electrical properties of the CdS thin films can be effectively improved by the introduction of TX-100 to the deposition medium.

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