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EFFECT OF NH_3 CONCENTRATION AND ANNEALING TEMPERATURE ON CHEMICAL BATH DEPOSITED CdS THIN FILMS

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While majority of the world's power is generated from traditional energy sources such as fossil fuels, coal, oil and natural gasses, these sources face many challenges including rising prices as well as potential extinction in near future. As a result, alternative energy sources such as wind power, biomass and solar etc., have emerged as potential solutions. Among various different solar cell technologies, thin film solar cells stand out due to its promising efficiencies in the range of 16-18% so far. One of the promising material systems for solar cell mass production is the p-CdTe/n-CdS/TCO/glass structure. As CdTe has a near optimal band gap (1.45 eV) for solar absorption. The n-CdS (2.42 eV) forms one side of the hetero junction and acts as the window layer. The calculated theoretical efficiency for CdS/CdTe solar cells have been estimated at around 29% but in practicality the conversion efficiency of 16% was achieved with the application of a post deposition $CdCl_2$ treatment of the CdTe layers. Indeed, control of deposition parameters of CdS films having good optoelectrical properties will be very useful from the technological point of view in developing the CdTe/CdS solar cell. In this research work effect of NH_3 concentration of the chemical bath and annealing of the films have been explored. CdS thin films were fabricated using Chemical Bath Deposition (CBD) method to be applied as the window layer of CdS/CdTe solar cells. CdS was grown using cadmium sulfate (0.1 M $CdSO_4$, 99%), thiourea (0.2 M $CS(NH)_2$, 99%) and ammonia (25% w/w) on commercially available (non-conducting) glass slides. Properties of the films were optimized by varying the NH_3 concentration and annealing temperature.Transmittance in the range 300 – 800 nm was found to decrease with increasing NH_3concentration. The best transmission as well as the best film quality were obtained when the CdS films were deposited at a bath temperature of 80 °C with 0.2 ml of 25% w/w NH_3 solution for 1 h. AFM results confirmed that the thickness of the fabricated films were about 80 nm and the SEM images show that the fabricated films have an average cluster size of about 138 nm. The effect of annealing temperature in air was also investigated in the temperature range 100 °C to 500 °C. With the increasing annealing temperature the transmittance edge was observed to shift toward the higher wavelengths region. The best transmission (about 90%) as well as the film quality was observed when deposited at a bath of 80 °C with 0.2 ml of NH_3 and annealed at 200 °C for 1 h in air.

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