# Growth of CdS and CdTe thin film semiconductors and fabrication of CdS/CdTe solar cells

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Thin films of CdS and CdTe semiconductor materials were electrodeposited onto glass/fluorine doped tin oxide conducting glass surfaces using a potentiostat/galvanostat equipped with a three electrode cell. Aqueous electrolytic bath containing $CdCl_2$ and $(NH_4)_2S_2O_3$ was used for the electrodeposition of CdS thin films. CdTe thin films were electrodeposited onto glass/FTO/CdS substrates from aqueous solution having high concentrations of $CdSO_4$ and low concentrations of $TeO_2$ and $CdCl_2$. The glass/FTO/CdS/CdTe/Cu-Au solar cell devices were prepared by thermal evaporation of Cu and Au on CdTe surface.

CdS films grown were annealed at ~400 °C for 15 minutes in air and photo-electro chemical (PEC) cell measurements were performed to identify the electrical conductivity type. Both as-deposited and annealed CdS layers were identified as n-type in electrical conduction. CdS thin films were shown enhanced PEC responses upon heat treatment. The respective band gap values for as-deposited and heat treated CdS were 2.35±0.05 eV and 2.40±0.05 eV which were close to the band gap of bulk CdS. XRD analysis of as-deposited CdS layers revealed the presence of hexagonal CdS materials with the major peak arising from (002) plane.

Following the CdTe deposition on glass/FTO/CdS substrate, the surface of CdTe layers were coated with a 0.1% $CdCl_2$ solution and structures were annealed at ~400°C for 10 minutes in air. Band gaps for CdTe layers were found to be 1.45±0.02 eV for both as-deposited and annealed samples which exhibited the band gap of bulk CdTe. There was a little improvement in cubic (220) and (311) peaks of XRD spectra of annealed CdTe layers compared to the as-deposited material, but annealing exhibited a small reduction of cubic phase preferential orientation (111). SEM images showed that CdS and CdTe layers were fairly uniform. The fabricated solar cell devices showed the efficiency of 2.1% with $V_{oc}$ ~330 mV, $J_{sc}$~20 mA $cm^{-2}$ and FF~33% under the illumination of air mass (AM) 1.5 conditions (100 mW/$cm^2$, 1 Sun).

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