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Improved n-type photoconductive Cu_2O thin films

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It has been reported earlier that electrodeposition of Cu_2O in slightly acidic solutions, attributes n-type conductivity and all other processing techniques produce p-type conductivity. The n-type conductivity of Cu_2O is very important in developing low cost thin film solar cells because the electron affinity of Cu_2O is comparatively low. However, the n-type Cu_2O reported so far exhibits n-type photoactivity in photoelectrochemical cells (PEC) at anodic potentials and p-type photoactivity at cathodic potentials. This effect is a major problem in the fabrication of PV devices, as it causes the reduction of the overall performance of the device.

In order to avoid the formation of p-type photoactivity in n-Cu_2O thin films, Cu_2O thin films electrodeposited on Ti substrate were studied in a three electrode electrochemical cell containing aqueous solutions of 0.1 M sodium acetate. The pH of the bath was adjusted to different values from 4.9 to 8.1 by adding dilute hydrochloric acid. Electrodeposition was carried out under a potentiostatic condition of -200 mV Vs Ag/AgCl for 60 min. at a temperature of 55 ^oC. Electrodeposited Cu_2O thin films were characterised by using dark and light current-voltage measurements and spectral response measurement in a PEC containing 0.1 M sodium acetate solution.

Dark and light current-voltage and spectral response characteristics in a PEC revealed that, in general, electrodeposited Cu_2O thin films produce p-type photoconductivity in addition to the n-type photoconductivity, which has been reported earlier in the literature. However, Cu_2O thin films grown at a pH value of 6.12 show only an n-type photosignal in both I-V and spectral response measurements. This improves significantly the overall n-type photoactivity of Cu_2O thin films and gives the optimum condition for growth of n-Cu_2O thin films. In conclusion, our study reveals that the pH of the bath is crucial for obtaining the n-type Cu_2O thin films and that the optimum pH value of the deposition bath is 6.12.

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