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Fabrication and characterization of electrodeposited CuO/Cu₂O heterojunction solar cell

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The need for sustainable energy technologies has invigorated research in many photovoltaic systems with increasing emphasis placed on balancing cost and performance. In this context, there has been a renewal of interest in solar cells based on cuprous oxide (Cu₂O) and cupric oxide (CuO) as semiconductors because these semiconductors show many important characteristics useful for solar cell fabrication. These include low raw material cost, direct energy gaps of 1.3 eV (CuO) and 2.0 eV (Cu₂O), nontoxicity, long term stability and their suitability to low cost scalable fabrication processes such as electrodeposition. This work reports the results of a study carried out on electrodeposited p-type CuO thin films on Ti substrates and n-type cuprous oxide (Cu₂O) electrodeposited on CuO to form a p-CuO/n-Cu₂O heterostructure. The surface of the Cu₂O films which had undergone the ammonium sulfide treatment showed reduced resistivity. XRD and SEM analysis revealed that the films were of good structural quality with the substrates being well covered by the films. The p-CuO/n-Cu₂O heterojunction showed good photovoltaic properties and diode characteristics. The resulting Ti/p-CuO/n-Cu₂O/Ni solar cell structure produced an energy conversion efficiency of 0.52 % with $V_{oc} = 190$ mV and $J_{sc} = 6.4$ mA cm⁻², under AM 1.5 illumination.

Keywords: Cupric oxide, cuprous oxide, electrodeposition, spectral response, IV characteristic

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