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Enhancement of the photovoltaic conversion efficiency of electrodeposited p-n homojunction cuprous oxide solar cells by surface passivation

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Cuprous oxide homojunction thin films on Ti substrates were fabricated by an inexpensive two-step electrochemical process depositing a p-Cu_2O layer on an n-Cu_2O layer. A p-Cu_2O layer was then sulfided with ammonium sulfide. Photocurrent spectral response and capacitance-voltage measurements were used to determine the conduction type of each layer. These measurements demonstrated the successful formation of a p-n homojunction of cuprous oxide. P-type Cu_2O layers which had undergone the ammonium sulfide treatment showed reduced resistivity, enhanced current-voltage (*I-V)* characteristics. The results revealed that, upon ammonium sulfide treatment, Cu_2O p-n homojunction solar cell performance improved compared to that of the unpassivated Cu_2O p-n homojunction solar cell. This improvement in the ammonium sulfide treated solar cell is attributed to the passivation of defects in the p-Cu_2O layer by sulfur. The resulting Ti/n-Cu_2O/p-Cu_2O/Ni solar cell structure produced an energy conversion efficiency of 1.94 % with V_{oc} = 430 mV and J_{sc}= 10.2 mA cm^{-2} under AM 1.5 illumination. This was a significant improvement compared to the efficiency of the unpassivated solar cell structure which was 0.12%.

Keywords: Cuprous oxide, electrodeposition, homojunction, spectral response, IV characteristic

Acknowledgements**:** Financial assistance from HETC project (grant KLN/O-Sci/N4)

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