Efficiency improvement of electrodeposited *p-n* homojunction cuprous oxide solar cells by surface passivation and annealing

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There is considerable interest on the efficiency improvement on Cu_2O based solar cells. However, the highest reported efficiencies on such structures have not exceeded 2% even though the theoretical efficiency is reported to be around 20%. It is generally accepted that a *p-n* homojunction of Cu_2O has the potential to become a structure with high conversion efficiency [1]. Mainly, the high resistivity and defects at the junctions are reported to have hindered the reliability and performance of resulting Cu_2O based devices. In this study two different electrodeposition media were used to produce n-Cu_2O layers [2] and p-Cu_2O layers [3]. Cuprous oxide homojunction thin films on Ti substrates were fabricated by two-step electrochemical deposition process depositing a p-Cu_2O layer on an n-Cu_2O layer. The p-Cu_2O surface layer was passivated by sulfur. 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. XRD and SEM analysis revealed that the n and p type films were single phase and the substrates were well covered by the films. p-type Cu_2O layers which had undergone the sulfur treatment showed reduced resistivity and enhanced current-voltage (*I-V)* characteristics. Results revealed that, upon sulfur treatment, Cu_2O *p-n* homojunction solar cell had improved characteristics compared to those of untreated Cu_2O *p-n* homojunction solar cell due to the passivation of defects and reduced resistivity in the sulfur treated p-Cu_2O layer [3]. Annealing of the sulfur treated solar cell structures improved efficiency further yielding an optimum annealing temperature and annealing time of 150 ^{0}C and 20 min. respectively with an energy conversion efficiency of 2.14 % ,V_{oc} = 485 mV and J_{sc} = 11.4 mAcm^{-2} under AM 1.5 illumination. This was a significant improvement compared to the efficiency of unpassivated unannealed solar cell structures.

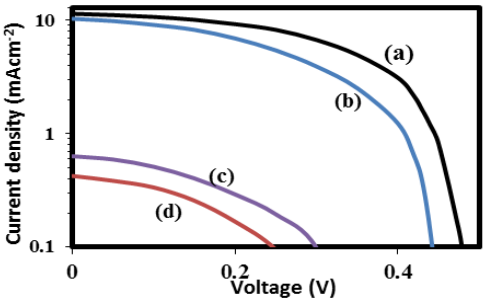

Figure1. Current- voltage characteristics of (a) annealed and sulfur treated (b) unanealed and sulfur treated (c) annealed and untreated (d) unannealed and untreated Ti/n-Cu_2O/p-Cu_2O/Ni solar cells.

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