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Fabrication Of Cuprous Oxide Homojunction Solar Cell By Varying The Lactic Acid Ion Concentration Of Thin Film p-Cu_2O Deposition Bath

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In this study, we have investigated the possibility of improving the V_{OC}, FF and η values of Cu_2O solar cells while preserving the resulted high J_{SC} values. Here we report that controlling the growth of p-Cu_2O by varying the lactic acid ion concentration of thin film p-Cu_2O deposition bath has improved the performance of Cu_2O homojunction solar cell while preserving high J_{SC} value. The fabricated surface treated thin film p-n homojunction solar cell has resulted J_{SC} = 12.95 mA cm^{-2}, V_{OC} = 445 mV, FF = 39.5% and η = 2.28%. The efficiency reported here is very significant in respect of Cu_2O homojunction solar cells because it clearly demonstrates the possibility of adapting the low cost Cu_2O material and fabrication methods in achieving a commercially viable solar cell.

Introduction

Cuprous oxide (Cu_2O) is known to be the oldest low-cost, environmentally friendly lattice defect type semiconducting solar energy material (1). For decades its optoelectronic properties have intrigued PV community to investigate on development of Cu_2O based solar cells (2–6). Of course, development of thin film Cu_2O solar cells could provide affordable solar cells to the tropical rural communities to benefit cost-free electricity.

TABLE I: Reported performance of Cu_2O homojunction solar cells; open circuit voltage (V_{OC}), short circuit current density (J_{SC}), fill factor (FF) and power conversion efficiency (η)

V_{OC} (mV)	J_{SC} (mA cm^{-2})	FF (%)	η(%)	Reference
287	12.4	25	0.89	(7)
423	2.5	27	0.29	(8)
490	12.8	NR*	2.64	(9)
420	2.68	38	0.42	(10)
621	4.07	42	1.06	(11)
324	12.67	30.7	1.3	(12)
320	1.23	35	0.102	(13)
120	3.97	23	0.104	(14)

*NR – Not Reported

Thin film Cu_2O can be synthesized easily using method of electrodeposition. Electrodeposited thin film Cu_2O will exhibit n- or p-type conductivity based on the deposition parameters as well as annealing conditions (15–18). In principle, fabrication of