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Electrodeposited $(Cu_2O)_{1-x}(CuO)_x/Cu_2O$ heterojunctionsolar cell

K D R N Kalubowila, R P Wijesundera and W Siripala
Department of Physics, University of Kelaniya, Kelaniya, Sri Lanka

Abstract

Cuprous oxide (Cu_2O) thin films werepotentiostatically electrodeposited on Ti substrates in an acetate bath and resultingfilms were annealed at 400 °C for 15 min in air forthe growth of p-$(Cu_2O)_{1-x}(CuO)_x$ composite thin films on Ti. Zero bias spectral response measurements were employed to investigate n-Cu_2O growth conditions on p-$(Cu_2O)_{1-x}(CuO)_x$ composite thin films.$(Cu_2O)_{1-x}(CuO)_x/Cu_2O$ heterojunction was fabricated for the application of a solarcell by electrodeposition of n-Cu_2O thin film on Ti/$(Cu_2O)_{1-x}(CuO)_x$ electrode at -500 mVVs SCE for 60 min. Spectral response, dark and light current-voltage and capacitance-voltage measurements in a PEC were employedin this investigation for the characterization of the thin films.Ti/$(Cu_2O)_{1-x}(CuO)_x/Cu_2O$/Ausolar cell structure was fabricated by sputtering avery thin Au grid on the Cu_2Ofilm andit producedV_{OC} of 320 mV and I_{SC} of 110 μA.

1.0Introduction

Solar cells are amongthe most advanced technologies that generate power from abundant solar energy.Silicon is used as the semiconductor material for conventional solar cellsbut Si solar cells have achieved their maximum efficiencies and they arestill very expensive. Therefore scientific community is focusing their attention on low cost thin film semiconductor materials for PV applications. As an alternative martial for Si, metal oxide semiconductors play a major role for the development of low cost solar cells. Copper oxides which have two stable forms,cuprous oxide (Cu_2O) and cupric oxide (CuO), are candidate materials for PV application due to their importantoptoelectonic properties[1, 2].Cu_2O has a cubic structurewith a lattice constant of 4.27 Åand a direct optical band gap energy of 2.0 eV,which is suitable asa window materialfor solar cells[3, 4]. Cu_2O is a defect type semiconductor and it is well understood as a p-type material due to copper vacancies created in the lattice.However,in 1986, it has beenreported that electrodeposition of Cu_2O in slightly acidic solutions produces n-type conductivitydue to the excess of Cu ions or oxygen vacancies in the Cu_2O lattice [5]. On the other hand, CuO, the other stable form of copper oxide, is a p-type semiconductor having a band gap energy of1.2 eV which is suitable as anabsorber material for PV applications [1]. Cu_2O thin films have been prepared by various methods and electrodeposition is an attractive technique because of its advantages such aslowcost, simplicity, low temperature process and capability of growth of large area thin films. [2-9]. Growth of CuO thin filmsby annealing of Cu_2O at 550 °C for 30 min in air have been reported earlier and use of thesefilms forapplication inCuO/Cu_2O heterojunction solar cell has already been demonstrated[10].Jayathilaka et al have recently reported the possibility of fabrication of CuO/Cu_2O heterojunction solar cells by electrodepositiontechnique [11]. On the other hand, it is very important to explore the possibility of growth of $(Cu_2O)_{1-x}(CuO)_x$ composite thin filmsfor possible