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Fabrication of an efficient Cu_2O homojunction by electrodeposition technique for solar cell applications

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Abstract

Electrodeposition is avery attractive low costtechnique for fabrication of Cu_2O homojunction solar cells. Although electrodeposited p-n homojunction Cu_2O(metal substrate/p-Cu_2O/n-Cu_2O) solar cells were reportedearlier, n-p homojunction Cu_2O(metal substrate/n-Cu_2O/p-Cu_2O) solar cellsare very limited in the literature. This solar cell structure is very important when exploring the possibilities to improve the efficiencies of reported Cu_2O homojunction solar cells.In this study, current-voltage characteristics and spectral response measurements were employed to investigate the possibilities of fabrication of n-p homojunction Cu_2O solar cell by electrodepositiontechnique. Different deposition conditions were adopted to grow and optimize the p-type and n-type Cu_2Ofilms.n-Cu_2O thin films were electrodeposited on Ti substrate using an acetate bath of pH 6.1,where the resulted filmsproduced only the n-type photoresponse in a PEC.Subsequently, ap-Cu_2O thin film was elecrodeposited on Ti/n-Cu_2O electrode usingan acetate bath with acupric ion concentration of 0.001 M. This study revealed the possibility of fabrication ofan efficientn-p homojunction of Cu_2O for the applications insolar cells by consecutive electrodeposition of ann-Cu_2Ofilm followed by a p-Cu_2O filmusingan acetate bath.

1.0 Introduction

Cuprous oxide (Cu_2O) is an attractive material for photovoltaic applications due to its unique properties [1-6]. It is a defect type semiconductor and it is well established as a p-type material due to the Cu vacancies created in the crystal lattice[7-12]. However, it has been reported earlier that n-Cu_2O films can be deposited using the electrodeposition technique[13]. Origin of the n-type conductivity of Cu_2O is considered as due to the excess of Cu ionsand /or O vacanciescreated in the Cu_2O lattice. In general, conductivity type in electrodeposited Cu_2O films strongly depends on the pH and cupric ion concentration of the depositing bath solution[14-15]. Acidic baths produce n-type films while basic baths produce p-type films.However, electrodeposition technique of Cu_2O is very attractive because ofits simplicity, low cost andlow-temperature process. Indeed, control of deposition parameters of the bath to produce n-Cu_2O or p-Cu_2O thin films having better optoelectrical propertiesis very important for them to be used in solar cell applications.

Many authors have reported the possibility of the p-n homojunction Cu_2O (metal substrate/p-Cu_2O/n-Cu_2O)solar cells[14, 16-18].However, to our knowledge, fabrication of n-phomojunction Cu_2O (metal substrate/n-Cu_2O/p-Cu_2O)solar cells using only acetate bathhas not been reported earlieralthough Jayathilaka et al [19] has reported the possibility of fabrication of similar solar cell using acetate and lactate baths for growth of n-Cu_2O and p-Cu_2O respectively.The reason may be that during the growth of p-type