

n - TYPE ELECTRICAL CONDUCTIVITY IN CUPROUS OXIDE THIN FILMS

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Abstract : Electrodeposited cuprous oxide thin films were investigated to determine whether their electrical conductivity is n-type or p-type. The experimental results based on the measurements of thermoelectric e.m.f., sheet resistance, dark and light current - voltage characteristics of $\text{Cu}_2\text{O}/\text{Cu}_2\text{S}$ and $\text{Cu}_2\text{O}/\text{CuCNS}$ heterojunctions reveal that the electrodeposited cuprous oxide films produce n-type electrical conductivity. These observations are in very good agreement with the previously reported n-type behaviour of the electro-deposited Cu_2O film electrodes in a photoelectrochemical cell.

1. Introduction

Cuprous oxide (Cu_2O) is an attractive material for photovoltaic energy conversion because it has a band gap of 2.0 eV and it is less expensive compared to many semiconducting materials. Experimental and theoretical studies of Cu_2O solar cells have been reported previously.^{1,2,3,4} However, the experimentally obtained efficiencies were much less than the theoretically predicted value. Moreover, all the work reported were based on the p-type semiconducting Cu_2O only. Many authors have claimed that the efficiency of Cu_2O solar cells may be improved significantly if a homojunction could be developed provided that the n-type Cu_2O is possible.⁵ Nevertheless, n-type photoconductivity of Cu_2O has been reported previously using the photoelectrochemical methods.^{1,8} In this investigation, we have undertaken several experiments, other than photoelectro-chemical, to verify the n-type behaviour of the electrodeposited Cu_2O films. Our experimental investigation reveals that the n-type conductivity is possible in electrodeposited Cu_2O films.

2. Experimental

Cuprous oxide thin films were deposited on various metal substrates (Cu, Ti, Pt) using the previously described electrodeposition technique.⁸ The metal plates were used as cathodes in an electrochemical cell containing an aqueous solution of 0.01 M CuSO_4 with an added few drops of NaOH, while a carbon rod was used as the anode. The electrodeposition was carried out for about 1 hour under the constant current density of 10 mA/cm². However, for Cu