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SPECTRAL RESPONSES OF ELECTRODEPOSITED CUPROUS OXIDE THIN FILM ELECTRODES

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Abstract: Photoresponse of the electrodeposited cuprous oxide thin film electrodes were investigated in a photoelectrochemical cell. Spectral response measurements reveal that a Schottky-type junction is formed at the junction between the substrate and cuprous oxide resulting in n-type and p-type photosignals in a photoelectrochemical cell. The electrodeposited cuprous oxide is an n-type semiconductor.

Key words: Cuprous oxide, electrodeposition, photoelectrochemistry, photoresponse.

INTRODUCTION

Cuprous oxide is an inexpensive and non-toxic semiconductor with the potential for use in low-cost solar energy converting devices.[1-4] Understanding the control of the different semiconducting properties of cuprous oxide will facilitate progress in this field. Cuprous oxide thin films prepared by electrochemical methods produce n-type photosignals in photoelectrochemical cells, irrespective of the well established p-type conductivity.[5-10] Various interpretations have been made to explain this behaviour.[7-10] We present here the results of spectral response measurements of electrodeposited cuprous oxide thin film electrodes in order to establish the conductivity type of this material.

METHODS AND MATERIALS

Thin cuprous oxide films were deposited on copper and platinum and also on tin oxide coated glass substrates by the previously reported method of electrodeposition.[6] Electrodeposition was carried out under galvanostatic current density of 10 mA/cm^2, in an aqueous electrolyte containing 0.3 M cupric acetate and a platinum wire as the counter electrode. The temperature of the electrolyte was maintained at 80°C and it was stirred continuously using a magnetic stirrer. Photoresponse of the film electrodes were measured in a three electrode electrochemical cell containing an aqueous solution of 0.1M sodium acetate. The counter electrode was a platinum wire and the reference electrode was a mercury sulphate electrode (MSE). Electrolytic solutions were prepared using Millipore HQ deionized water and reagent grade chemicals. They were deoxygenated in the electrochemical cell by argon bubbling during the experiments.

The spectral response measurements of the photoelectrodes were made using the phase sensitive detection method to monitor the photocurrent signal produced by a chopped monochromatic light beam. An apparatus consisting of a monochromator (Jobin Yvon H 20), potentiostat (PAR 273 A), a lock-in amplifier