THE FABRICATION AND CHARACTERIZATION OF IRON DISULFIDE [FeS_2] PHOTOELECTROCHEMICAL (PEC) SOLAR CELL

BY

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DECLARATION

This Thesis is my original work and has not been presented for examination in any other University.

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SIGN..............

DATE 13/11/98

This work has been presented for examination with our authority as supervisors.

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ABSTRACT

Iron pyrite, also known as iron disulfide, has been classified as one of the most promising materials for both thin film and photoelectrochemical (PEC) solar cells. In this study, iron pyrite was grown on tin oxide coated glass substrate. Iron oxide was first grown by spray pyrolysis and then sulfurized to convert the iron oxide into iron pyrite. The deposition parameters were optimized. Iron pyrite was characterized with respect to its optical and structural properties. Finally, a PEC solar cell was fabricated with iron pyrite as photoanode.

The optimized deposition parameters were: spray rate = 14 ml/min, substrate temperature = 370.0 °C for iron oxide and 420.0 °C for tin oxide, spray distance 30-35 cm. Annealing the iron oxide in sulfur vapour was done with the following optimized parameters: heating rate 4-5 °C/min, up to a temperature of 350.0 °C, cooling rate of 1-2 °C/min down to below 80.0 °C. The sample was then dipped in carbon disulfide and rinsed with distilled water.

Optical studies of iron pyrite gave an absorption band edge of about 1.0 ev, and an absorption coefficient in the range of $10^4 cm^{-1}$. The thermoelectric effect measurement failed to show whether the films were clearly n or p type. However, the current direction in the PEC solar cell indicated the films to be n type.

The PEC solar cell gave a short circuit current density of about 40.0 $\mu A/cm^2$ and an open circuit voltage of about 64.5 mv for a vacuum-annealed photoanode and 2.4 $\mu A/cm^2$ (short circuit current density) and 11.0 mv (open circuit voltage) for a non-vacuum-annealed photoanode.The efficiency of the vacuum annealed photoanode was $2.71x10^{-4}$% while that of the non-vacuum annealed photoanode was $1.83x10^{-6}$%.