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OPTICAL AND ELECTRICAL CHARACTERIZATION OF CuS AND CdS:B THIN FILMS FOR SOLAR CELLS APPLICATION

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DECLARATION

This thesis is my original work and has not been submitted for a degree or any other award in any other university.

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ABSTRACT

Thin film Photovoltaic cells will have high efficiency when a p-type material with a narrow band gap and a n-type material with wide band gap are used. Their Efficiency is influenced by; deposition techniques, deposition conditions and the components in the reaction bath used in depositing the films. These factors influence the optical properties of the solar cell. Hetero-junction devices with Boron doped CdS (*n*-type) thin films used as window layers in solar cells show improved electrical conductivity. Despite CdS:B and CuS having good qualities for use as window and absorber layers respectively for a solar cell, there is no information on CdS:B / CuS p-n junction solar cell. In this research, CdS:B thin films were prepared by CBD method on glass substrates and optimized for application as a window material. On the other hand, copper sulphide (CuS) layer was prepared using same method on ordinary glass substrates and optimized as an absorber material. The film's electrical resistivity was determined using the four point probe to determine their sheet resistance. Optical properties like Reflectance(%) and Transmittance(%) were measured by UV-VIS NIR 3700 spectrophotometer and used to calculate other optical constants like band gap (E_g),refractive index (n),extinction coefficient (k) and absorption coefficient (α). The results were analysed to determine how optical transmittance, absorbance and the electrical resistivity varied with the conditions of deposition using the Scout software. Conditions that gave Boron doped CdS and CuS optimum optical and electrical properties were then chosen and used to prepare CdS:B-CuS photovoltaic cell. The CdS:B thin film deposited at 85°C using $20cm^3$ of boric acid was selected as the best for fabricating the solar cell's window layer. It had the highest electrical conductivity of 83.71 $(\Omega cm)^{-1}$, transmittance of 82.2% and band gap of 2.4468eV. The CuS thin film deposited in a time of four hours was selected as the best for preparation of solar cell's absorber layer, with low band gap of 1.77 eV. Solar cell simulator was used in characterizing the prepared CdS:B/CuS solar cell. The cell had the following parameters: Open circuit voltage (V_{oc}) = 0.39V, Short circuit current (I_{sc}) = 0.032A, maximum current (I_{max}) = 0.028A, maximum voltage (V_{max}) = 0.26V, Maximum power = 0.00728W cell area = $1.425\times 10^{-3}m^2$, Field factor (FF) =0.583 and efficiency (η) of 0.51%.