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Indian J. Phys. **68A** (5), 503 – 505 (1994)

I J P A
- an international journal

Photoelectrical properties of thin film Cu_2S-CdS solar cells

M Kalafi and H Bidadi

Center for Applied Physics Research, Tabriz University, Tabriz, Iran

and

A I Bairamov and V M Salmanov

Institute of Physics of Azerbaijan Academy of Sciences, Baku, Republic of Azerbaijan

Received 8 June 1994, accepted 15 June 1994

Abstract : Electrical, photoelectrical and degradation properties of thin film Cu_2S–CdS solar cells on the basis of CdS produced in quasiclosed volume were investigated It was shown that these cells have high efficiency ($\eta = 7\%$) and are stable.

Keywords : Photoelectrical properties, Cu_2S–CdS thin film, solar cells

PACS Nos. : 72 40.+w, 84 60 Jt

The thin Cu_2S–CdS heterojunctions are the subjects of numerous investigations aimed at the creation of effective, stable and inexpensive solar cells. As a basis layer for production of such elements, CdS films prepared by vacuum evaporation [1,2], epitaxial deposition [3], ionic spray [4], spray pyrolysis [5-7] and deposition from solution [8] are used. The vacuum evaporation method appeared to be technologically viable for the preparation of effective solar solar cells.

It should be noted that thin film Cu_2S–CdS solar cells often degrade and therefore, efforts are directed to the creation of effective thin film Cu_2S–CdS solar cells with stable parameters.

In the present paper, the preparation procedures of Cu_2S–CdS solar cells produced on the basis of vacuum evaporated CdS films and investigation of their structural, electrical and photoelectrical properties are presented.

As a basis material, we used CdS thin films produced by vacuum evaporation in a quasiclosed volume, in which high purity cadmium sulfide powder was deposited in vacuum onto glass substrates with and without a conducting cover of SnO_2. The source temperature was kept at 800–850°C and substrate temperature varied in the range 150–200°C.

X-ray diffractometric investigations revealed that CdS films prepared by vacuum evaporation at substrate temperatures of 150–200°C crystallize in a hexagonal wurtzite structure and appear to be fully oriented along c[002] axis. These films have columnar structure each column being a separate grain perpendicular to the substrate surface. Resistivity of the prepared films considerably depends on the deposition temperature and changes in the range 10^2–10^6 Ω.cm. For the fabrication of Cu_2S–CdS solar cells, CdS films prepared at 200°C having resistivities ρ = (3–5) 10^2 Ω.cm and thicknesses of (6–8) μm were used.

The I–V characteristics analysis of heterojunction has shown that the dominant transport mechanism is generation-recombination in the depletion region with diode factor n = 2. The barrier height of heterojunction determined from temperature dependence of forward saturation current is Φ_B = 0.85 eV which is in good agreement with literature data [9].

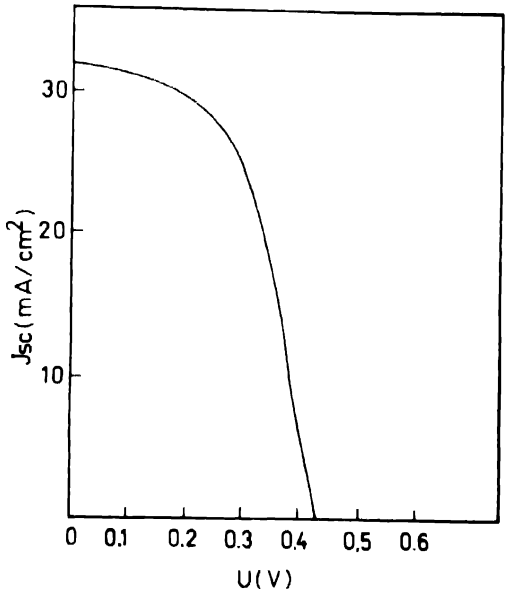

Figure 1. Light J-V characteristics (W = 100 mW/cm^2) of Cu_2S–CdS solar cells on the basis of CdS films prepared by vacuum evaporation

Light current-voltage characteristics of one of these solar cells with efficiency η = 7% (I_{sc} = 32 mA/cm^2, U_{oc} = 0.45 V, ff = 0.5 at W = 100 mWt/cm^2) is shown at Figure 1. It should be noted that, these solar cells have sufficiently high stability of photoelectric

parameters (Figure 2). Preliminary experiments have indicated that putting protective cover on such cells increase stability of their operation.

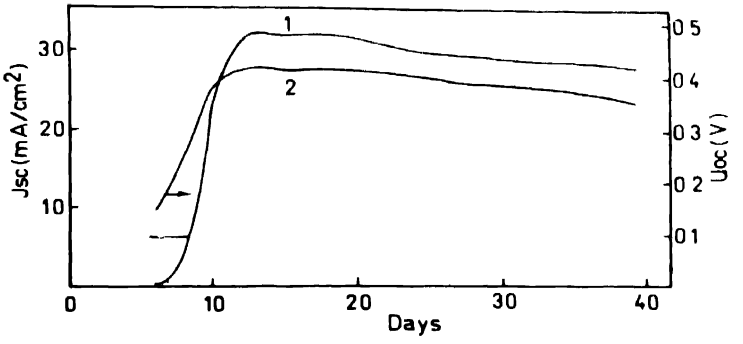

Figure 2. Short circuit J_{sc} (1)and open-circuit voltage V_{oc} (2) degradation curves of Cu_2S–CdS solar cell on the basis of CdS prepared by vacuum evaporation

References

[1] C S Wu and R H Bube *J Appl. Phys* **45** 648 (1974)
J C Burton and T L Hench *Appl Phys Lett* **29** 612 (1976)
[3] D C Cameron, W Dunkan and W U Jsang *Thin Sol Films* **58** 61 (1979)
[4] S Durand *Thin Sol Films* **44** 43 (1977)
[5] R R Chamberlin and J S Scarman *J Electrochem Soc* **113** 90 (1966)
[6] C S Wu, R S Fiegelson and R H Bube *J Appl Phys* **43** 756 (1972)
[7] A I Bairamov, T D Dzhafarov, H I Nadzhafov, V D Novruzov and N A Rzakuliev *Neorganich Mater.* **28** 2423 (1992)
[8] I Kaur, D K Paudya and K L Chopra *J. Electrochem Soc* **127** 943 (1981)
[9] S R Das, A Banerjee and K L Chopra *Solid State Electron* **22** 533 (1979)