TECHNOLOGICAL DEVELOPMENT OF CERAMIC CdS/Cu_2S SOLAR CELLS

Manyonge, Wellington Matasi

A thesis submitted in part fulfilment for the Degree of Master of Science in the University of Nairobi 1981.

ABSTRACT

The results of an experimental study of the development of CdS/Cu_2S solar cells are reported in the present thesis. Two different approaches, i.e. thin film CdS/Cu_2S and ceramic CdS/Cu_2S cells for the fabrication of CdS/Cu_2S solar cells were adopted. The thin-film approach to the fabrication of CdS/Cu_2S solar cells is the most convenient method of developing solar cells with regard to the costs. However, the development of thin-film type of solar cells was not possible within the existing laboratory facilities and it was decided to develop and study the properties of ceramic CdS/Cu_2S solar cells.

Ceramic CdS/Cu_2S solar cells were fabricated using CdS as base material in form of pellets. A number of additives to CdS ($CdCl_2$ and $AlCl_3$) were added. Pellets were sintered in various atmospheres (reducing, oxidizing, and neutral) in order to reduce the resistivity of the pellets.

It was found that the resistances of the pellets were insensitive to the pellet production pressure (3 tons/cm^2 to 8 tons/cm^2) sintering temperature ($400^\circ C$ to $600^\circ C$), and sintering time (½ hour to 3 hours). The resistance of the pellets was found to be of magnitude 10^4 ohms per millimetre.

Sintering under hydrogen produced pellets which were ohmic in behaviour and resistances of the pellets increased with time but the ohmic behaviour did not change. The pellets made

poor contact with silver paste. Sintering under argon produced pellets whose resistances were similar to those sintered under hydrogen but silver paste provided better contact. Sintering under air produced pellets whose resistance increased at a very high rate.

A layer of Cu_2S was grown on top of CdS pellets by dipping process. Cells fabricated from these pellets had a high rate of degradation, low open-circuit voltages, short-circuit currents and fill-factor.

The rate of degradation was reduced by reducing the thermal inertia between the pellets and cuprous ion solution at the time of dipping. The cell outputs were improved by applying Joshi and Sharma's method (21) in preparing the pellets. This caused a considerable increase in open-circuit voltage, short-circuit current and fill-factor. The efficiency of a sample cell was calculated to be approximately 0.0012%.

The efficiency reported here is fairly low, and to improve it, it is suggested that the series resistance should be reduced significantly by creating a metal grid on the Cu_xS layer using a material which makes effective ohmic contact with the layer, the areal homogeneity must be improved and the Cu_xS stoichiometry must be improved by using a better dipping bath free from oxygen and other impurity influence.