A Comprehensive Study Of Some Heterojunction Solar Cells

ABSTRACT

There are three different models which have been developed to describe the current-voltage characteristics of a heterojunction solar cell with different mechanisms assumed for the dark current in each model while the short circuit current is assumed to be due to the diffusion of the minority carriers. The first model was developed by R.L. Anderson in which he assumed that the dark current is due to the injection of carriers across the barriers. The second model was developed by R. Sahai and A.G. Milnes in which they assumed that the dark current is due to the diffusion of minority carriers in the depletion region. The third model was developed by H.J. Pauwels and G. Vanhoutte, in which they assumed that the dark current is due to the thermionic emission of majority carriers over the junction barriers.

This work presents a comprehensive study of n-CdS/p-InP, n-CdS/p-CdTe, and n-CdS/p-GaAs heterojunction solar cells that aims at simulating their observed characteristics. This study is based on Sahai – Milnes model, and Pauwels – Vanhoutte model and the modified Pauwels models which is the same as Pauwels-Milnes model but the generation-recombination of carriers in the depletion region is taken into consideration. It is found that Sahai-Milnes model and the modified Pauwels model give values for the cell parameters of CdS/InP and CdS/CdTe are identical and in good agreement with the most recently published experimental results while Pauwels-Vanhoutte models gives values in disagreement with those results.. This reveals that the generation –recombination of carriers in the depletion region represents a significant part of the dark current of CdS/InP and CdS/CdTe cells. It also found that tunneling is the dominant mechanism for CdS/GaAs cell so it is not surprising that the above three models give incorrect values for this last pair. It is found that the optical reflection losses are significantly reduced and the short circuit current density is increased by applying an antireflection layer to the cell.