Modeling of the Basic Solar cells Characteristics on the Basis of *n*-ZnS/*p*-CdTe and *n*-CdS/*p*-CdTe Heterojunctions

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Nowadays the maximal efficiency of the best film solar cells (SC) on the basis of *n*-CdS/*p*-CdTe heterojunctions (HJ) is 17.3 %, but the rates of its increase had been essentially slowed down. The increase of SC efficiency with absorbing CdTe layer is possible, for example, by means of the replacement of optical window material. Meanwhile, CdS (E_g=2.42 eV) window layers may be replaced for more wide-gap material – ZnS (E_g=3.68 eV) [1]. According to the theory it can lead to the increase of SC photosensivity in the ultraviolet spectrum area and to their efficiency increase. From the ecological point of view, it's important that ZnS is nontoxic («Cd-free») material due to the absence in the composition of heavy metals. However, the efficiency of existing SC on the basis of *n*-ZnS/*p*-CdTe heterojunction doesn't exceed 4%. To increase the effectiveness of such SC one need the optimization of the characteristics of the separate layers and of the constructions of photovoltaic devices in general, that is possible with the help of modeling of physical processes in the device.

In this work we used SCAPS-3200 software environment for the realistic modeling of the basic electrical characteristics (current density of short circuit (J_{sc}), open circuit voltage (U_{oc}), fill factor (*FF*) and efficiency (h)) of thin solar cells films with *n*-ZnS/*p*-CdTe heterojunction. In order to compare the modeling of characteristics of photovoltaic devices with the traditional *n*-CdS/*p*-CdTe construction was held with the same parameters. Modeling of dark and light current-voltage characteristics of photovoltaic devices was held at different operational temperatures, thickness of window and absorber layers. Meanwhile, it was considered that the recombination of carriers on the interphase region is absent. As a result of modeling the optimal constructive SC parameters, that provide their maximal efficiency at the temperature 300 K, namely the thickness of absorber layer CdTe – 3.00 μm, of window layer ZnS – 0.05 μm were established. The analysis of the basic characteristics of two constructions showed that SC on the basis of *n*-ZnS/*p*-CdTe heterojunction have greater short circuit current (J_{sc}=28.91 mA/cm^2), fill factor (*FF*=87.61 %) and efficiency (h=26.46 %) in comparison with *n*-CdS/*p*-CdTe heterojunction (J_{sc}=28.06 mA/cm^2, *FF*=86.30 %, h=25.05 %).

1. Structural and electrical properties of ZnS/CdTe and ZnTe/CdTe heterostructures / Kosyak V.V., Kurbatov D.I., Kolesnyk M.M., Opanasyuk A.S., Danilchenko S.N., Gnatenko Yu.P. // Journal of Materials Chemistry and Physics. – 2013. - doi.org/10.1016/j.matchemphys.2012.12.049

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