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Efficiency modeling of solar cells based on the n-Zn1-xMgxO / p-SnS heterojunction(Article)

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The recombination and optical losses were determined in auxiliary and absorbing layers of solar cells (SCs) based on the n-MgxZn1-xO / p-SnS heterojunction (where x 0; 0.3; 1) with transparent front contacts (ZnO:Al and ITO). The spectral dependences of the transmittance of light by SCs have been calculated, taking into account the reflection of light from the boundaries of the contacting materials, as well as its absorption in the auxiliary layers of the devices. The quantum yield of the investigated structures of photoconductors were determined. The effect of recombination and optical losses in such SCs on the short-circuit current and the efficiency were determined with different thickness of window layer MgxZn1-xO (25-400 nm) and constant thickness of Al:ZnO and ITO layers (100-200 nm). The efficiency of the structures was calculated for the case of the open circuit voltage Uoc determined from the energy diagrams and taken from the literature. It was found that in the first case, the SCs can have an efficiency that increases from 4.91 % (ZnO / SnS) to 10.8 % (MgO / SnS) with an increase in the Mg content in the solid solution. In the second case, SCs based on the ZnO/SnS heterojunction with a conductive contact Al:ZnO have the highest efficiency values (η = 11.62 %). Devices based on Mg0.3Zn0.7O / SnS and MgO / SnS heterojunction show an efficiency value of 5.97 % and 5.84 %, respectively. The material of the front conductive contact has little effect on the efficiency of the SCs. The obtained results allow to determine the maximum value of the efficiency of considered SCs taking into account recombination and optical losses in device layers and to optimize the parameters of real devices in order to achieve these values of efficiency.