n-CdTe-Based Thin-Film Solar Converters

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The *n*-CdS/*p*-CdTe solar converters (SC) belong to the most efficient thin-film SC. The advances obtained using *n*-CdTe in this area are less substantial because there is no optimal broad-band "window" of *p*-type. Here we propose application of strongly degenerate digenite $Cu_{1.8}S$ as a *p*-type component of *n*-CdTe-based SC. Based on *p*-$Cu_{1.8}S$/*n*-II–VI surface-barrier structures, efficient photoconverters of UV and visible radiation are obtained. The investigations presented in this work show that the above surface-barrier structure is also promising for application in solar power engineering.

Cadmium telluride was grown on Mo/CdSe substrates through a graded-gap $CdSe_xTe_{1-x}$ interlayer using the quasi-closed volume technique. A multilayer *p*-$Cu_{1.8}S$/*n*-CdTe/*n*-CdSe/Mo structure was prepared that made it possible to increase the degree of structural perfection of thin photosensitive *n*-CdTe layers without application of additional high-temperature treatments, as well as to obtain an ohmic back contact without additional doping of CdTe. A thin layer of insulating TeO_2 oxide was grown on the *n*-CdTe surface to raise SC quantum efficiency. When growing TeO_2, accumulation of cadmium on the CdTe surface is possible, with formation of a low-resistance near-surface region. The low-resistance layer leads to redistribution of drag electric field whose maximal values are localized at the $Cu_{1.8}S$/CdTe interface. This results in 15-20% increase of SC efficiency over the whole spectral sensitivity area. Presence of a low-resistance near-surface layer was supported by the results of studies of *I–V* and *C–V* curves.

The main operating parameters of SC were measured at natural solar lighting. The emittance of incident radiation was 0.74 mW/cm^2. The best parameters were demonstrated by the $Cu_{1.8}S$-CdTe SC in which CdTe was doped with indium. For such SC, the peak open-circuit emf U_{oc} = 0.71 V, fill factor of load characteristic FF = 0.7, short-circuit current density I_{sc} = 15.8 mA/cm^2, efficiency η = 10.7%. The SC area (with allowance made for ~10% shadowing with the upper current-collecting electrode) was S = 0.25 cm^2.