

Structure and Optical Properties of CdTe and CdS Thin Films after Hard Ultraviolet Irradiation

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Solar cells based on the CdS/CdTe heterosystem are considered to be promising for space use. Therefore the study of the hard ultraviolet influence on the structural and optical properties of CdS and CdTe thin films is relevant.

CdS and CdTe films were obtained on glass substrates by non-pulsed DC magnetron sputtering in accordance with [1]. The crystal structure of the films was investigated by using X-ray diffractometry, scanning electron microscope and optical spectroscopy. Cadmium sulfide and cadmium telluride films were irradiated by hard ultraviolet with the energy of quanta 10 eV for 10 hours.

After irradiation of the CdS film structural changes were detected. An increase of the integral intensity in the reflection of the hexagonal phase (002) at the angle of 11.99° was found. And the constant crystal lattice c , which was $c = 6.78$ (88) Å, was 1.03% different from the table value. The value of the integral width of the peak (002) decreases to 0.2 deg from 0.24 deg in the initial sample of the cadmium sulfide layer. The spectral dependence of the transmission coefficient did not change. The mean values of the refractive index n and band gap E_g for samples, irradiated by hard ultraviolet, are similar to the corresponding values of non-irradiated cadmium sulfide films.

After irradiation of the CdTe film it was found, that the intensity of the reflection peak (201) increased, while the intensity of all other peaks decreased. At the same time, the integral width of all peaks decreased. The calculated values of permanent crystalline lattice constant for CdTe were similar to these values in the initial state. As for CdS, the spectral dependence of the transmission coefficient of CdTe films has not changed. The mean values of n and E_g did not differ from these values before irradiation.

Thus, the optical characteristics of semiconductor films obtained by the non-pulsed DC magnetron sputtering method were insensitive to irradiation by hard ultraviolet. The crystalline structure of the CdS and CdTe films changes after irradiation. The lattice period for cadmium sulfide films increases, which may be due to the formation of point defects and defective complexes. The decrease of the peaks width on the X-ray diffraction patterns of CdS and CdTe layers is due to the increase of the coherent scattering regions in the process of near-surface layers partial recrystallization of the developed grain boundary surface of the films as a result of irradiation by the hard ultraviolet.

1. G.I. Kopach, R.P. Mygushchenko, G.S. Khrypunov, A.I. Dobrozhan, M.M. Harchenko, J. Nano-Electron. Phys. 9, (2017) 05035.