Surface-modified layers CdTe of oxygen-doped

Mazur Markiian-Yulian, Institute of Applied Systems Analysis, National Technical University of Ukraine «Igor Sikorsky Kyiv Polytechnic Institute»

Mazur Tetiana, tetiana.mazur@nung.edu.ua, Department of General and Applied Physics, Institute of Architecture, Construction and Energy, Ivano-Frankivsk National Technical University of Oil and Gas

Mazur Myroslav, Institute of Architecture, Construction and Energy, Ivano-Frankivsk National Technical University of Oil and Gas

Cadmium teluride is a promising material for the manufacture of various types of detectors, such as light, X-ray, electron, proton, and others [1]. Diode structures with a surface barrier that can be used in solar cells play an important role among such devices [2]. Thin layers in these structures determine the physical and technical characteristics of the devices and are the active region. Therefore, an important problem arises of minimizing the concentration of defects at the separation boundary between the contact and the semiconductor [3]. These defects form surface levels, which can be effective recombination centers, which as a result leads to an increase in loss currents and noise levels, a decrease in the breakdown voltage, and the appearance of various types of instabilities [3]. An effective technological approach to reduce the influence of these levels is the creation of modified surface layers that significantly improve the photoelectric properties of diode structures. One of the important aspects is the introduction of isovalent impurities that impart specific properties to the material [4]. In this paper, we consider the process of obtaining modified CdTe layers doped with an isovalent oxygen impurity.

In this study, n-CdTe single crystals were used as the base material. They were obtained using the Bridgman method and had a resistivity of approximately 40 Ω cm at 300 K. The studied modified CdTe:O layers were obtained by doping with oxygen during annealing of the CdTe samples in air at temperatures from 700 to 1000 K. Condition surface of the initial substrates and the doped layer were monitored using a Nanoscope-IIIa atomic force microscope in the periodic contact mode.

After annealing the output n-CdTe plates, a CdTe:O layer is formed on their surface, which leads to a modification of the microstructure. The initial surface looks like a mirror, but after annealing it becomes matte. Studies using an atomic force microscope revealed that after heat treatment of CdTe, large blocks with arbitrary orientation and sizes up to 800 nm are formed on its surface. These results are consistent with similar observations of the effect of annealing on the state of the surface.

The appearance of highly efficient luminescence in CdTe:O layers at 300 K is an important phenomenon both for theoretical research and for practical use. This phenomenon is not observed in the initial single crystals. The emerging radiation is predominantly localized in the edge region. It has the following features: the presence of photons with an energy exceeding the band gap Eg, the independence of the position $\hbar\omega_m$ from the photoexcitation intensity when the latter changes by three orders of magnitude, as well as similar temperature dependences of the positions $\hbar\omega_m$ and Eg in the temperature range from 77 to 450 K. These features indicate the participation of interband transitions in the recombination process. In this case, the emission spectrum can be described by a known expression

$$N_\omega \approx (\hbar\omega)^2 \sqrt{\hbar\omega - E_g} \exp\left(-\frac{\hbar\omega - E_g}{kT}\right) \qquad (1)$$

where k is the Boltzmann constant, T is the temperature, N_ω is the number of photons in a unit energy interval.

Fig. 1 shows the Photoluminescence spectrum (curve 2) calculated using formula (1) with an energy bandgap value of *Eg* = 1.5 eV. This spectrum is in good agreement with experimental results, indicating confirmation of the dominant role of interband transitions in the process of photoluminescence in CdTe:O layers.

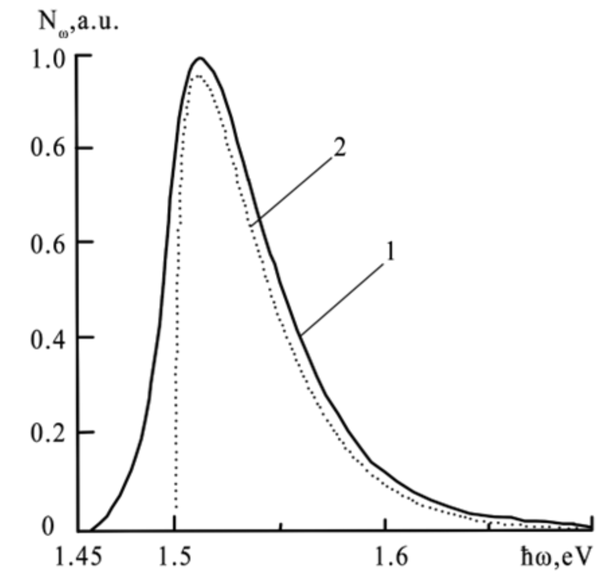

Fig. 1. Photoluminescence spectrum of CdTe:O layers (curve 1) and the calculated interband recombination spectrum (curve 2).

The appearance of intense luminescence at 300 K in CdTe:O layers is explained by the isovalent character of oxygen as an impurity. This phenomenon is caused by interband recombination of free charge carriers.

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