MECHANISM OF NANOSTRUCTURE FORMATION ON A SURFACE OF CdZnTe CRYSTAL BY LASER IRRADIATION

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Since crystalline $Cd_{1-x}Zn_xTe$ is widely used in the radiation techniques for the production of the detectors of X-ray, γ-ray, and other kind of hard radiation. The present work is a further study of processes occurring near the surface of $Cd_{1-x}Zn_xTe$ under laser radiation.

The change of optical properties and surface morphology of near-surface layer of $Cd_{0.9}Zn_{0.1}Te$ crystal by laser radiation with aim to create graded band-gap was investigated. Nd:YAG laser working in Q-modulation mode with parameters λ=0.532 μm; τ=10 ns; I=4.0-12.0 MW/cm^2 was used as radiation source. The methods of photoluminescence and atomic force microscope were used in the experiments. On the surface of the semiconductor crystal the nanostructure was formed after irradiation by laser with intensity up to I ≈ 4 MW/cm^2. The main role in the initiation of this process has thermogradient effect (TGE) [1].

In conformity with TGE during laser irradiation Zn atoms move in the bulk of the sample were substitute Cd atoms which move toward the irradiated surface of the sample. Two layers are formed near the irradiated surface of semiconductor: the top layer consists of mostly CdTe crystal but the underlying layer – ZnTe crystal. A mismatch of lattices of CdTe and ZnTe crystals is equal up to 5.8% [2]. This plastically deformation of the top layer leads to creation of nanostructures of the irradiated surface according to the modified Stransky-Krastanov model.

The surface layer of this sample is characterized by high radiation hardness because modified near surface layer contains more atoms of Cd which have larger atom weight than atom of Zn.

A built-in electric field arises due to graded band gap in nano-cone is direct in the bulk of the sample. As the result a surface recombination velocity decreases and the carrier collection in this structure (CdZnTe) increases.

References

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