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 radiation techniques to produce X-ray, γ-ray, and other hard radiation detectors, present work is a further study of processes, occurring near the surface of $Cd_{1-x}Zn_xTe$ under laser radiation.

Surface morphology and optical property change of $Cd_{0.9}Zn_{0.1}Te$ crystal near-surface layer after irradiation with laser, aimed to create graded band-gap, was investigated. As a radiation source 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. Atomic force microscopy and photoluminescence evaluation method was used in the experiments. After irradiation by laser with intensity up to I ≈ 4 MW/cm^2 nanostructure formed on the surface of the semiconductor crystal. The main role in the initiation of this process has thermogradient effect (TGE) (Medvid ey al. 2007).

According TGE during laser irradiation Zn atoms move into the bulk of the sample where they substitute Cd atoms, which move toward the irradiated surface. Two layers form near the irradiated surface of semiconductor: the top layer consists mostly of CdTe crystal, but the underlying layer – ZnTe crystal. A mismatch of lattices of CdTe and ZnTe crystals is up to 5.8% (Academic press, Moscow, 1979). This plastic 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 of modified near-surface layer, which contains more atoms of Cd with atomic weight larger then those 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 a result, a surface recombination velocity decreases and the carrier collection in this structure (CdZnTe) increases. The spectral distribution of photoconductivity of CdZnTe crystal strongly changes after laser processing.

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