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INFLUENCE OF THE GAMMA IRRADIATION ONTO IV CURVE OF THE SURFACE BARRIER METALL - SEMICONDUCTOR STRUCTURES WITH MICRO - TEXTURED INTERFACE

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Abstract. *The paper concerns the results of the study of radiation treatment of Schottky's barriers with a micro relief interface. Changes in electrophysical parameters manifested in the evolution of volt-ampere characteristics with increasing radiation dose are shown. The analysis of I-V curve by using the equivalent scheme and taking into account all the canals of charge transfer and the presence of substrate resistance shows a higher resistance of micro-textured structures to radiation treatment.*

Keywords: *Schottky barrier, GaAs, microrelief border, I-V curve, gamma-irradiation.*

As you know, moth-eye surfaces of semiconductors are used in optoelectronics and special electronic equipment in order to increase the efficiency of light absorption and increase the sensitivity of photodetectors and the efficiency of solar cells. Moreover, periodically profiled surfaces are the element base of a new branch of applied science, namely, polariton optoelectronics, since the excitation of electromagnetic waves is possible only on non-planar surfaces and at interfaces [1, 2]. Therefore, further study of the interaction of light with nonplanar semiconductor surfaces and the effect of surface curvature on its other properties are relevant. This, in turn, refers to radiation effects in semiconductors and especially in metal-semiconductor structures [3, 4].

In addition, it should be noted that the moth-eye surface is used as a passive element of a semiconductor structure and much less frequently as an active interface creating a barrier contact. The influence of the non-flatness of this boundary in surface-barrier structures (SBS) based on a metal-semiconductor, as shown in [5, 6], is rather complicated. This is especially true for the radiation behavior of SBS with moth-eye IF.

In our work, we have carried out an experimental study of the effect of penetrating gamma radiation of the ^{60}Co isotope on the current-voltage characteristic of Au-GaAs SBS, the moth-eye facets of which were prepared by wet anisotropic etching. The geometric structure of the surface (its morphology) was studied in detail using a scanning microscope of atomic forces. This made it possible to quantitatively describe the surface structure, which, in turn, facilitated an adequate description of the characteristics of the V-A characteristics of moth-eye SBS. Note that the results presented in [7-10] on the effect of the surface microrelief on the effect of radiation-stimulated ordering by no means exhaust the problems, if only because only the range of low radiation doses was investigated there, where the usual radiation defect does not yet prevail.

Typical I-V charactercs before and after irradiation are shown in Fig.1. When analyzing the I-V charactercs, we took into account:

1. The current of thermionic emission, determined by the height of the barrier;

2. Thermal field current, the contribution of which at room temperature for a given doping level is equivalent to a decrease in the barrier height by 0.02 eV, and its additional component due to the enhancement of the field in areas of the microrelief with a small radius of curvature.

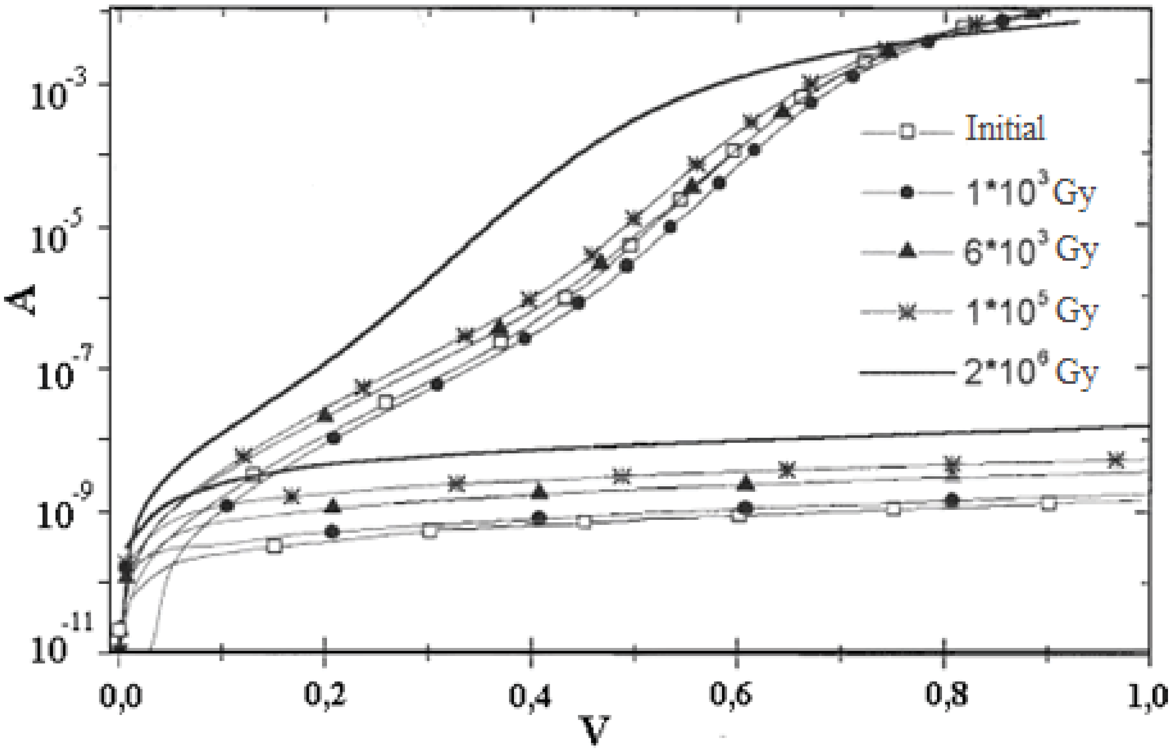

Fig.1. Forward and reverse branches of the V-A characteristic by a diode with Schottky barriers Au-GaAs from a moth-eye interface: initial and irradiated with ^{60}Co gamma quanta to doses of 10^3, 6×10^3, 10^5, 2×10^6 Gy, respectively

3. The recombination current in the near-contact space-charge region (SCR), determined by the lifetime of charge carriers in the SCR;

4. Leakage current, set by the value of the shunt resistance;

5. Current limitation by series resistance;

6. The presence of an intermediate layer and surface states on the interface, leading to an increase in the ideality factor parameter n>1 in the exponential dependence of the forward current on voltage.

Thus, the interpretation of the current-voltage characteristics of Schottky barriers with a moth-eye boundary using an empirical model of current passage based on equivalent circuits showed that the barrier characteristics of the moth-eye interface structures of metal (Au) - GaAs change insignificantly as a result of irradiation with gamma quanta up to a dose of 5×10^6 Gy. The region of "small" doses improving the parameters of the barrier structure is narrowed (up to $\Phi \leq 10^3$ Gy) in comparison with planar structures. We believe that the observed effect is explained by the great structural perfection of the samples with a moth-eye surface prepared by the method of chemical anisotropic etching, since, first of all, more defective areas of the crystal surface are removed, which have arisen during the chemical-mechanical processing of the wafers, especially polishing.

In addition, at low irradiation doses on moth-eye surface-barrier structures based on gallium arsenide, an increase in the effective height of the Schottky barrier and the lifetime of minority charge carriers is observed, as well as a decrease in the ideality factor, which may be associated with the intensification of radiation gettering processes on the developed in comparison planar interface. In the dose range 10^3-10^5 Gy, the parameters of the structures under study change insignificantly.

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