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THE RELAXATION OF ELECTROPHYSICAL PROPERTIES OF MCT EPITAXIAL FILMS AFTER INFLUENCE OF A HIGH FREQUENCY NANOSECOND VOLUME DISCHARGE IN ATMOSPHERIC PRESSURE AIR [1]

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In modern times, infrared photoreceivers and devices based on them are widely used. The progress achieved in the study of the infrared range has led to the creation of a variety of medical, military, scientific and industrial techniques. A wide range of semiconductor materials exist to create photonic IR receivers, but the most promising is the triple bond of mercury cadmium telluride ($Hg_{1-x}Cd_xTe$), due to its large spectral range and low carrier concentration at operating temperatures. Much attention is paid to the development of multielement photodetective matrices based on MCT films, grown by molecular beam epitaxy. The main problem is the production of films of large area and uniformity. The task of purposefully changing the parameters of the material remains relevant. One of the most common methods of changing parameters is radiation methods. Recently for modification of near-surface layers of various materials discharges of various types and electron beams began to be used. The first experiments on the effect of low-frequency discharge [1, 2] showed the possibility of using this method in relation for MCT. The effect exerted on epitaxial films under the action of a volume discharge is complex, but while each of the effects is individually well studied, the complex effect in the literature is little studied, and is of interest in further research.

To achieve this goal, studies of prepared epitaxial films of p-type conductivity ($p = 7 \div 8\times10^{16}$ cm^{-3}, μ_p = 400 cm^{2}V^{-1}s^{-1}) were carried out, grown by molecular beam epitaxy in the Institute of Semiconductor Physics Siberian Branch of the Russian Academy of Sciences (ISP SB RAS) in Novosibirsk. The composition of the working layer of epitaxial films was x = 0.22. Samples were subjected to a high-frequency volumetric nanosecond discharge in air at atmospheric pressure. Prepared MCT samples were irradiated with a volume nanosecond discharge in a pulse-periodic mode with a repetition rate of 1200 Hz. The duration of exposure was 30 seconds, 1, 2, 5, 10 and 20 minutes. The electrophysical parameters of the MCT samples before and after the discharge action were determined from measurements of the Hall effect by the Van der Pauw method. The measurements were carried out at a constant current flowing through the sample (I = 1 μA) for two directions of the current and two directions of the constant magnetic field.

From the experimental data we made conclusion that with an increase in the irradiation time t significant changes are observed both in the value of the Hall coefficient R_{hall} and in the behavior of the field dependence. At t = 30 and 60 seconds, there is a decrease in R_{hall}, at t = 120 and 300 seconds there is an alternating dependence of R_{hall}. For samples 5 and 6 irradiated 600 and 1200 seconds, respectively, a complete inversion of the sign of R_{hall} is observed in comparison with the initial values.

According to the results of the studies carried out, it can be concluded that with an increase in the discharge time, a significant change is observed, both in the value of the Hall coefficient, and in the nature of the dependence on the magnetic field. The observed changes in the field dependence of irradiated samples can be explained by the formation of a high-conductivity layer of the n-type conductivity in the near-surface region of the material, and with increasing exposure time the integral conductivity increases. It should also be noted that, over time, there is a relaxation of the Hall coefficient to the initial values.

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