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Formation of diode structures by the In/CdTe/Au method of laser-induced doping in a liquid medium

Cadmium telluride is one of the most promising materials used for semiconductor detectors of various types of ionizing radiation [1-2]. When developing and creating detectors, great attention is paid to the formation of electrical contacts with specified properties (ohmic or barrier), as well as doping of the surface layer of the semiconductor to create diode structures that are the most effective in registering high-energy radiation.
The main problem in the manufacture of diodes based on p-n structures is the formation of a shallow and sharp p-n junction, that is, the creation of a heavily doped thin surface layer. However, the process of doping CdTe is accompanied by a self-compensation effect - the formation of oppositely charged intrinsic defects or complexation, which limits the concentration of charges to a value that is significantly smaller than the amount of the introduced doping impurity, so one of the most important problems of creating a p-n junction in high-resistance CdTe is the search for a doping method that can "exclude" the phenomenon of self-compensation. In addition, such a method should provide a sharp impurity distribution profile, a small p-n junction depth, and the doping process should not disturb the defective structure and electrical properties in the bulk of the crystals. To ensure such conditions, it is promising to use the method of laser-induced doping of semiconductor materials. The main advantage of this alloying method is the non-thermal mechanism of alloying impurity entry, and there is no destruction of the contact material in the near-surface area.
The paper presents the results of research into the electrical properties of In/CdTe/Au diode structures obtained by laser-induced alloying in a liquid medium. For the manufacture of In/CdTe/Au diode structures, plates of industrial high-resistance p-type CdTe crystals obtained by the zone melting technology (Traveling Heater Method) [3], size 5 □ 5 □0.5 mm3 with specific resistance □ = (2 - 4)□109Ω·cm at room temperature. Electrical contacts (In and Au) were applied by thermal sputtering in a vacuum. The indium electrode was irradiated with nanosecond pulses of a neodymium Nd:YAG laser (λ = 532 nm, τ = 7 ns), which led to doping of the thin surface layer of the semiconductor [4]. During irradiation, the sample was placed in a liquid environment, in this case in water. The In/CdTe/Au structures produced in this way had sharp rectifying properties. With the help of a number of technical solutions (the technology of applying contact material and irradiation in a liquid medium with a series of pulses), diode structures with stable parameters were obtained, which can be used as nuclear radiation detectors in the future. One of the features of crystal irradiation in a liquid medium is the use of a series of pulses (up to a thousand) as a result of which we optimize the rectifying properties of the formed diode structures.

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Primary author: LEVYTSKYI, S. M. (V.E. Lashkaryov Institute of Semiconductor Physics of National Academy of Sciences of Ukraine 41 prospekt Nauky, Kyiv 03028, Ukraine)

Presenter: LEVYTSKYI, S. M. (V.E. Lashkaryov Institute of Semiconductor Physics of National Academy of Sciences of Ukraine 41 prospekt Nauky, Kyiv 03028, Ukraine)

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