Photovoltaic and Thermal Effects at PbTe $p-n$ Junction under CO_2 Laser Irradiation

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In this work, two effects appeared in PbTe $p-n$ junctions under long-wave irradiation by CO_2 laser were investigated. The first effect was created by the optical absorption of long-wave photons in PbTe and caused by its photovoltaic effect. The mechanism of photoeffect is connected with the formation of electron–hole pairs by two-photon processes of absorption and separation of pairs at the $p-n$ junction. The second novel effect is related to the heating process and the formation of temperature difference at the $p-n$ junction. The main feature of PbTe semiconductor is a strong temperature dependence of static dielectric constant ε. In this case, for PbTe $p-n$ junction it was created a barrier pyroelectric effect. PbTe $p-n$ junctions were fabricated employing indium donor diffusion into PbTe single crystals grown by the Chochrasky technique. Current–voltage and capacitance–voltage characteristics have been measured over a wide temperature range. The dark saturation current density was $\sim 10^{-7}$ A/cm^2 at $T = 100$ K. Two methods were used. The short-pulsed CO_2 laser light (with a pulse duration of 150 ns) across the PbTe $p-n$ junction was used for the investigation of the photovoltaic effect. The continuous irradiation of CO_2 was used for the investigation of the thermal effect and caused by its barrier pyroelectric effect (BPE). These two effects were investigated over the 40–150 K temperature range.

Keywords: PbTe semiconductor, p.n junction, two-photon absorption, barrier pyroelectric effect.

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