Schottky Photosesors on High Radiation Resistivity Semiconductors

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Semiconductor $Hg_3In_2Te_6$ crystals and their analogous are solid solutions of In_2Te_3 and HgTe. $Hg_3In_2Te_6$ crystals are congruently melted as chemical compound. Like In_2Te_3 the $Hg_3In_2Te_6$ crystal has cubic crystal lattice with stoichiometric vacancies in their crystal structure. The electroconductivity, photoconductivity, mechanical, chemical properties of the crystals do not deteriorate after their irradiation by γ-photons with energies up to 1 MeV and doses up to 10^{18} cm^{-2}, by electrons with energies up to 300 MeV and doses up to 10^{19} cm^{-2} and by mixed reactor irradiation (filtered slow neutrons) with doses up to 10^{19} cm^{-2}. This feature is determined by high concentration (~$5\cdot10^{21}$ cm^{-3}) of stoihiometric vacancies (V_s) in crystal structure, where every third In-cation node is empty. These V_s are electroneutral, they capture all impurity atoms in these crystals and kept them in electroneutral state too. On the other hand, this feature does not allow forming direct p-n junctions in these crystals by introducing the impurities. However, we have developed p-n junction analogues in form of Schottky diodes and corresponding photodiodes with semitransparent metal layer on single crystal $Hg_3In_2Te_6$ substrate that allows irradiation to get into active region preserving this way all the advantages compared to p-n junction.

We have synthesized $Hg_3In_2Te_6$ single crystals and their more wide-gap analogues $Hg_2CdInGaTe_6$, $Hg_2MnInGaTe_6$ for Shottky diodes and photodiodes preparation.

Schottky diodes were fabricated using vacuum thermal or magnetron sputtering of semi-transparent nickel films of 200 Å thickness or In_2O_3SnO films of 1000 Å thickness on the n-type substrates made of all the investigated crystals. The bottom ohmic contact was manufactured by indium fusing.

Comparison of I–V characteristics of Ni – $Hg_3In_2Te_6$ diode: measured (circles) and calculated according to the generation-recombination Sah–Noyce–Shockley theory (solid line). The dashed line shows the calculation results according to the thermionic theory (fig.1).

Schottky photodiodes based on these wide-gap semiconductors are designed for the detectors of near-infrared, visible (fig.2) and ionizing radiation emission, which do not require additional cooling. The latter is associated with a weak dependence of their photosensitivity on temperature.

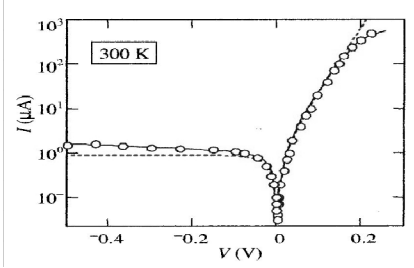

Fig.1

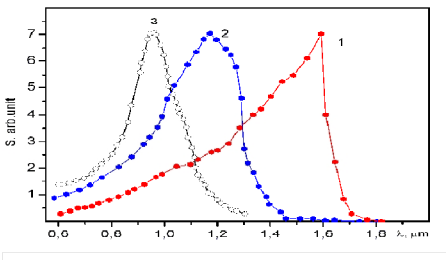

Fig.2