The Studies of Chemical Etching Processes of Highly Radiation Stable $Hg_3In_2Te_6$ Single Crystals for Applying Thin Films Coatings for Schottky Diode

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Semiconductor $A_2^{III}B_3^{VI}$ group crystals and based on them solid solutions have extremely high radiation resistance and electrophotovoltaic parameters to X-, γ-, β- and neutron radiation. The most successful in this area is creation, study and application of semiconductor crystals based on solid solutions of $A_2^{III}B_3^{VI}$ and $A^{II}B^{IV}$ chemical compounds, including composition having a fixed melting point. Among them most attractive is $Hg_3In_2Te_6$ compound (MIT). We have obtained single crystals of MIT solid solution and found that the material consists of $Hg_3In_2Te_6$ phase with lattice parameters a=6,2900 Å. It is known that there are unoccupied In sites (stoichiometric vacancies) in $A_2^{III}B_3^{VI}$ group single crystals whose concentration is independent of temperature. These vacancies capture alloying impurities and keep them in an electrically neutral state. This property does not allow to create a simple p-n junction, so we have designed Schottky diodes and photodiodes on MIT substrates. Another feature of MIT crystals with stoichiometric vacancies is low density of surface states that requires special treatment of substrate surface during the formation on it metal thin film coatings or In_2O_3·SnO degenerate semiconductor films for Schottky diodes.

The studies of the parting border surface–etchant effectively use the thermodynamic analysis method – the method of Pourbaix diagram. As a result of the construction and analysis of the Pourbaix diagram a prediction of chemical composition of anodic oxide films on $Hg_3In_2Te_6$ surface have been done, and optimum conditions for polishing and selective etching were found. The upper limit of the thermodynamic stability of $Hg_3In_2Te_6$ solid phase line is determined by equilibrium potential in the range from -0.459 V to -1.227 V. The nature of the electrode reactions at each region depends on pH, redox potential and system activity of ions which determine the potential. Optimal conditions for chemical and electrochemical etching, surface oxidation and sulphidation of $Hg_3In_2Te_6$ crystals have been found. Thin film Schottky diode structures, which can be used as near infrared, visible and X-, γ- radiation photodetectors, have been developed on this material.