Compensated GaAs based radiation hard structures for electronic componential base of space application

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A technology of multilayer structures whose electronic properties are determined by deep level impurities (d-impurities in GaAs) is proposed. The given level of doping on one hand and controlled compensation of GaAs by impurities of the transition group of the periodic system on the other make it possible to vary the properties and characteristics of structures within a wide range. One of the significant advantages is their high radiation hardness which offers the challenge of using multi-layer structures in space programs for creation of the sensitive elements for various purposes and devices of functional electronics. The variety of electronic properties which are observed and expected in the investigated structures in this promising scientific field is primarily due to the change of the charge state of deep impurity centers. The process of deep impurity centers recharging controlling will make it possible to create a radiation hard element base of micro-opto- and functional space-based electronics that exceeds the known analogues in terms of the set of parameters.

Even now using a high-resistivity gallium arsenide structures compensated by Fe and Cr, a series of original semiconductor devices has been created the set of basic parameters of which exceeds the known analogues: ultrafast electronic switches, photodetectors and radiation imaging array sensors.

The prototypes of radiation-resistant electronic switches controlled by electric and light power are developed. These switches are used in power pulse technology to generate large voltage drops up to 1 kV and current up to 100 A within (40-200 ps) and an operation rate of up to 1 MHz. Devices are efficient as shapers in the mode of passive relaxation oscillator and in the enhancement mode.

Samples of multi-element photodetective arrays of visible and UV spectral ranges with threshold sensitivity reaching (10^{-15}) $W/Hz^{1/2}$ in the spectral range of (0.2-0.4) μm were developed.

The technology of large area (84.6x28.2 mm^2) array sensors, with the number of elements up to 1 million pixels for single quanta of the synchrotron radiation recording in experimental high-energy physics, in digital color imaging systems in X-ray and gamma rays, in scientific and industrial purposes is developed.