The influence of electrical field distribution profile on amplitude spectrum shape and charge collection efficiency of GaAs:Cr X-ray radiation sensors

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A new method of gallium arsenide (HR GaAs) processing has been proposed by Tomsk State University. This technology allowed us to produce detector quality material of 2, 3 and 4 inch diameter and thickness of up to 1000 μm. High resistivity (up to 10^9 Ohm cm) and mobility-lifetime product of nonequilibrium electrons (up to $2 \cdot 10^{-4}$ cm^2/V) are the hallmarks of the material. It was shown GaAs:Cr detectors provide better X-ray radiation efficiency in the energy range above 10 keV in comparison with Si sensors. Due to this fact GaAs:Cr detectors can be used in such new applied researches as high energy physics, in systems of recording and measuring of X-ray radiation for medical, industrial and special purposes.

Investigated sensors were a symmetrical structure "metal-GaAs:Cr-metal" with active area size of 0.3×0.3 cm^2 and thickness of 500 μm.

Investigation results of current-voltage characteristics, amplitude spectrum and charge collection efficiency dependencies on electrical field distribution profile across the sensors' volume are presented in the paper. Investigation of electrical field distribution was held due to the electro-optical Pockels effect. The I-V – characteristics were measured in the range from 1 mV to 1000 V by means of Keithley 2410. Amplitude spectra were measured by "CAMAC" standard spectrometer using ^{241}Am as a source of gamma radiation. The values of mobility-lifetime of nonequilibrium electrons ($\mu_e\tau_e$) were estimated using Hecht equation based on approximation of experimental dependences.

In this article the results of amplitude spectrum and charge collection efficiency calculation for a nonuniform distribution of electrical field across the sensor are shown.

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