

# The study of ion-implanted structures based on chromium compensated gallium arsenide

Leila Shaimerdenova, Irina Kolesnikova, Anastasia Lozinskaya, Oleg Tolbanov, Anton Tyazhev

*National Research Tomsk State University, Tomsk, Russia, 634050*

Micro and nanoelectronics development requires material quality and characteristics improvement of the finished product for the following industries. The scientist's ambitions of recreating the Big explosion with the ATLAS experiment assistance makes the characteristics study of X-ray sensors based on semi-insulating chromium compensated gallium arsenide (GaAs:Cr) important. These sensors can be also used for creating low-dose devices for medical researches and at cargo inspection in airports and railway stations.

The paper presents the investigation results of X-ray sensors based on ion-implanted «p<sup>+</sup>-i-Ni», «n<sup>+</sup>-i-Ni», «p<sup>+</sup>-i-n<sup>+</sup>» GaAs:Cr structures. Highly doped p<sup>+</sup> and n<sup>+</sup> layers were obtained by implanting magnesium and silicon ions respectively. GaAs:Cr layer was the i-type region. Thicknesses of p<sup>+</sup> and n<sup>+</sup> layers were about 0.2 μm, the thickness of i-layer varied in the range of 450-510 μm. Activation of the ion-implanted dope was carried out by rapid annealing in an argon atmosphere. Sensors based on "Ni-GaAs:Cr-Ni" structures were used as reference samples, in which metal contacts were deposited directly on the GaAs:Cr wafers' surface.

Using single samples of 3×3 mm<sup>2</sup> the field strength distribution by means of the Pockels effect, the dark current level, the charge collection efficiency and the resistivity on the Hall effect basis were studied. The lifetime of nonequilibrium charge carriers was estimated from the experimental dependences of the charge collection efficiency on the electric field.

Current-voltage characteristics studying (I-V) of the structures was performed by using Keithley 2410 source-meter. It is established that the I-V of sensors based on "Ni-GaAs:Cr-Ni" structures has three characteristic regions: linear, sublinear and superlinear. In ion-implanted structures, the linear region becomes more extended, and the sublinear region becomes more evident. The resistivity, calculated from the linear region of the current-voltage characteristic, is about 10<sup>9</sup> Ω·cm.

This work was carried out with financial support under the project HY 8.2.01.2017.