Lux-ampere characteristics of a high-resistance GaAs:Cr

Irina Kolesnikova, Oleg P. Tolbanov, Vladimir A. Novikov, Leila Shaimerdenova

Laboratory of Functional Electronics, National Research Tomsk State University, Tomsk 634045, Russia

Producing of large area matrix detectors based on semiconductor materials with high atomic number suitable for the registration of the synchrotron radiation of high intensity in the photon energy range 20–90 keV opens a fundamentally new experimental base of scientific research conducted at leading X-ray synchrotron centres with high luminosity beams. GaAs:Cr satisfies the requirements to the materials used in the radiation detectors production.To determine the suitability of the material for the sensor production, the electrophysical and optical properties of the material must be investigated.

The paper presents the results of experimental studies of the lux-ampere characteristics of a sensors based on a high-resistance (HR) GaAs:Cr. As objects of study HR GaAs pad sensors with an area of 0.2 - 0.25 cm and the thickness of the sensitive layer in the range of 450-650 microns were used. Metal contacts were fabricated by chemical deposition of nickel (Ni) with thickness of 0.5 - 1 micron or by electron-beam sputtering of Cr / Ni film with a total thickness of 0.1 - 0.2 micron on both sides of pad sensor. Therefore, sensors have «Ni - HR GaAs - Ni» symmetrical structure or «Ni / Cr - HR GaAs - Cr / Ni» structure. The samples were chosen with a uniform field distribution across the thickness. The distribution of intensity across the thickness of samples was investigated using the Pockels effect.

Using illumination with a high intensity allows to simulate a situation analogous to the irradiation of samples with high intensity X-rays. A comparative analysis of the lux-ampere characteristics obtained with this two types of illumination was carried out. As a result of the experiment, lux-ampere characteristics were obtained for sensors based on (HR) GaAs:Cr from different ingots and with different diffusion temperature. The form of this characteristics allows to estimate the uniformity of characteristics and material suitability for the sensor production. The investigation was financially supported under the project «НУ 8.2.01.2017».