ROENTGEN-DOSIMETRIC CHARACTERISTICS OF InSe – GaSe – InSe HETEROJUNCTIONS

S.N.MUSTAFAEVA, N.Z.GASANOV, S.S. ABDINBEKOV
Institute of Physics,
National Academy of Sciences of Azerbaijan
Az 1143, Baku, H.Javid av., 33

Изучением рентгендозиметрических характеристик эпитаксиальной гетероструктуры InSe – GaSe – InSe установлено, что эта полупроводниковая система характеризуется высокой рентгеночувствительностью ($10^{-10} \div 10^{-9}$ A·min/R) и может быть использована для создания неохлаждаемых (работающих при комнатной температуре) рентгендетекторов.

The investigation of X-ray dosimetry of epitaxial heterojunctions on the base of InSe – GaSe –InSe semiconductors has demonstrated that these structures are characterized by a high roentgen-sensitivity ($10^{-10} \div 10^{-9}$ A·min/R) and can be used in the design of uncooled (operable at room temperature) X-ray detectors.

In our previous works we have investigated the roentgen-dosimetric properties of $TlGaSe_2$ [1] and $TlInSe_2$ [2] single crystals, which characterized by a high roentgen-sensitivity. The layer GaSe and InSe single crystals, which are binary analogs of $TlGaSe_2$ and $TlInSe_2$, are also sensitive to X-rays.

The purpose of this work was to investigate X-ray dosimetric characteristics of InSe – GaSe – InSe epitaxial heterojunctions, obtained by melting of low-temperature component. The configuration of investigated sample was shown in Figure 1. Indium was used as a contact material.

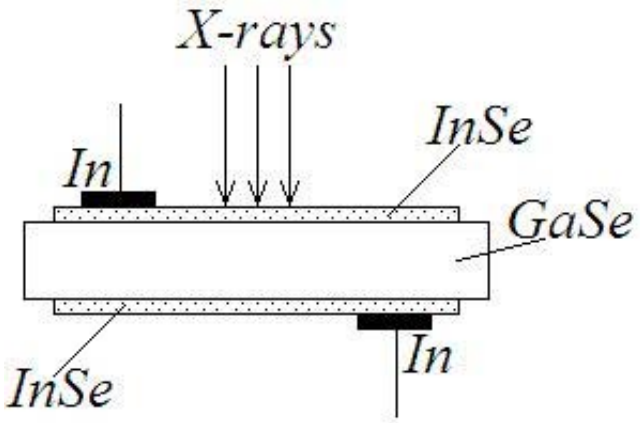

Fig.1. Configuration of the sample on the base of InSe – GaSe – InSe heterojunction.

As an X-ray source, we used a URS-55a instrument with a BSV-2(Cu) tube. The X-ray intensity was controlled by varying the electric current in the tube at each specified value of the accelerating voltage. The absolute values of the X-ray dose were measured on a DRGZ-02 dosimeter.

All measurements were carried out at the temperature T = 300 K.

In the Figure 2 the current – dose characteristics of InSe – GaSe – InSe heterojunction were shown. The thicknesses of GaSe and InSe single crystals were equal to 200 and 50 μm, correspondingly; the distance between the In contacts was equal to 0.6 cm. It must be noted, that these characteristics were measured in the ventilated regime, i.e. without of supply voltage.

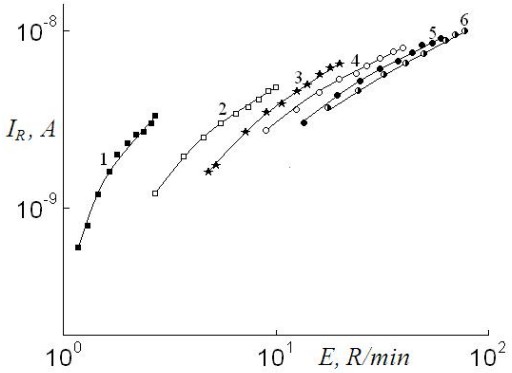

Fig.2. Roentgen-ampere characteristics of InSe – GaSe – InSe heterojunction at various accelerating voltages on the tube V_a, keV: 1 – 25; 2 – 30; 3 – 35; 4 – 40; 5 – 45; 6 – 50. T = 300 K.

From analyzing the current – dose characteristics of InSe – GaSe – InSe heterojunction, it follows that the dependence of the steady-state X-ray current on the dose rate can be adequately described by a power law: $J_R \sim E^{\alpha}$.

The exponent α is plotted in Fig. 3 as a function of the effective X-ray hardness V_a for the InSe – GaSe – InSe system.

It follows from Figures 2 and 3 that at low rates of soft X-rays (at low voltages V_a) $J_R \sim E^3$. At relatively high dose rates of hard X-rays (at high voltages V_a), the exponent α tends to 0.5.

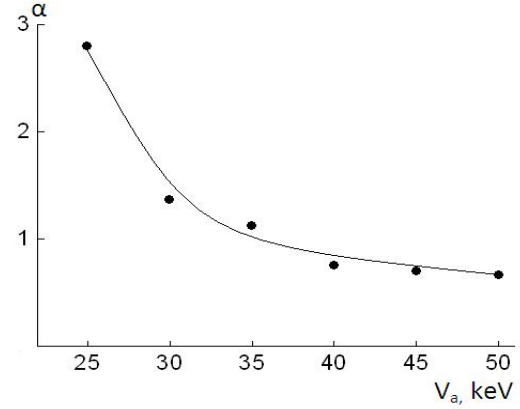

Fig.3. Dependence $\alpha(V_a)$ for InSe – GaSe – InSe heterojunction.

The dose sensitivity of studied detectors made $10^{-10} \div 10^{-9}$ A·min/R in the range of the measured power E = 0.75 ÷ 78.0 R/min. The registered range of the X-rays energy made 25 ÷ 50 keV.

The results obtained have demonstrated that InSe – GaSe – InSe heterojunctions are characterized by a high X-ray sensitivity and can be used in the design of uncooled (operable at room temperature) roentgendetectors.

X-ray detector on the base of InSe – GaSe – InSe heterojunction is quick-response crystal detector with the stable and reproducing dosimetric characteristics.

---

[1]. *S.N.Mustafaeva, M.M.Asadov* Proceedings of International Workshop "Quantum particles, Fields and Strings". Baku. Azerbaijan. Sept. 2005. P. 9 – 15.

[2]. *S.N.Mustafaeva* Materials of the 11-th International Conference on Ternary and Multinary Compounds. ICTMC – 11. United Kingdom. Department of Physics, University of Salford. 8 – 12 th Sept. 1997. P. 71.

Received:10.02.2007