TEMPERATURE DEPENDENCE OF THE PHOTOCURRENTS AND SPECTRAL DISTRIBUTION OF PHOTOCONDUCTIVITY OF IRRADIATED BY γ-QUANTUM MONO CRYSTAL $GaS_{0.75}Se_{0.25}$:Er

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ABSTRACT

The influents of γ-quantum was studied according to the temperature dependence of photo-current and spectral spreading of photo-conductivity (T=300 K, E=1.3 MeV, F=10÷100 krad). On the base of the experimental results obtained, parameters of local centers in mono-crystals $GaS_{0.75}Se_{0.25}$:Er were defermined.

Keywords: temperature, dependence, photo-current, mono-crystals.

I. INTRODUCTION

In connection with the wide prospects of the practical employment of semiconductor compounds, the problem of the influence of radiation on these substances is of great interest. Theoretical analyses of the possible cases of rise of very small defects in these crystals are much more complicated than in homogeneous semiconductors. The experimental data show that under the coercion of ionization radiation, in all cases both donor and acceptor centers appear. As the number of radiation defects increases up to the point which exceeds to a great extent the initial concentration of chemical admixtures balanced concentration of the bearers and the state of Fermi level connected with it approaches the maximum point. These maximum points are defined by the system of power levels which appear as a result of radiation disturbance. Creating plenty of atomic detects by means of irradiation leads to the change of many physico-chemical characters tics of the substance: power conductivity, photo-conductivity and it is a very convenient way of the controlled operation over both the property of the materials and the character and type of the grating [1].

In order to get the systematized data on the radiation stability of the flaky monocrystal $GaS_{0.75}Se_{0.25}$:Er some studies on the influence of γ-radiation of the C_0^{60} origin upon its photo-power property. The studied samples were exposed to rays with the γ-quantum with the power of 1.3 MeV, at the dose interval of 10÷100 krad.

The studies included monocrystals $GaS_{0.75}Se_{0.25}$:Er with the specific resistance of $\sim 10^9$ Om·sm at the room temperature, cultivated according to Bridgman method. The admixture Er was led during the synthesis and its concentration come to $\sim 10^{-18} sm^{-3}$. The contacts were put on the surface of the crystal with the silver paste. The measuring of the photoconductivity was carried out with the stationary method [2].

II. EXPERIMENTAL RESULTS

The temperature dependence of the photocurrent $GaS_{0.75}Se_{0.25}$:Er has been studied by the light of the from the ray of its own absorption (λ=0.490 mkm).

In the pic.1. there is dependence of the photo-conductivity I_f on the temperature before (curve 1) and after (curve 2,3) irradiation. As you see in the pic.1. before the irradiation of the dependence $I_f \sim 10^3/T$ has four areas. At low temperature the photo-conductivity is practically steady.

Beginning from T_1=178 K the temperature increases exponentially till T_2=500 K. Above T_2=500 K exponential reducing of the temperature of the photo-current begins. The energy of the activation of the levels E_1=0.260eV, E_2=0.043eV was found out of temperature dependence of the photo-conductivity.

Activation of the photo-current is explained by the adhesiveness of the main carriers of ions within the framework of three-leveled model for the mono-polar semi-conductor [3], in which there are two types of recombination centre (r- and s-centers) and one centre of adhesion of the main carries (t).

The engaging the levels of adhesion lead to the activation, and the engaging of r-centers leads to the temperature reduce of the photo-current.

The beginning of the activation by means of the increase of doses is shifted high temperatures and the corresponding point of the bend P_1 depends on the temperature according to the Law:

$$P_1 = N_v \exp\left(-\frac{E_{vt}}{kT_1}\right) \qquad (1)$$

With the slope E_{vt}.

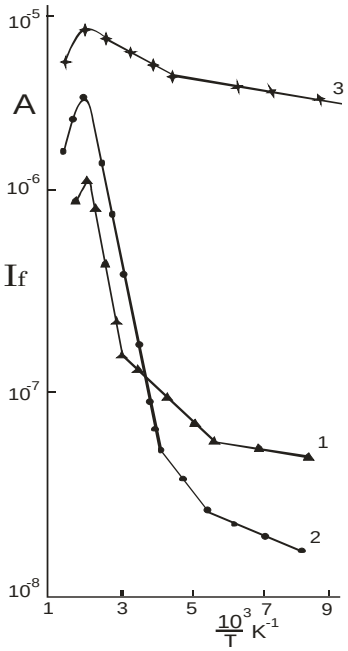

Fig.1. Temperature dependence of the photo-conductivity $GaS_{0.75}Se_{0.25}$:Er at different doses of irradiation; 1.before irradiation, 2. F=30 krad, 3. F=50 krad.

Activation of the photo-current by all doses of radiation ends at the temperature T_2, determined from the equation:

$$N_t=N_v\exp(-\frac{E_{vt}}{kT_2}) \qquad (2)$$

From the experimental data we get of E_{vt}=0.38 eV, $N_t=2\cdot10^{14}sm^{-3}$, $P_1=10^8sm^{-3}$.

In the terms of temperature reduce and adhesion of ion carriers [3] we get:

$$P=\frac{L}{N_t}\frac{N_v}{N_c}\exp\left(-\frac{E_{vt}-E_{cr}}{kT}\right) \qquad (3)$$

Where E_{cr} distance from r-centre of the recombination to the bottom of the conductivity zone.

Using experimental data and E_{vt} from formula (3) we define the depth of the lie of r-recombination of E_{cr}=0.45 eV.

In order to find out the reasons of the changes of the photo-sensitive in the irradiated crystals, the studies of the photo-conductivity in different doses of irradiation by γ-quantum were carried out (pic.2).

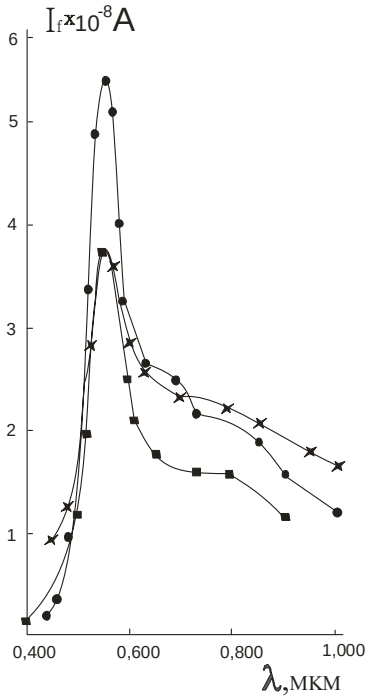

Fig.2. Spectrum of photo-conductivity $GaS_{0.75}Se_{0.25}$:Er at different doses of irradiation; 1.before irradiation, 2. F=10 krad, 3. F=30 krad.

It's seen from the picture that at small doses (10 krad) the irradiation of photo- sensitive was not changed, and it depends on the high solidity of the structural defects at the initial crystals.

III. CONCLUSION

With the increase of doses of irradiation (F>10 krad) photo- sensitivity $GaS_{0.75}Se_{0.25}$:Er grew higher. The width of barred area of the studied samples, which is determined by the photo-conductivity E_g=2.28 eV.

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