PHOTOCONDUCTIVITY OF $Au_3Ga_5Se_9$ SINGLE CRYSTALS

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The photoconductivity spectrums at different temperatures as well as the temperature dependences of the photocurrent in $Au_3Ga_5Se_9$ compound have been investigated in the present paper. The band gap and its temperature coefficient have been determined from the photoconductivity spectrum. The lifetime of nonequilibrium carriers of the current has also been determined.

In [1] the phase analysis has been carried out and the character of interaction the quasibinary $AuGaSe_2$-Ga_2Se_3 system has been considered. The technology of synthesis and growth of single crystals of a new compound semiconductor $Au_3Ga_5Se_9$ has been developed. The materials for ohmic contact have been chosen and certain electrical, optical and thermal properties have been investigated. The main fundamental semiconductive parameters of $Au_3Ga_5Se_9$ compound have been determined.

The results of studying the photoelectric properties of $Au_3Ga_5Se_9$ single crystals are shown in the present paper.

The spectral dependence of the photocurrent in $Au_3Ga_5Se_9$ samples has been investigated in steady-state conditions at light intensity modulation at the frequency of 82 Hz.

The light pulse duration is usually several times higher as compared to generation and recombination time of nonequilibrium carriers. The photoconductivity spectra of $Au_3Ga_5Se_9$ crystal at temperatures of 100, 300 and 420 K are shown in Fig. 1. The curve 1 denotes the photoconductivity spectrum at 100 K. The sensitivity region of the photoconductivity spectrum is at 1.4-2.4 eV of the radiation quantum energy.

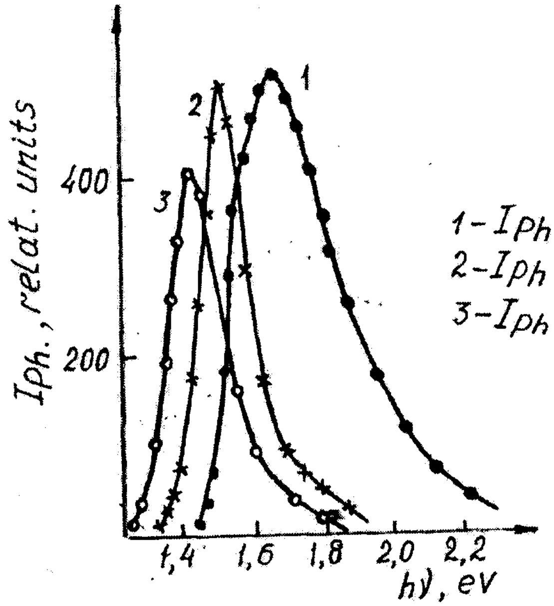

Fig. 1. The photoconductivity spectrum of $Au_3Ga_5Se_9$ single crystals at different temperatures: T, K: 1 – 100, 2 – 300, 3 – 420.

The energy gap at 100, 300 and 420 K has been determined according to the Moh's criterion and is equal to 1.5, 1.45 and 1.38 eV, respectively. With increasing temperature the photocurrent maximum shifts toward the lower energies. At 300 and 420 K the photoconductivity spectrum covers the quantum energy region narrower than at 100 K, while in the high energies region the curves drop sharply that as usual is attributed to increase of surface recombination with increasing temperature.

The energy gap coefficient of $Au_3Ga_5Se_9$ compounds is $\partial(\Delta E_g)/\partial T \approx -2.5\cdot10^{-4}$ eV/K.

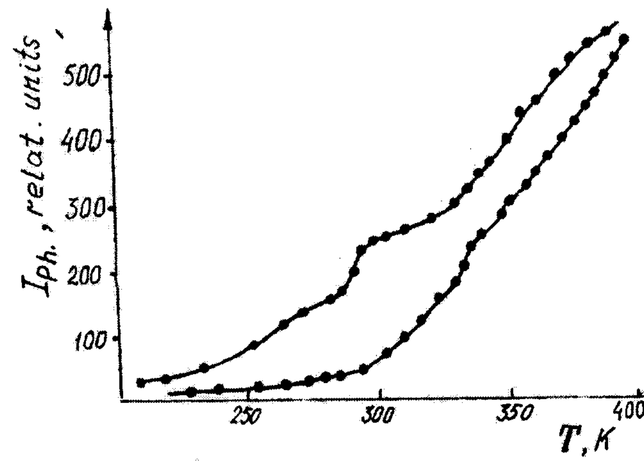

Fig. 2. The temperature dependences of photocurrent in two $Au_3Ga_5Se_9$ crystals.

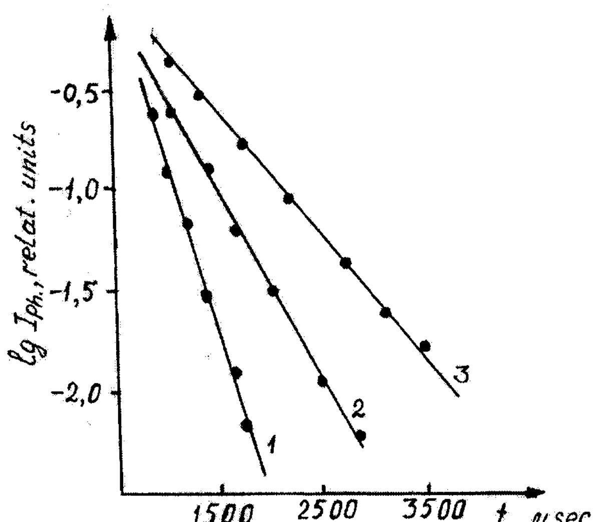

Fig. 3. Relaxation curves of photocurrent in $Au_3Ga_5Se_9$ at different temperatures: T, K: 1 – 100, 2 – 300, 3 – 420.

The temperature dependences of the photocurrent in two $Au_3Ga_5Se_9$ crystals are shown in Fig. 2. As seen in Fig. 2, at low temperatures (T<250 K) the samples are nearly not sensitive to radiation. Then with increasing temperature the photocurrent also increases. In $Au_3Ga_5Se_9$ crystals the stepped regions are observed in the $I_{ph.}(T)$ dependences. It is known that the photocurrent is determined by quantum yield, the radiation intensity, the relaxation time and the absorption coefficient [2]. As the first two values are constant in our experiments, the behaviour of the $I_{ph.}(T)$ dependences is attributed to the temperature dependence of the lifetime and the absorption coefficient. To study the temperature dependence of the lifetime, $\tau(T)$, the relaxation curves of the photocurrent have been taken after the excitation of samples by light pulses of the ISSh-100 lamp. The light pulse duration is no less than 5μsec. The time dependences of the photocurrent in $Au_3Ga_5Se_9$ compound are shown in Fig. 3. The lifetime τ of nonequilibrium carriers of current at temperature of 100, 300 and 420 K has been determined from the linear regions and is equal to 3.2, 4.3 and 7.9 μsec, respectively. It is seen that with increasing temperature the τ value increases.

The results of measuring τ in different crystals show that in the temperature region of 100-410 K the τ value increases no more than 2.5 times, but the photocurrent increases nearly by two orders. Thus, the behaviour of the curves of $I_{ph.}(T)$ dependence is greatly characterized by the temperature dependence of the absorption coefficient. Hence, the steps observed in the temperature dependence of the photocurrent, $I_{ph.}(T)$, are due to the impurity absorption.

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[2] *V.E. Lashkaryev, A.V. Lyubchenko, M.K. Sheinkman.* In book "Nonequilibrium processes in semiconductors", Naukova Dumka, Kiev, 1981.

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$Au_3Ga_5Se_9$ MONOKRİSTALININ FOTOKEÇİRİCİLİYİ

İşdə $Au_3Ga_5Se_9$ birləşməsinin müxtəlif temperaturlarda fotokeçiricilik spektri və fotocərəyanın temperatur asılılığı tədqiq olunmuşdur. Təcrübi nəticələrdən qadağan olunmuş zonanın eni, onun temperatur əmsalı və qeyri-tarazlıq yükdaşıyıcılarının yaşama müddəti tə`yin edilmişdir.

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ФОТОПРОВОДИМОСТЬ МОНОКРИСТАЛЛОВ $Au_3Ga_5Se_9$

В работе исследованы спектры фотопроводимости при различных температурах и температурные зависимости фототока соединения $Au_3Ga_5Se_9$. Из спектра фотопроводимости определены ширина запрещенной зоны и ее температурный коэффициент. Определено время жизни неравновесных носителей тока.

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