duration of the saturating pulses. The scatter of the parameters of the empirical $\tau_2^{-1}(T)$ curves is apparently connected with the narrowness of the temperature-measurement interval, where the simultaneous presence of linearly and exponentially varying terms admits of a certain indeterminacy in the determination of these parameters. It should be noted that the exponential term in $\tau_2^{-1}(T)$ is not connected with relaxation via the excited Nd^{3+} level, since the latter is separated from the fundamental one by $\Delta = 134\ cm^{-1}$ (= 193°K) [6]. As to the observed strong temperature dependence of the relaxation rate τ_1^{-1} for the fast exponential, it can be explained according to (6) by assuming a cross-relaxation mechanism in which phonons take part, such as considered in [7].

We are planning experiments with specially pure crystals and in a broader temperature interval for a direct confirmation of the mechanism proposed here for the relaxation of Nd^{3+} via impurities.

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LUMINESCENCE INDUCED IN GALLIUM PHOSPHIDE BY INFRARED LIGHT

V. G. Gaivorin and V. I. Sidorov
Institute of Radio Engineering and Electronics, USSR Academy of Sciences

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In 1963, Gross and Nedzvedskii [1] noted that infrared radiation increases the photoluminescence of gallium-phosphide samples at low temperatures. Our investigations of this phenomenon have shown that this effect is very appreciable under certain conditions, and have also made it possible, in our opinion, to explain the physical mechanism of this phenomenon.

Figure 1 shows an oscillogram of the signal from an FEU-36 photomultiplier used to register the recombination radiation of a sample of gallium phosphide (n-type, $N_d - N_a = 10^{17}$ cm^{-3}) [1)], kept, for example, at the temperature of pumped-off liquid nitrogen. At the in-

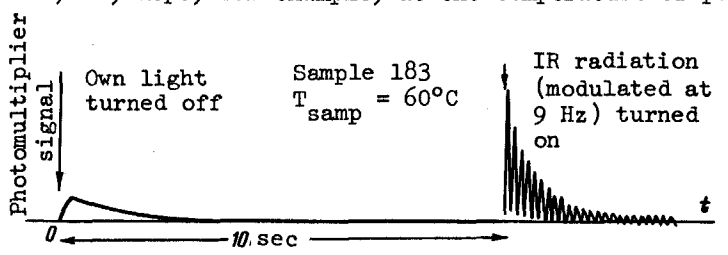

Fig. 1

1) The authors thank T. Ya. Zhvanetskaya, A. V. Lishin, M. Pivovarov, and V. V. Shishkov for supplying the GaP samples.

instant of time t = 0, the excited intrinsic radiation is turned off and the shutter of the photomultiplier is opened. After ten seconds, when the intensity of the recombination radiation drops practically to zero, the modulated infrared radiation is turned on. As seen from the oscillogram, the infrared radiation causes luminescence of the sample. This luminescence radiation has the same spectral composition as the recombination radiation occurring when the intrinsic radiation is absorbed, at all the temperatures investigated by us (80, 60, and 7°K). Figure 2 shows plots of the spectral distribution of the photoluminescent radiation and reradiation (luminescence stimulated by the infrared light) of one of the GaP samples investigated by us. The radiation consists of the characteristic green and red bands, which, as shown in [2,3], are due to the interimpurity recombination of donor-acceptor pairs. Measurements of the photoluminescence and reradiation kinetics have shown that the radiation relaxation follows an exponential law in both cases. The effective time constants of both processes are very close and amount to ~2msec. As seen from the oscillogram (Fig. 1), the luminescence induced by the infrared radiation is nonstationary and vanishes in the course of time. The time of vanishing of the induced luminescence is determined at the temperatures investigated by us by the intensity of the infrared radiation and its order of magnituded is usually several seconds. Figure 3 shows plots of the intensity of the induced luminescence against the photon energy of the exciting infrared radiation at a fixed intensity of the intrinsic illumination. At all the temperatures, the long-wave excitation boundary amounts to approximately 5 μ. Measurements of the impurity photoconductivity of the same sample have shown that the spectra of the impurity photoconductivity and the excitation

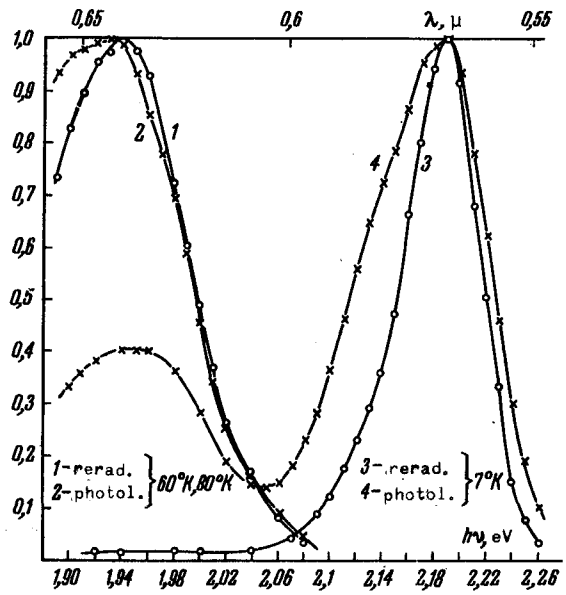

Fig. 2

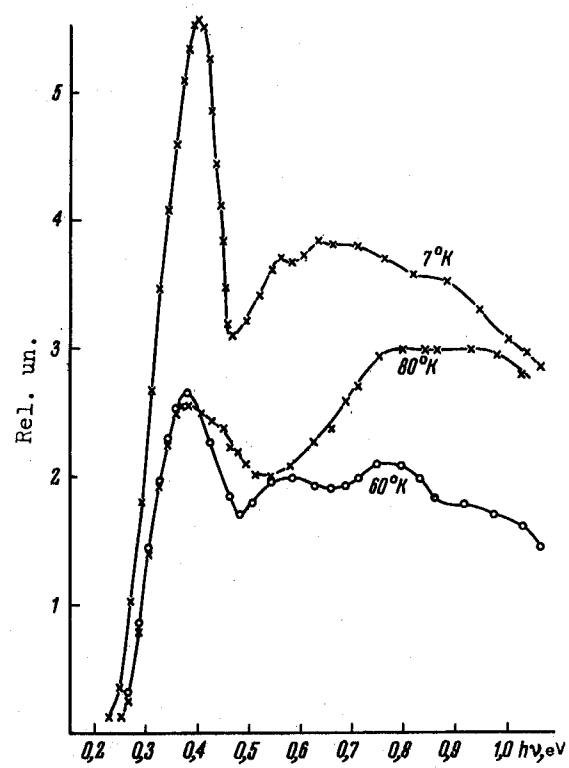

Fig. 3. Ordinates - sample radiation intensity divided by the infrared power.

spectrum of the induced luminescence practically coincide.

The features of the aforesaid effect of transformation of the average infrared radiation into visible light can be attributed to the following electronic transition mechanism. As is well known, the main mechanism of carrier recombination in gallium phosphide with impurity density $N \geq 10^{16}$ cm^{-3} is the interimpurity recombination of the carriers captured by donor-acceptor pairs. The first to recombine are close pairs with small distances between the donor and acceptor centers. The pairs with sufficiently large interimpurity distances can be in a charge-exchange state for a sufficiently long time. Infrared irradiation of a sample containing such nonrecombining remote pairs ionizes the impurity centers making up these remote pairs. The generated photocarriers can be captured by already-recombined close pairs and take part in the new process of recombination by the close pairs. The spectral composition and the kinetics of the photoluminescence and reradiation should be the same in this case. The excitation, recombination, and impurity photoconductivity spectra should also be the same. The relaxation of the remote charge-exchange pairs at low temperatures should be determined essentially by the intensity of the infrared radiation ionizing them. As already emphasized above, all these features were observed in the experiment.

In conclusion, the authors thank T. M. Lifshitz and D. S. Nedzvedskii for interest in the work and a discussion of the results.

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OBTAINING HOLOGRAMS WITH AN INCOHERENT LIGHT SOURCE

G. I. Rukman and Yu. I. Filenko
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In [1] are presented theoretical considerations and a description of an experimental procedure for obtaining holograms using an incoherent radiation source with $\Delta\lambda/\lambda \leq 0.1$. The experimental results of [1] were obtained with a source (superhigh-pressure mercury lamp) in which, as a result of filtering, $\Delta\lambda \sim 100$ Å.

We obtained on the basis of the procedure of [1], holograms with unfiltered radiation from a superhigh-pressure mercury lamp and an incandescent lamp.

The experimental setup is shown in Fig. 1. Figure 2 shows holograms obtained with unfiltered radiation of a mercury lamp (a) and an incandescent lamp (c) and the images (b, d) reconstructed from these holograms with the aid of a laser.

In holography by the scheme of Fig. 1, the "carrying three-dimensional grating" in the holography plane is the image of the diffraction grating. This image can be regarded as a result of interference between zero- and first-order rays diffracted by the grating. The achromatism of such a holography system (independence of the period d of the interference pattern of the wavelength λ) is due to the fact that the convergence angle of the interfering rays (θ) is proportional to the wavelength, $d = \lambda/\sin\theta(\lambda) = \text{const}$. The dimensions of the