ments $V \sim 10$ keV and consequently $u < 3 \times 10^9$ cm/sec and $\lambda \lesssim 3 \times 10^9 \times 10/\sqrt{3 \times 10^9 n} < l$ if $n \gtrsim 10^8$. Hence we can introduce an effective conductivity $\sigma = e^2 n\lambda/mu \approx \omega_p$ and write Ohm's Law

$$I = V / R_{\text{eff}}, \quad R_{\text{eff}} = l \cdot 10^{12} / \sqrt{3 \cdot 10^9 \, nS}$$

(the cross section of the pinch $S \approx 50$ cm^2).

The resistance derived in this way is of the same order as the experimental value of R. Consider Fig. 1. At the transition to the oscillatory regime the current is approximately 200-300 A so that R = 30-50 Ω. If it is assumed that the density at this time is 10^{12} cm^{-3} then $R_{\text{eff}} \approx 30$ Ω. The qualitative nature of the curve can be explaned as follows: The trap is filled by plasma in 10-15 μsec. During this time interval the current increases because the resistance R_{eff} is being reduced. As the density increases the streaming velocity $u \sim n^{-1/2}$ is reduced. At some value of n the velocity u becomes smaller than the critical value, the instability is quenched, and the anomalous resistance disappears. This instant of time may be related to the onset of the periodic discharge.

The ion heating can arise as a result of an instability due to opposed ion streams or as a result of Landau damping of the oscillations excited by the electron current.

Thus, in these experiments we have observed an anomalously high resistance and intense electron heating in the plasma in a linear discharge that takes place along the magnetic field in the "probkotron." This effect in conjunction with adiabatic compression results in a plasma characterized by a density greater than 10^{12} cm^{-3}, an electron temperature of approximately 200 keV and an ion temperature of approximately 3 keV. Plasmas of this kind have been confined in the probkotron for the entire lifetime of the magnetic field, which is approximately 2 msec.

In conclusion the authors wish to thank A. I. Gorlanov for his help in the experiments.

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226

SPECTRAL DISTRIBUTION OF THE EFFECT OF QUENCHING OF THE RECOMBINATION RADIATION OF GERMANIUM BY INFRARED LIGHT

I. K. KIKOIN and Yu. P. KOZYREV

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In an earlier paper [1], we reported the quenching of the recombination radiation of germanium by the illumination of the sample with spectrally unresolved infrared light. The present note reports the preliminary results of a study of the spectral distribution of this effect.

Ge disks, of about 10 mm diameter and from 4 mm to 50 μ thick, were placed in a special holder. Minority carriers were injected by illumination with white light from an incandescent lamp, the light having been passed first through a water filter 100 mm thick so that only the wavelengths $\lambda < 1\,\mu$ reached the sample. This light was modulated at 117 cps by means of a rotating disk with apertures. The same surface of the sample could be illuminated with unmodulated monochromatic infrared radiation coming from a monochromator. A PbS photoresistor, placed next to the unilluminated side of the sample, served as the receiver of the recombination radiation. The signal from the PbS was fed to a measuring circuit, consisting of a resonance amplifier, a synchronous detector and an automatic recorder.

The germanium sample, together with the PbS receiver, was placed in a metal Dewar with KBr windows and cooled with liquid nitrogen.

The integral intensity of the recombination radiation was measured with and without the additional illumination of the sample by means of infrared light. Some of the infrared light reached the PbS receiver after passing through the sample. Because of this, the working point of the photoresistor characteristic shifted, which in turn altered the magnitude of the signal generated by the recombination radiation being measured.

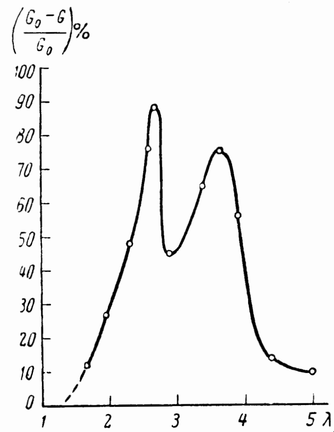

FIG. 1. G_0 is the intensity of the recombination radiation in the absence of infrared illumination; G is the intensity of this radiation for illumination with infrared light.

To allow for this, we developed a special measurement method which will be described in detail in a later communication.

We investigated p- and n-type samples, both of high and low resistivity. It was found that for p-type samples of 50 ohm. cm resistivity and n-type samples of 40, 20, and 11 ohm. cm resistivity, the quenching effect had maxima at the infrared wavelengths $\lambda_1 \approx 2.7\ \mu$ and $\lambda_2 \approx 3.6\ \mu$ (Fig. 1) (the quenching effect was defined as the relative change in the integral intensity of the recombination radiation under the action of the infrared illumination).

For p-type samples of 0.7 and 3 ohm. cm resistivity, we found only one quenching-effect maximum at the wavelength $\lambda_1 \approx 2.7\ \mu$ (Fig. 2) and the amplitude of this maximum was smaller than that for high-resistivity samples.

For p- and n-type Ge of resistivity of the order of 0.01 ohm. cm, no quenching was observed at all. On reduction of the sample thickness, the spectral width of the maxima decreased.

It is very likely that there is some analogy between the investigated effect and the photoconductivity quenching.[2] As is known,[2] the photoconductivity quenching is usually ascribed to the presence of impurities which give rise to deep levels in a semiconductor. In our case, such an impurity is, obviously, copper which forms three acceptor levels in germanium.[2] The recombination radiation quenching is likely to be associated with the 0.33 eV level whose energy separations from the conduction and valence bands correspond exactly to the frequencies at which the quenching maxima were observed. The absence of quenching in samples with the lowest resistivity can be accounted for by the predominance of the "band-band" recombination process,[3] over the recombination process through impurity levels.

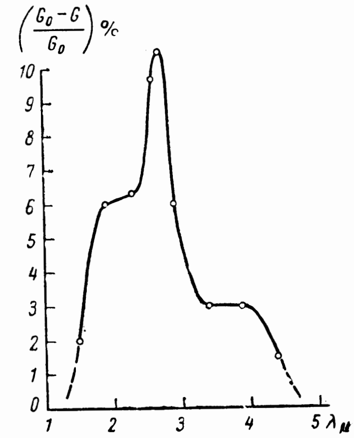

FIG. 2

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227

CONCERNING THE SINGLE-ELECTRON APPROXIMATION IN COLLISION THEORY

R. Ya. DAMBURG and R. K. PETERKOP

Institute of Physics, Academy of Sciences, Latvian S. S. R.

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VEKLENKO and Novobrantsev[1] (VN) proposed a variant of the one-electron approximation for the case when one of the particles is in a continuous spectrum state. Specific calculations were made for the scattering of electrons by hydrogen atoms at zero energy. Unexpectedly good agreement was obtained with the results of the thorough but much more laborious calculations of Temkin[2] and Schwartz[3].

Temkin solved the electron scattering problem