as δ_p increased. The figure also shows the theoretical curve δ_s^{theor}, calculated from the formula

$$\delta_s^{\text{theor}} = -\sin 2\varphi \frac{8\pi\gamma\varepsilon_2}{(1-\varepsilon_1)^2+\varepsilon_2^2}\frac{I}{\omega}, \qquad (1)$$

obtained from the formulas quoted in [1] for the following value of the nondiagonal component of the permeability tensor [3]

$$M_1' = 4\pi\gamma I/\omega$$

$$(\gamma = e/mc, \quad \omega \gg \omega_{\text{res}}, \quad \mu_1 = 1, \quad \mu_2 = 0).$$

From the cited data, it is evident that the experimental values of δ_s agree well in magnitude and sign with the theory of the Landau–Lifshitz ferromagnetic resonance even in the optical range of frequencies, where the nondiagonal component of the permeability tensor of iron varies within the limits $(1-3)\times 10^{-4}$ in the wavelength range 0.9–2.4 μ. It should be noted that the systematically lower experimental values compared with theory are obviously due to the fact that during the measurements the sample failed to reach saturation by 10-20% (this also reduced the gyroelectric effect δ_p).

In conclusion, we note that the results of our measurements contradict the recently published conclusion[4] that the permeability of pure ferromagnetic metals plays the same role in magnetooptics as the permittivity. The figure gives a curve δ_s^{calc}, calculated from values of M_1' obtained in [4]. The calculated values of δ_s are larger by about two orders of magnitude than the experimental values and have a wrong sign in the $\lambda > 0.9\,\mu$ region. The authors of that work[4] determined the permeability of ferromagnetic metals M_1' indirectly on the assumption that the difference between the magnetooptical characteristics obtained from the Faraday effect and from the polar Kerr effect is associated with the large values of the components of the tensor μ in the optical region. Our direct measurements of the gyromagnetic Kerr effect did not confirm this assumption.

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A NEW PHOTOPIEZOELECTRIC EFFECT IN SEMICONDUCTORS'

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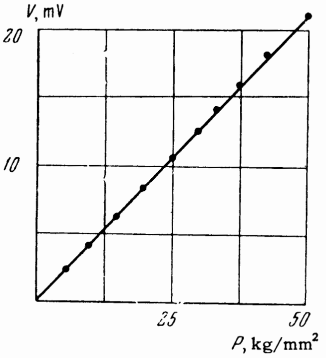
In an investigation of the influence of unidirectional pressure on the anisotropic properties of germanium single crystals, we discovered an effect which, to the best of our knowledge, is new. We describe below the tests which illustrate the essence of this new effect, which we shall call the photopiezoelectric effect (PPE).

A single crystal of n-type germanium was cut in the form of a rectangular parallelepiped measuring 2×2×10 mm. Copper electrodes were soldered along the sample perimeter about one millimeter from each of the ends. The sample was placed in a special press in which it could be compressed along its length. The sample was illuminated from one side with a weakly convergent beam of light. A normal 500W incandescent lamp with a nominal working voltage of 110 V, connected to an ac supply of 60 V, was used at the source of light. It was found that the application of pressure to an illuminated sample gave rise to a potential difference between the electrodes, which could easily be recorded with a galvanometer. This was the PPE.

In an unilluminated sample, the application of a mechanical force produced, as expected, no electrical effects. Illumination of a sample which was not under load also produced practially no potential difference between the electrodes. In these tests, special measures were taken to screen the electrodes from direct or scattered light in order to avoid all contact photoelectric effects. Only the middle part of the sample was illuminated, the length of this section being approximately 0.7 of the total sample length. The figure shows the dependence of the PPE potential difference V on the pressure (stress) P; this in-



dicates that quite moderate compressions and relatively low illuminations of the sample produced a potential difference of 20 mV varying, within the experimental error, linearly with the load. On repeated tests, the effect was found to be fully reproducible. The PPE potential difference under a constant load varied linearly with the illumination intensity. The dependence shown in the figure was obtained by illuminating that sample surface which was oriented along the crystallographic plane (111), with the direction of the applied stress coinciding with the projection of the [100] axis on this plane.

The effect described here is obviously due to the anisotropy of the diffusion coefficient of carriers, caused by the unidirectional deformation of the crystal.1) The carrier diffusion is due to the difference between the carrier densities at the illuminated and unilluminated surfaces of the sample. The following tests support this explanation.

A. On rotation of the test sample by 180° about an axis coinciding with the direction of the applied deforming force (keeping the direction of illumination and the measuring electrode positions fixed), the sign of the potential difference changed.

B. On rotation of the sample by 90° about the same axis and under the same experimental conditions, the potential difference decreased by more than one order of magnitude.

C. The effect was negligibly small in a sample cut in such a way that the illuminated surface coincided with the crystallographic plane (100).

The same tests may be regarded as a proof that the effect described here cannot be ascribed to phenomena of the photovoltaic type which appear in inhomogeneous semiconductors. At present, we are continuing detailed studies of the PPE in germanium and other semiconductors. The PPE may obviously find practical application in those cases where the normal piezoelectric effect in dielectrics is used.

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1) We have recently learned that such an effect has already been considered theoretically by van Roosbroeck and Pfann.[1].

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SECOND HARMONIC RADIATION FROM INHOMOGENEITIES IN AN INTENSE LIGHT FIELD

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LET us consider the effects of radiation of double-frequency waves when small inhomogeneities of an isotropic medium are placed in an intense electromagnetic field $\mathbf{E}(t) = \mathbf{E}_0 \sin \omega t$. These effects are connected with the quadratic transverse polarization of particles under the effect of the Lorentz force due to the interaction between the variable dipole moment of the inhomogeneity and the magnetic field of the wave, and are not connected with the nonlinear properties of the medium.

If the dimension a of the inhomogeneity is much smaller than the wavelength λ, then the dipole moment is

$$\mathbf{P}(t) \approx \frac{\varepsilon - 1}{\varepsilon + 2} a^3 \mathbf{E}(t)$$

For simplicity we shall assume the inhomogeneities to be quasispherical). This dipole moment is acted upon by a Lorentz force $\mathbf{F} = \mathbf{P} \times \mathbf{H}/c$ in a direction transverse to the electric field. This force is equivalent to the field intensity acting on the electrons $\mathbf{E}_{\mathrm{eq}} \approx \mathbf{E}/qN_a$ (where N_a —total number of atoms in the inhomogeneity, q —charge of the atom electrons responsible for the polarization), and equivalent to an external field*

$$E_{\mathrm{eq}}(t) = \frac{1}{qN_A} \frac{(\varepsilon - 1) a^3}{(\varepsilon + 2) c} [\dot{\mathbf{E}}\mathbf{H}] = \frac{\varkappa_1}{2\lambda q} [\mathbf{E}_0 \mathbf{H}_0] \sin 2\omega t,$$

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*$[\mathbf{E}_0\mathbf{H}_0] = [\mathbf{E}_0 \times \mathbf{H}_0]$.