silicon and germanium crystals are well described by a formula of type (1) if it is assumed that for transverse waves the relaxation time τ is equal to the effective thermal-phonon relaxation time τ_{ph}, and is twice as large for longitudinal waves.

It has been proposed that this difference is due to the different character of the interaction between the longitudinal and transverse elastic waves with thermal phonons, as is the case when $\omega\tau > 1$. Indeed, from the energy and momentum conservation laws it follows that in the interaction between elastic waves and phonons the transverse waves can interact directly with the high-frequency thermal phonons, and the longitudinal waves only with thermal phonons having approximately the same frequencies; this should lead to relatively large relaxation times for the longitudinal waves.

If it is assumed that the germanium impurity in the silicon scatters thermal phonons in accordance with the Rayleigh law, a strong decrease of the relaxation can be expected for the high-frequency phonons, but the relaxation time of the low-frequency phonons is affected little. Accordingly, the relaxation time, and according to (2) also the damping, should decrease strongly in the case of transverse elastic waves interacting with high-frequency thermal phonons. The change in the damping is small for longitudinal waves interacting with the low-frequency phonons.

The rigorous explanation of the results requires, of course, a detailed theoretical analysis.

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FARADAY EFFECT IN YTTRIUM ORTHOFERRITE

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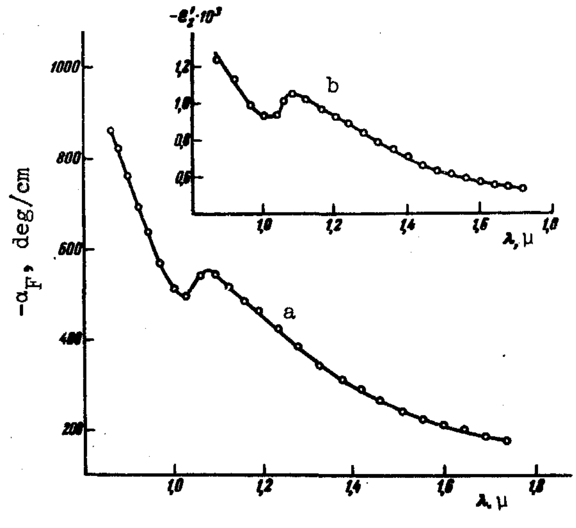
The transparency of orthoferrites in the visible and in the infrared has been known already for more than 10 years [1], but the Faraday effects in them has not been investigated to this day. Study of this effect in other transparent ferromagnets revealed magnetic susceptibility at optical frequencies [2] and a number of other phenomena. In all the magnetooptic investigations performed to date on orthoferrites, the light propagated along the weak-ferromagnetism axis [4]. The use of the Faraday procedure yielded in this case very small rotations of the polarization plane, on the order of one degree, and not proportional to the sample thickness. The reason, as shown in [4, 5], is that orthoferrites are birefringent crystals. Light propagating in them along directions that do not coincide with the optical axes produces not the Faraday effect, but elliptic birefringence. The major axis of the resultant ellipse rotates on emerging from the sample through an angle χ proportional to the ratio of the off-diagonal component ε' of the tensor $[\varepsilon]$ to the birefringence



Faraday effect in $YFeO_3$: a - in the band from 0.8 to 1.8 μ, b - imaginary part of the off-diagonal ε' component of the tensor [ε].

Δn [6]. Since Δn for orthoferrites is quite large and is equal to (3 - 4) × 10^{-2} in the c plane, the angle χ is quite small. We present here the results of an investigation of the Faraday effect in $YFeO_3$ for light propagating along the optical axis. In this case the polarization-plane rotation is larger by 1000 times than for light propagating along the weak-ferromagnetism axis. The values of the specific rotation amount to 10^3 deg/cm and exceed by several times the analogous quantities for iron garnets. This is all the more interesting if it is recognized that the magnetic moments of orthoferrites, which are weak ferromagnets, are smaller by two orders of magnitude than the moments of iron garnets. An investigation of the Faraday effect in orthoferrites is of interest for a clarification of the nature of large magnetooptic effects of first order in all weak ferromagnets [7].

The figure shows the spectral dependence of the specific rotation of the polarization plane in $YFeO_3$ in the band from 0.8 to 1.7 μ. With increasing wavelength, α_F decreases like $1/\lambda^2$, and in the wavelength region near 1 μ there is an anomaly connected with the electronic transition $^4T_{1g} \to {}^4T_{2g}$ in the Fe^{3+} ion. The optical axes of the yttrium orthoferrite lie in the a plane and make an angle of about 47° with the c axis. This ensures rather large Faraday rotations in the orthoferrites, unlike other uniaxial weak ferromagnets of the $FeBO_3$ type, in which the "light" plane and the optical axis are mutually perpendicular. From $\alpha_F(\lambda)$ one determines the imaginary part ε_2' of the off-diagonal component of the tensor [ε]. These values agree with the data of [5], where the light propagated along the weak-ferromagnetism axis.

The use of orthoferrite plates cut perpendicular to the optical axis greatly increases the contrast of the observed magnetooptic domain structure compared with the contrast in plates cut perpendicular to the weak-ferromagnetism axis. Investigations of the position of the optical axis of the orthoferrite on going through the Curie point and the point of reorientation make it possible to verify the validity of the mechanism proposed in [7] for the magnetooptic effects in weak ferromagnets. It is of interest to determine the contribution of magnetic birefringence [8] to the birefringence of the otheroferrite.

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"TURNING" OF CURRENT-VOLTAGE CHARACTERISTIC OF GERMANIUM IN A STRONG MAGNETIC FIELD

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The influence of the boundary conditions on the current-voltage characteristic of a semiconductor in the presence of a strong magnetic field H perpendicular to the electric field E was considered theoretically by Bass [1] for different mechanisms of the energy and momentum dissipation by the electron. Usually one considers in the theory the extreme cases

$$E_H = 0, \; j_H \neq 0 \tag{1}$$

and

$$E_H \neq 0, \; j_H = 0, \tag{2}$$

where E_H and j_H are the Hall field and the Hall current, respectively. Both cases, especially the first, are difficult to realize experimentally in pure form. Indeed, the case (1) can be realized only on a sample in the form of a Corbino disc, which in our case, however, is not suitable for the investigations, first because in an anisotropic and multivalley semiconductor the field has different directions relative to different valleys, and second because the electric field is inhomogeneous. Yet a case close to (1) can be realized with a sample having a small ratio of length b to the width c [2]. The Hall field is then weak, since a strong Hall current will flow through the current-conducting electrodes. We have prepared samples of p-Ge 2 mm long and 25 mm wide (see the figure). Massive electrodes, with areas about 10 - 15 larger than the area of the narrow working part, made it possible to eliminate injection. We measured the current-voltage characteristics of such p-Ge samples ($p \simeq 1.4 \times 10^{14}$ cm^{-3}) in static magnetic fields 0, 10, 25, 50, and 100 kOe at T = 77°K, when electron-phonon scattering takes place. The electric field pulse duration was 2 μsec.

The measurement results are shown in the figure. We see that the behavior of the current-voltage characteristics is radically altered, viz., whereas at H = 0 the conductivity decreases with increasing temperature, in a strong magnetic field H perpendicular to E, to the contrary, the conductivity increases with increasing E. A "turning" of the current voltage characteristics takes place. Such a change in the form of the current-voltage characteristics in a strong perpendicular magnetic field, when the boundary conditions (1) are satisfied, was indicated in [1], in particular, also for the case experimentally realized by us of electron scattering by the deformation potential of the acoustic phonons. Physically this change of the behavior of the current-voltage characteristics is perfectly understandable. In an electric field crossed with a strong magnetic field ($\vec{E} \perp \vec{H}$) the electron drifts in the direction of $\vec{E} \times \vec{H}$. The larger the number of electron-phonon collisions, the larger experimentally-measured current in the F direction.