enter the channel or that crossed it cause displacements of the atoms of the BeO lattice and lose their energy to this process, and are therefore decelerated and remain in the crystal. The displaced lattice atoms and the penetrating helium atoms distort the structure of the channels in the BeO crystal. When a channeled particle encounters such distortions, it is deflected through a large angle and is also decelerated. In final analysis, this leads to an over-all decrease of the transparency of the crystal to fast particles, as is indeed observed in the experiments.

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LOSS OF DISSIPATIVE EFFECTS IN INELASTIC SCATTERING IN MANY-VALLEY SEMICONDUCTORS

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It was shown in [1] that scattering of electrons by optical phonons of energy $\hbar\omega_0$ at low temperatures ($kT \ll \hbar\omega_0$) can be regarded in a certain interval of electric fields $\vec{E}$ as absolutely inelastic. This means that when the electron energy ϵ, which increases under the influence of the field $\vec{E}$, reaches a value $\epsilon = \hbar\omega_0$, an optical photon is emitted instantaneously, and the electron is stopped. If the acceleration of the stopped electron is in a magnetic field $\vec{H}$ (crossed with $\vec{E}$), then its maximum energy is $\epsilon_{max} = 2mc^2(E/H)^2$. Therefore, when $H > H_c \equiv 2(c/v_0)E$ (where v_0 is the velocity of an electron of energy $\hbar\omega_0$) we have $\epsilon_{max} < \hbar\omega_0$, and the electron loses its ability to emit optical photons after the first scattering. This means that dissipative effects disappear completely when $H > H_c$. As a result, the gauss-ampere characteristic (dependence of the current $\vec{j}$ on $\vec{H}$ at fixed $\vec{E}$) has singularities at $H = H_c$, namely a jump in the dissipative current $j_{\parallel}$ and an asymmetric sharp peak of the Hall current $j_{\perp}$ [1].

We indicate in this note effects of similar nature, which can occur in many-valley semiconductors. For simplicity we confine ourselves to the case of two valleys (Fig. 1) and assume $T = 0$. The latter means that when $E = 0$ the electrons are at the centers of the valleys, and that absorption of optical phonons is impossible. We neglect also other elastic scattering mechanisms (impurities and acoustic phonons). The effects in the many-valley model are distinguished by two circumstances. First, the fields $\vec{E}$ and $\vec{H}$ have different orientations relative to different valleys, and therefore the fields H_c are different in them [2]. Second, both intravalley g-scattering and intervalley f-scattering take place in a many-valley semiconductor. The characteristic velocity v_0 and the critical field H_c in each valley are determined here with the aid of the energies $\hbar\omega_g$ of the intravalley phonon and $\hbar\omega_f$ of the intervalley phonon, respectively. Figure 1 shows the motion of the electrons in momentum space after the field E is turned on. The upper row of figures pertains to g-scattering, the lower to f-scattering. The figure shows the equal-energy surfaces $\epsilon = \hbar\omega_g$ and $\epsilon = \hbar\omega_f$, respectively, the trajectories of electron motion (solid lines), and the transitions following phonon emission (dashed lines). In a field H_c (for a certain valley), the trajectories that start at $\epsilon = 0$ are closed inside a region $\epsilon < \hbar\omega_g$ or $\epsilon < \hbar\omega_f$ (of the same valley). The figure corresponds to the case $H_{c1} < H_{c2}$, the magnetic field is perpendicular to the plane of the figure, and the electric field lies in this plane and is vertical. If the coupling constants for both types of scattering are of the same order, then the phonons that appear are those having the lower energy.

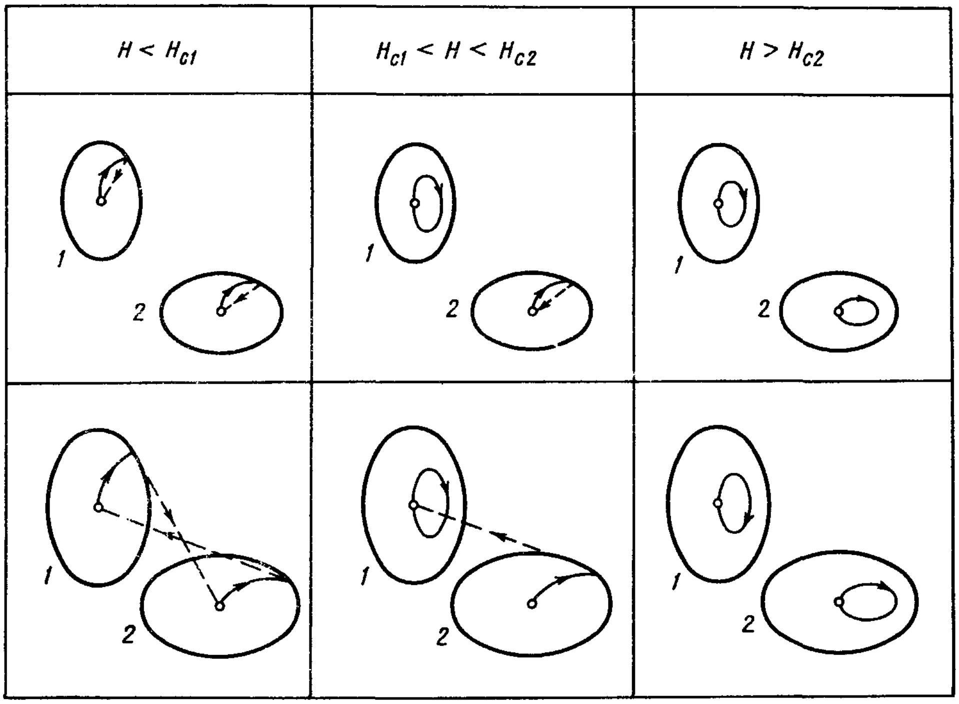

Fig. 1

Let us consider first g-scattering. Since we disregard the elastic intervalley scattering, the current is obtained by simply adding the individual valley currents calculated in [2]. The gauss-ampere characteristic has singularities at two values, $H = H_{c1}$ and $H = H_{c2}$, and the singularities are of the same type as in the case of one valley (Fig. 2).

If we rotate $\vec{E}$ by 45° in the plane of the figure, then we get $H_{c1} = H_{c2}$, and the singularity of the gauss-ampere characteristic will be observed at one value of H. In real many-valley models, the number of singularities is very sensitive to the arrangement of the valleys. Thus, for example, for the arrangement of the valleys in n-Ge, the number of singularities is minimal, namely, one ($\vec{H} \parallel [001]$, $\vec{E} \parallel [100]$), whereas for the valley arrangement in n-Si there are no fewer than two singularities ($\vec{H} \parallel [001]$, $\vec{E} \parallel [110]$). The maximum number of singularities is reached in fields $\vec{E}$ and $\vec{H}$ of a general orientation and is equal to the number of differently oriented valleys, i.e., four in n-Ge and three in n-Si.

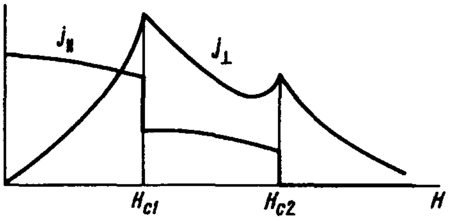

Fig. 2

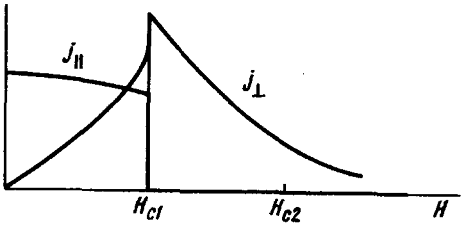

Fig. 3

We proceed now to the case of f-scattering. It is seen from Fig. 1 that in the field interval $H_{c1} < H < H_{c2}$ all the electrons go over to valley 1. Therefore when $H = H_{c1}$, unlike the case of g-scattering, the dissipative current disappears completely, and the Hall current vanishes (Fig. 3). When $H > H_{c2}$, the electrons return to the valley 2, but since all the closed trajectories make the same contribution to the Hall current, the gauss-ampere characteristic has no singularities at $H = H_{c2}$. Thus, the effects under consideration discriminate strongly between intervalley and intravalley scattering.

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ENERGIES OF THE ELECTRONS DETACHED FROM THE NEGATIVE IONS I^-, Br^-, AND Cl^- IN COLLISIONS WITH INERT-GAS ATOMS

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The energy spectra of the electrons that are split off negative ions by collisions with gas atoms have not been experimentally investigated as yet. We have studied in the present work the energy spectra of the electrons that appear when the negative ions I^- (with energies 500 - 2000 eV), Br^- (400 - 1500 eV), and Cl^- (500 - 2700 eV) are disintegrated by collisions with He, Ne, Ar, and Kr atoms.

An electrostatic analyzer, having at its output an electron detector operating in the individual-particle counting mode, was used for an energy analysis of the electrons emitted