circuit decrease by a factor $e \approx 2.7$ within ~ 0.5 μsec, i.e., after 2 - 3 oscillation cycles; without the plasma, this decrease takes approximately 11 cycles.

The damping decrement calculated from the rate of decrease of the oscillation amplitude in the circuit under resonant conditions, $\gamma_{exp} \simeq 6.5 \times 10^{-2}\omega$, exceeds by more than two orders of magnitude the damping decrement of magnetic-sound waves due to Coulomb losses [10]. It is possible that the observed damping is due to Cerenkov absorption of the magnetic-sound wave energy by the plasma electrons, since the Cerenkov damping decrement for a homogeneous plasma [1,2], $\gamma_{Cer} \simeq 2 \times 10^{-2}\omega$, differs insignificantly from γ_{exp}. The presence of plasma inhomogeneities increases γ_{Cer} [3].

The temperature calculated from the energy balance under the assumption that the entire energy absorbed by the plasma goes into its heating, is $T_i + T_e \simeq 90$ eV, in good agreement with the experimental data.

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SCATTERING OF ELECTRON-GAS ENERGY IN n-InSb AT HELIUM TEMPERATURES

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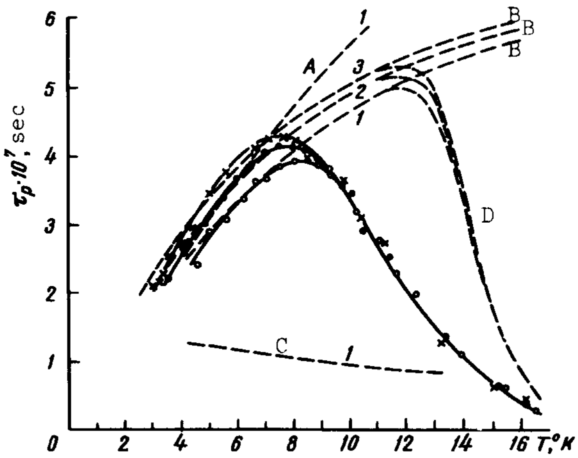
The variation in the electric conductivity of n-type indium antimonide with impurity concentration $\gtrsim 1 \times 10^{14}$ cm^{-3} at helium temperatures with variation of the electric field is usually attributed to a change in the electron mobility, due to the heating of the electron gas. The carrier momentum is scattered in this case by the electrostatic potential of the charged impurity centers, while the energy is scattered by the lattice vibrations. Since InSb is a piezoelectric crystal, the electron energy can, generally speaking, be scattered from either the deformation or the piezoelectric potentials of the acoustic phonons and, in the case of strong heating of the electron gas, also from optical phonons [1-3].

To study the energy scattering mechanisms, we investigated the field and temperature dependences of the time of electric conductivity relaxation of n-InSb samples. This time is simultaneously the time required to transfer the excess average energy from the electron gas to the crystal lattice.

A sample with nonlinear voltage-current characteristic, to which a dc voltage was applied from a battery, is a linear element with respect to small alternating signals, and it can be characterized by a complex admittance $G(\omega)$. By measuring the active and reactive components of $G(\omega)$ by a bridge method, we can calculate from these components the relaxation time τ of the average energy for each value of the lattice temperature and of the power dissipated in the sample. It must be noted that the electric-conductivity relaxation time depends on the circuit parameters and on the manner in which the sample is connected in the circuit, this being the consequence of the pump action of the battery [4]. If the sample is connected in series with the load and with the dc and ac voltage sources, then the power dissipated in the crystal remains constant under small changes of the electric conductivity if the resistances of the sample and of the load are equal. The corresponding relaxation time of the average electron gas energy will be denoted τ_P.

The figure shows a plot of τ_P against the electron temperature for one of the measured samples (No. 33-2, electron concentration $n = 5 \times 10^{13}$ cm^{-3}, mobility $\mu_{4.2°} = 3 \times 10^4$ cm^{2}V^{-1}sec^{-1}). The electron temperature was determined by comparing the curves $\sigma = \sigma(T_0)$ and $\sigma = \sigma(P)$ (σ - electric conductivity of the crystal, T_0 - lattice temperature, P - power dissipated in the sample when a static electric field is applied to it).



Dependence of τ_P on the electron-gas temperature for different crystal temperatures. Solid lines - experiment, dashed - theory. The experimental points correspond to the following temperatures T_0: o - 4.2°K, • - 3.2°K, x - 2.5°K. A -- $P = P_{piez}$, $e_{14} = 2.6 \times 10^4$ dyne$^{1/2}$ cm^{-1}; B -- $P = P_{piez} + P_{def}$, $e_{14} = 2.6 \times 10^4$ dyne$^{1/2}$ cm^{-1}, $\epsilon_c = 5.8$ eV; C -- $P = P_{piez} + P_{def}$, $e_{14} = 2.6 \times 10^4$ dyne$^{1/2}$ cm^{-1}, $\epsilon_c = 30$ eV; D -- $P = P_{piez} + P_{opt}$, $e_{14} = 2.6 \times 10^4$ dyne$^{1/2}$ cm^{-1}, $\epsilon_c = 5.8$ eV, $e^*/e = 0.16$; 1 - 4.2°K, 2 - 3.2°K, 3 - 2.6°K.

In the electron-temperature approximation, the equation for the balance of the electron-gas energy leads directly to an expression for τ_P [4]:

$$\tau_P = nc/(dP/dT),$$

where n is the electron concentration and $c = d\bar{\epsilon}/dT$ the specific heat of the electron gas per electron.

To compare the obtained data with theory, we used the results of a calculation of the electron energy loss function P(T) for scattering by the piezoelectric and deformation potentials of the acoustic phonons and by the optical phonons, obtained in references [2] and [5] respectively. Comparison of the experimental and theoretical curves leads to the conclusion that the nonmonotonic dependence of τ_p on T is connected with the interchange of mechanisms for the transfer of energy to the lattice from the electron gas when the temperature of the latter increases. When $T < 8°K$, energy scattering by the piezoelectric potential of the acoustic phonons predominates, and the deformation potential makes a relatively small contribution to the scattering. In this temperature region, the experimental results are in good agreement with theory, so that it becomes possible to estimate the constants of the piezoelectric (e_{14}) and deformation (ϵ_c) potentials. According to our measurements, $e_{14} \approx 2.6 \times 10^4$ dyne$^{1/2}$ cm^{-1} and $\epsilon_c < 10$ eV.

At electron temperatures $T \geq 10°K$, the agreement between theory and experiment is only qualitative. It is obvious that the decisive contribution to the energy dissipation is made here by the optical phonons. A correct account of this scattering calls for a special calculation of the electron energy distribution in the electric field, with account taken of its non-Maxwellian character.

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INFLUENCE OF THE MIRROR RATIO ON PLASMA HEATING BY AN ELECTRON BEAM IN A "PROBKOTRON"

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The use of electron beams to heat plasma has been stimulated by several theoretical investigations, which have pointed out the existence of a strong beam retardation mechanism, wherein part of the beam energy is transmitted to the plasma [1-3]. It has been shown experimentally that an appreciable part of the beam energy is transferred to the plasma [4,5].

High electron temperatures have been reported in [6,7]. In these experiments, the plasma was produced by an electron beam passing through a neutral gas.

We have investigated the interaction between an electron beam and a ready-made highly ionized plasma.