In this case the intensities of the 4130 Å line Zeeman components have the same appearance as if the quenching in the excited state were to be very weak. We have arrived at this conclusion by comparing the observed component intensities with those calculated in the intermediate-field approximation, developed by M. V. Eremin [3] for the calculation of the fd-configuration levels. Calculation predicts in this case, for example, that the the σ_{17} component should be more intense than its neighbor σ_{14}, and that σ_{24} should in general be the most intense spectral component. This is precisely the intensity ratio obtained by pumping with π light. σ_{17} and σ_{24} are relatively weak in the case of pumping with unpolarized or π light.

The described effect suggests that the polarized light that excites the luminescence in broad bands includes different channels of two-step pumping, and that in each of these channels the selection rules that lead to the population of the Zeeman sublevels of the radiating state via nonradiative relaxation are different. It should be noted here that strong dichroism is observed [4] in the absorption spectrum of $CaF_2:Eu^{2+}$ in a magnetic field at low temperatures, when the sublevel ${}^1\Gamma_5^-(f^7)$ is predominantly populated, so that light of different polarization excites different bands.

The proposed mechanism of the phenomenon can be called "spin memory" [5,6], provided this term is intepreted more broadly, taking it to mean not simply the response of the populations of the sublevels of the excited state to the population of the sublevels of the ground state having the same symmetry.

It is obvious that the observed phenomenon of optical pumping in the excited state uncovers a way of investigating nonradiative recombination processes in the case of complex optical excitation in crystals.

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DEVIATION FROM OHM'S LAW AND RF GENERATION IN Bi-Sb ALLOYS IN STRONG ELECTRIC FIELDS AT HELIUM TEMPERATURES

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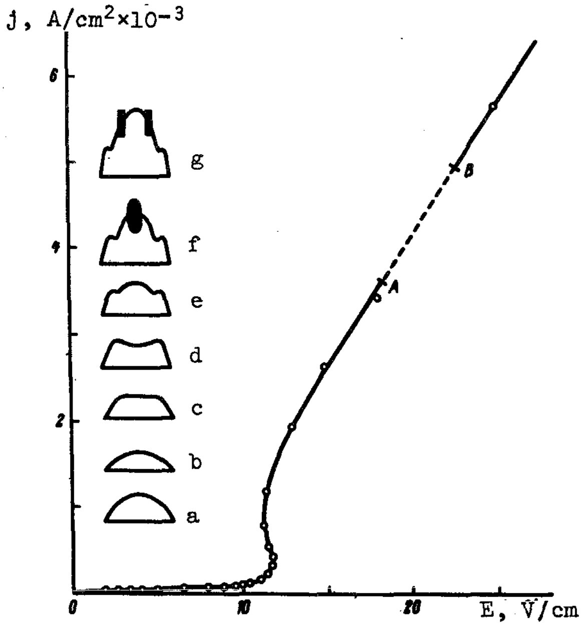
An investigation of the current-voltage characteristics of single-crystal semiconducting $Bi_{1-x}Sb_x$ alloys (x = 8 - 20 at.%) at 4.2°K, a strong increase of the current density was observed in an electric field exceeding a certain critcal value E_c.

Samples measuring approximately 0.3 x 0.5 x 3 mm were cut from single-crystal ingots of Bi-Sb alloys with component purity 99.9999%. Current contacts of copper foil were attached with Wood's alloy to opposite faces along the sample. Potential leads of copper wire (20 μ diameter) were welded [1] to the side face spaced about 1 mm apart. The current flowed either along the binary or the bisector axis of the crystal. The measurements were made with the aid

Current-voltage characteristics of $Bi_{89.5}Sb_{10.5}$ with $\rho(4.2°K)/\rho(300°K) = 330$ at $T = 4.2°K$. Current parallel to bisector axis. Generation is observed in section A - B. On the left are shown the waveform of the current pulse (a) and of the voltage pulses (b - g) on the potential electrodes at various current-pulse amplitudes j_{max} (in A/cm^2): b) $<10^2$, c) $\sim 3\times10^2$, d) $\sim 9\times10^2$, e) $\sim 2\times10^3$, f) $\sim 4.4\times10^3$, g) $\sim 5\times10^3$.



of current pulses in the form of a half-sinusoid with approximate duration 13 μsec. A linear j(E) characteristic is observed only in weak electric fields. With further increase of the field, the linearity is lost and the current density increases sharply at field values $E > E_c$ (see the figure). The critical field E_c depends on the Sb concentration and also on the quality of the sample (on the resistance ratio $\rho(4.2°K)/\rho(300°K)$ [2]). For certain samples with Sb concentration 10.5 - 12 at.% the increase of the current in fields stronger than E_c was accompanied by a decrease of the voltage on the sample and by the appearance of a region with negative differential resistance. The character of the oscillograms obtained in such a case is illustrated in the figure on the left. Generation of oscillations with frequency close to 20 MHz was observed on the samples with negative differential resistance (f and g in the figure). The oscillating circuit was the set of potential leads connected to the oscilloscope input.

The form of the decreasing section of the current-voltage characteristic and the generation amplitude depended on the direction of the current flowing through the sample; this might have been due to the asymmetry of the current contacts.

A characteristic feature of the observed generation is that it appears not on the section with the negative resistance, but on the rising branch of the j(E) curve, in a limited current range. Generation is maintained in the temperature region up to about 25°K.

One cannot exclude the possibility that the negative differential resistance of the semiconducting Bi-Sb alloys is interband electric breakdown [3]. This assumption is confirmed by the observed correlation between the breakdown field E_c and the energy gap of the investigated samples. The mechanism producing the generation remains unclear.

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DISPERSION OF SOUND VELOCITY IN GALLIUM IN STRONG MAGNETIC FIELDS

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As first noted by Kulik [1], an appreciable (10 - 20%) change of the longitudinal-sound velocity should be observed in metals, assuming a quadratic dispersion law at $\omega\tau \geq 1$, $\vec{q} \perp \vec{H}$, in strong magnetic field such that $qr_H \ll 1$. Here ω and q are respectively the requency and the wave vector of the sound, r_H the electron-orbit radius in the magnetic field H, and τ the electron relaxation time. This effect is connected with the fact that the dispersion of the longitudinal phonons is determined to a considerable degree by the screening action of the electron gas [2 - 4].

The influence of the magnetic field on the change of the longitudinal-sound velocity can be qualitatively explained as follows: In the approximation of the simple Hartree theory of dielectric screening and of the jelly model, the dispersion of the longitudinal phonons is given by the well known Bohm-Staver formula

$$\omega^2(q) = \Omega_p^2/\varepsilon(q),$$

where Ω_p is the plasma frequency of the lattice ions and $\varepsilon(q)$ is the dielectric constant of the metal. In the presence of magnetic field, the character of the variation of the longitudinal-sound velocity in the metal is determined by the behavior of the component of the tensor $\varepsilon_{11}(\vec{q}, \omega, \vec{H})$ along the sound-propagation direction. As follows from [5, 6], when $\omega\tau \gg 1$ and $\vec{q} \perp \vec{H}$, an anomalously large change of ε_{11} takes place in a strong magnetic field when $qr_H \ll 1$, and the longitudinal-sound velocity changes accordingly.

It must be noted that in the approximation where $\omega\tau \to \infty$ and $\beta = 0$ (β - ratio of skin-layer depth in metal to the wavelength of the sound) the main results of [1] agree fully with the results obtained in [5]. According to these papers, the relative change of the longitudinal sound velocity is determined when $\vec{q} \perp \vec{H}$ by the expression

$$\frac{\Delta S}{S} = \frac{z m\omega^2 \tau^2 v_F^2}{6MS^2(1 + \omega^2\tau^2)} f(qr_H),$$

where z is the number of valence electrons, v_F the electron Fermi velocity, M the metal ion mass, and $f(qr_H)$ a function characterizing the change $\Delta S/S$ in a magnetic field and having the following limiting values: $f(0) = 0.2$ and $f(\infty) = 0$.

The presently available experimental data on the change of the longitudinal-sound velocity in metals in magnetic fields yield a value of $\Delta S/S$ smaller by several orders of magnitude than the maximal value (10 - 20%) obtained in [1]. For aluminum [7] at $\omega\tau \sim 10^{-2}$, $qr_H \ll 1$, and $\vec{q} \perp \vec{H}$, the change of the sound velocity amounted to 5×10^{-5}. The strong-field condition was not satisfied in [8]. The maximum value of $\Delta S/S$ at $\omega\tau \sim 1/3$ and $qr_H \sim 1$ was about 2 x