following circumstance. The nonlinear interaction between a traveling elastic wave and an alternating electric field of double the frequency gives rise to a force that excites resonantly an elastic wave of the same frequency as the original one, but propagating in the opposite direction (for semiconductors this question was discussed in [5]). Then the presence of two elastic waves traveling in opposite directions and forming a standing wave can lead to amplification of both waves under the influence of the electric field. The corresponding conditions were obtained above.

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RESONANCE METHOD OF DETERMINING THE SPIN-ELECTRON-PHONON COUPLING CONSTANT IN SIMECONDUCTORS

L. I. Korovin and S. T. Pavlov
Semiconductors Institute, USSR Academy of Sciences

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The constants of electron-phonon interaction induced in crystals by short-range forces are usually difficult to calculate since it is necessary to know the potential energy of the electron inside the unit cell. These include, in particular, the constant for the interaction between the electron spin and transverse optical phonons, since the method for determining this constant from galvanomagnetic effects is inaccurate, for it requires separation of contributions from different scattering mechanisms.

We propose in this note a resonance method for determining the constant d of the spin-electron-phonon interaction of conduction electrons in a semiconductor, using experiments on interband magnetooptic absorption. It is possible to use for this purpose an effect similar to the Johnson and Larsen effect [1], in which splitting was observed of the peak of interband magnetooptic absorption in InSb in a strong magnetic field when $\Omega_c = \omega_{||}$ (Ω_c - cyclotron frequency of the electrons in the conduction band, $\omega_{||}$ - limiting frequency of the longitudinal optical (polarized) phonons).

Inclusion of the electron spin in the theory of this effect leads to a splitting of the magnetooptic oscillation into two peaks in the region of magnetic fields such that $|g|\mu_0 H \simeq \hbar\omega_\perp$ (g - effective factor of spectroscopic splitting in the conduction band, μ_0 - Bohr magneton, H - magnetic field, $\omega_\perp$ - limiting frequency of transverse optical phonons). The splitting of the oscillation is connected with the crossing of two terms of the electron-phonon system: the lower spin level plus optical phonon, and the upper Landau spin level with quantum number n = 0. Turning on a spin-flipping interaction with transverse optical phonons [2] lifts the degeneracy at the point of term crossing and causes the appearance of two branches of the electron-phonon spectrum. This explains the splitting of the magnetooptic oscillation in this case. Spin-phonon interaction with the longitudinal optical

phonons does not lift the aforementioned degeneracy at the term crossing point, since the structure of the Hamiltonian $H_{el\text{-}ph}^{(sp)}$ [2] is such that the square of the modulus of the corresponding matrix element of the transition with spin flip turns out to be proportional to k_z^2 (k_z is the projection of the electron wave vector in the initial state on the direction of the magnetic field H). Therefore the product of the densities of the initial and final states, which is proportional to $(k_z k_z')^{-1}$, does not lead to a singularity in the transition probability at the point $k_z = 0$, and it is precisely this singularity, in final analysis, which causes the splitting of the terms and makes ordinary perturbation theory with respect to the weak spin-electron-phonon interaction inapplicable.*

It is assumed that the electron is thrown by the light from the valence band to the upper spin sublevel of the zero Landau band and that a direct dipole transition is allowed.

A calculation similar to that made in [4], using the Hamiltonian for the interaction between the electron spin and the transverse optical phonons [2], leads to the following value for the splitting of the branches of the electron-phonon spectrum (at a temperature T = 0 and with the spin-magnetophonon resonance condition $|g|\mu_0 H = \hbar\omega_\perp$ satisfied):

$$\hbar\Delta_{sp} = \frac{3}{2}\eta_{sp}^{2/3}\hbar\Omega_c, \tag{1}$$

where

$$\eta_{sp} = \frac{1}{2^{7/2}\pi}\frac{\hbar}{\bar{\rho}\omega_\perp \ell_H^5}\left(\frac{d}{\hbar\Omega_c}\right)^2 \tag{2}$$

Here $\ell_H = (c\hbar/eH)^{1/2}$, $\bar{\rho} = N\bar{M}/V$ is the reduced density of the crystal, V the volume of the crystal, N the number of unit cells in the crystal, $\bar{M} = (M_1M_2)/(M_1 + M_2)$ the reduced mass of the unit cell, and M_1 and M_2 the masses of the two atoms of the cell.

The distance between the indicated maxima is $\hbar\Delta_{sp}$. Using (1), (2), and the experimental value of $\hbar\Delta_{sp}$ we can determine d. Estimates made for InSb show that the expected splitting of the maxima of the absorption coefficient is 10^{-4} - 10^{-5} eV in a resonant magnetic field $H \simeq 75 \times 10^3$ Oe. The effect can be observed if other scattering mechanisms (by acoustic phonons and neutral impurities) broaden the absorption peaks by an amount smaller than the distance $\hbar\Delta_{sp}$. In the case of temperatures ~4°K, this condition is well satisfied for acoustic phonons, and the permissible concentration of the neutral impurities is $\leq 10^{13}$ cm^{-3}. The splitting of the absorption peak itself lies in the resolution region of the modern infrared for wavelengths ~10 μ.

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* For the same reason, spin scattering by longitudinal optical phonons does not lead to spin-magnetophonon oscillations of the transverse magnetoresistance $\sigma_{xx}(H)$. This question is discussed in detail in [3].