filled, and the sub-band $3d_2$, shifting upward when the crystal momentum k is increased, is free. It should be mentioned that the sub-bands $3d_0$ and $3d_1$ contain a large admixture of the p-states and are not pure d-bands.

At $\delta > 3.2$, the 3d-band lies below the 3p-band, and the sub-band $3d_2$ touches the sub-bands $3d_0$ and $3d_1$. Figure 2 shows this case for $\delta = 4$. Throughout the region $\delta > 3.2$, we have solid argon in the metallic state with a free sub-band $3d_2$. The pressure at the transition point at $\delta = 3.2$ is 1.29 Mbar at $T = 0$.

Alder and Van Thiel [2] have reported that, at a pressure of about 0.35 Mbar and T = 1 eV, considerable electrical conductivity is observed in a shock wave in liquid argon. If the gap width is of the order of 6 eV, there will be marked thermal electron excitation at 1 eV and the observed conductivity is not surprising. If argon is compressed by two shock waves to 0.7 Mbar and $\delta = 2.5$, then, according to our estimates, the temperature is ≈ 0.4 eV but the gap width is only 2.4 eV and we can expect considerable electrical conductivity.

The experimental observation of the metallization of solid argon in the predicted range of pressures at low temperatures would be of considerable interest. It would also be very interesting to investigate theoretically and experimentally the features associated with the fact that a free band is in contact with filled bands. In the one-electron Bloch theory, we come to the formal conclusion that the number of free electrons and holes is $n \propto T^{3/2}$ and there is no exponential dependence characteristic of semiconductors. It is not clear how the interaction between electrons and holes may change the theoretical predictions.

The contact at the point $k = 0$ between bands with different l_z applies also in the theory which allows exactly for the lattice symmetry (but not in the Wigner-Seitz approximation).

Since the situation described here occurs over a wide range of pressures, it is possible that this may apply also to another element or chemical compound at normal density, i.e., at zero pressure.

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MAGNETORESISTANCE AND STATIC SKIN EFFECT IN CADMIUM SINGLE CRYSTALS

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THE magnetoresistance of cadmium single crystals, with a resistance ratio $R(4.2°)/R(293°) \approx 10^{-5}$, was measured as a function of an inclined external field when the field dependence was accompanied by the ballistically detected [1] static skin effect. [2] The cylindrical samples, with an inner channel, differed from those described in [1] by their length (25 mm) and the presence of voltage terminals 6 mm from their ends. The magnetoresistance was measured with a compensation circuit, which included a photoelectric amplifier having a sensitivity of 2×10^{-9} V per division of the compensator scale. The angle between the axis of a sample and the magnetic field was 84°.

Figure 1 shows the results of the ballistic $(\Delta\Phi/\Delta\Phi_0)$ and resistometric $[H^2/(R(H) - R(0))]$ measurements, where $\Delta\Phi$, $\Delta\Phi_0$ are the changes in the magnetic flux due to the current in the core of a sample, situated, respectively, in a field H and in the terrestrial magnetic field; R(H), R(0) are the magnetoresistances in the same fields. The observed tendency for curve 1 to approach the origin of coordinates indicates the presence of a linear term in the dependence R(H) in the same range of fields (0-800 Oe), where the ballistic measurements show the process of re-

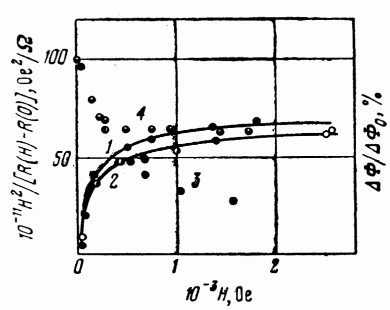

FIG. 1. Results of the ballistic (curves 3 and 4) and resistometric (curves 1 and 2) measurements on cadmium single crystals. Curves are given for samples with smooth (1, 3) and damaged (2, 4) surfaces. Notation: ● – curve 1; ○ – curve 2; ◐ – curve 3; ◒ – curve 4.

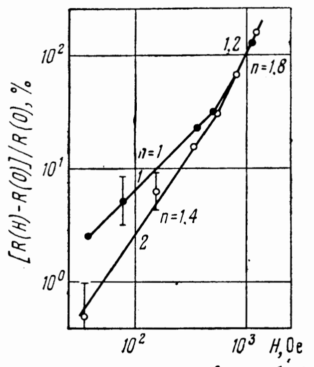

FIG. 2. Magnetoresistance of a cadmium single crystal plotted as a function of H for samples with smooth (1) and damaged (2) surfaces; n is the exponent of the power dependence R(H).

arrangement of the current flow pattern so that it is concentrated in the surface layer (curve 3).

After the production of randomly distributed grooves, 0.5—1 mm deep, on the surface of a sample (by etching with a glass fiber wetted with nitric acid), the power exponent of the dependence R(H) in the same range of fields increased to 1.4 (curve 2 in Fig. 2) and the ballistic measurements showed that the current was concentrated to lesser degree near the surface (curve 4 in Fig. 1).

This interrelationship between the results obtained by independent methods of measurement led us to the conclusion that we had observed one of the consequences of the static skin effect: a linear dependence of the magnetoresistance on the external field.

We take this opportunity to thank I. G. D'yakov for his kind assistance in our measurements.

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INFLUENCE OF A MAGNETIC FIELD ON THE THERMAL CONDUCTIVITY OF GASES WITH NONSPHERICAL MOLECULES

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It has been shown [1,2] that the transport coefficients (viscosity and thermal conductivity) of nitrogen depend on the magnetic field. It has been suggested [1] that this effect is due to both the nuclear and rotational magnetic moments of nitrogen molecules resulting from their nonsphericity. A comparison of this effect in nitrogen with the corresponding effect in oxygen, which is due to its paramagnetism (the Senftleben effect), made it possible to estimate the effective magnetic moment μ_{eff} of nitrogen [2] and confirm the validity of the suggestion referred to above. It is obvious that such an effect should be present in all gases whose molecules are nonspherical. The present work reports briefly the results of investigations of this effect in N_2, CO, CO_2, H_2 and D_2, and gives the average values of the rotational magnetic moments $\bar{\mu}_{rot}$, together with data on the nonsphericity of these molecules, derived from this study.

A theoretical treatment due to Yu. M. Kagan and L. A. Maksimov (private communication) shows that their theory of this effect in O_2 [3] may be adapted to other molecules having moments of inertia of the same order or larger than that of O_2. For such gases, the relative reduction in the thermal conductivity $\epsilon = -\Delta\kappa/\kappa$ is given by the formula

$$\varepsilon = af(\eta), \tag{1}$$

where

$$a = b\lambda^2, \quad \eta = K\mu_{eff}H/p, \quad K = K_1K_2,$$

$$K_2 = \frac{n^2}{A^{33}}\sqrt{\frac{kT}{2I}},$$

K_1 is a coefficient which depends on the nature of the magnetic moment; K is a coefficient which depends on the molecular-kinetic properties of the gas (the notation is the same as in [3]); λ is a nonsphericity parameter; and b is a coefficient depending on the nature of the gas. The form of the function f (η) and more detailed data on the coefficients are given in the work of Kagan and Maksimov, according to which $K_1 = \sqrt{\pi}/20$ for O_2.