and the best agreement is obtained again at angles θ from 45 to 90°.

Thus, all the presented experimental data offer evidence favoring the assumption that the observed absorption peak corresponds to natural magnetoelastic resonance. Nonetheless, this phenomenon requires further study.

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SIZE EFFECTS IN ZINC WHISKERS

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A number of recent papers are devoted to a most consistent and complete analysis of the electric conductivity of thin metal samples under the condition $\lambda_\infty \gg d$ (λ_∞ - electron mean free path connected with scattering by phonons, impurity atoms, and defects, and d - transverse dimension of sample).

In this connection, we investigated the galvanomagnetic properties of zinc whiskers - filamentary (F) and platelike (P) thin single crystals. They are convenient because it is easy to satisfy for them the condition $\lambda_\infty \gg d$.

The whiskers were grown by a method described in [1], uzing zinc for which $\rho_{295}/\rho_{4.2} \approx$ 10,000 ($\lambda_{\infty;4.2} \approx 300\ \mu$). The electric connections of the samples were produced by the "clamping contact" method.

We investigated more than a hundred F and P, the thicknesses of which ranged from 10 to 0.2 μ. We present below the main results, and a brief comparison with the conclusions of the theoretical papers [2, 3].

1. Influence of transverse dimensions on the resistivity at T = 4.2°K. It is well known [4, 5] that the connection between the resistivity and the thickness of the sample under the condition $\lambda_\infty \gg d$ is given by the formulas

$$\rho_d = [(1 - p)/(1 + p)]\lambda_\infty\rho_\infty/d = Ad^{-1} \qquad \text{for F} \qquad (1)$$

$$\rho_d = (4/3)[(1 - p)/(1 + p)](\lambda_\infty\rho_\infty/d)(1/\ln\lambda_\infty/d) \qquad \text{for P} \qquad (2)$$

where p is the coefficient of specular reflection of the electrons from the surface. In the processing of the results on the dependence of ρ_d on d, we assumed that the value of $\lambda_\infty\rho_\infty$ for zinc is known and equals 1.8×10^{-11} ohm-cm^2 [6]. For most F the plot of $\rho_{d;4.2}$ vs. d^{-1} is a straight line. For some F there is a scatter of the points, apparently due to the deformations introduced during the course of wiring, and to differences in the crystallographic orientations of the F. According to the parameters of the line $\rho_d = Ad^{-1}$, we get for the investigated F $\lambda_{\infty;4.2} \gtrsim 200\ \mu$ and $p \approx 0.6$.

The same values of $\lambda_{\infty;4.2}$ and p are obtained by using formula (2) to process the $\rho(d)$ dependence for P.

2. Temperature dependence of resistance. The possible temperature dependence of the

resistance in thin samples was analyzed in [2]. The analysis was based on Olsen's idea [7] that at low temperatures the small-angle scattering in electron-phonon collisions can lead to a collision of the electron with the sample surface. If $T/\theta > d/\lambda_\infty$, the electron-phonon collisions are effective, and this causes the factor $(T/\theta)^2$ to drop out from the Bloch-Gruneisen formula - $\rho \sim (T/\theta)^5$. The quantitatively new temperature dependence of the resistance becomes manifest, in particular, in the fact that the residual resistance is reached at a much lower temperature than in bulky samples.

In our experiments we obtained the $\rho(T)$ dependences in the interval 1.4 - 295°K for several bulky samples ($d \approx 1$ mm), for F 1 - 3 μ thick and P 0.6 - 2 μ thick. We observed no qualitative differences between the temperature dependence $\rho(T)$ of whiskers and of bulky samples. In both cases a dependence $\rho \sim T^{(5\pm0.3)}$ is observed in the interval ≈10 - 25°K, above which there begins an intermediate region that gives way at T > 100°K to a linear relation $\rho \sim T$. Below 4°K it can be stated, accurate to 1%, that the residual resistance is

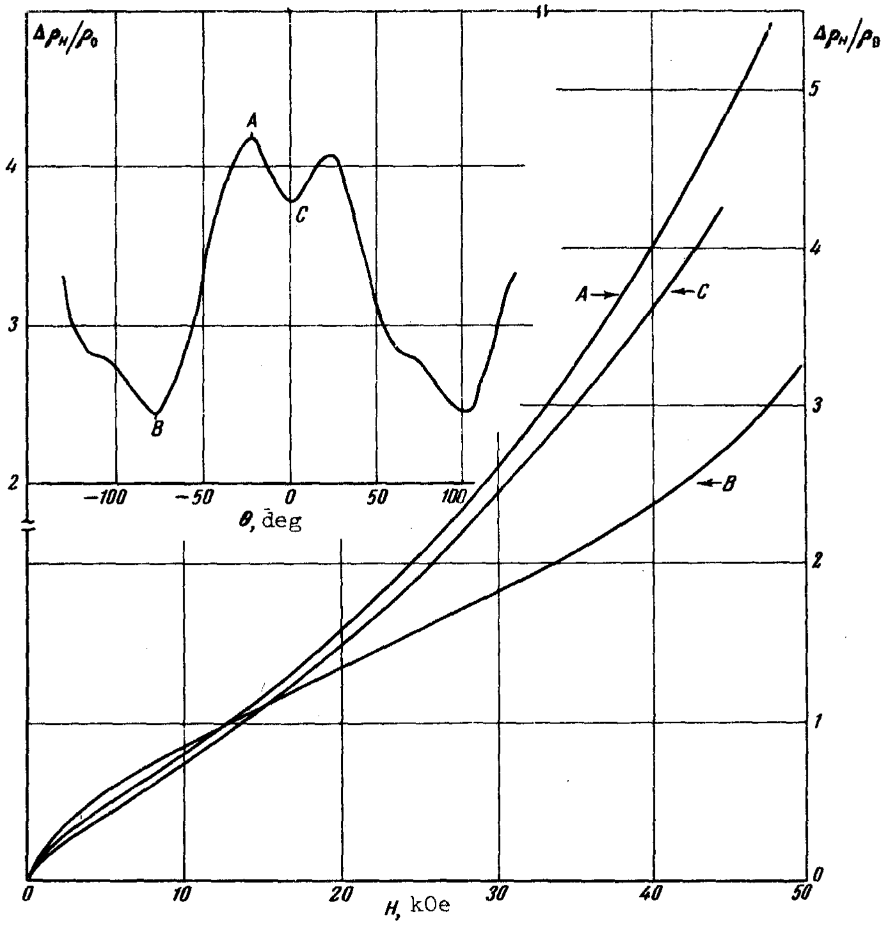

Fig. 1. Transverse resistance, $\bar{H} \perp \bar{I}$. Filamentary whisker Zn-54; d = 1.6 μ; T = 4.2°K. Top - resistance vs. rotation of the magnetic field H = 40 kOe. Bottom - resistance vs. magnetic field for several directions designated in the figure by the letters.

attained for all whiskers, $((\rho_{4.2} - \rho_{1.5})/\rho_{1.5} \leq 0.01)$.

The disparity between our results and the conclusions of [2] can be attributed to the fact that the electrons traveling almost parallel to the surface, whose contribution to the temperature dependence of the resistance is significant at low temperatures, are all reflected specularly upon collision with the surface. They are therefore not subject to the "size effect." An influence of the dimensions on the temperature dependence of the resistance is observed nonetheless. It is manifest in the fact that when T < 10°K the coefficient β in the expression $\rho \sim \beta T^5$ depends on d. This is particularly clearly seen for F, for which $\beta \sim d^{-1}$.

3. Transverse magnetic field. a) Filamentary whiskers. According to the conclusion of [3], a drop in the resistance should be observed in this case, from H = 0 to the value of the magnetic field at which the electron radius of curvature is $r \approx d$. Beyond this, up to fields for which $r \approx \delta$ (δ - dimension of the surface defects of the sample), there extends a region of "static skin effect," where $\rho \sim H$. With further increase of the field, the resistance behaves as in a bulky sample, in full accord with the topology of the concrete Fermi surface. It follows therefore, in particular, that for metals with an open Fermi surface (such as zinc, for example) the anisotropy of the resistance should not come into play up to very large values of the field ($H \approx 10^5$ Oe). The measurements have shown that: (1) a strong resistance anisotropy appears for all the investigated F starting with 20 kOe, (2) the resistance increases in the initial region of the magnetic fields (H > 10 Oe) like $\rho \sim H^n$, where n varies from 1 to 0.5 for the different samples, and (3) there is no distinct re-

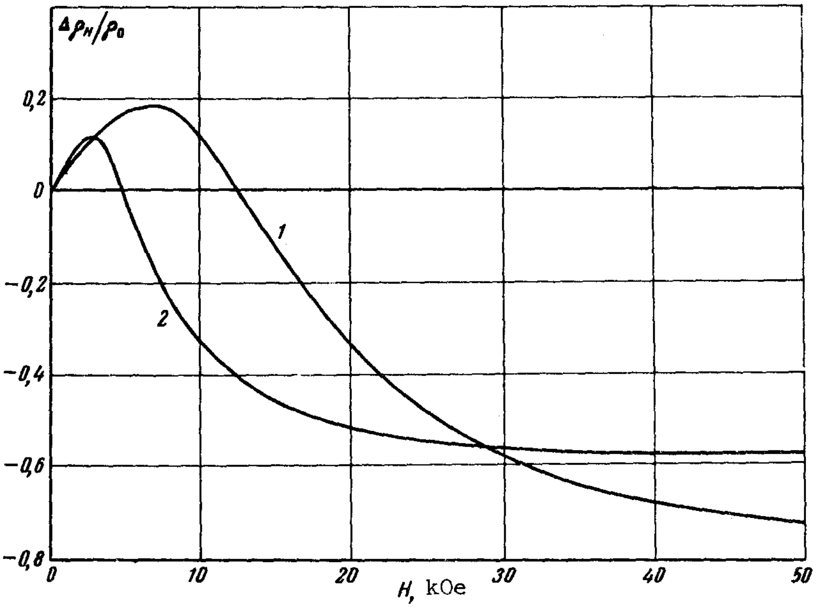

Fig. 2. Longitudinal resistance, $\bar{H} \parallel \bar{I}$, T = 4.2°K: 1 - filamentary whisker Zn-85, d = 4.8 μ; 2 - platelike whisker Zn-68, d = 4.9 μ.

gion that can be regarded as the region of the "static skin effect." Figure 1 shows typical plots obtained for F.

b) Plates. According to [3], a drop in resistance should be observed for P in a magnetic field, up to values $r \approx \lambda_\infty^2/d$. Further, up to fields $r \approx d$, the resistance should increase like $A_1 + B/(c - \ln H)$, after which the resistance anisotropy connected with the Fermi-surface topology comes into play.

If we regard the region of the magnetic field up to values $r \approx \lambda_\infty^2/d$ (several Oe), the measurements for P agree qualitatively with the conclusions of [3], although the value of r is not well known for zinc.

There are no essential differences between the $\rho(H)$ plots for P and F.

4. According to [3], in the case of F an increase of the longitudinal magnetic field leads to a gradual drop of the resistance. In fields for which $r \approx d$, it reaches the value $\rho_{\infty;H}$ typical of the bulky sample. For P (excluding the region up to $r \approx \lambda_\infty^2/d$), the resistance will increase, reach a maximum at $r \approx \sqrt{\lambda_\infty d} = 1/H_{max}$, and then start to drop to the value $\rho_{\infty;H}$ reached in strong fields ($r < d$). Figure 2 shows two typical experimental curves for a filamentary whisker and a plate of equal thickness. We see that both for F and P the resistance first increases sharply, reaches a maximum, and then drops. This behavior is qualitatively similar to the picture described in [3] only for P. The value of H_{max} depends lineary on d^{-1}, and not on $d^{-1/2}$ as in [3]. $H_{max}d \approx 1.5$ cm-Oe for P. A similar variation is observed also in F, for which $H_{max}d \approx 3.8$ cm-Oe. It is impossible to relate these quantities with any particular large group of electrons, owing to the extreme complexity of the Fermi surface of zinc. They correspond more likely to a certain average over all parts of the Fermi surface. We note also that the observed behavior of the longitudinal magnetoresistance is connected almost fully with the size effect, since the role of the volume magnetoresistance is negligible when $\lambda_\infty \gg d$. This is experimentally manifest, in particular, in the fact that the thinner the sample the larger the specific magnetoresistance. This is most clearly pronounced in F, for which the increment of the resistance in the field is approximately proportional to d^{-1}.

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ANISOTROPY OF THE FARADAY EFFECT IN IRON GARNETS

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The Faraday effect in transparent ferromagnets in the visible and infrared regions of the spectrum and in a broad temperature interval has been the subject of a large number of