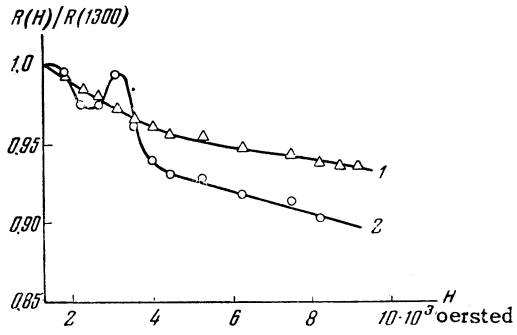
gion, lead has the feature that its conductivity in the helium temperature region increases significantly as the temperature is reduced,[5] indicating an increase in the electron relaxation time t_0. Thus, the change due to resonant effects, observed in the same sample of tin as the temperature was reduced from 4.2° K to 2° K,[3] should have a larger effect in lead, by virtue of the observations given above.

The sample was a lead single-crystal wire approximately 12 mm in length and approximately 0.8 mm in diameter extracted in a quartz capillary from lead obtained from the Kalbaum company;* the sample was placed along the axis of a coaxial copper resonator. The measurement of the surface resistance of the sample was carried out by the same methods used in studying cyclotron resonance in tin.[3]

The results of the measurements of R(H)/R(1300) [R(H) is the surface resistance in a fixed field H > 1300 oersted†] in lead at a frequency of 8,900 Mcs and temperatures of 4.2° K (Curve 1) and 2°K (Curve 2) are shown in the figure. The effect of



electron relaxation time is obvious from the figure. At 4.2° a monotonic decrease of resistance is noted with increasing field; at a temperature of 2°K and H ≈ 2400 oersted there is rather deep resonance minimum followed by a maximum; then the surface resistance falls off sharply in accordance with the theoretical predictions. An estimate of the effective mass m^* of the conduction electrons in lead, carried out under the assumption that the resonance minimum at H = 2400 oersted corresponds to the condition $\nu = eH/2\pi m^* c$, yields the value $m^* = 0.8\ m_0$.

The fact that the obtained effective conduction-electron mass does not differ significantly from the free-electron mass indicates that just as in tin,[3] the electrons at the bottom of the band are responsible for the cyclotron resonance in lead.[6]

*The same samples of lead were investigated by Borovik.[5]

†In view of the fact that lead is a superconductor with T_c = 7.2°, the impedance in the field does not refer to the value of R at H = 0, but to its value at 1300 oersted, when the sample is in the normal state

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[2] E. Fawcett, Phys. Rev. **103**, 1582 (1956).

[3] P. A. Bezuglyi and A. A. Galkin, J. Exptl. Theoret. Phys. (U.S.S.R.) **33**, 1076 (1957), Soviet Phys. JETP **6**, 831 (1958).

[4] I. E. Aubrey and R. G. Chambers, Physics and Chemistry of Solids (1957).

[5] E. S. Borovik, J. Exptl. Theoret. Phys. (U.S.S.R.) **27**, 355 (1954).

[6] E. S. Borovik, Doctoral Dissertation, Physico-Technical Institute, Academy of Sciences, Ukrainian S.S.R. (1954).

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INVESTIGATION OF THE SURFACE RESISTANCE OF TIN IN WEAK MAGNETIC FIELDS

P. A. BEZUGLYI and A. A. GALKIN

Physico-Technical Institute, Academy of Sciences, Ukrainian S.S.R.

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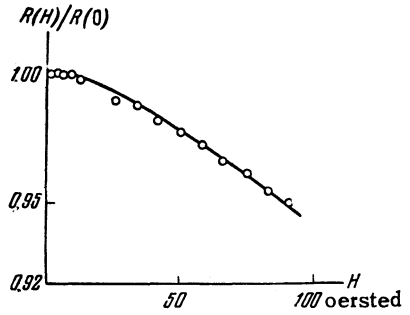
In work on cyclotron resonance[1] it has been shown that in weak fields parallel to the surface of the metal the surface resistance is a very weak function of the field. On the other hand, experiments carried out by Fawcett[2] on cyclotron resonance in tin and copper have shown that in weak fields there is a considerable dependence of surface resistance on field; dR(H)/dH is considerably different from zero as H → 0. The same conclusion may be drawn from our earlier work.[3]

In this connection we have investigated the surface resistance of tin in fields up to 100 oersted, using the method escribed earlier.[3] The results of these experiments, carried out with the tin sample used earlier[3] at a frequency of 9,300 Mcs and a temperature of 4.2° K are shown in the figure. These results indicate that, in accordance with the theoretical predictions, the real part of the resistance of the metal is virtually independent of



field up to 10 oersted, i.e., $dR/dH \to 0$ as $H \to 0$. In fields with $H > 10$ oersted there is a monotonic reduction of the surface resistance with increasing field, in agreement with the results of the earlier work.[2,3]

It is interesting to note that the dependence of the surface resistance of metals on the magnitude of the magnetic field should be taken into account in measuring the temperature dependence of R_S/R_n for superconductors (R_S and R_n are the surface resistances of the metal in the superconducting and normal state) if as R_n we take the surface resistance of the metal under conditions in which the superconductivity is destroyed by the field. Neglecting this effect may lead to values of R_S/R_n which are too high.

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THE PHASE DIAGRAM OF THE HYDROGEN-DEUTERIUM SYSTEM

V. S. KOGAN, B. G. LAZAREV, and R. F. BULATOVA

Physico-Technical Institute, Academy of Sciences, Ukrainian, S.S.R.

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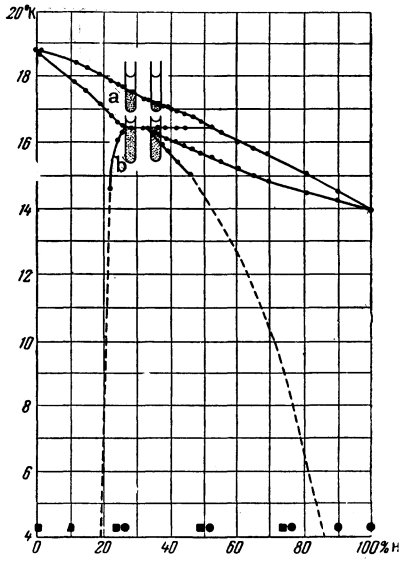
In a previous letter[1] we reported some preliminary results of x-ray studies of hydrogen and deuterium at liquid helium temperatures. In it we showed that the previous determinations of the crystal structure of hydrogen at Leyden[2] had been done incorrectly.

At the Symposium on Low Temperature Physics in Leningrad in June, 1956, we also reported some results of crystal structure studies on mixtures of the hydrogen isotopes, in which it was shown that there was only a limited range of concentrations for which a solid solution could exist in this system.

In the present report we shall present more detailed data for the system, obtained from the thermal analysis of hydrogen-deuterium mixtures. The mixtures were prepared from the pure isotopes, condensed into a calorimeter cooled with liquid hydrogen kept at reduced pressure by a vacuum pump, and then frozen. After the pump was stopped, the mixture was allowed to warm up slowly over the temperature interval from 14° to 19° K.

Thermal analysis revealed a horizontal portion in the solidus curve at a temperature of 16.4° K. Comparison of the thermal analysis data with the results of x-ray patterns at 4.2° K enabled us to determine the approximate limits of the two-phase region, to connect this low-temperature portion with the solidus line, and outline the general shape of the phase diagram for the hydrogen-deuterium system (see the figure).

During the crystallization of mixtures in the concentration range 26 — 52% of hydrogen by volume, the presence of peritectic regions was established visually. We made use of the fact that in the vapor over liquid helium a stable tempera-



○ — results of thermal analysis, ■, ● — results of x-ray analysis (■ — D_2 lattice; ● — H_2 lattice)