may develop, and the resulting osmotic pressure (cf. Ref. 1) may seriously affect the results obtained.

The results obtained are given in Figs. 1 and 2, in the first of which is shown the dependence of the

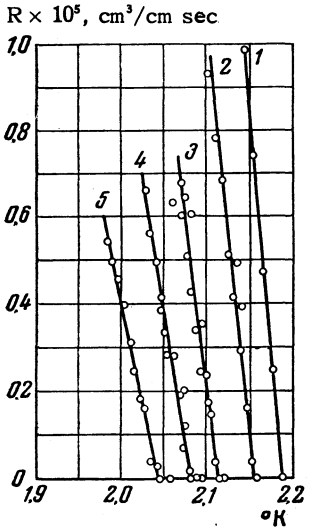

FIG. 1. Temperature dependence of the film transfer rate, for helium isotope mixtures having He^3 concentrations of 1.5% (curve 2), 4.7% (curve 3), 7.0% (curve 4) and 9.6% (curve 5). Curve 1 gives the same dependence for pure He^4, obtained by extrapolation of the curves showing the concentration dependence of the film transfer rate.

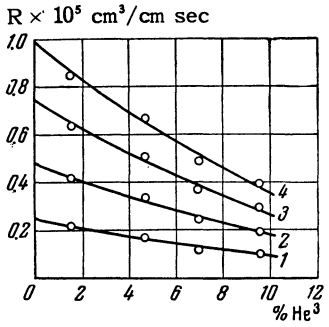

FIG. 2. Dependence of the film transfer rate upon He^3 concentration. Curve 1 refers to $T_\lambda - T = 0.01°$, 2 – 0.02°, 3 – 0.03°, 4 – 0.04°.

film transfer rate upon temperature, and in the second, upon the He^3 concentration. It follows immediately from these diagrams that the film transfer rate is reduced with increasing He^3 concentration.

Comparing the data on the temperature dependence of the normal component density for helium isotope mixtures,[3,4] one may conclude that in the temperature region investigated the film transfer rate is directly proportional to the density of the superfluid component: $R = A\rho_s/\rho$, where $A = 3.2 \times 10^{-5}$ cm³/cm sec.

It should be noted that the temperature of the He I – He II phase transition could be determined for the mixtures used from the onset of the film flow. In this way values were obtained which were in convincing agreement with similar data obtained by other methods.[5]

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[3] N. G. Berezniak and B. N. Esel'son, Dokl. Akad. Nauk SSSR 111, 322 (1956), Soviet Phys. "Doklady" 1, 645 (1956).

[4] N. G. Berezniak and B. N. Esel'son, J. Exptl. Theoret. Phys. (U.S.S.R.) 31, 902 (1956), Soviet Phys. JETP 4, 766 (1957).

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Translated by S. D. Elliott
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RELATION BETWEEN SECONDARY EMISSION OF NEGATIVE IONS AND THE ANGLE OF ENTRY OF PRIMARY PROTONS INTO A METAL TARGET

I. M. MITROPAN and V. S. GUMENIUK

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

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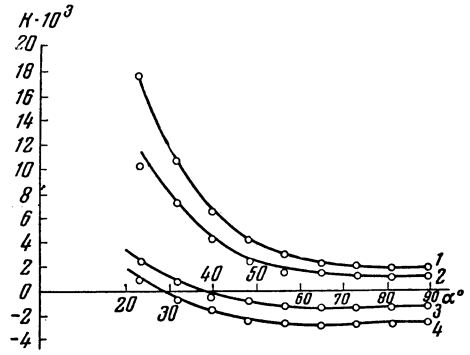
In an earlier paper[1] we have determined the coefficient for K-emission of secondary negative ions from a target under bombardment by hydrogen ions with energies of 200 — 1,000 kev, and have shown that the total coefficient for secondary emission of negative ions, K^-, does not exceed 10^{-3}. However, it might be supposed that at small angles of entry of the proton beam into the target the coefficient K^- would increase, as in the case in secondary electron emission.[2]

In the present work we have attempted to estimate the change in the coefficient K^- as a function of the entry angle of the proton beam striking the target. To carry out this investigation we used a proton beam with an energy of 50 kev, extracted by a magnetic analyzer; the method described ear-

lier[1] was used with the following modifications: the target, which was the internal electrode of a spherical condenser, was a circular plate fastened to a hemisphere 28 mm in diameter, inside of which there was a tungsten helix for heating the target. The entire spherical condenser could be rotated about an axis in the plane of the target. As in the earlier work, the spherical condenser was located in a magnetic field directed along the axis of rotation of the target. The magnetic field required for suppression of electron emission was less than 100 oersted. A retarding potential of 400 volts was applied to the target to suppress the emission of slow secondary positive ions. All experiments were carried out in a vacuum of 2×10^{-6} mm Hg.

The relation obtained between the coefficient of secondary negative ion emission and the angle of entry of the beam are shown in the figure. As is



The secondary ion emission coefficient as a function of entry angle of the primary proton beam in a plane target. 1 – Cu, 2 – stainless steel, 3 – Al, 4 – Be.

apparent from the figure, in copper and E Ia–1 stainless steel this coefficient is positive over the entire entry-angle region which was studied. In aluminum and beryllium targets the secondary ion emission coefficient is negative at large entry angles; at entry angles below 30 — 40° it passes through zero and becomes positive.

Preheating the targets at 900° C for 20 minutes results in a reduction of K^- in the beryllium targets and an increase in K^+ in the copper targets.

The present results can be understood if one keeps in mind the fact that the secondary-ion emission is composed of true secondary negative ions and of protons of the primary beam, scattered at angles larger than 90° by the Coulomb field of the target nuclei. The observed sign of the secondary-emission coefficient depends on the relative strengths of these two components.

The results obtained indicate that at proton energies of 50 kev in copper and stainless steel targets the number of scattered protons is larger than the number of secondary negative ions at all entry angles. In aluminum and beryllium targets the number of secondary negative ions exceeds the number of scattered protons at entry angles below 30 — 40°.

Attempts to compute the current of single positive scattered ions indicate that the calculation errors are as large as the experimental errors; hence it is impossible to determine accurately the negative-ion coefficient from the difference of currents when the present method is employed.

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CYCLOTRON RESONANCE IN LEAD AT 8,900 Mcs

P. A. BEZUGLYI and A. A. GALKIN

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

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CYCLOTRON resonance effects in metals, predicted theoretically by Azbel' and Kaner,[1] have been recently observed experimentally in tin[2,3] and bismuth.[4]

In the present note we present a brief report concerning the results of experiments on cyclotron resonance in lead at 8,900 Mcs.

The choice of lead as a test material is occasioned by the following considerations. It follows from the theory of cyclotron resonance that the amplitude of the oscillations of surface resistance of the metal in the resonance region at a given frequency of the alternating electromagnetic field depends in an important way on the electron relaxation time in the metal t_0, increasing as t_0 increases. In contrast with the materials investigated earlier, such as copper and tin,[2,3] for which the dc resistance changes slowly in the helium-temperature re-