tory frequency $\omega(k)$ in terms of parameters that characterize a uniform spatial distribution (the ground state), the principal characteristic being the average energy of a single particle when all interactions (kinetic energy, exchange interaction, and Coulomb correlations) are taken into account.

The second possible method was considered in Ref. 1. Small deviations from uniform density are described by linearized time-dependent Hartree equations in hydrodynamical form, with the coefficients of the equations given in terms of the ground-state particle energy. In Ref. 1 the dispersion equation for weak excitations (long waves) is given as

$$\omega^2 = n_0 G(k) k^2 / m + 2\bar{E}_0 k^2 / m + O(k^4),$$

where $G(k)$ is a Fourier component of the interaction potential, $\bar{E}_0$ is the average energy per particle taking into account exchange and Coulomb correlations in the ground state, and $n_0$ is the average particle density.

For an electron gas we have

$$\bar{E}_0 = E_F + E_x + E_C,$$

where $E_F = 3P_0^2/10m$ is the Fermi kinetic energy, $E_x = -(3e^2/4\pi\hbar)P_0$ is the Coulomb exchange energy, and $E_C$ is the Coulomb correlation energy. Wigner's calculations[2] give

$$E_C = -0.288/(r_s + 5.1\, r_B), \qquad r_s = (3/4\pi n_0)^{1/2}, \qquad r_B = e^2/m\hbar^2.$$

This expression for $E_C$ is valid with 20% accuracy for both small and large densities. Transforming to the usual notation of the theory of electron-plasma oscillations, we obtain the following expression for the frequency of normal oscillations:

$$\omega^2 = \omega_0^2 + \left[1 - 0.47\xi^2 - \frac{0.065}{1 + 0.22\xi^2}\xi^4\right]\left(\frac{3P_0^2}{5m^2}\right)k^2 + O(k^4);$$

here we have $\omega_0$ for the Langmuir frequency, and the dimensionless quantity $\xi = \hbar\omega_0/(P_0^2/2m)$. For metals $\xi \sim 1$, and exchange effects play a larger part than Coulomb correlations, whose contribution in the dispersion equation is about seven times smaller. For a very dense electron gas ($r_s/r_B \ll 1$) the correlation energy was recently calculated by Gell-Mann and Brueckner,[3] who obtained the following expression:

$$E_C = [0.0622 \ln(r_s/r_B) - 0.096](e^4 m/2\hbar^2).$$

Here the contribution of Coulomb correlations to the dispersion equation is still smaller. This can easily be understood, because in a dense gas the Fermi kinetic energy is proportional to $n_0^{2/3}$ and the energy associated with interactions is proportional to $n_0^{1/3}$. Therefore as the density increases the kinetic energy rises more rapidly than the Coulomb interaction energy.

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## *FILM TRANSFER RATE IN HELIUM ISOTOPE MIXTURES*

B. N. ESEL'SON, A. D. SHVETS, and R. A. BABLIDZE

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

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As is well-known,[1,2] the effect of He$^3$ dissolved in He II upon the phenomenon of film transfer is to reduce the transfer rate.

It appeared of some interest to investigate this situation in more detail, for which purpose experiments were carried out with helium isotope mixtures of 1.5, 4.7, 7.0, and 9.6% He$^3$ content. The experiments were performed with the aid of an apparatus consisting of two reservoirs, communicating through the helium film, made of thin-walled capillary tubing (1.08 mm in diameter) and of different lengths,[1] so that as the helium isotope mixture was condensed into the system a difference in level was established, and film transfer from the higher level to the lower began to take place below the λ-point. Measurements of the rate of change in the height of the level in one of the reservoirs of the system, made with the aid of a cathetometer, permitted determination of the film transfer rate $R = v\delta$, where $v$ is the velocity of the film and $\delta$ is its thickness. The temperature region investigated was immediately adjacent to the λ-point. This is due to the fact that at sufficiently low temperatures (where the transfer rate becomes large) a substantial difference in the concentrations of the mixtures in the two reservoirs of the system 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 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.

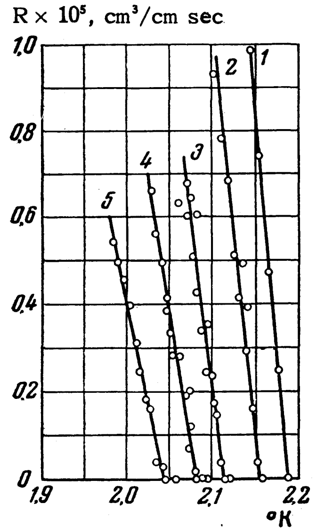

FIG. 1. Temperature dependence of the film transfer rate, for helium isotope mixtures having He$^3$ concentrations of 1.5% (curve 2), 4.7% (curve 3), 7.0% (curve 4) and 9.6% (curve 5). Curve 1 gives the same dependence for pure He$^4$, obtained by extrapolation of the curves showing the concentration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

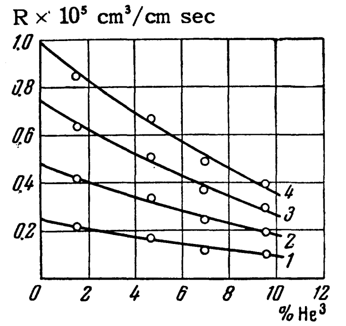

FIG. 2. Dependence of the film transfer rate upon He$^3$ concentration. Curve 1 refers to $T_\lambda - T = 0.01°$, 2 – 0.02°, 3 – 0.03°, 4 – 0.04°.

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 $A = 3.2 \times 10^{-5}$ cm$^3$/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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# *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-