# The Surface Tension of Liquid $He^3$ in the Temperature Range 0.93 - 3.34 °K

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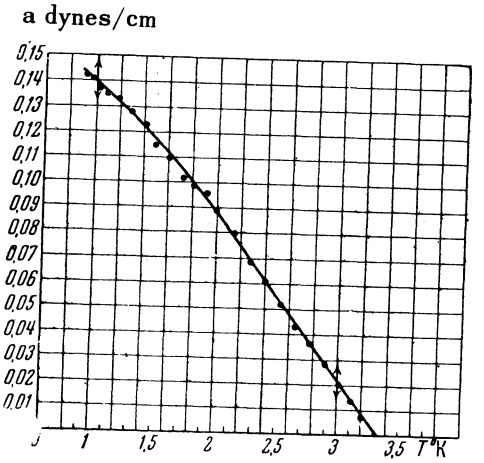
MEASUREMENTS of the surface tension of liquid $He^3$ have been carried out by the method of liquid rise in capillaries. Three capillaries were used in this research, each of length 2cm, and with diameters 0.360 mm, 0.224mm and 0.188 mm. The capillaries were carefully tested for uniform bore. The calibration of the capillaries was carried out within 1% by the usual method-- filling with mercury and measuring the length and weight of the mercury column. The capillaries were embedded in a glass test tube of 6 mm diameter and 30 mm length, at the end of which a resistance thermometer of phosphor bronze wire, diameter 40$\mu$, was sealed in with platinum lead wires. The test tube was connected to a German silver tube of internal diameter 1.44 mm through a copper-glass connection. The $He^3$, whose purity was determined by mass spectrographic methods to be not less than 99.8%, was condensed along this tube, which leads across the trap of a Dewar into the test tube. This test tube was placed in the helium bath, which was constructed in similar fashion to that described by Peshkov[1]. This bath consisted of two Dewars placed one within the other. Temperature reduction was obtained by pumping.

Observation of the liquid level in the capillaries and in the test tube was made by means of a cathetometer which permitted measurement to within 0.01 mm. Actually the dispersion of the individual measurements at one temperature was large in several cases. Since the observation of the meniscus was carried out through seven glass layers, the form of the meniscus in the capillaries was not entirely clear, and the sight setting was made on some mean position of the interface. Distortions due to inhomogeneitis in the glass were detected by special measurements in which a straight edge of height 6.5 mm and with markings at each half millimeter was located inside the test tube in one of the experiments. The absolute error of the various measurements did not exceed 0.05 mm.

The coefficient of surface tension was computed by the equation

$$\alpha = \rho\, grh/2.$$

The density values of liquid $He^3$ were taken from Grilly, Hammel and Sydoriak [2]. The results of the three experiments, averaged at each temperature




for all three capillaries, are shown in the figure. At very low temperatures, the mean error of measurement amounted to ±5%, with the maximum error ±7%. The maximum spread of the individual measurements is shown by the arrow on the graph.

The temperature of the liquid $He^3$ was determined by the resistance thermometer, which was first calibrated by the vapor pressure of $He^3$ (given by Abraham, Osborne and Weinstock[3]) and separately in $He^4$ (Mond Laboratory scale) with accuracy within 0.01 °K. Both scales agreed within the limits of error. Measurements of the surface tension of $He^4$ were carried out as a check on the method. Our results agreed well with the accepted values [4,5].

Comparison of the surface tension of $He^3$ and $He^4$ shows that the character of the temperature dependence of $\alpha$ in the region of investigation is the same in each case, but the curve for $He^3$ is displaced to the left by the difference in the critical temperatures (5.2° and 3.34 °K), and has the smaller slope. For T = 1 °K, the surface tension of $He^3$ is 2½ times less than for $He^4$.

Translated by R. T. Beyer
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