$\times 10^6$, $U=4350$ cal/mole, $V_s=8\times 10^4$ cm/sec, a good agreement is obtained with the data. 4350 cal/mole is in good agreement with the binding energy of an impurity atom,[4]

$$U=\tfrac{2}{3}[(1+\sigma)/(1-\sigma)]\mu b^3\epsilon \text{ ergs,} \qquad (6)$$

where σ is Poisson's ratio and $\epsilon=(r'-r)/r$ represents the increase in radius of the impurity atom over the normal atom.

It is a pleasure to acknowledge a number of helpful discussions with W. T. Read on dislocation theory.

[1] P. C. Bordoni, J. Acoust. Soc. Am. **26**, 495–503 (1954).
[2] H. E. Bömmel, Phys. Rev. **96**, 220–221 (1954).
[3] C. Zener, *Theory of Diffusion, Imperfections in Nearly Perfect Crystals* (John Wiley and Sons, Inc., New York, 1952), Chap. 7.
[4] See A. H. Cottrell, *Dislocations and Plastic Flow in Crystals* (Oxford University Press, London, 1953), p. 57.

Effect of a Centrifugal Field upon the Rate of Transfer through a Helium II Film*

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THE rate of transfer of liquid in helium II films over surfaces is believed[1] to be slightly dependent upon the difference in height between the two levels of liquid helium II. This effect should be greatly magnified if the helium II film is acted upon by a centrifugal field which can be made many times larger than the gravitational field of the earth. An attempt has been made to investigate this effect by observing the transfer through a helium II film creeping from the periphery to the axis in a spinning rotor. The results, while complicated by rotor heating, are believed to be of sufficient interest to report at this time.

The rotor is spun on the lower end of a 60-cm long stainless steel 0.08-cm i.d. thin-walled hypodermic needle tube by an air turbine situated above the apparatus. The rotor contains two radial tubes tightly packed with radial one-mil nichrome wires and is so constructed that the only connection between the axis and periphery is through the channels between the wires. The rotor is surrounded by two concentric cylindrical Dewar flasks. The outer Dewar contains liquid nitrogen, while the inner contains liquid helium. The inner one is so arranged that it can be evacuated. A measured amount of helium slightly above atmospheric pressure is admitted through the hypodermic needle shaft and condenses in the rotor. The inner Dewar is next pumped down until the temperature of the liquid helium surrounding the rotor is below the lambda point. The rotor is always immersed at least 15 cm below the surface of the helium II. The temperature of the liquid helium II inside the rotor is determined approximately by the pressure at the upper end of the hypodermic needle shaft.

When the rotor is spun, a pressure difference is set up between the periphery and the axis. This produces a radial flow of vapor through the small channels between the wires from the axis to the periphery. At the same time, since there is a supply of liquid helium II at the periphery, it creeps toward the axis through the helium II films on the surfaces of the wires. The rotor is so constructed that the helium II cannot move continuously perpendicular to the radius. If the amount of radial flow of gas toward the periphery is greater than the creep of liquid to the axis, the pressure at the axis as measured through the spinning hollow hypodermic needle shaft should fall.

From measurements of the rate of flow of helium through the channels at room temperature the amount of flow of vapor produced by the pressure gradient in the spinning rotor at the low temperature could be calculated. Also the amount of transfer of helium II over the surfaces of the small wires to the axis could be reliably estimated when the rotor was not spinning. It was found that when the rotor (3.5 cm i.d. and 4.45 cm o.d.) was quickly accelerated to a speed between 100 and 140 rps, the pressure at the axis first dropped and then started rising. At these rotor speeds, the mass transfer through the helium II film to the axis should be over 10 times that of the gas flowing from the axis to periphery through the channels, provided that the amount transferred through the film was independent of the centrifugal field. Therefore, the drop in pressure at the axis indicated that the rate of transfer through the helium II film was reduced by the centrifugal field. The later rise in pressure was shown to be due to the heating of the rotor by surface friction produced by the surrounding helium II. At rotor speeds very much below 100 rps the calculated pressure drops produced by the centrifugal fields were too small to measure with precision, while above 140 rps the heating was too rapid for reliable observation. However, there seems to be good evidence that in a centrifugal field of the order of 10^3 times gravity or a centrifugal potential corresponding to a height of the order of 10 meters, the transfer through the film is definitely reduced. The effect, of course, may become appreciable at values below those listed above. It should be noted that radial temperature gradients inside the rotor produced say by evaporation at the axis or heating around the periphery also would produce radial flow of helium II toward the periphery and hence possibly produce a pressure drop. However, the effect of heating at the periphery was greatly reduced by using a double-walled (Dewar-flask-like) rotor with thermal connection near the axis only, while the effect of evaporation is estimated to be small. The writer is much indebted to Dr. J. W. Stewart and Dr. L. G. Hoxton for help with part of the experiment.

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[1] J. G. Daunt and R. S. Smith, Revs. Modern Phys. **26**, 172 (1954).