EXPERIMENT 4: LATTICE ENERGY OF SOLID ARGON

In this experiment the heat of sublimation of argon will be determined through measurement of the vapor pressure of solid argon over the temperature range of 65 to 78 K. This heat of sublimation will be used, together the Debye theory of lattice vibrations, to determine the lattice energy of solid argon. The interaction potential between a pair of argon atoms has been estimated from a variety of gas-phase properties, including the second virial coefficient, Joule-Thomson effect, gas viscosity, and integral and differential molecular beam scattering experiments. The most precise information on the Ar–Ar potential comes from the latter experiments.[1] It will be interesting to see how well the lattice energy of the solid can be calculated from the gas-phase 2-body interaction potential.

This experiment is fully described in Experiment 47 of Shoemaker *et al.* We are using the vapor pressure of nitrogen to measure the temperature. Follow the experimental procedure given there, and analyze the results as therein described. Be careful about the units in which the various quantities are expressed. Note that in the Theory section of the writeup in the text pressure is expressed in atm since the standard state is defined as 1 atm.

In place of one of the mercury manometers, the pressure will be measured with a capacitance manometer. In such a device, the pressure (*i.e.* force per unit area) is determined from the deflection of a thin metal diaphragm separating a compartment connected to the vacuum manifold and an evacuated compartment. The deflection is sensed by measuring the change in capacitance in a sensitive ac circuit. An output voltage, which is proportional to the pressure, is provided. For the model of manometer employed in this experiment, the pressure in Torr equals 100 times the output in volts.

References

1. J. M. Parson, P. E. Siska, and Y. T. Lee, "Intermolecular Potentials from Crossed-Beam Differential Elastic Scattering Measurements. IV. Ar + Ar," *J. Chem. Phys.* **56**, 1511 (1972).