THE THERMOELECTRIC POWER OF LIQUID MERCURY AT ELEVATED TEMPERATURES AND PRESSURES

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Received 10 January 1969

The thermoelectric power of liquid mercury is measured at pressures up to 1000 bar and temperatures to 1000°C and values are given for the variation of absolute thermoelectric power with temperature, pressure and volume.

The absolute thermoelectric power of liquid mercury has been measured and discussed several times [1-3]. At or near zero pressure it is given by [1]

$$S_{p=0} = 2.00 - 23.3 \times 10^{-3} T \ \mu V/^{o}K$$

The temperature coefficient is an order of magnitude larger than for other metals.

Possibly the pseudopotential theory of electron transport in liquid metals [4] is adequate to account for this property of mercury if the model were to include the temperature and volume dependence of the structure factor, and the volume and energy dependence of the pseudopotential. But these are still difficult to incorporate numerically into a calculation. However it is also possible that the theory is inadequate to cover the case of mercury because the electron ion interaction is too strong and the Fermi surface is smeared out in consequence [5].

Pending clarification of these theoretical points we have made two further experimental investigations which extend the temperature range over which S is known and find its volume dependence.

The experiments were performed up to 1000 bar inside the pressure vessel described by Postill et al. [6]. The specimen was a column of mercury inside an open ended silica tube. The latter was inside a thin tantalum or steel sheath closed at the hot end. Contact between the mercury and the thermocouple and counter electrode was through the sheath. The effect of pressure on the thermoelectricity of copper is given up to 100°C by Bridgman [7] and if copper behaves like gold up to 1000°C [8] we are justified in assuming that up to 1000 bar the effect of pressure on the counter electrode is negligible for our purposes. More technical details will be published elsewhere.

At low pressures and up to 300°C there was good agreement with eq. (1), but at 500 bar or greater, the mercury could be taken to 1000° without boiling and it was observed that at higher temperatures and lower densities, $(\partial S/\partial T)_p$ became more and more negative. At 500 bar and up to 1000°C,

$$S_{p=500} = -(1.90 + 5.48\times 10^{-3} T + 1.86\times 10^{-5} T^2) \pm 0 \ \mu V/^{o}K$$

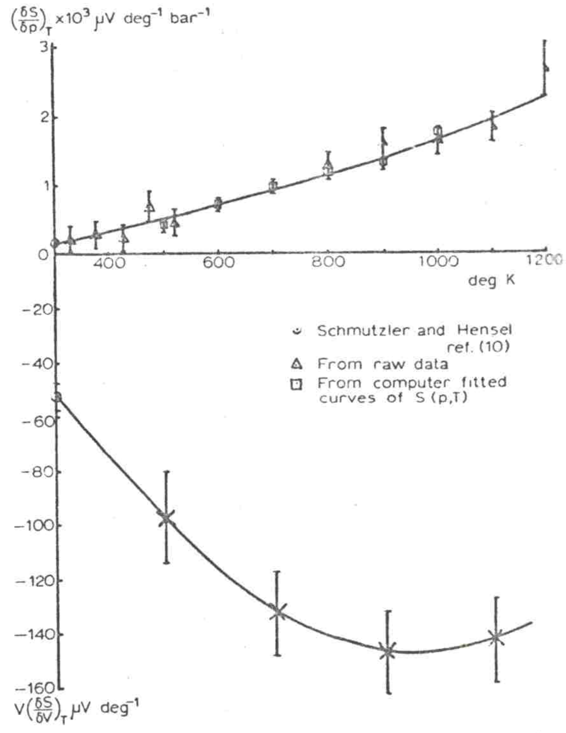

Fig. 1. Pressure and volume dependence of the absolute thermoelectric power of liquid mercury.