The Electrical Conductivity of Molten Lead Iodide

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The electrical conductivity of molten PbI_2 has been determined in the temperature range 798–978 K. The data have been fitted to the equation

$$\varkappa = -0.8167 + 1.5668 \times 10^{-3}\,T + 3.810 \times 10^{-7}\,T^2 .$$

The data are compared with previously published data for PbI_2.

The electrical conductivity of molten lead iodide has recently been critically re-examined by Janz and co-workers [1], with the result that the data of Bogacz and Zuca [2] have been recommended as reference data for the salt. The data base which was selected for the conductivity of PbI_2 supersedes the previous recommendation [3] which was based on the data published by Karl and Klemm [4]. The purpose of this communication is to present new data for lead iodide, which are in substantially better agreement with the older data [4] than with the currently recommended data, and hence cast some doubt on the reliability of the recommended data.

The PbI_2 was British Drug Houses Laboratory Reagent grade material, used without additional purification. The conductivity cell* and associated equipment, and the experimental procedure were essentially as described previously [5], [6]. The overall precision of values of conductivity is estimated to be within $\pm 0.5\%$. Temperatures were measured with a calibrated Pt/13% Rh-Pt thermocouple, with estimated accuracy ± 0.5 K.

The conductivity ($\varkappa$) of PbI_2 was measured in the temperature range 798–978 K. The temperature dependence of $\varkappa$ is described with good precision (r.m.s. deviation of experimental points from the calculated curve 0.005) by the equation

$$\varkappa = -0.8167 + 1.5668 \times 10^{-3}\,T + 3.810 \times 10^{-7}\,T^2 , \qquad (1)$$

where the units of T and $\varkappa$ are K and S cm^{-1}. The variation of $\varkappa$ with temperature is shown graphically in Fig. 1, together with previously published data. Our plotted data are values interpolated at 20 K intervals using Eq. (1) plus the values corresponding to the extremes of the experimental temperature range. The raw data of Karl and Klemm are shown, and the data due to Bogacz and Zuca in Fig. 1 are the values tabulated by Janz and co-workers [1].

It is clear from Fig. 1 that the present data and those due to Karl and Klemm show fairly good agreement, particularly at higher temperatures.

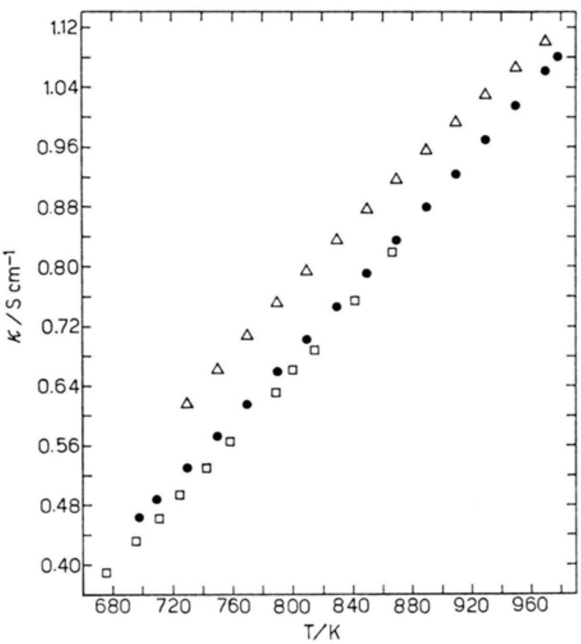

Fig. 1. Electrical conductivity of molten lead iodide. △: Ref. [1]; □: Ref. [4]; ●: this work.

Table 1. Comparison of electrical conductivity data for molten lead iodide at selected temperatures.

T/K	$\varkappa$/S cm^{-1}	data base	$\delta\varkappa$ (%)
723	0.600	a	16.5
	0.489	b	5.0
	0.515	c	—
863	0.903	a	10.3
	0.805	b	1.7
	0.819	c	—
973	1.108	a	3.7
	1.069	c	—

a: Ref. [2], cited in Ref. [1]; b: Ref. [4]; c: this work.

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* An all-quartz construction with platinum electrodes; melt protected by nitrogen.

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Both data sets deviate considerably from the values of Bogacz and Zuca. A quantitative comparison of the three sets of data is given in Table 1 below. To make comparison, Karl and Klemm's data have been fitted by the equation

$$\varkappa = -0.6501 + 1.0054 \times 10^{-3}\,T + 7.888 \times 10^{-7}\,T^2\,. \quad (2)$$

The deviations ($\delta\varkappa$) listed in Table 1 are expressed as percentages relative to our values at the temperatures specified. The discrepancies between our data and those of Karl and Klemm are greater than can be accounted for by the probable experimental uncertainties of the measurements and may be due largely to use of PbI_2 from different sources. The much greater discrepancies between the data of Bogacz and Zuca and the other two sets are, however, too large to have arisen from differing sources of material, and no explanation for the discrepancies is apparent.

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