THERMAL EXPANSION OF POTASSIUM BROMIDE FROM LIQUID AIR TEMPERATURE TO 300° C.

BY R. SRINIVASAN

(Department of Physics, Indian Institute of Science, Bangalore-3)

Received October 22, 1955

ABSTRACT

In continuation with his work on the expansion of sodium and potassium chlorides reported in this journal, the author has determined the thermal expansion of potassium bromide from – 160 to 300° C. The expansion coefficient is found to vary linearly with temperature over the entire range according to the following equation.

$$\alpha_t = (37\cdot62 + 4\cdot1 \times 10^{-2}\, t_c^0) . 10^{-6}$$

INTRODUCTION

The thermal expansion of sodium and potassium chlorides were determined sometime back by the author from liquid air temperatures to 300° C. using the expansion apparatus set up by Sreedhar (1952) and Press (1949) in this Laboratory. In this paper the measurements on potassium bromide are reported.

PREVIOUS WORK

The expansion coefficient of potassium bromide was determined at 40° C. by Fizeau (1867) using his interference dilatometer. Measurements on potassium bromide up to 700° C. have been carried out by Eucken and Dannohl (1934) using the heterodyne beat method.

Henglein (1925) measured the densities of potassium bromide at – 184° C., – 79° C., 0° C. and 50° C. and determined the mean volume expansion coefficient between these temperatures to an accuracy of 4%.

To determine whether the macroscopic and lattice expansion were identical in this crystal Gott (1942) made a series of careful measurements. He found that the macroscopic expansion was systematically larger than the lattice expansion by 3%. Connel and Martin (1951) have measured the lattice expansion of this salt between 20 to 100 and 20 to 190° C. and found good agreement with Gott's macroscopic values.

RESULTS

The potassium bromide specimens used in these investigations were cut from a single transparent crystal of the substance grown from melt in this laboratory by Dr. Vedam and Mr. Gopalakrishnan to whom the author's thanks are due.

The values of the expansion coefficient α at various temperatures T° C. obtained in these experiments are collected in Table I. The variation of α with

TABLE I. *Mean expansion coefficient $\alpha \times 10^6$ of potassium bromide at various temperatures*

T° C.	$\alpha \times 10^6$ (author)
−158·9	31·1
−139·8	31·9
−119·0	32·8
−97·7	33·6
−77·0	34·5
−56·8	35·3
−37·0	36·1
−17·3	36·9
3·3	37·7
45·5	39·5
81·8	40·7
117·0	42·6
151·0	43·8
183·8	45·2
213·9	46·2
244·8	47·4
274·2	48·7
298·1	49·7

Values in literature

T° C.	Mean Temp. T° C.	$\alpha \times 10^6$	Author	Present value of
−184/−79	−132	33·7	Henglein	32·3
−79/0	−40	36·7	± 4%	36·0
0/50	25	39·3	(1925)	38·8

T° C.	$\alpha \times 10^6$	Author	Present values
40	42·01	Fizeau (1867)	39·2
0	37·99	Eucken and	37·6
100	39·78	Dannohl	41·8
200	42·63	1934	45·9
300	46·50		49·9
40	39·2	Gott (1942)	39·2
116	41·1	Interferometer	42·4
59	40·6	Connel and	40·1
104	41·7	Martin (1951) (X-ray method)	42·0

temperature T for potassium bromide is illustrated graphically in Fig. 1. The values present in the literature are also indicated in the table.

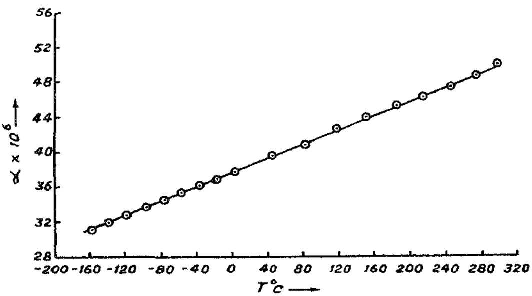

FIG. 1. Thermal expansion of potassium bromide.

A glance at Table I shows the good agreement between the values of the author and the values in literature. The value of Fizeau is too high. The values of Eucken and Dannohl are systematically lower than all the values in the table over the entire temperature range up to 300° C. It is noteworthy that the macroscopic expansion values of the author are in splendid agreement with the lattice expansion values of Connel and Martin.

The expansion coefficient α_t obeys the following equation over the entire temperature range

$$\alpha_t = (37\cdot62 + 4\cdot1 \times 10^{-2}\ t\ ^\circ C.) \times 10^{-6}.$$

To show how far the Gruneisen's relation α/C_p = constant holds for potassium bromide, the values of the expansion coefficient α, the molar specific heat C_p and the ratio of α/C_p at various temperatures are collected in the following table.

The values of C_p are taken from the *International Critical Tables*.

TABLE II. *Linear expansion coefficient α, the molar specific heat C_p, and the Gruneisen's ratio α/C_p at various temperatures for pottassium bromide*

T °K.	$\alpha \times 10^6$	C_p Joules/gm. Mole.	$\alpha/C_p \times 10^6$
150	32·6	46·8	0·697
200	34·7	48·9	0·710
250	36·8	50·6	0·727
273	37·6	51·3	0·733
293	38·5	51·8	0·743

The Gruneisen's ratio shows the usual decrease with temperature.

In conclusion the author desires to express his gratitude to Prof. R. S. Krishnan for his kind interest in this work.

REFERENCES

1. Connel and Martin .. *Acta. Cryst.*, 1951, **4**, 76.
2. Eucken and Dannohl .. *Zeit. f. Elec. Chem.*, 1934, **40**, 814.
3. Fizeau .. *C.R. Acad. Paris*, 1867, **64**, 314.
4. Gott .. *Ann. d. Phys.*, 1942, **41**, 520.
5. Henglein .. *Zeit. f. Elec. Chem.*, 1925, **31**, 424.
   .. *Zeit. f. Phy. Chem.*, 1925, **115**, 91.
6. Press .. *Proc. Ind. Acad. Sci.*, 1949, **30 A**, 284.
7. Sridhar .. *Ibid.*, 1952, **36 A**, 141.
8. Srinivasan .. *Jour. Ind. Inst. Sci.*, 1955, **37**, 232.
9. *International Critical Tables*, 1929, **5**, 91.