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Note

The high temperature heat capacity of dysprosium(III) bromide by differential scanning calorimetry

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INTRODUCTION

Inorganic metal halides are widely used as additives within the envelope of currently available high-pressure discharge lamps [1,2]. Their effect is to improve significantly the spectral distribution of the lamp. In order to simulate the discharge spectrum, the identity of the species present and their thermodynamic and transport properties over a wide range of temperature must be known.

The heat capacities of several metal halides used by the lamp industry have been reported previously [3–6] from this laboratory. This note reports the heat capacity of crystalline dysprosium tribromide in the range 323–623 K.

EXPERIMENTAL

Materials

The dysprosium tribromide (APL Engineered Materials, formerly Anderson Physics Laboratories, Inc., commercial specification 99.99%, H_2O, $OH^- < 50$ ppm) was supplied in a sealed glass ampoule under argon, by courtesy of GE Thorn Lamps Ltd. The sample was analysed by inductively coupled plasma spectroscopy and the mean of eight determinations gave 40.63 ± 0.40 mass% of Dy (literature 40.4%). The dysprosium tribromide (24.18 mg) was sealed under argon in 0.2 mm thick gold DSC cells.

Differential scanning calorimeter

A Perkin-Elmer model DSC-2 equipped with a type 3600 Data Station was used. The instrumental temperature scale was checked by determining the melting points of standard materials [3]. The enthalpy scale has been

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checked similarly [5]. For heat capacity studies, the scan speed was 10 K min^{-1} at a sensitivity of 1 mcal s^{-1}. The instrument operates in a comparative mode, the unknown heat capacity being determined relative to a sapphire standard, for which reliable heat capacities [7] from 400 to 1200 K are known.

Results between 400 and 960 K obtained by this procedure for molybdenum metal, a recommended heat capacity test material [8], have been described previously [3,6]. The mean absolute deviation between the experimental points from 400 to 960 K and a regression line for the reference values was 0.81%.

RESULTS AND DISCUSSION

There are no experimental data for the heat capacity of $DyBr_3$ in the literature. However, an estimated value [9] exists, and Fig. 1 shows our

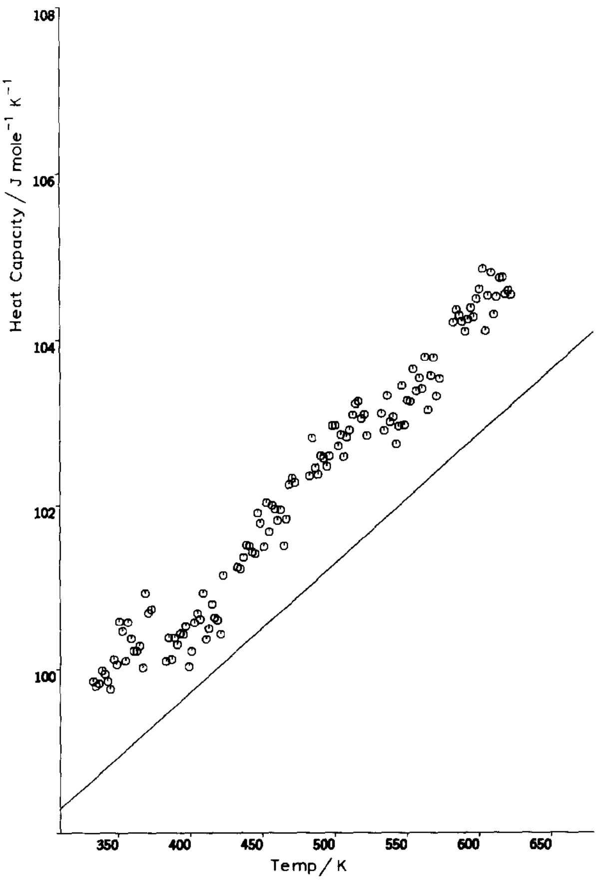

Fig. 1. Experimental heat capacities of $DyBr_3$ from 323 to 623 K at 2 K intervals and a literature estimate (———) [9].

results compared with the estimate. The heat capacity C_p of $DyBr_3$ was regressed to a linear function

$$C_p\ (\mathrm{J\ mol^{-1}\ K^{-1}}) = (0.0175 \pm 0.00023)T + (95.02 \pm 0.11) \qquad (1)$$

where the uncertainty intervals are ±one standard deviation of the regression coefficients. The absolute mean deviation of our experimental points from the literature estimate was 1.17%.

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