Heat Capacity and Thermodynamic Properties of $LaBr_3$ at 300 – 1100 K

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The heat capacity of solid and liquid $LaBr_3$ was measured by Differential Scanning Calorimetry (DSC) in the temperature range 300 – 1100 K. The obtained results were fitted by a polynomial temperature dependence. The enthalpy of fusion of $LaBr_3$ was also measured. By combination of these results with the literature data on the entropy, $S^0_m(LaBr_3, s, 298.15\ K)$ and the standard molar enthalpy of formation, $\Delta_{form}H^0_m(LaBr_3, s, 298.15\ K)$, the thermodynamic functions of lanthanum tribromide were calculated up to 1300 K.

Key words: Heat Capacity; Lanthanum Bromide; Enthalpy of Fusion; Thermodynamic Functions.

1. Introduction

Numerous experimental investigations were conducted on the lanthanide chlorides ($LnCl_3$) and their mixtures with alkali chlorides ($LnCl_3$-MCl). The enthalpy variation and heat capacity were measured over a wide temperature range of these solid and liquid chlorides [1 – 4], as well as for several stoichiometric M_xLnCl_{3+x} compounds [5 – 8] that exist in most $LnCl_3$-MCl mixtures. Enthalpies of mixing were also determined [9 – 13]. Some investigation performed on lanthanide bromides and lanthanide bromide – alkali metal bromide systems were also carried out [14 – 20]. This work continues our general research program on lanthanide halides, and their mixtures with alkali metal halides, and it presents thermodynamic properties of pure lanthanum(III) bromide.

2. Experimental

2.1. Chemicals

Lanthanum(III) bromide was prepared from lanthanum(III) oxide in a manner similar to that described previously [15]. No insoluble matter was found on dissolving it in water. The chemical analysis of the synthesised $LaBr_3$ was performed by titration methods for bromide (mercurimetric) and lanthanide (complexometric). These results are presented in Table 1.

Table 1. Chemical analysis of $LaBr_3$.

Compound	$Br_{experimental}$ mass %	$Br_{theoretical}$ mass %	$La_{experimental}$ mass %	$La_{theoretical}$ mass %
$LaBr_3$	63.30	63.31	36.70	36.69

Synthesized $LaBr_3$ was handled in an argon glove box with a measured volume fraction of water of about 2×10^{-6} and continuous gas purification by forced recirculation through external molecular sieves.

2.2. Measurements

The heat capacities were measured with a SETARAM DSC 121 differential scanning calorimeter. The apparatus and the measurements procedure were described in [2]. Quartz cells (7 mm diameter and 15 mm length) were filled with lanthanum bromide in a glove box, sealed under vacuum, and then placed into the DSC 121 calorimeter.

Enthalpy of transition measurements were carried out with heating and cooling rates between 1 and 5 K min^{-1}.

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