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Vapor Pressures of Aluminum Tribromide and Aluminum Triiodide and Their Standard Sublimation Enthalpies

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Total vapor pressures of $AlBr_3$ and AlI_3 were measured by a torsion effusion apparatus. Their temperature dependences are expressed by the equations $\log(p/\mathrm{Pa}) = (14.78 \pm 0.60) - (4700 \pm 200)/(T/\mathrm{K})$ from (301.0 to 351.0) K and $\log(p/\mathrm{Pa}) = (15.52 \pm 0.30) - (5960 \pm 150)/(T/\mathrm{K})$ from (359.5 to 419.5) K for $AlBr_3$ and AlI_3, respectively. Practically, $AlBr_3$ vaporizes in a dimeric form, while AlI_3 vaporizes in monomeric and dimeric forms. Treating the vapor pressures of $AlBr_3$ by second- and third-law methods, the standard sublimation enthalpy $\Delta H°(298\ \mathrm{K}) = (90 \pm 4)\ \mathrm{kJ \cdot mol^{-1}}$ was derived. For AlI_3, treating the partial pressures of monomer and dimer gaseous species, deduced from the measured total vapor pressures and the constant of dimer−monomer equilibrium reported in the literature, by second- and third-law methods, the standard enthalpies $\Delta H°(298\ \mathrm{K}) = (110 \pm 4)\ \mathrm{kJ \cdot mol^{-1}}$ and $\Delta H°(298\ \mathrm{K}) = (119 \pm 4)\ \mathrm{kJ \cdot mol^{-1}}$ associated to the sublimation reactions of AlI_3 according to the $AlI_3(s) \rightarrow AlI_3(g)$ and $2AlI_3(s) \rightarrow Al_2I_6(g)$, respectively, were selected.

Introduction

Apparently, the first reliable vapor pressure data on $AlBr_3$ were those measured above the molten compound by Fischer et al.[1] using a static method. These authors have shown that the dimeric form is practically the only species present in the vapor and established melting point and heat of fusion of this compound. From these data, the vapor pressures above the solid phase were evaluated and selected by Kelley.[2] Jonson et al.[3] measured above the molten compound by an inverted capillary very high vapor pressures (from $1.20 \cdot 10^5$ Pa to $2.87 \cdot 10^6$ Pa). Dunne and Gregory[4] by the Knudsen effusion method and Sulzmann[5] by a precision capacitance micromanometer measured the vapor pressures above the solid compound. Recently, Rusin and Niesel’son[6] studied at temperatures around the critical point, (763 ± 4) K, the complex equilibria involving monomer, dimer, and trimer forms in the gaseous phase.

Also, for AlI_3 the first vapor pressures were those measured above the liquid phase by Fischer et al.[1] using a static method. The authors have shown that, unlike other triiodides of IIIA group elements (GaI_3 and InI_3), the vapor consists of only monomer species in the vapor above AlI_3 which are present in both monomeric and dimeric forms. Gregory[7] by absorbance measurements in the ultraviolet region shows that at low temperatures (around ambient) the vapor is virtually all $Al_2I_6(g)$, but with increasing temperature, the dissociation process to the monomeric form becomes important. In a figure from this work[7] are drawn the temperature dependence of the partial pressures of monomer and dimer species below the melting point, pressure values derived by the equilibrium constants of these forms taken from ref 1, and the measured total absorbance. Rusin,[8] using the vapor pressure data from ref 1, recalculated the standard enthalpy associated to the dimer−monomer equilibrium. As part of a systematic study on the vaporization of group III metal halides,[9−11] we have measured by a torsion method the total vapor pressures of aluminum tribromide and triiodide and derived their sublimation enthalpies treating the pressure data by the second- and third-law methods.

Table 1. Torsion Total Vapor Pressures of $AlBr_3$

run 1		run 2		run 4	
T/K	log(p/Pa)	T/K	log(p/Pa)	T/K	log(p/Pa)
309.0	−0.37	303.0	−0.75	314.0	−0.21
315.5	−0.07	307.0	−0.45	316.0	−0.15
318.5	0.03	310.0	−0.35	318.0	−0.05
323.0	0.17	312.5	−0.27	320.0	0.03
324.0	0.23	314.5	−0.15	323.0	0.23
327.5	0.37	317.5	−0.05	324.0	0.25
330.5	0.49	318.5	0.01	326.0	0.31
333.5	0.64	320.5	0.09	328.0	0.43
338.0	0.87	321.5	0.15	331.0	0.59
343.0	1.10	324.0	0.25	335.0	0.76
345.0	1.17	327.0	0.38	336.0	0.79
348.0	1.29	333.0	0.66	338.0	0.90
351.0	1.40	336.0	0.76	340.0	0.97
				344.0	1.11

run 6		run 8		run 9	
T/K	log(p/Pa)	T/K	log(p/Pa)	T/K	log(p/Pa)
307.0	−0.47	301.0	−0.87	309.0	−0.46
312.0	−0.25	306.0	−0.62	312.0	−0.31
315.0	−0.14	312.0	−0.34	315.0	−0.17
316.5	−0.05	317.0	−0.02	317.0	−0.08
318.5	0.05	323.0	0.22	318.5	0.01
321.0	0.13	325.0	0.32	320.0	0.09
324.5	0.28	328.0	0.40	323.0	0.20
327.0	0.45	330.0	0.51	326.0	0.33
330.0	0.56	333.0	0.60		
332.5	0.67	336.0	0.75		
337.0	0.86	340.0	0.91		

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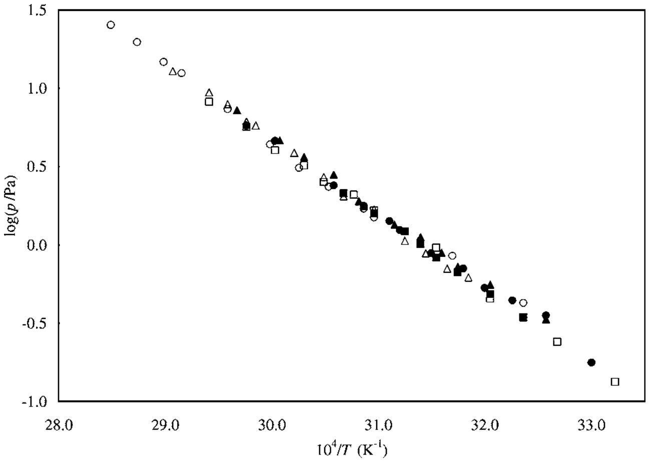

Figure 1. Torsion total vapor pressures of $AlBr_3$. ○, run 1; ●, run 2; Δ, run 4; ▲, run 6; □, run 8; ■, run 9.

Table 2. Temperature Dependence of the Total Vapor Pressures of $AlBr_3$ and AlI_3

compound	run	ΔT	points	$\log(p/\text{Pa}) = A - B/(T/\text{K})$	
		K		A^a	B^a
$AlBr_3$	1	309.0 to 351.0	13	14.70 ± 0.32	4675 ± 105
	2	303.0 to 336.0	13	14.26 ± 0.27	4537 ± 85
	4	314.0 to 344.0	14	15.48 ± 0.20	4936 ± 66
	6	307.0 to 337.0	11	14.64 ± 0.24	4648 ± 77
	8	301.0 to 340.0	11	14.68 ± 0.23	4677 ± 75
	9	309.0 to 326.0	8	14.83 ± 0.22	4725 ± 71
AlI_3	1	365.0 to 417.5	14	15.05 ± 0.07	5757 ± 27
	2	361.0 to 417.0	15	15.31 ± 0.17	5880 ± 64
	3	361.0 to 416.0	14	15.71 ± 0.11	6041 ± 42
	5	368.0 to 414.5	15	15.77 ± 0.12	6062 ± 48
	6	359.5 to 419.5	15	15.74 ± 0.15	6047 ± 57
	8	367.5 to 416.0	14	15.63 ± 0.20	6000 ± 77
	9	364.0 to 415.0	15	15.44 ± 0.12	5928 ± 45

[a] The quoted uncertainties are standard deviations.

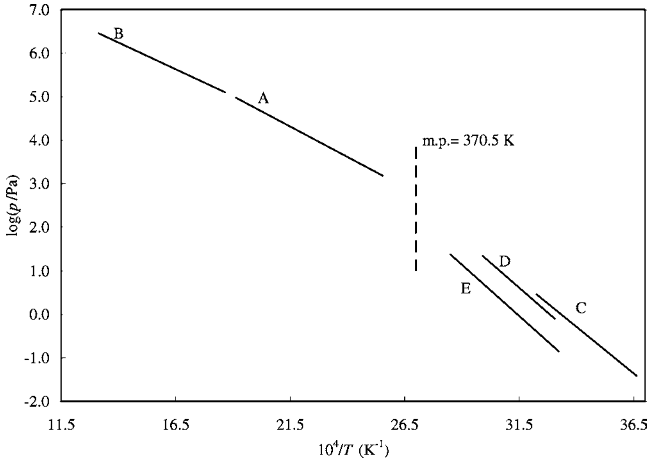

Figure 2. Comparison of the total vapor pressures of $AlBr_3$. A, Fisher et al.;[1] B, Johnson et al.;[2] C, Dunne and Gregory;[4] D, Sulzmann;[5] E, this work.

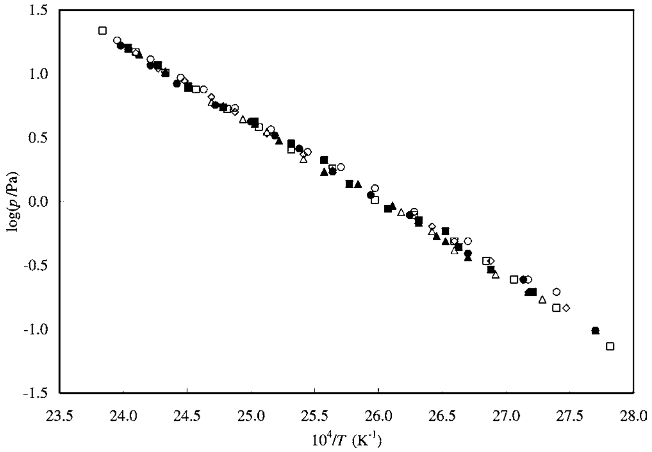

Figure 3. Torsion total vapor pressures of AlI_3. ○, run 1; ●, run 2; Δ, run 3; ▲, run 5; □, run 6; ■, run 8; ◇, run 9.

Experimental and Results

Very pure samples of $AlBr_3$ and AlI_3 were supplied by Aldrich (both 99.999 % pure as stated by the same supplier). Both compounds are hygroscopic and easily hydrolyzed and oxidized so that the containers of the samples were opened and the cells filled with the samples in a efficient drybox in an argon atmosphere. Moreover, both effusion holes of the cell were closed employing small pins of naphthalene. These pins sublime quickly when the cell was put under vacuum. This procedure excludes the contact of the sample with air. The vapor pressures of $AlBr_3$ and AlI_3 were measured by the torsion assembly substantially described in the previous work.[12] A conventional graphite torsion cell, with the effusion holes having a nominal diameter of 1 mm with knife edged orifices, was used in this study. The cell constant necessary to convert pressure data from experimental torsion angles was obtained vaporizing very pure benzoic acid and urea, the vapor pressures of which are well-known.[13,14] The constant values obtained with both standards were found practically equal, and when it was checked in runs carried out during the study of the compounds, they were reproducible (within about 5 % of their average value). This uncertainty produces a very negligible shift in the intercepts of the final log *p* equations. In each vaporization run, the torsion angles, and then the vapor pressures, were measured randomly in both ascending and descending temperatures (though in the

Table 3. Comparison of the Temperature Dependence of the Total Vapor Pressures of $AlBr_3$ and AlI_3

compound	ref	method	equilibrium	ΔT	n° of points	$\log(p/\text{Pa}) = A - B/(T/\text{K})$	
				K	points	A	B
$AlBr_3$	Fischer et al.[1]	static	liq-vap	391.5 to 522.7	18	10.33[a]	2800[a]
	Kelley[2]	extrapolated from ref 1 data	sol-vap	320 to 355		15.262	4651
	Dunne and Gregory[4]	Knudsen-effussion	sol-vap	273 to 310		14.31	4292
	Johnson et al.[3]	static	liq-vap	536 to 761	18	9.68	2452
	Sulzmann[5]	static	sol-vap	302.6 to 334.4	13	15.135	4611
	this work	torsion effusion	sol-vap	301.0 to 351.0	70	14.78 ± 0.60	4700 ± 200
AlI_3	Fischer et al.[1]	static	liq-vap	493.8 645.2	20	10.76[a]	3766[a]
	this work	torsion effusion	sol-vap	359.5 419.5	102	15.52 ± 0.30	5960 ± 150

[a] By us, calculated from the pressure data reported in Fisher's work.[1]

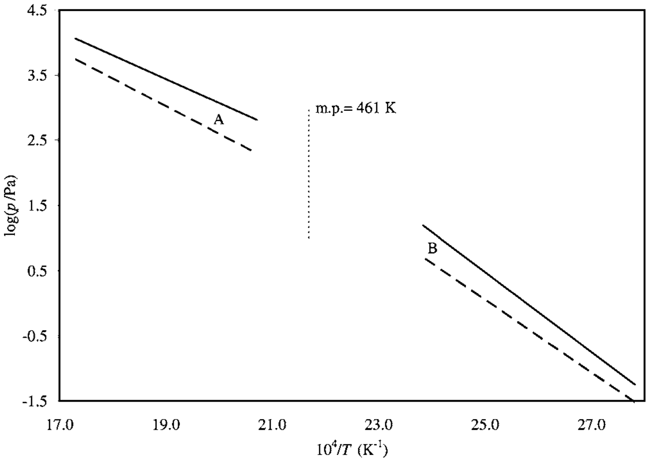

Figure 4. Comparison of the partial pressures of AlI_3 (solid lines) and Al_2I_6 (dotted lines). A, Fischer et al.;[1] B, this work.

tables the data are reported as ascending), and at the beginning and the end of each experiment, the measurements were made at approximately equal temperatures.

$AlBr_3$. The vapor pressures of $AlBr_3$ are reported in Table 1 and Figure 1. Because the experimental operative temperatures of both $AlBr_3$ and AlI_3 are near ambient, where the vapor pressure values are high enough, then to thermostat the cell a long time was necessary with consequent sublimation of a large amount of sample. For this reason and considering that a condition for the correct use of the effusion method is an upper limit of the pressure in the cell, in each run a small temperature range was covered, and a limited number of points were determined. The experimental data of each run were treated by the linear least-squares method to represent the temperature dependence of the vapor pressures as a log p versus $1/T$ equation. The obtained equations are reported in Table 2. Weighting the slopes and intercepts proportionally to the experimental points, the following equation representative of the total vapor pressures of $AlBr_3$ in the temperature range (301.0 to 351.0) K was selected

$$\log(p/\mathrm{Pa}) = (14.78 \pm 0.60) - (4700 \pm 200)/(T/\mathrm{K}) \tag{1}$$

where the associated uncertainties are estimated.

This equation is compared in Table 3 and Figure 2 with those found in the literature. From the slope of eq 1, the second-law enthalpy associated to the sublimation of $AlBr_3$, according the reaction

$$2AlBr_3(s) \rightarrow Al_2Br_6(g) \tag{2}$$

$\Delta_{sub}H°(326\ \mathrm{K}) = (90 \pm 4)\ \mathrm{kJ{\cdot}mol^{-1}}$ was calculated. By third-law treatment of the vapor pressures evaluated by eq 1 at two temperatures at the extremes of the experimental range, (300 and 350) K, two values of the standard enthalpy of the sublimation of $AlBr_3$ were calculated. The free energy functions (fef), $[G°(T) - H°(298\ \mathrm{K})]/T$, necessary for these calculations were taken from the IVTANTHERMO database[15] and by Pankratz.[16] The fef of Al_2Br_6(g) reported by these references (see Table 4) are different because of use of two different values of the absolute standard entropy, $S°(298\ \mathrm{K}) = (537$ and $547)\ \mathrm{J{\cdot}K^{-1}{\cdot}mol^{-1}}$, for refs 15 and 16, respectively. The third-law $\Delta_{sub}H°(298\ \mathrm{K})$ values so obtained, and those recalculated from Dunne's[4] and Sulzmann's[5] vapor pressures evaluated at (300 and 350) K from the log p versus $1/T$ equations reported in their works, are reported in Table 4. In Table 4 are also reported the second-law sublimation enthalpy values, all reported at 298 K using an enthalpic increment of 1 $\mathrm{kJ{\cdot}mol^{-1}}$.[15,3] Both our third-law enthalpies (86.5 and 89.9) $\mathrm{kJ{\cdot}mol^{-1}}$ obtained from the fef of refs 15 and 16, respectively, are higher than those reported by the other authors. It is difficult to choose between our two enthalpy values, but the lack of a temperature trend in the

Table 5. Torsion Total Vapor Pressures of AlI_3

run 1		run 2		run 3		run 5	
T/K	log(p/Pa)	T/K	log(p/Pa)	T/K	log(p/Pa)	T/K	log(p/Pa)
365.0	−0.71	361.0	−1.01	361.0	−1.01	368.0	−0.71
368.0	−0.61	368.5	−0.61	366.5	−0.77	372.0	−0.53
374.5	−0.31	372.0	−0.53	371.5	−0.57	374.5	−0.44
377.0	−0.23	374.5	−0.41	376.0	−0.38	378.0	−0.27
380.5	−0.08	377.0	−0.23	378.5	−0.23	377.0	−0.31
385.0	0.10	381.0	−0.11	382.0	−0.08	380.0	−0.17
389.0	0.27	385.5	0.05	388.0	0.13	383.0	−0.03
393.0	0.39	390.0	0.23	393.5	0.33	387.0	0.13
397.5	0.56	394.0	0.41	398.0	0.54	391.0	0.23
402.0	0.73	397.0	0.51	401.0	0.64	396.5	0.47
406.0	0.88	400.0	0.62	405.0	0.78	399.5	0.61
409.0	0.97	404.5	0.75	408.0	0.89	403.5	0.75
413.0	1.11	409.5	0.92	412.0	1.07	408.0	0.89
417.5	1.26	413.0	1.06	416.0	1.19	411.0	1.02
		417.0	1.22			414.5	1.15

run 6		run 8		run 9	
T/K	log(p/Pa)	T/K	log(p/Pa)	T/K	log(p/Pa)
359.5	−1.14	367.5	−0.71	364.0	−0.84
365.0	−0.84	372.0	−0.53	368.0	−0.71
369.5	−0.61	375.5	−0.36	372.0	−0.47
372.5	−0.47	377.0	−0.23	376.0	−0.31
376.0	−0.31	380.0	−0.15	378.5	−0.20
380.5	−0.11	383.5	−0.06	381.0	−0.11
385.0	0.01	388.0	0.13	385.5	0.05
390.0	0.26	391.0	0.32	390.0	0.24
395.0	0.40	395.0	0.45	393.5	0.37
399.0	0.58	399.5	0.62	398.0	0.53
403.0	0.72	403.5	0.74	402.0	0.70
407.0	0.88	408.0	0.90	405.0	0.82
411.0	1.01	412.0	1.07	408.5	0.94
415.0	1.17	416.0	1.20	412.0	1.04
419.5	1.34			415.0	1.16

Table 4. Standard Sublimation Enthalpy of $AlBr_3$ According to the Reaction: $2AlBr_3 \rightarrow Al_2Br_6(g)$

			Dunne and Gregory[4]			Sulzmann[5]			this work		
	$\Delta[(G°(T) - H°(298\ \mathrm{K})/T]$		third-law $\Delta H°(298\ \mathrm{K})$			third-law $\Delta H°(298\ \mathrm{K})$			third-law $\Delta H°(298\ \mathrm{K})$		
T	$\mathrm{J{\cdot}K^{-1}{\cdot}mol^{-1}}$		p	$\mathrm{kJ{\cdot}mol^{-1}}$		p	$\mathrm{kJ{\cdot}mol^{-1}}$		p	$\mathrm{kJ{\cdot}mol^{-1}}$	
K	from ref 15	from ref 16	Pa	a	b	Pa	a	b	Pa	a	b
300	−176.54	−186.62	1.008	81.7	84.7	0.5821	83.1	86.1	0.1254	86.9	89.9
350	−176.20	−186.68	111.5	81.4	85.2	91.35	82.0	85.7	21.78	86.2	89.9
			average	81.6	84.9	average	82.5	85.9	average	86.5	89.9
			second-law $\Delta H°(298\ \mathrm{K})$ = 83.2 $\mathrm{kJ{\cdot}mol^{-1}}$			second-law $\Delta H°(298\ \mathrm{K})$ = 89.3 $\mathrm{kJ{\cdot}mol^{-1}}$			second-law $\Delta H°(298\ \mathrm{K})$ = 91 ± 4 $\mathrm{KJ{\cdot}mol^{-1}}$		

[a] Values obtained by using the fef from ref 15. [b] Values obtained by using the fef from ref 16.

Table 6. Third-Law Standard Sublimation Enthalpies Associated to the Sublimation of Solid AlI_3 According to Reactions 6 and 7 (See Text)

	reaction 5: $AlI_3(s) \rightarrow AlI_3(g)$					reaction 6: $2AlI_3(s) \rightarrow Al_2I_6(g)$				
T	p_{AlI_3}	Δfef^{a}	$\Delta H°(298\ K)^{a}$	Δfef^{b}	$\Delta H°(298\ K)^{b}$	$p_{Al_2I_6}$	Δfef^{a}	$\Delta H°(298\ K)^{a}$	Δfef^{b}	$\Delta H°(298\ K)^{b}$
K	Pa	$J \cdot K^{-1} \cdot mol^{-1}$	$kJ \cdot mol^{-1}$	$J \cdot K^{-1} \cdot mol^{-1}$	$kJ \cdot mol^{-1}$	Pa	$J \cdot K^{-1} \cdot mol^{-1}$	$kJ \cdot mol^{-1}$	$J \cdot K^{-1} \cdot mol^{-1}$	$kJ \cdot mol^{-1}$
360	0.0323	183.3	110.8	211.0	120.7	0.0603	209.0	118.2	72.7	141.1
420	5.31	182.5	111.0	213.2	124.0	16.2	207.9	117.8	277.6	147.1
			110.9		122.3			118.0		144.1

[a] Values obtained by using the fef from ref 15. [b] Values obtained by using the fef from ref 16.

sublimation enthalpies obtained from the fef of ref 16 and the better agreement with the second-law enthalpy value (91 ± 4) $kJ \cdot mol^{-1}$, although considering the small experimental temperature range this value is less reliable than that obtained from the third-law, lead one to propose as the more reliable value of the standard sublimation enthalpy of $AlBr_3$ 90 $kJ \cdot mol^{-1}$, with an overestimated uncertainty of 4 $kJ \cdot mol^{-1}$.

AlI*$_3$*. The total vapor pressures of solid AlI_3 are reported in Table 5 and Figure 3. By least-squares treatment of the data measured in each run, the temperature dependence of the total vapor pressures was represented as a log p versus $1/T$ equation. The obtained equations are reported in Table 2. Weighting slopes and intercepts of these equations proportionally to the experimental points, an equation representative of the total vapor pressure of solid AlI_3 in the temperature range (359.5 to 419.5) K was selected

$$\log(p/\mathrm{Pa}) = (15.52 \pm 0.30) - (5960 \pm 150)/(T/\mathrm{K}) \tag{3}$$

where the associated uncertainties have been estimated.

Considering that in the vapor above the solid phase both monomeric and dimeric forms are present, the temperature dependence of their partial pressures was derived from eq 3 and from the temperature dependence of the constant of the dimer−monomer equilibrium, $\log[(p^2_{AlI_3}/p_{Al_2I_3})/\mathrm{Pa}] = 5045 - 12.253/(T/\mathrm{K})$, the equation obtained from that reported by Fischer et al.[1] above the molten compound and the heat of fusion (15.9 $kJ \cdot mol^{-1}$) selected by ref 15. The temperature dependence of the partial pressures of $AlI_3(g)$ and $Al_2I_6(g)$ is expressed by the equations

$$\log(P_{AlI_3}p/\mathrm{Pa}) = 14.02 - 5582/(T/\mathrm{K}) \tag{4}$$

$$\log(P_{Al_2I_6}p/\mathrm{Pa}) = 15.78 - 6119/(T/\mathrm{K}) \tag{5}$$

The uncertainties associated with the slopes and intercepts of these equations are difficult to evaluate but can be considered comparable with those estimated in eq 3. In Figure 4, these equations are drawn for comparison with those reported by Fischer et al.[1] above the liquid phase. The second-law enthalpies of solid AlI_3 according to the processes

$$AlI_3(s) \rightarrow AlI_3(g) \tag{6}$$

$$2AlI_3(s) \rightarrow Al_2I_6(g) \tag{7}$$

were calculated at the average experimental temperature, $\Delta_{sub}H°(389.5\ K) = 107\ kJ \cdot mol^{-1}$ and $117\ kJ \cdot mol^{-1}$ for reactions, 7 respectively. These values are corrected to 298 K by using the enthalpic increments for solid and gaseous aluminum iodides selected by ref 15, $\Delta_{sub}H°(298\ K) = 109\ kJ \cdot mol^{-1}$ and $120\ kJ \cdot mol^{-1}$ for reactions 6 and 7, respectively, with an uncertainty that should not exceed 6 $kJ \cdot mol^{-1}$ for both reactions. These standard enthalpies were also calculated by third-law treatment of the partial pressures of $AlI_3(g)$ and $Al_2I_6(g)$ obtained at the extreme experimental temperatures (360 and 420) K by eqs 4 and 5. The fef necessary for the calculations were taken from ref 15 and 16. The fef of solid AlI_3 are different because of the use of a different standard entropy, $S°(298\ K) = 190\ J \cdot K^{-1} \cdot mol^{-1}$ from ref 15 (taken from JANAF[17]) and 158.9 $J \cdot K^{-1} \cdot mol^{-1}$ by ref 16 (taken from Volgman[18]). The obtained enthalpy values are reported in Table 6. The third-law enthalpies of both sublimation reactions 6 and 7 obtained by using the Δfef from ref 15 are more reliable than those obtained by using the Δfef from ref 16 because of negligible temperature trends and are in better agreement with the second-law results. On this basis, we propose as partial standard sublimation enthalpies of AlI_3 according to reactions 6 and 7 the values 110 $kJ \cdot mol^{-1}$ and 119 $kJ \cdot mol^{-1}$, respectively, with an overestimated uncertainty for both reactions of 4 $kJ \cdot mol^{-1}$, with a recommended standard entropy of solid AlI_3 of 190 $J \cdot K^{-1} \cdot mol^{-1}$ proposed by ref 15.

Literature Cited

(1) Fischer, W.; Rahlfs, O.; Benze, B. Molecular-Weight Determinations by Horstmann's Combination of Vapor Pressure Measurements. II. Vapor Pressures and Vapor Densities of Aluminum Halides. *Z. Anorg. Allg. Chem.* **1932**, *205*, 1–41.

(2) Kelley, K. K. Heat and Free Energies of Vaporization Equations. *U.S. Bur. Mines Bull.* **1962**, 601.

(3) Johnson, J. W.; Silva, W. J.; Cubicciotti, D. The Vapor Pressure and Enthalpy of Vaporization of Molten Aluminum Bromide to the Critical Point. *J. Phys. Chem.* **1968**, *72*, 1669–1672.

(4) Dunne, T. G.; Gregory, N. W. Vapor Pressures of aluminium Chloride, Aluminium Bromide and the Mixed Halide Phase $Al_2Br_2Cl_4$. *J. Am. Chem. Soc.* **1958**, *80*, 1526–1530.

(5) Sulzmann, K. G. P. The vapor Pressure of Solid Aluminum Bromide. *J. Electrochem. Soc.* **1974**, *121*, 1239–1240.

(6) Rusin, A. D.; Niesel'son, L. A. Complex Equilibria in Unsaturated Vapor over $AlBr_3$. *Russ. J. Phys. Chem. A* **2008**, *82*, 1801–1807.

(7) Gregory, N. W. Absorbance of Aluminum Iodide Vapor in the Ultraviolet Region. The Dimer-Monomer Dissociation Equilibrium and the Vapor Pressure of Solid Aluminum Iodide. *J. Phys. Chem.* **1977**, *81*, 1854–1856.

(8) Rusin, A. D. Mutually Consistent thermodynamic properties of aluminium Iodides. *Russ. Vestn. Mosk. Univ., Ser. 2: Khim.* **2000**, *41*, 219–223.

(9) Brunetti, B.; Piacente, V.; Scardala, P. Torsion Vapor Pressures and Sublimation Enthalpies of Aluminum Trifluoride and Aluminum Trichloride. *J. Chem. Eng. Data* **2009**, *54*, 940–944.

(10) Brunetti, B.; Piacente, V.; Scardala, P. A Study on the Sublimation of Gallium Tribromide. *J. Chem. Eng. Data*, accepted for publication.

(11) Brunetti, B.; Piacente, V.; Scardala, P. Vapor Pressures of Gallium Trifluoride, Trichloride, and Triiodide and their Standard Sublimation Enthalpies. *J. Chem. Eng. Data*, submitted for publication.

(12) Brunetti, B.; Piacente, V.; Scardala, P. Torsion Vapor Pressures and Sublimation Enthalpies of Arsenic Triselenide and Tritelluride. *J. Chem. Eng. Data* **2007**, *52*, 24–29.

(13) Monte, M. J. S.; Santos, L. M. N. B. F.; Fulem, M.; Fonseca, J. M. S.; Sousa, C. A. D. New Static Apparatus and Vapor Pressure of Reference Materials: Naphthalene, Benzoic Acid, Benzophenone, and Ferrocene. *J. Chem. Eng. Data* **2006**, *51*, 757–766.

(14) Emel'yanenko, V. N.; Kabo, G. J.; Verevkin, S. P. Measurement and Prediction of Thermochemical Properties: Improved Increments for the Estimation of Enthalpies of Sublimation and Standard Enthalpies of Formation of Alkyl Derivatives of Urea. *J. Chem. Eng. Data* **2006**, *51*, 79–87.

(15) Gurvich, L. V.; Yungman, V. S. *IVTANTHERMO Database of Thermodynamic Properties of Individual Substances and Thermody-*

namic Modeling Software, Version 3.0; Glushko Thermocenter of the Russian Academy of Sciences: Moscow, 2005.

(16) Pankratz, L. B. *Thermodynamic Properties of Halides*; Bull U. S. Dept. Int., Bureau of Mines 674: Washington, D.C., 1984.

(17) JANAF Thermochemical Tables, 3rd ed.; Chase, M. W., et al., Eds.; *J. Phys. Ref. Data* 1985; Vol. 14, Suppl. 1.

(18) Wagman, D. D.; Evans, W. H.; Parcher, V. B.; Halow, I.; Barley, S. M.; Schum, R. H. *Selected Values of Chemical Thermodynamic properties*; American Chemical Society and the American Institute of Physics for the National Bureau of Standards Tech. Note 270-4: New York, Washington, D.C., 1969; p 49.

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