Sn – V (Tin – Vanadium)

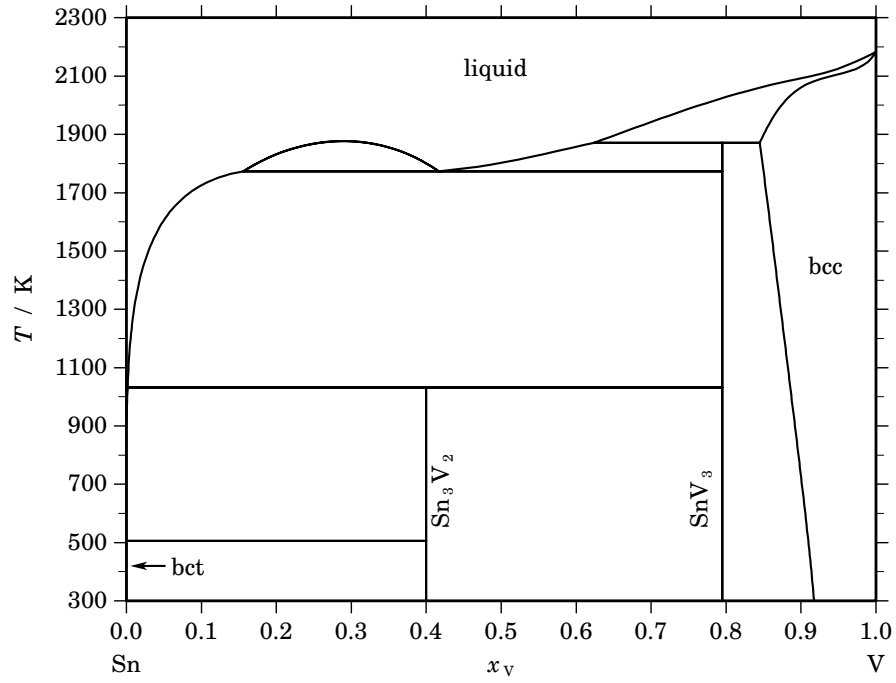

Fig. 1. Calculated phase diagram for the system Sn-V.

The literature on the Sn-V system has been reviewed in [1989Smi, 2002Stu] and a thermodynamic dataset has been optimised by [2002Stu] using the element data recommended by SGTE. In the assessment the selected data for the phase diagram have been taken from the literature [1969Dar, 1973Mar, 1979Gon] as well as from new experiments done by the assessors [2002Stu]. The heat capacity of SnV_3 has been adjusted to the experimental data of [1975Kna]. The partial enthalphy of solution of V in the melt at 1783 K from 0-67 at.% V has been determined by Esin *et al.* [1977Esi] and it has been used in the optimisation of the liquid. However, in a more recent calorimetric investigation of liquid Sn-V alloys [2000Bou] a much higher value of the partial enthalpy of V in the limit of pure Sn has been reported than by [1977Esi]. The dataset should not be used at too high temperatures because an artificial inverse miscibility gap opens in the liquid above 3300 K.

Table I. Phases, structures and models.

Phase	Struktur-bericht	Prototype	Pearson symbol	Space group	SGTE name	Model
liquid					LIQUID	$(Sn,V)_1$
bct	$A5$	βSn	$tI4$	$I4_1/amd$	BCT_A5	Sn_1
Sn_3V_2	C_b	$CuMg_2$	$oF48$	$Fddd$	SN3V2	Sn_3V_2
SnV_3	$A15$	Cr_3Si	$cP8$	$Pm\overline{3}n$	SNV3	$Sn_{41}V_{159}$
bcc	$A2$	W	$cI2$	$Im\overline{3}m$	BCC_A2	$(Sn,V)_1$

Table II. Invariant reactions.

Reaction	Type	T / K	Compositions / x_{V}			$\Delta_{\mathrm{r}}H$ / (J/mol)
liquid $\rightleftharpoons$ liquid′ + liquid″	critical	1874.5	0.290	0.290	0.290	0
liquid″ + bcc $\rightleftharpoons$ SnV_3	peritectic	1871.3	0.624	0.845	0.795	−10090
liquid″ $\rightleftharpoons$ liquid′ + SnV_3	monotectic	1773.4	0.417	0.156	0.795	−10786
liquid′ + SnV_3 $\rightleftharpoons$ Sn_3V_2	peritectic	1032.2	0.002	0.795	0.400	−21282
liquid′ $\rightleftharpoons$ bct + Sn_3V_2	eutectic	505.1	0.000	0.000	0.400	−7029

Table IIIa. Integral quantities for the liquid phase at 2200 K.

x_{V}	ΔG_{m} [J/mol]	ΔH_{m} [J/mol]	ΔS_{m} [J/(mol·K)]	$G^{\mathrm{E}}_{\mathrm{m}}$ [J/mol]	$S^{\mathrm{E}}_{\mathrm{m}}$ [J/(mol·K)]	ΔC_P [J/(mol·K)]
0.000	0	0	0.000	0	0.000	0.000
0.100	−2953	1611	2.075	2994	−0.628	0.000
0.200	−4073	1409	2.492	5080	−1.669	0.000
0.300	−4835	−71	2.165	6339	−2.914	0.000
0.400	−5456	−2290	1.439	6855	−4.157	0.000
0.500	−5958	−4701	0.571	6721	−5.192	0.000
0.600	−6275	−6749	−0.215	6036	−5.811	0.000
0.700	−6268	−7873	−0.729	4905	−5.808	0.000
0.800	−5711	−7507	−0.816	3442	−4.977	0.000
0.900	−4181	−5076	−0.407	1765	−3.110	0.000
1.000	0	0	0.000	0	0.000	0.000

Reference states: Sn(liquid), V(liquid)

Table IIIb. Partial quantities for Sn in the liquid phase at 2200 K.

x_{Sn}	ΔG_{Sn} [J/mol]	ΔH_{Sn} [J/mol]	ΔS_{Sn} [J/(mol·K)]	$G^{\mathrm{E}}_{\mathrm{Sn}}$ [J/mol]	$S^{\mathrm{E}}_{\mathrm{Sn}}$ [J/(mol·K)]	a_{Sn}	γ_{Sn}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	−1461	995	1.116	466	0.240	0.923	1.026
0.800	−2319	3271	2.541	1762	0.686	0.881	1.101
0.700	−2803	5750	3.888	3721	0.922	0.858	1.226
0.600	−3190	7336	4.784	6154	0.537	0.840	1.400
0.500	−3825	6909	4.879	8854	−0.884	0.811	1.623
0.400	−5169	3332	3.864	11592	−3.754	0.754	1.885
0.300	−7904	−4553	1.523	14119	−8.487	0.649	2.164
0.200	−13272	−17925	−2.115	16167	−15.497	0.484	2.420
0.100	−24671	−37982	−6.051	17448	−25.196	0.260	2.596
0.000	$-\infty$	−65944	∞	17652	−37.998	0.000	2.625

Reference state: Sn(liquid)

Table IIIc. Partial quantities for V in the liquid phase at 2200 K.

x_V	ΔG_V [J/mol]	ΔH_V [J/mol]	ΔS_V [J/(mol·K)]	G_V^E [J/mol]	S_V^E [J/(mol·K)]	a_V	γ_V
0.000	$-\infty$	26937	∞	34716	−3.536	0.000	6.672
0.100	−16378	7158	10.698	25741	−8.447	0.408	4.085
0.200	−11088	−6036	2.296	18352	−11.085	0.545	2.727
0.300	−9576	−13655	−1.854	12447	−11.865	0.592	1.975
0.400	−8855	−16730	−3.580	7906	−11.198	0.616	1.541
0.500	−8091	−16311	−3.736	4588	−9.500	0.643	1.285
0.600	−7012	−13470	−2.935	2332	−7.183	0.682	1.136
0.700	−5568	−9296	−1.695	957	−4.661	0.738	1.054
0.800	−3821	−4903	−0.492	261	−2.347	0.811	1.014
0.900	−1905	−1420	0.220	22	−0.656	0.901	1.001
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: V(liquid)

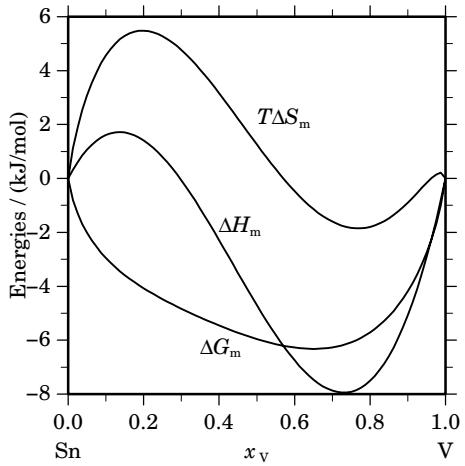

Fig. 2. Integral quantities of the liquid phase at T=2200 K.

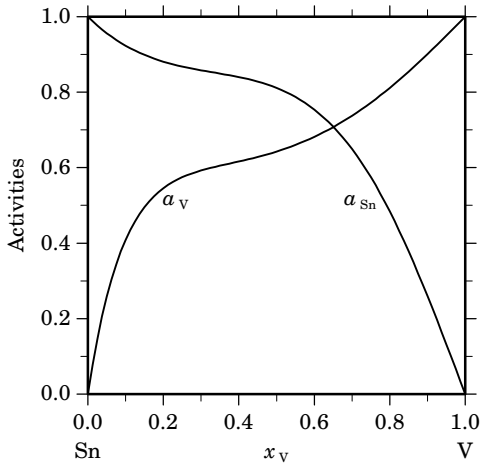

Fig. 3. Activities in the liquid phase at T=2200 K.

Table IV. Standard reaction quantities at 298.15 K for the compounds per mole of atoms.

Compound	x_V	$\Delta_f G^\circ$ / (J/mol)	$\Delta_f H^\circ$ / (J/mol)	$\Delta_f S^\circ$ / (J/(mol·K))	$\Delta_f C_P^\circ$ / (J/(mol·K))
Sn_3V_2	0.400	−21588	−26353	−15.984	0.000
SnV_3	0.795	−15538	−16710	−3.932	−0.504

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