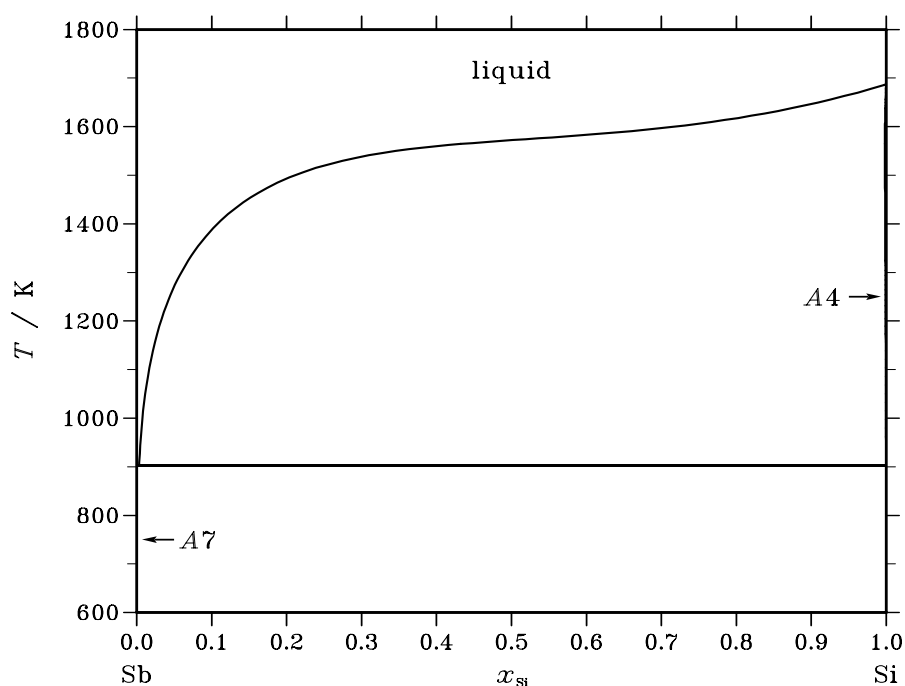


Sb – Si (Antimony – Silicon)**Fig. 1.** Calculated phase diagram for the system Sb-Si.

The Sb-Si system is characterised by complete mixing of the components in the liquid phase and very low solubility in both the diamond form of Si and the rhombohedral form of Sb. The shape of the liquidus surface indicates positive enthalpies of mixing and the likelihood of a metastable miscibility gap. While this system seems to have no particular technological importance in its own right, an understanding of the phase diagram and thermodynamic properties are important in order to model possible interactions between Sb containing solders and electronic components.

The data adopted by SGTE is from the critical assessment by Olesinski and Abbaschian [85Ole]. This assessment is in good agreement with the rather small number of measurements of the liquidus curve. The system has also been analysed from a thermodynamic perspective by Thurmond [53Thu] and Thurmond and Kowalchik [60Thu].

Table I. Phases, structures and models.

Phase	Strukturbericht	Prototype	Pearson symbol	Space group	SGTE name	Model
liquid					LIQUID	(Sb,Si) ₁
A7	A7	α As	<i>hR</i> 2	$R\bar{3}m$	RHOMBOHEDRAL_A7	Sb ₁
A4	A4	C(diamond)	<i>cF</i> 8	$Fd\bar{3}m$	DIAMOND_A4	Si ₁

Table II. Invariant reactions.

Reaction	Type	T / K	Compositions / x_{Si}			$\Delta_r H / (J/mol)$
liquid \rightleftharpoons A7 + A4	eutectic	902.7	0.003	0.000	1.000	–20022

Table IIIa. Integral quantities for the liquid phase at 1700 K.

x_{Si}	ΔG_{m} [J/mol]	ΔH_{m} [J/mol]	ΔS_{m} [J/(mol·K)]	G_{m}^{E} [J/mol]	S_{m}^{E} [J/(mol·K)]	ΔC_P [J/(mol·K)]
0.000	0	0	0.000	0	0.000	0.000
0.100	−2530	1467	2.351	2065	−0.352	0.000
0.200	−3402	2608	3.535	3671	−0.626	0.000
0.300	−3816	3422	4.258	4818	−0.821	0.000
0.400	−4006	3911	4.657	5507	−0.938	0.000
0.500	−4061	4074	4.786	5736	−0.978	0.000
0.600	−4006	3911	4.657	5507	−0.938	0.000
0.700	−3816	3422	4.258	4818	−0.821	0.000
0.800	−3402	2608	3.535	3671	−0.626	0.000
0.900	−2530	1467	2.351	2065	−0.352	0.000
1.000	0	0	0.000	0	0.000	0.000

Reference states: Sb(liquid), Si(liquid)

Table IIIb. Partial quantities for Sb in the liquid phase at 1700 K.

x_{Sb}	ΔG_{Sb} [J/mol]	ΔH_{Sb} [J/mol]	ΔS_{Sb} [J/(mol·K)]	G_{Sb}^{E} [J/mol]	S_{Sb}^{E} [J/(mol·K)]	a_{Sb}	γ_{Sb}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	−1260	163	0.837	229	−0.039	0.915	1.016
0.800	−2236	652	1.699	918	−0.156	0.854	1.067
0.700	−2977	1467	2.614	2065	−0.352	0.810	1.157
0.600	−3549	2608	3.622	3671	−0.626	0.778	1.297
0.500	−4061	4074	4.786	5736	−0.978	0.750	1.501
0.400	−4692	5867	6.211	8260	−1.408	0.718	1.794
0.300	−5775	7986	8.095	11243	−1.916	0.665	2.215
0.200	−8065	10430	10.879	14684	−2.502	0.565	2.826
0.100	−13962	13201	15.978	18585	−3.167	0.372	3.724
0.000	−∞	16297	∞	22944	−3.910	0.000	5.069

Reference state: Sb(liquid)

Table IIIc. Partial quantities for Si in the liquid phase at 1700 K.

x_{Si}	ΔG_{Si} [J/mol]	ΔH_{Si} [J/mol]	ΔS_{Si} [J/(mol·K)]	G_{Si}^{E} [J/mol]	S_{Si}^{E} [J/(mol·K)]	a_{Si}	γ_{Si}
0.000	−∞	16297	∞	22944	−3.910	0.000	5.069
0.100	−13962	13201	15.978	18585	−3.167	0.372	3.724
0.200	−8065	10430	10.879	14684	−2.502	0.565	2.826
0.300	−5775	7986	8.095	11243	−1.916	0.665	2.215
0.400	−4692	5867	6.211	8260	−1.408	0.718	1.794
0.500	−4061	4074	4.786	5736	−0.978	0.750	1.501
0.600	−3549	2608	3.622	3671	−0.626	0.778	1.297
0.700	−2977	1467	2.614	2065	−0.352	0.810	1.157
0.800	−2236	652	1.699	918	−0.156	0.854	1.067
0.900	−1260	163	0.837	229	−0.039	0.915	1.016
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Si(liquid)

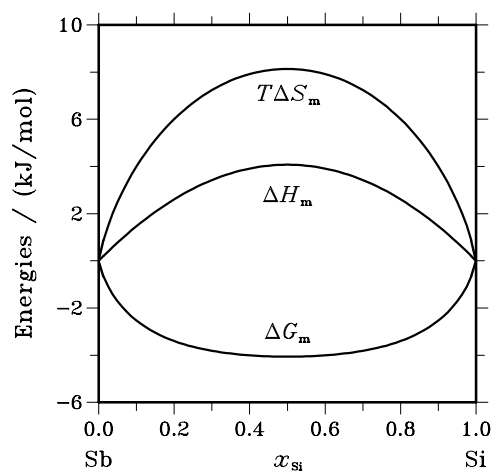


Fig. 2. Integral quantities of the liquid phase at $T=1700$ K.

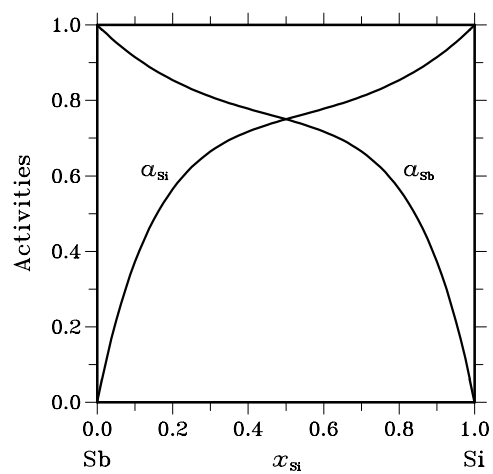


Fig. 3. Activities in the liquid phase at $T=1700$ K.

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