Al – Sn (Aluminium – Tin)

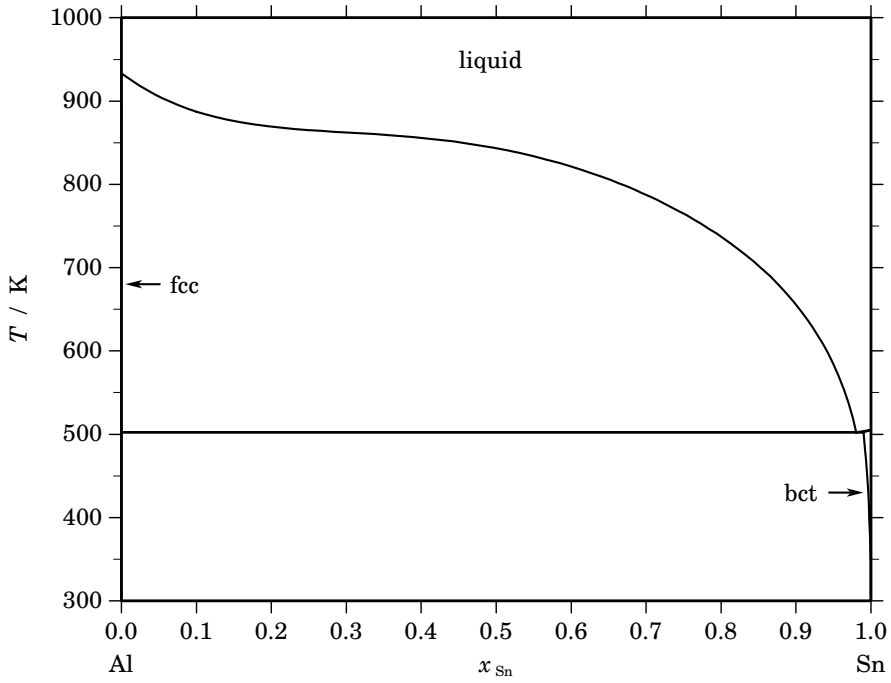

Fig. 1. Calculated phase diagram for the system Al-Sn.

The Al-Sn is a simple eutectic system with the eutectic point close to the tin side. The mutual solubility in the solid metals is quite low. An optimised dataset for the Al-Sn system has been reported by [1998Fri] which has been corrected recently [2003Luk]. A review of the system has been given in [1983McA]. Since then no additional experimental investigations on the thermodynamics of Al-Sn have been reported. The liquidus has been measured across the whole composition range in several investigations using various techniques [1906Gwy, 1949Sul, 1964Bon]. The mixing enthalpy in the liquid has been determined at different temperatures [1930Kaw, 1958Oel, 1963Wit] and measurements of the activities of Al in the liquid are reported in [1964Bon, 1966Tik, 1968Bat, 1969Lee]. The solubility of Sn in fcc-Al has been determined by [1976Dor].

Table I. Phases, structures and models.

Phase	Struktur-bericht	Prototype	Pearson symbol	Space group	SGTE name	Model
liquid					LIQUID	$(Al,Sn)_1$
fcc	$A1$	Cu	$cF4$	$Fm\overline{3}m$	FCC_A1	$(Al,Sn)_1$
bct	$A5$	βSn	$tI4$	$I4_1/amd$	BCT_A5	$(Al,Sn)_1$

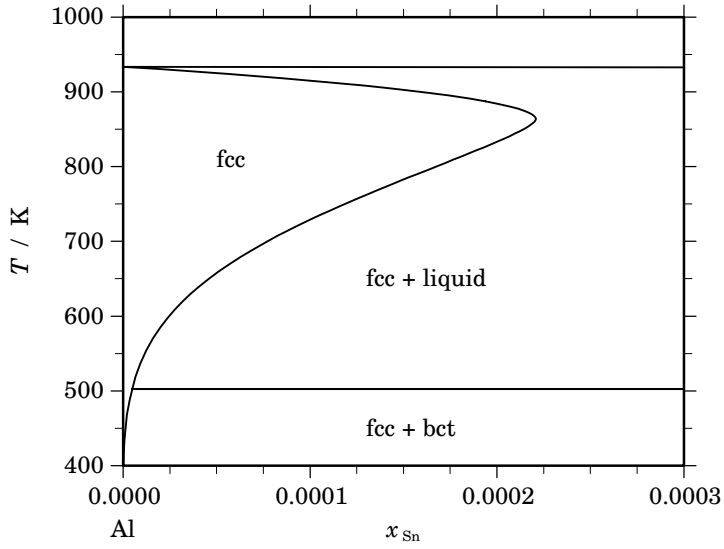

Fig. 2. Partial phase diagram for the system Al-Sn.

Table II. Invariant reactions.

Reaction	Type	T / K	Compositions / x_{Sn}			$\Delta_{\mathrm{r}}H$ / (J/mol)
liquid $\rightleftharpoons$ fcc + bct	eutectic	502.4	0.980	0.000	0.990	−7139

Table IIIa. Integral quantities for the liquid phase at 973 K.

x_{Sn}	ΔG_{m} [J/mol]	ΔH_{m} [J/mol]	ΔS_{m} [J/(mol·K)]	$G_{\mathrm{m}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{m}}^{\mathrm{E}}$ [J/(mol·K)]	ΔC_P [J/(mol·K)]
0.000	0	0	0.000	0	0.000	0.000
0.100	−1312	1867	3.267	1318	0.564	0.000
0.200	−1855	3109	5.101	2194	0.941	0.000
0.300	−2239	3834	6.241	2703	1.162	0.000
0.400	−2534	4133	6.852	2911	1.257	0.000
0.500	−2737	4082	7.009	2870	1.246	0.000
0.600	−2821	3739	6.742	2624	1.146	0.000
0.700	−2742	3143	6.048	2200	0.969	0.000
0.800	−2429	2320	4.880	1619	0.720	0.000
0.900	−1742	1275	3.102	887	0.399	0.000
1.000	0	0	0.000	0	0.000	0.000

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

Table IIIb. Partial quantities for Al in the liquid phase at 973 K.

x_{Al}	ΔG_{Al} [J/mol]	ΔH_{Al} [J/mol]	ΔS_{Al} [J/(mol·K)]	G^E_{Al} [J/mol]	S^E_{Al} [J/(mol·K)]	a_{Al}	γ_{Al}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	−617	332	0.976	235	0.100	0.927	1.029
0.800	−973	1176	2.208	833	0.353	0.887	1.108
0.700	−1229	2339	3.667	1657	0.701	0.859	1.227
0.600	−1525	3681	5.350	2608	1.103	0.828	1.380
0.500	−1989	5110	7.297	3618	1.534	0.782	1.564
0.400	−2755	6589	9.603	4658	1.985	0.711	1.778
0.300	−4010	8128	12.475	5730	2.465	0.609	2.030
0.200	−6148	9789	16.379	6872	2.998	0.468	2.338
0.100	−10469	11686	22.770	8159	3.625	0.274	2.741
0.000	−∞	13983	∞	9697	4.406	0.000	3.315

Reference state: Al(liquid)

Table IIIc. Partial quantities for Sn in the liquid phase at 973 K.

x_{Sn}	ΔG_{Sn} [J/mol]	ΔH_{Sn} [J/mol]	ΔS_{Sn} [J/(mol·K)]	G^E_{Sn} [J/mol]	S^E_{Sn} [J/(mol·K)]	a_{Sn}	γ_{Sn}
0.000	−∞	22207	∞	15680	6.708	0.000	6.946
0.100	−7561	15683	23.889	11067	4.745	0.393	3.927
0.200	−5382	10842	16.674	7638	3.292	0.514	2.571
0.300	−4597	7322	12.249	5143	2.239	0.567	1.888
0.400	−4047	4813	9.106	3365	1.487	0.606	1.516
0.500	−3485	3054	6.721	2122	0.958	0.650	1.300
0.600	−2865	1839	4.834	1267	0.587	0.702	1.170
0.700	−2198	1007	3.294	688	0.328	0.762	1.089
0.800	−1499	452	2.006	306	0.150	0.831	1.039
0.900	−773	119	0.916	80	0.040	0.909	1.010
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Sn(liquid)

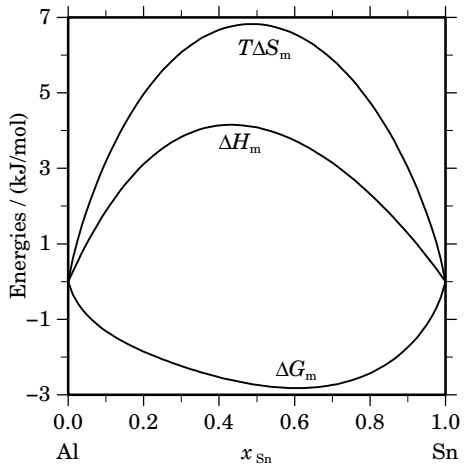

Fig. 3. Integral quantities of the liquid phase at T=973 K.

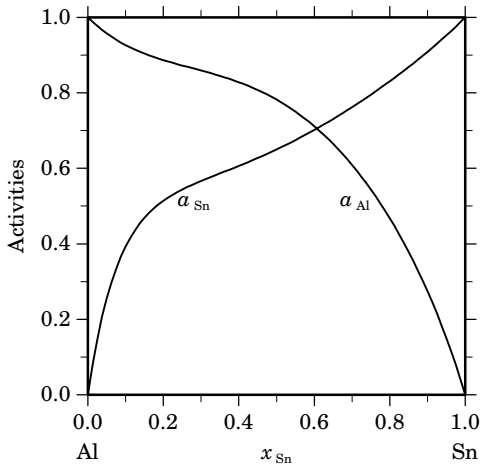

Fig. 4. Activities in the liquid phase at T=973 K.

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