Pb – Si (Lead – Silicon)

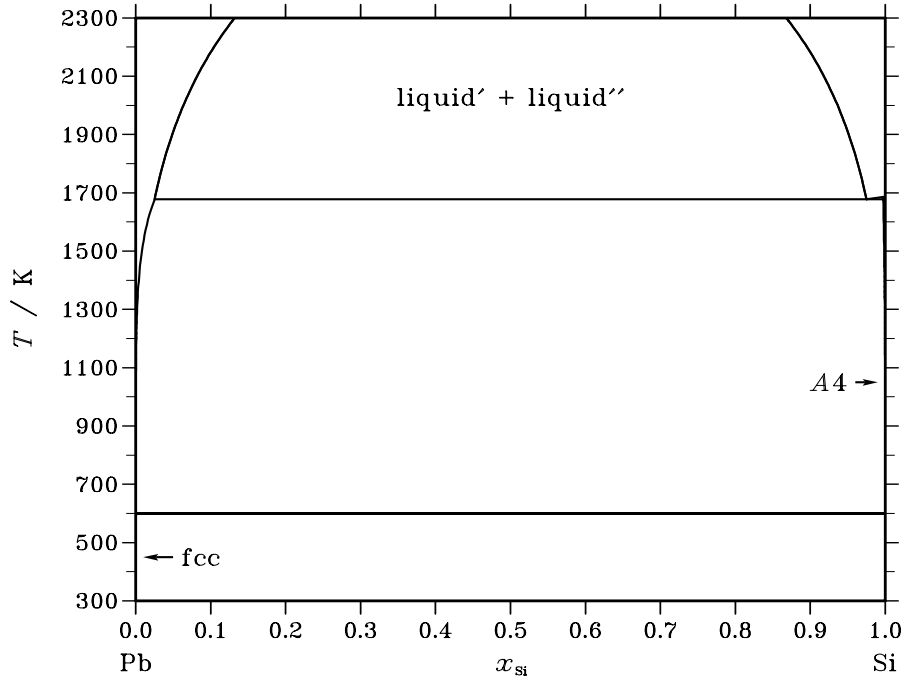

Fig. 1. Calculated phase diagram for the system Pb-Si.

There have been few investigations of either the phase diagram or thermodynamic properties of the Pb-Si system. The phase diagram is dominated by a miscibility gap in the liquid phase which extends up to high temperatures, probably in excess of 2300 K. Experimental measurements, however, have been carried out only over a limited temperature range. At low temperatures e.g. in the region of the melting point of Pb, the solubility of Si in the liquid has been estimated to be $4 \cdot 10^{-4}$ at.%. There appears to be negligible solubility within the terminal solid solutions, the diamond structure of crystalline Si and fcc Pb.
The critically assessed data for this system were taken from the analysis of Olesinski and Abbaschian [84Ole]. Other analyses of the data have been carried out by Thurmond and Kowalchik [60Thu], Girault [77Gir] and Stringfellow and Greene [70Str].

Table I. Phases, structures and models.

Phase	Struktur-bericht	Prototype	Pearson symbol	Space group	SGTE name	Model
liquid					LIQUID	$(Pb,Si)_1$
fcc	$A1$	Cu	$cF4$	$Fm\overline{3}m$	FCC_A1	$(Pb,Si)_1$
$A4$	$A4$	C(diamond)	$cF8$	$Fd\overline{3}m$	DIAMOND_A4	Si_1

Table II. Invariant reactions.

Reaction	Type	T / K	Compositions / x_{Si}			$\Delta_r H$ / (J/mol)
liquid″ $\rightleftharpoons$ liquid′ + $A4$	monotectic	1677.4	0.975	0.025	0.997	−50352
liquid′ $\rightleftharpoons$ fcc + $A4$	degenerate	600.6	0.000	0.000	1.000	−4774

Table IIIa. Integral quantities for the liquid phase at 1800 K.

x_{Si}	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
0.037	−489	2357	1.581	1867	0.272	0.000
0.963	−489	2357	1.581	1867	0.272	0.000
1.000	0	0	0.000	0	0.000	0.000

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

Table IIIb. Partial quantities for Pb in the liquid phase at 1800 K.

x_{Pb}	ΔG_{Pb} [J/mol]	ΔH_{Pb} [J/mol]	ΔS_{Pb} [J/(mol·K)]	$G_{\mathrm{Pb}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Pb}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Pb}	γ_{Pb}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.963	−489	90	0.321	71	0.010	0.968	1.005
0.037	−489	61827	34.620	48966	7.145	0.968	26.358
0.000	$-\infty$	66630	∞	52770	7.700	0.000	33.986

Reference state: Pb(liquid)

Table IIIc. Partial quantities for Si in the liquid phase at 1800 K.

x_{Si}	ΔG_{Si} [J/mol]	ΔH_{Si} [J/mol]	ΔS_{Si} [J/(mol·K)]	$G_{\mathrm{Si}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Si}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Si}	γ_{Si}
0.000	$-\infty$	66630	∞	52770	7.700	0.000	33.986
0.037	−489	61827	34.620	48966	7.145	0.968	26.358
0.963	−489	90	0.321	71	0.010	0.968	1.005
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Si(liquid)

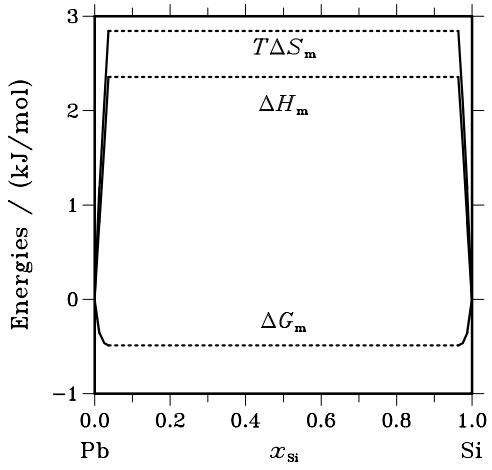

Fig. 2. Integral quantities of the liquid phase at T=1800 K.

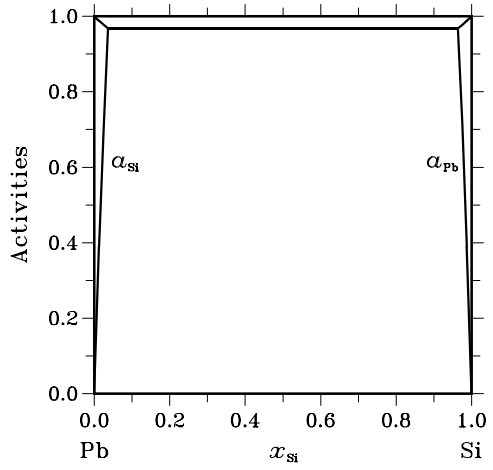

Fig. 3. Activities in the liquid phase at T=1800 K.

References

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