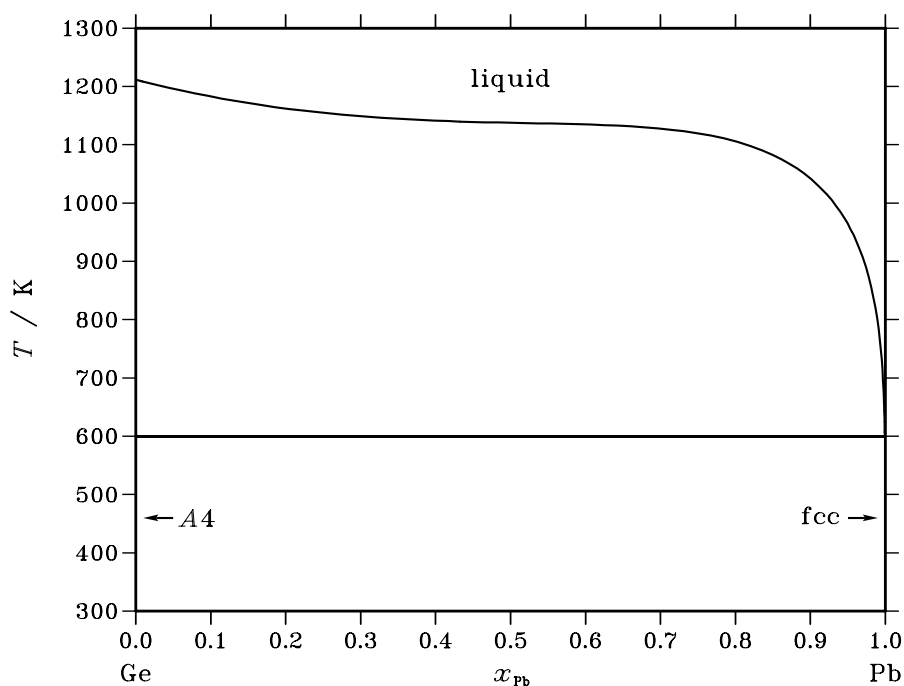


**Ge – Pb (Germanium – Lead)****Fig. 1.** Calculated phase diagram for the system Ge-Pb.

The Ge-Pb system has been reviewed in [84Ole] and a thermodynamic assessment has been given by Chevalier [89Che] which has been updated later [03Che]. The phase diagram is rather simple and of eutectic type, deported on the Pb rich side, with complete mutual solubility in the liquid state, a very limited solid solubility of Pb in solid Ge [56Thu, 60Thu, 60Tru] and an unknown but negligible solubility of Ge in solid lead. There is no compound in the system and the solution phases are described by substitutional models. The liquidus has been investigated by thermal analysis [30Bri, 40Rut]. Investigations of the solubility of Pb in solid germanium are reported in [56Thu, 60Thu, 60Tru]. Ge can dissolve about  $10^{-3}$  at.% of Pb at 1173 K. The enthalpy of mixing of liquid alloys has been measured by direct high temperature calorimetry [71Pre, 78Mec]. Further experimental work would be necessary to assess the variation of activity with temperature, which is important for extrapolation of data at high temperatures.

**Table I.** Phases, structures and models.

Phase	Strukturbericht	Prototype	Pearson symbol	Space group	SGTE name	Model
liquid					LIQUID	(Ge,Pb) <sub>1</sub>
A4	A4	C(diamond)	<i>cF</i> 8	<i>Fd</i> $\bar{3}$ <i>m</i>	DIAMOND_A4	(Ge,Pb) <sub>1</sub>
fcc	A1	Cu	<i>cF</i> 4	<i>Fm</i> $\bar{3}$ <i>m</i>	FCC_A1	(Ge,Pb) <sub>1</sub>

**Table II.** Invariant reactions.

Reaction	Type	<i>T</i> / K	Compositions / <i>x</i> <sub>Pb</sub>			$\Delta_r H$ / (J/mol)
liquid $\rightleftharpoons$ A4 + fcc	eutectic	600.2	0.999	0.000	1.000	−4808

**Table IIIa.** Integral quantities for the liquid phase at 1273 K.

$x_{\text{Pb}}$	$\Delta G_{\text{m}}$ [J/mol]	$\Delta H_{\text{m}}$ [J/mol]	$\Delta S_{\text{m}}$ [J/(mol·K)]	$G_{\text{m}}^{\text{E}}$ [J/mol]	$S_{\text{m}}^{\text{E}}$ [J/(mol·K)]	$\Delta C_P$ [J/(mol·K)]
0.000	0	0	0.000	0	0.000	0.000
0.100	−1848	1319	2.488	1593	−0.215	0.000
0.200	−2440	2370	3.779	2856	−0.382	0.000
0.300	−2684	3144	4.578	3782	−0.501	0.000
0.400	−2764	3630	5.023	4360	−0.573	0.000
0.500	−2756	3821	5.166	4581	−0.597	0.000
0.600	−2688	3706	5.023	4435	−0.573	0.000
0.700	−2552	3275	4.578	3913	−0.501	0.000
0.800	−2290	2521	3.779	3007	−0.382	0.000
0.900	−1735	1432	2.488	1705	−0.215	0.000
1.000	0	0	0.000	0	0.000	0.000

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

**Table IIIb.** Partial quantities for Ge in the liquid phase at 1273 K.

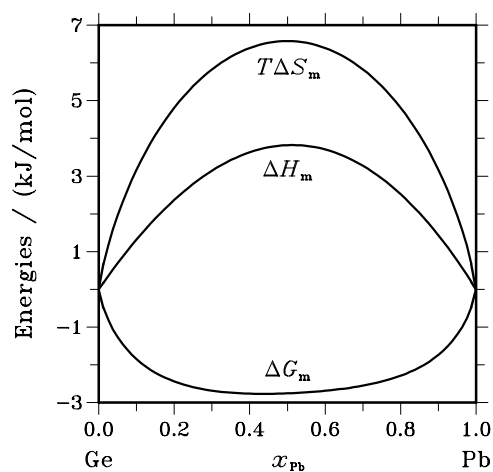
$x_{\text{Ge}}$	$\Delta G_{\text{Ge}}$ [J/mol]	$\Delta H_{\text{Ge}}$ [J/mol]	$\Delta S_{\text{Ge}}$ [J/(mol·K)]	$G_{\text{Ge}}^{\text{E}}$ [J/mol]	$S_{\text{Ge}}^{\text{E}}$ [J/(mol·K)]	$a_{\text{Ge}}$	$\gamma_{\text{Ge}}$
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	−952	132	0.852	163	−0.024	0.914	1.015
0.800	−1698	542	1.760	664	−0.095	0.852	1.065
0.700	−2253	1249	2.751	1522	−0.215	0.808	1.155
0.600	−2651	2270	3.865	2756	−0.382	0.778	1.297
0.500	−2952	3625	5.166	4385	−0.597	0.757	1.513
0.400	−3272	5333	6.759	6427	−0.859	0.734	1.835
0.300	−3842	7412	8.841	8901	−1.170	0.696	2.319
0.200	−5208	9882	11.854	11827	−1.528	0.611	3.057
0.100	−9150	12760	17.211	15222	−1.934	0.421	4.213
0.000	−∞	16067	∞	19106	−2.387	0.000	6.080

Reference state: Ge(liquid)

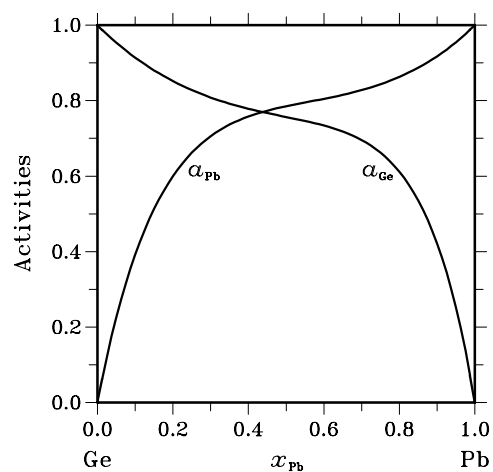
**Table IIIc.** Partial quantities for Pb in the liquid phase at 1273 K.

$x_{\text{Pb}}$	$\Delta G_{\text{Pb}}$ [J/mol]	$\Delta H_{\text{Pb}}$ [J/mol]	$\Delta S_{\text{Pb}}$ [J/(mol·K)]	$G_{\text{Pb}}^{\text{E}}$ [J/mol]	$S_{\text{Pb}}^{\text{E}}$ [J/(mol·K)]	$a_{\text{Pb}}$	$\gamma_{\text{Pb}}$
0.000	−∞	14500	∞	17539	−2.387	0.000	5.244
0.100	−9911	11999	17.211	14460	−1.934	0.392	3.920
0.200	−5409	9681	11.854	11626	−1.528	0.600	2.999
0.300	−3689	7566	8.841	9055	−1.170	0.706	2.352
0.400	−2933	5671	6.759	6765	−0.859	0.758	1.895
0.500	−2560	4017	5.166	4776	−0.597	0.785	1.570
0.600	−2300	2621	3.865	3107	−0.382	0.805	1.341
0.700	−1999	1502	2.751	1776	−0.215	0.828	1.183
0.800	−1560	680	1.760	802	−0.095	0.863	1.079
0.900	−912	173	0.852	204	−0.024	0.917	1.019
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Pb(liquid)



**Fig. 2.** Integral quantities of the liquid phase at  $T=1273$  K.



**Fig. 3.** Activities in the liquid phase at  $T=1273$  K.

## References

- [30Bri] T.R. Briggs, W.S. Benedict: J. Phys. Chem. **34** (1930) 173–177.
- [40Rut] K. Ruttewit, G. Masing: Z. Metallkd. **32** (1940) 52–61.
- [56Thu] C.D. Thurmond, F.A. Trumbore, M. Kowalchik: J. Chem. Phys. **25** (1956) 799–800.
- [60Thu] C.D. Thurmond, M. Kowalchik: Bell System Tech. J. **39** (1960) 169–204.
- [60Tru] F.A. Trumbore: Bell System Tech. J. **39** (1960) 205–233.
- [71Pre] B. Predel, D.W. Stein: Z. Metallkd. **62** (1971) 381–386.
- [78Mec] L.A. Mechkovskii, P.P. Zhuk, A.A. Veher: Zh. Fiz. Khim. **52** (1978) 2779–2781; Russ. J. Phys. Chem. **52** (1978) 1602–1603.
- [84Ole] R.W. Olesinski, G.J. Abbaschian: Bull. Alloy Phase Diagrams **5** (1984) 374–377.
- [89Che] P.-Y. Chevalier: Thermochim. Acta **155** (1989) 227–240.
- [03Che] P.-Y. Chevalier, E. Fischer: unpublished work, 2003.