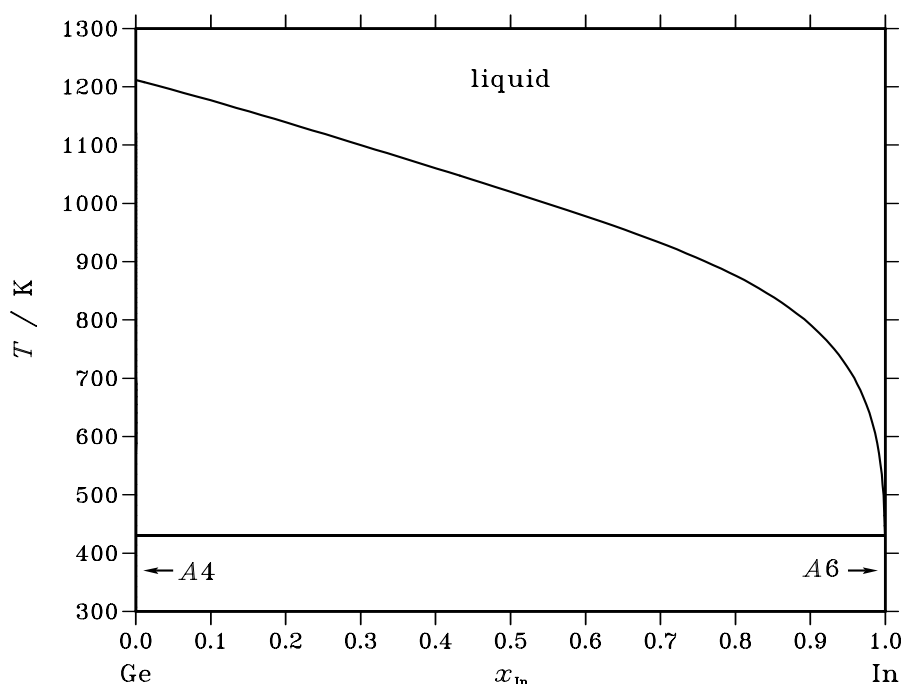


Ge – In (Germanium – Indium)**Fig. 1.** Calculated phase diagram for the system Ge-In.

A thermodynamic assessment for the Ge-In system has been prepared by Chevalier [89Che] and updated in [03Che]. The phase diagram is rather simple and of eutectic type, deported on the In rich side, with complete mutual solubility in the liquid, a very limited solid solubility of indium in solid germanium [56Thu, 59Zhu, 60Tru], and an unknown but negligible solubility of Ge in solid indium. There is no compound in the system and the solution phases were modelled as substitutional solutions. The experimental data for the liquidus are reported in [48Kle, 53Kec, 60Thu]. The solubility of In in crystalline Ge has been measured by [59Zhu, 56Thu, 60Thu, 60Tru]. The eutectic was calculated as: 429.5 K, $x_{\text{In}}^{\text{liq}} = 0.99946$, $x_{\text{In}}^{\text{A4}} = 0.00064$. The mixing behaviour of liquid alloys has been measured by EMF [71Bat] and by calorimetry [70Pre, 76Bat]. The enthalpy of mixing determined by Batalin *et al.* [71Bat, 76Bat] have not been selected because they are less consistent with the phase diagram and they are considerably higher than those of [70Pre]. However, further experimental work would be necessary to assess definitively the liquid enthalpy of mixing, and 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,In) ₁
A4	A4	C(diamond)	<i>cF8</i>	<i>Fd$\bar{3}m$</i>	DIAMOND_A4	(Ge,In) ₁
A6	A6	In	<i>tI2</i>	<i>I4/mmm</i>	TETRAGONAL_A6	In ₁

Table II. Invariant reactions.

Reaction	Type	<i>T</i> / K	Compositions / x_{In}			$\Delta_{\text{r}}H$ / (J/mol)
liquid \rightleftharpoons A4 + A6	eutectic	429.5	0.999	0.001	1.000	–3303

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

x_{In}	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	−3413	101	2.760	28	0.057	0.000
0.200	−5175	198	4.221	121	0.061	0.000
0.300	−6213	285	5.104	252	0.025	0.000
0.400	−6728	353	5.563	395	−0.033	0.000
0.500	−6814	397	5.665	523	−0.099	0.000
0.600	−6515	409	5.439	608	−0.157	0.000
0.700	−5840	382	4.888	626	−0.191	0.000
0.800	−4749	310	3.974	548	−0.187	0.000
0.900	−3093	185	2.575	348	−0.128	0.000
1.000	0	0	0.000	0	0.000	0.000

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

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

x_{Ge}	ΔG_{Ge} [J/mol]	ΔH_{Ge} [J/mol]	ΔS_{Ge} [J/(mol·K)]	G_{Ge}^{E} [J/mol]	S_{Ge}^{E} [J/(mol·K)]	a_{Ge}	γ_{Ge}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	−1152	1	0.906	−37	0.030	0.897	0.997
0.800	−2474	12	1.953	−112	0.098	0.792	0.989
0.700	−3947	49	3.139	−172	0.173	0.689	0.984
0.600	−5570	124	4.473	−163	0.226	0.591	0.985
0.500	−7369	252	5.987	−33	0.224	0.498	0.997
0.400	−9426	446	7.755	273	0.136	0.410	1.026
0.300	−11937	721	9.943	806	−0.067	0.324	1.079
0.200	−15413	1091	12.964	1622	−0.417	0.233	1.166
0.100	−21599	1569	18.199	2773	−0.946	0.130	1.299
0.000	−∞	2169	∞	4312	−1.683	0.000	1.503

Reference state: Ge(liquid)

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

x_{In}	ΔG_{In} [J/mol]	ΔH_{In} [J/mol]	ΔS_{In} [J/(mol·K)]	G_{In}^{E} [J/mol]	S_{In}^{E} [J/(mol·K)]	a_{In}	γ_{In}
0.000	−∞	1007	∞	−132	0.894	0.000	0.988
0.100	−23758	1004	19.452	613	0.307	0.106	1.060
0.200	−15982	942	13.294	1053	−0.088	0.221	1.105
0.300	−11501	835	9.691	1242	−0.320	0.337	1.124
0.400	−8466	697	7.198	1232	−0.420	0.449	1.123
0.500	−6259	542	5.342	1078	−0.421	0.554	1.107
0.600	−4575	384	3.895	832	−0.352	0.649	1.082
0.700	−3227	237	2.721	548	−0.244	0.737	1.053
0.800	−2083	115	1.726	279	−0.129	0.821	1.027
0.900	−1037	31	0.839	79	−0.037	0.907	1.007
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: In(liquid)

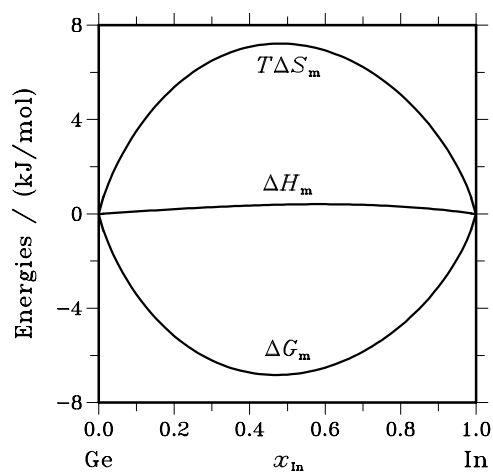


Fig. 2. Integral quantities of the liquid phase at $T=1273$ K.

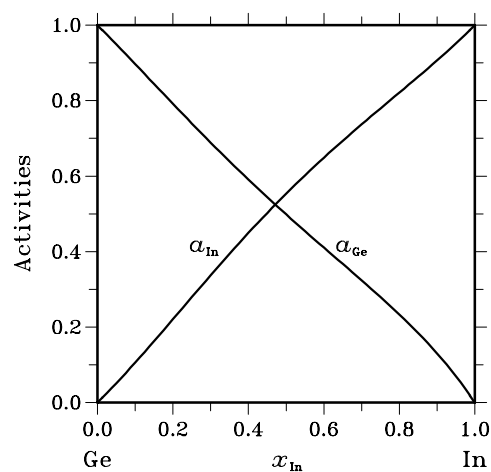


Fig. 3. Activities in the liquid phase at $T=1273$ K.

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