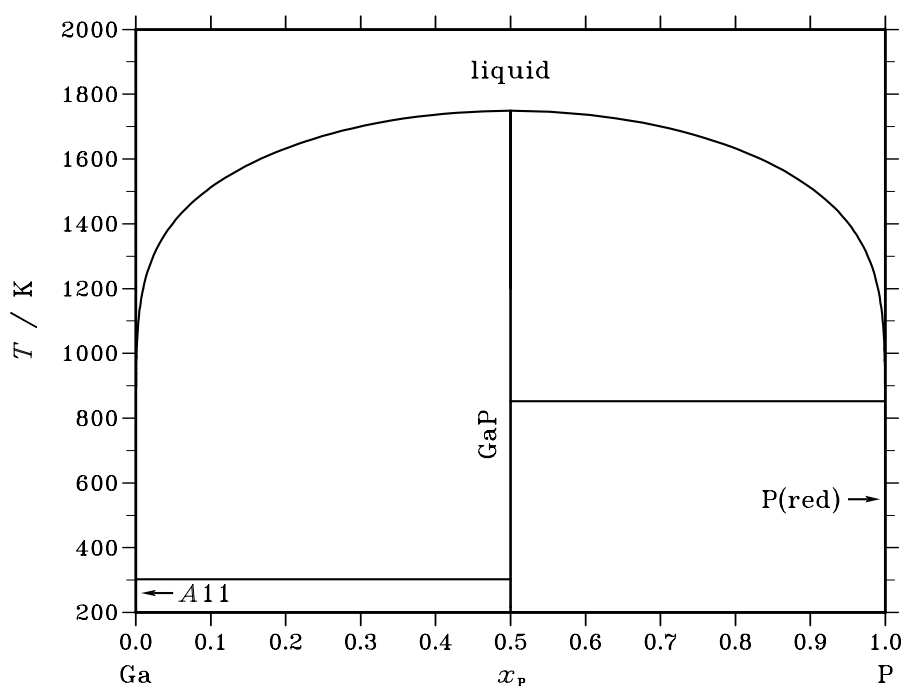


Ga – P (Gallium – Phosphorus)**Fig. 1.** Calculated phase diagram for the system Ga-P (constrained system).

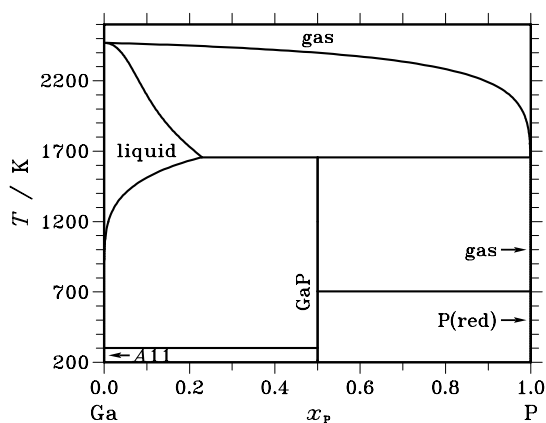
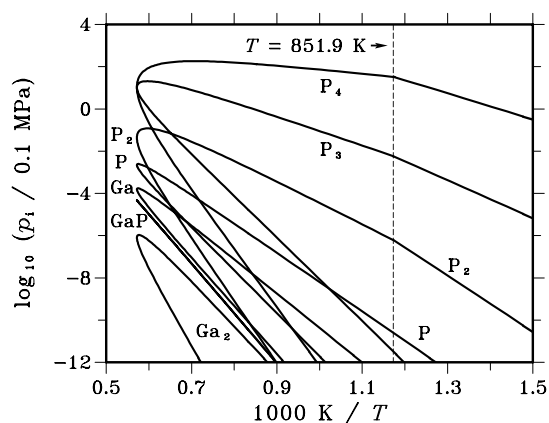
The Ga-P system is part of the III-V semiconductor systems used in optoelectronic and high speed device applications. An understanding of the phase diagram and the thermochemistry of the system is essential to model the process conditions for device fabrication. The phase diagram of the Ga-P system is very simple featuring a near stoichiometric compound GaP which melts congruently at 1749 K, a complete miscibility in the liquid phase and negligible solubility of Ga in solid red P and of P in crystalline Ga. The eutectics on either side are both degenerate and close to the pure elements. The thermodynamic assessment by Ansara *et al.* [94Ans] is based on an extensive literature overview published by Tmar *et al.* [84Tma]. The calculated phase diagram is in good agreement with the experimental data. In the first diagram, the formation of a gas phase is prevented by sufficiently high pressures. The second diagram presents the equilibrium phase diagram under a total pressure of 0.1 MPa. The third diagram presents the course of the partial pressures of the gas species along the 2-phase equilibria shown in the first diagram.

Table I. Phases, structures and models.

Phase	Struktur-bericht	Prototype	Pearson symbol	Space group	SGTE name	Model
liquid					LIQUID	(Ga,P) ₁
A11	A11	α Ga	<i>oC</i> 8	<i>Cmca</i>	ORTHORHOMBIC_CMCA	Ga ₁
GaP	B3	ZnS	<i>cF</i> 8	<i>F43m</i>	FCC_B3	Ga ₁ P ₁
P(red)	P_RED	P ₁
α P	...	α P	<i>c*</i> *	...	P_WHITE	P ₁

Table II. Invariant reactions.

Reaction	Type	T / K	Compositions / x_{P}			$\Delta_{\text{r}}H / (\text{J/mol})$
liquid \rightleftharpoons GaP	congruent	1748.8	0.500	0.500		–59020
liquid \rightleftharpoons GaP + P(red)	degenerate	852.3	1.000	0.500	1.000	–18553
liquid \rightleftharpoons AlI + GaP	degenerate	302.9	0.000	0.000	0.500	–5590

**Fig. 2.** Calculated phase diagram at 0.1 MPa.**Fig. 3.** Calculated partial pressures of gaseous species in the phase equilibria of the constrained system.**Table III.** Standard reaction quantities at 298.15 K for the compounds per mole of atoms.

Compound	x_{P}	$\Delta_{\text{f}}G^{\circ} / (\text{J/mol})$	$\Delta_{\text{f}}H^{\circ} / (\text{J/mol})$	$\Delta_{\text{f}}S^{\circ} / (\text{J/(mol}\cdot\text{K)})$	$\Delta_{\text{f}}C_P^{\circ} / (\text{J/(mol}\cdot\text{K)})$
Ga ₁ P ₁	0.500	–52799	–57324	–15.177	–3.053

References

- [84Tma] M. Tmar, A. Gabriel, C. Chatillon, I. Ansara: J. Cryst. Growth **68** (1984) 557–580.
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