V – Zr (Vanadium – Zirconium)

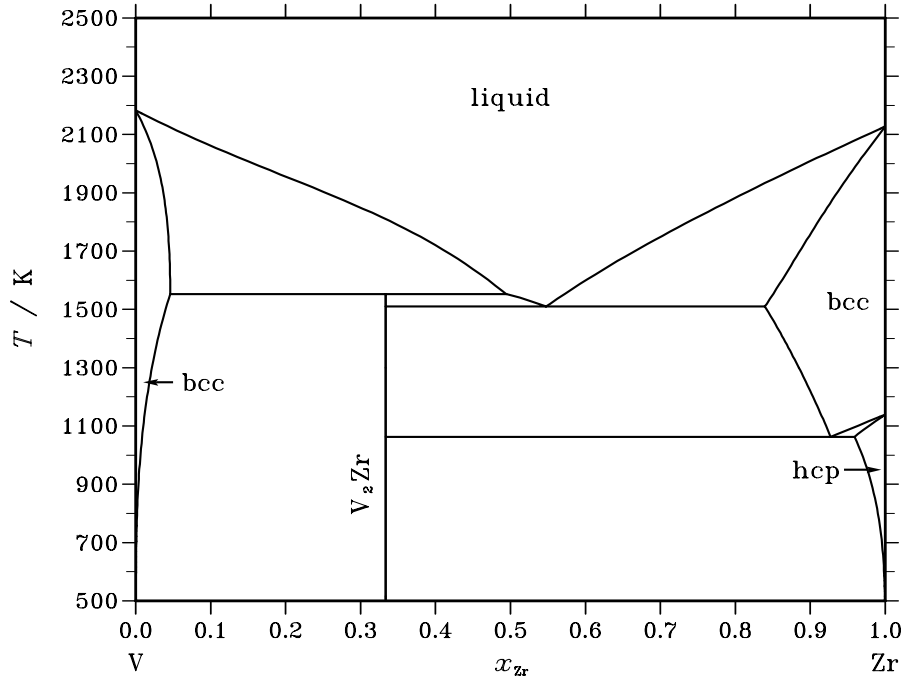

Fig. 1. Calculated phase diagram for the system V-Zr.

This phase diagram is a simple eutectic with a single intermetallic of the $C15$ Laves type. V stabilises the bcc form of Zr and the solubility of V in Zr is almost 20%. An assessment of the V-Zr system has been prepared by [98Kor].

Table I. Phases, structures and models.

Phase	Struktur-bericht	Prototype	Pearson symbol	Space group	SGTE name	Model
liquid					LIQUID	$(V,Zr)_1$
bcc	$A2$	W	$cI2$	$Im\overline{3}m$	BCC_A2	$(V,Zr)_1$
V_2Zr	$C15$	Cu_2Mg	$cF24$	$Fd\overline{3}m$	C15_VZR	V_2Zr_1
hcp	$A3$	Mg	$hP2$	$P6_3/mmc$	HCP_A3	$(V,Zr)_1$

Table II. Invariant reactions.

Reaction	Type	T / K	Compositions / x_{Zr}			$\Delta_r H$ / (J/mol)
bcc + liquid $\rightleftharpoons$ V_2Zr	peritectic	1552.7	0.046	0.494	0.333	−10248
liquid $\rightleftharpoons$ V_2Zr + bcc	eutectic	1510.2	0.548	0.333	0.839	−12653
bcc $\rightleftharpoons$ V_2Zr + hcp	eutectoid	1062.9	0.927	0.333	0.959	−4023

Table IIIa. Integral quantities for the liquid phase at 2200 K.

x_{Zr}	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	−3903	−2307	0.726	2043	−1.977	0.000
0.200	−5687	−4035	0.751	3466	−3.410	0.000
0.300	−6842	−5210	0.742	4332	−4.337	0.000
0.400	−7608	−5855	0.797	4702	−4.799	0.000
0.500	−8040	−5997	0.929	4639	−4.834	0.000
0.600	−8105	−5658	1.113	4205	−4.483	0.000
0.700	−7712	−4864	1.294	3462	−3.785	0.000
0.800	−6681	−3640	1.382	2472	−2.778	0.000
0.900	−4649	−2011	1.199	1297	−1.504	0.000
1.000	0	0	0.000	0	0.000	0.000

Reference states: V(liquid), Zr(liquid)

Table IIIb. Partial quantities for V in the liquid phase at 2200 K.

x_{V}	ΔG_{V} [J/mol]	ΔH_{V} [J/mol]	ΔS_{V} [J/(mol·K)]	$G_{\mathrm{V}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{V}}^{\mathrm{E}}$ [J/(mol·K)]	a_{V}	γ_{V}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	−1607	−293	0.597	320	−0.279	0.916	1.018
0.800	−2884	−1141	0.792	1198	−1.063	0.854	1.068
0.700	−4015	−2492	0.692	2509	−2.273	0.803	1.147
0.600	−5215	−4299	0.416	4129	−3.831	0.752	1.253
0.500	−6745	−6511	0.106	5934	−5.657	0.692	1.383
0.400	−8962	−9080	−0.054	7799	−7.672	0.613	1.532
0.300	−12422	−11955	0.213	9601	−9.798	0.507	1.690
0.200	−18226	−15088	1.426	11214	−11.955	0.369	1.846
0.100	−29603	−18428	5.080	12515	−14.065	0.198	1.982
0.000	$-\infty$	−21928	∞	13380	−16.049	0.000	2.078

Reference state: V(liquid)

Table IIIc. Partial quantities for Zr in the liquid phase at 2200 K.

x_{Zr}	ΔG_{Zr} [J/mol]	ΔH_{Zr} [J/mol]	ΔS_{Zr} [J/(mol·K)]	$G_{\mathrm{Zr}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Zr}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Zr}	γ_{Zr}
0.000	$-\infty$	−26044	∞	23735	−22.627	0.000	3.660
0.100	−24571	−20429	1.883	17548	−17.262	0.261	2.610
0.200	−16900	−15615	0.584	12540	−12.797	0.397	1.985
0.300	−13437	−11551	0.857	8586	−9.153	0.480	1.599
0.400	−11198	−8190	1.367	5562	−6.251	0.542	1.355
0.500	−9334	−5482	1.751	3345	−4.012	0.600	1.201
0.600	−7535	−3377	1.890	1809	−2.357	0.662	1.104
0.700	−5693	−1825	1.758	831	−1.208	0.733	1.046
0.800	−3795	−778	1.371	287	−0.484	0.813	1.016
0.900	−1876	−186	0.768	51	−0.108	0.903	1.003
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Zr(liquid)

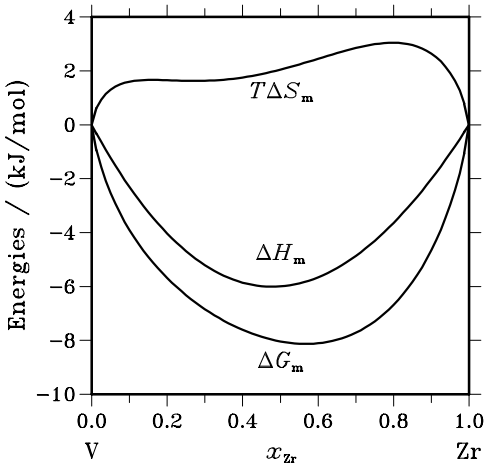

Fig. 2. Integral quantities of the liquid phase at T=2200 K.

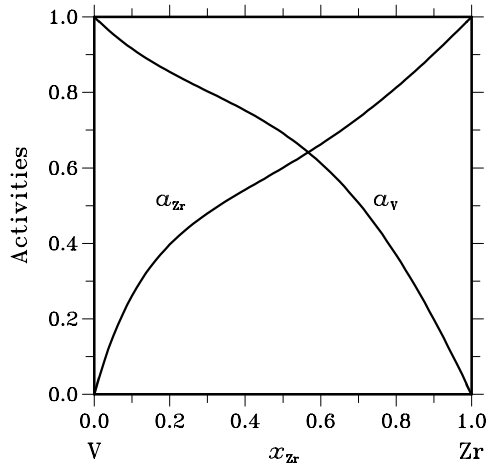

Fig. 3. Activities in the liquid phase at T=2200 K.

Table IV. Standard reaction quantities at 298.15 K for the compounds per mole of atoms.

Compound	x_{Zr}	$\Delta_f G^\circ$ / (J/mol)	$\Delta_f H^\circ$ / (J/mol)	$\Delta_f S^\circ$ / (J/(mol·K))	$\Delta_f C_P^\circ$ / (J/(mol·K))
V_2Zr_1	0.333	−1257	−1141	0.387	0.000

References

[98Kor] J. Korb, K. Hack in: I. Ansara, A.T. Dinsdale, M.H. Rand (eds.): COST 507, "Thermochemical database for light metal alloys", Vol. 2, EUR 18499, 1998, 303–304.