Cs – K (Caesium – Potassium)

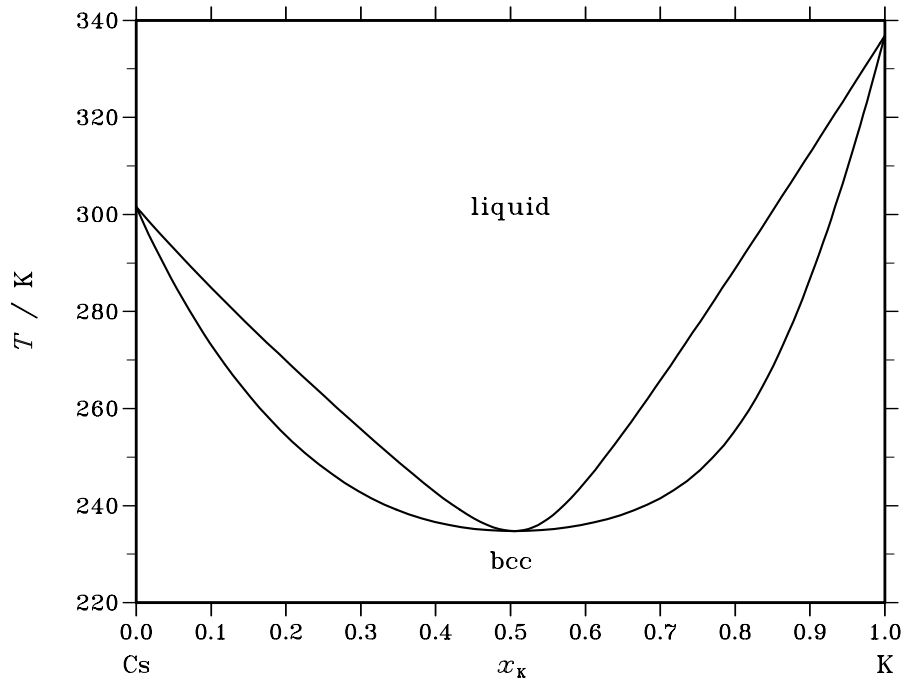

Fig. 1. Calculated phase diagram for the system Cs-K.

The phase diagram for the Cs-K system is very simple showing complete mixing above room temperature between the pure elements in the liquid and the bcc phases with a minimum in the solidus/liquidus surface at about 235 K. An intermetallic compound phase CsK_2 is stable below 185 K [81Shm]. The dataset adopted by SGTE were derived by Potter and Rand [85Pot] and is in very good agreement with the experimental data for the system. The phase diagram has been studied by Goates *et al.* [71Goa], Goria [35Gor] and Rinck [36Rin]. Thermodynamic properties in the liquid phase were measured by Yokokawa and Kleppa [64Yok] with a reaction calorimeter and the assessment was based on these data coupled to the experimental phase diagram information. More recently the activities of the components in the liquid phase have been studied extensively [84Shk, 86Pok, 88Pok, 87Ros, 88Kag, 90Erm]. The system has also been reviewed by Bale and Pelton [83Bal].

Table I. Phases, structures and models.

Phase	Struktur-bericht	Prototype	Pearson symbol	Space group	SGTE name	Model
liquid					LIQUID	$(Cs,K)_1$
bcc	$A2$	W	$cI2$	$Im\overline{3}m$	BCC_A2	$(Cs,K)_1$

Table II. Invariant reactions.

Reaction	Type	T / K	Compositions / x_K		$\Delta_r H$ / (J/mol)
liquid $\rightleftharpoons$ bcc	congruent	234.7	0.505	0.505	−1140

Table IIIa. Integral quantities for the liquid phase at 340 K.

x_{K}	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	−808	17	2.424	111	−0.279	0.299
0.200	−1229	34	3.716	185	−0.445	0.553
0.300	−1501	51	4.563	226	−0.516	0.754
0.400	−1663	65	5.084	239	−0.512	0.894
0.500	−1730	75	5.310	229	−0.453	0.965
0.600	−1702	79	5.239	201	−0.357	0.959
0.700	−1568	75	4.834	159	−0.245	0.867
0.800	−1307	62	4.026	108	−0.135	0.682
0.900	−866	38	2.656	53	−0.047	0.396
1.000	0	0	0.000	0	0.000	0.000

Reference states: Cs(liquid), K(liquid)

Table IIIb. Partial quantities for Cs in the liquid phase at 340 K.

x_{Cs}	ΔG_{Cs} [J/mol]	ΔH_{Cs} [J/mol]	ΔS_{Cs} [J/(mol·K)]	$G_{\mathrm{Cs}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Cs}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Cs}	γ_{Cs}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	−278	−1	0.816	20	−0.060	0.906	1.007
0.800	−559	−1	1.641	72	−0.215	0.821	1.026
0.700	−861	3	2.541	148	−0.425	0.738	1.054
0.600	−1207	15	3.596	237	−0.651	0.652	1.087
0.500	−1630	39	4.907	330	−0.856	0.562	1.124
0.400	−2173	77	6.618	417	−1.001	0.464	1.159
0.300	−2915	133	8.965	488	−1.046	0.357	1.189
0.200	−4015	211	12.429	535	−0.953	0.242	1.208
0.100	−5963	314	18.462	546	−0.683	0.121	1.213
0.000	$-\infty$	446	∞	513	−0.197	0.000	1.199

Reference state: Cs(liquid)

Table IIIc. Partial quantities for K in the liquid phase at 340 K.

x_{K}	ΔG_{K} [J/mol]	ΔH_{K} [J/mol]	ΔS_{K} [J/(mol·K)]	$G_{\mathrm{K}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{K}}^{\mathrm{E}}$ [J/(mol·K)]	a_{K}	γ_{K}
0.000	$-\infty$	155	∞	1319	−3.426	0.000	1.595
0.100	−5571	172	16.893	938	−2.252	0.139	1.394
0.200	−3912	174	12.016	638	−1.366	0.251	1.253
0.300	−2994	161	9.281	409	−0.729	0.347	1.156
0.400	−2348	140	7.315	243	−0.303	0.436	1.090
0.500	−1831	111	5.714	128	−0.049	0.523	1.046
0.600	−1388	81	4.319	56	0.072	0.612	1.020
0.700	−991	51	3.064	17	0.099	0.704	1.006
0.800	−630	25	1.925	1	0.070	0.800	1.000
0.900	−299	7	0.900	−1	0.024	0.900	1.000
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: K(liquid)

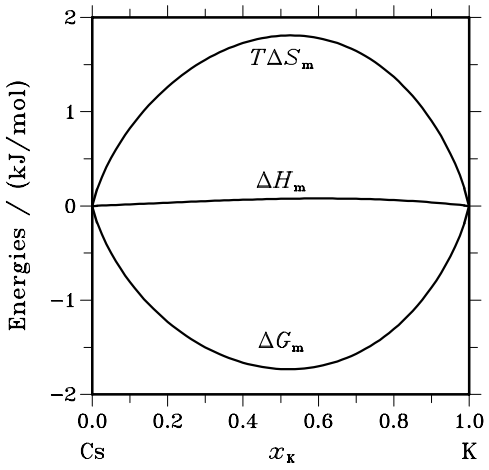

Fig. 2. Integral quantities of the liquid phase at T=340 K.

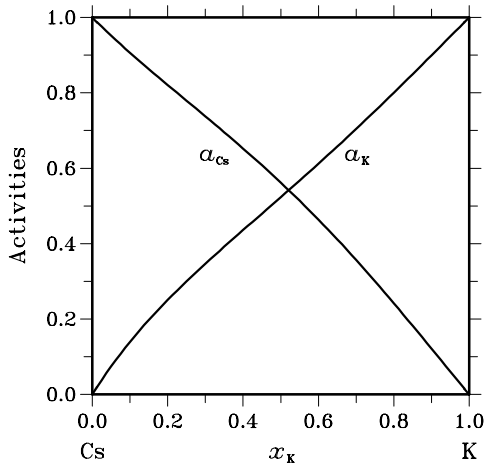

Fig. 3. Activities in the liquid phase at T=340 K.

Table IVa. Integral quantities for the stable phases at 230 K.

Phase	x_{K}	ΔG_{m} [J/mol]	ΔH_{m} [J/mol]	ΔS_{m} [J/(mol·K)]	$G^{\mathrm{E}}_{\mathrm{m}}$ [J/mol]	$S^{\mathrm{E}}_{\mathrm{m}}$ [J/(mol·K)]	ΔC_P [J/(mol·K)]
bcc	0.000	0	0	0.000	0	0.000	0.000
	0.100	−355	263	2.690	266	−0.013	0.000
	0.200	−487	521	4.381	470	0.220	0.000
	0.300	−551	749	5.652	617	0.573	0.000
	0.400	−575	928	6.535	712	0.940	0.000
	0.500	−572	1037	6.997	753	1.234	0.000
	0.600	−547	1060	6.986	740	1.390	0.000
	0.700	−501	980	6.440	667	1.361	0.000
	0.800	−430	784	5.282	527	1.121	0.000
	0.900	−313	461	3.366	309	0.663	0.000
	1.000	0	0	0.000	0	0.000	0.000

Reference states: Cs(bcc), K(bcc)

Table IVb. Partial quantities for Cs in the stable phases at 230 K.

Phase	x_{Cs}	ΔG_{Cs} [J/mol]	ΔH_{Cs} [J/mol]	ΔS_{Cs} [J/(mol·K)]	$G^{\mathrm{E}}_{\mathrm{Cs}}$ [J/mol]	$S^{\mathrm{E}}_{\mathrm{Cs}}$ [J/(mol·K)]	a_{Cs}	γ_{Cs}
bcc	1.000	0	0	0.000	0	0.000	1.000	1.000
	0.900	−169	−1	0.730	32	−0.146	0.915	1.017
	0.800	−306	27	1.451	120	−0.404	0.852	1.065
	0.700	−426	129	2.411	256	−0.555	0.800	1.143
	0.600	−537	340	3.814	440	−0.434	0.755	1.259
	0.500	−646	694	5.824	680	0.061	0.713	1.427
	0.400	−760	1216	8.591	992	0.973	0.672	1.680
	0.300	−900	1928	12.295	1403	2.284	0.625	2.082
	0.200	−1134	2845	17.301	1944	3.919	0.553	2.764
	0.100	−1746	3978	24.887	2657	5.742	0.401	4.012
	0.000	$-\infty$	5329	∞	3591	7.556	0.000	6.539

Reference state: Cs(bcc)

Table IVc. Partial quantities for K in the stable phases at 230 K.

Phase	x_K	ΔG_K [J/mol]	ΔH_K [J/mol]	ΔS_K [J/(mol·K)]	G_K^E [J/mol]	S_K^E [J/(mol·K)]	a_K	γ_K
bcc	0.000	$-\infty$	2582	∞	3002	−1.828	0.000	4.806
	0.100	−2033	2642	20.326	2371	1.181	0.345	3.455
	0.200	−1209	2494	16.100	1869	2.718	0.531	2.657
	0.300	−842	2197	13.214	1461	3.204	0.644	2.146
	0.400	−633	1809	10.618	1120	3.000	0.718	1.796
	0.500	−499	1380	8.170	827	2.407	0.770	1.541
	0.600	−405	955	5.916	572	1.668	0.809	1.348
	0.700	−331	574	3.931	352	0.966	0.841	1.202
	0.800	−254	269	2.277	172	0.421	0.875	1.094
	0.900	−154	70	0.974	48	0.098	0.923	1.025
	1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: K(bcc)

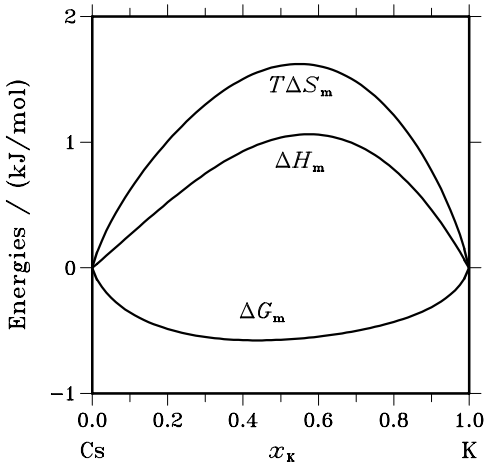

Fig. 4. Integral quantities of the stable phases at T=230 K.

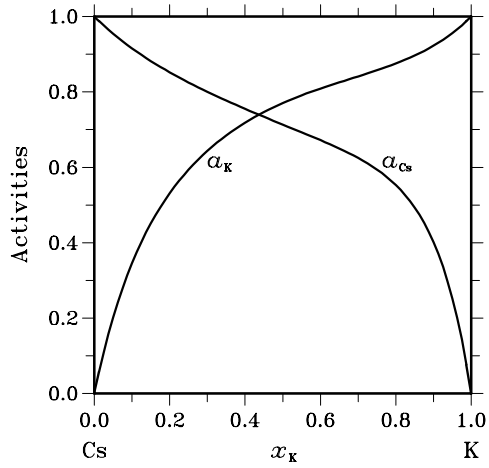

Fig. 5. Activities in the stable phases at T=230 K.

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