Cs – Rb (Caesium – Rubidium)

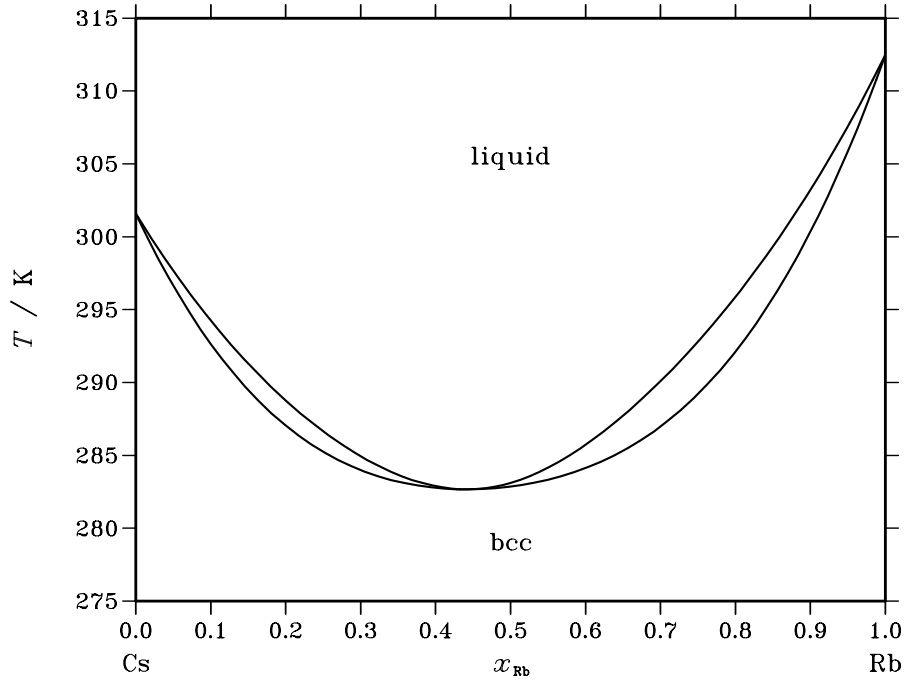

Fig. 1. Calculated phase diagram for the system Cs-Rb.

The phase diagram for the Cs-Rb system is very simple showing complete mixing between the pure elements in the liquid and the bcc phases with a minimum in the solidus/liquidus surface at about 282.9 K. The dataset adopted by SGTE were derived by Potter and Rand [85Pot] and is in good agreement on the whole with the experimental data for the system. The phase diagram has been studied by Goates *et al.* [71Goa], Rinck [36Rin] and Böhm and Klemm [39Boh]. 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 [88Kal, 90Ros]. 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	$(Cs,Rb)_1$
bcc	$A2$	W	$cI2$	$Im\overline{3}m$	BCC_A2	$(Cs,Rb)_1$

Table II. Invariant reactions.

Reaction	Type	T / K	Compositions / x_{Rb}		$\Delta_{\mathrm{r}}H$ / (J/mol)
liquid $\rightleftharpoons$ bcc	congruent	282.7	0.442	0.442	−2219

Table IIIa. Integral quantities for the liquid phase at 384 K.

x_{Rb}	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)]
0.000	0	0	0.000	0	0.000	0.000
0.100	−689	−45	1.677	349	−1.026	0.000
0.200	−978	−81	2.336	620	−1.825	0.000
0.300	−1136	−106	2.684	814	−2.395	0.000
0.400	−1219	−121	2.859	930	−2.737	0.000
0.500	−1244	−126	2.912	969	−2.851	0.000
0.600	−1219	−121	2.859	930	−2.737	0.000
0.700	−1136	−106	2.684	814	−2.395	0.000
0.800	−978	−81	2.336	620	−1.825	0.000
0.900	−689	−45	1.677	349	−1.026	0.000
1.000	0	0	0.000	0	0.000	0.000

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

Table IIIb. Partial quantities for Cs in the liquid phase at 384 K.

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}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	−298	−5	0.762	39	−0.114	0.911	1.012
0.800	−557	−20	1.399	155	−0.456	0.840	1.050
0.700	−790	−45	1.939	349	−1.026	0.781	1.115
0.600	−1011	−81	2.423	620	−1.825	0.729	1.214
0.500	−1244	−126	2.912	969	−2.851	0.677	1.355
0.400	−1530	−181	3.513	1395	−4.106	0.619	1.548
0.300	−1945	−247	4.422	1899	−5.588	0.544	1.813
0.200	−2658	−322	6.083	2481	−7.299	0.435	2.175
0.100	−4212	−408	9.907	3139	−9.237	0.267	2.673
0.000	$-\infty$	−503	∞	3876	−11.404	0.000	3.367

Reference state: Cs(liquid)

Table IIIc. Partial quantities for Rb in the liquid phase at 384 K.

x_{Rb}	ΔG_{Rb} [J/mol]	ΔH_{Rb} [J/mol]	ΔS_{Rb} [J/(mol·K)]	$G^{\mathrm{E}}_{\mathrm{Rb}}$ [J/mol]	$S^{\mathrm{E}}_{\mathrm{Rb}}$ [J/(mol·K)]	a_{Rb}	γ_{Rb}
0.000	$-\infty$	−503	∞	3876	−11.404	0.000	3.367
0.100	−4212	−408	9.907	3139	−9.237	0.267	2.673
0.200	−2658	−322	6.083	2481	−7.299	0.435	2.175
0.300	−1945	−247	4.422	1899	−5.588	0.544	1.813
0.400	−1530	−181	3.513	1395	−4.106	0.619	1.548
0.500	−1244	−126	2.912	969	−2.851	0.677	1.355
0.600	−1011	−81	2.423	620	−1.825	0.729	1.214
0.700	−790	−45	1.939	349	−1.026	0.781	1.115
0.800	−557	−20	1.399	155	−0.456	0.840	1.050
0.900	−298	−5	0.762	39	−0.114	0.911	1.012
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Rb(liquid)

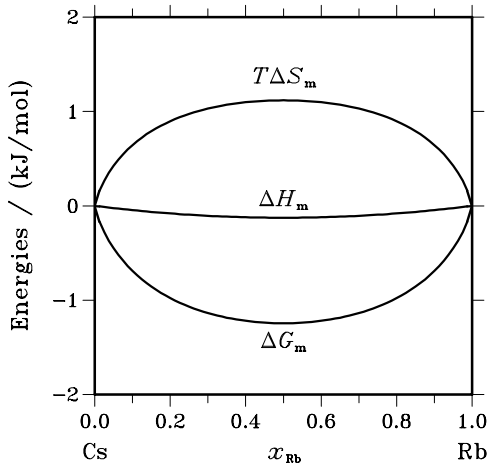

Fig. 2. Integral quantities of the liquid phase at T=384 K.

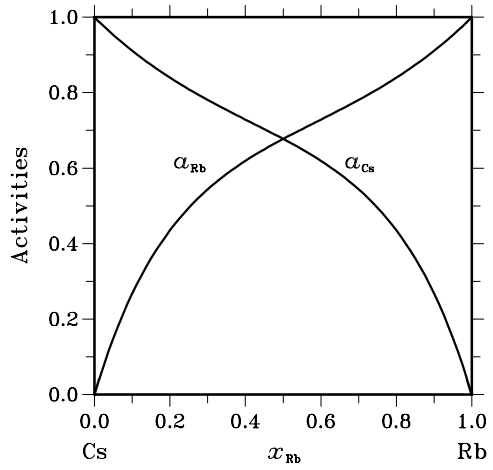

Fig. 3. Activities in the liquid phase at T=384 K.

Table IVa. Integral quantities for the stable phases at 280 K.

Phase	x_{Rb}	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	−455	−73	1.364	302	−1.338	0.000
	0.200	−628	−130	1.781	537	−2.379	0.000
	0.300	−718	−170	1.956	704	−3.123	0.000
	0.400	−762	−194	2.027	805	−3.569	0.000
	0.500	−775	−203	2.045	838	−3.718	0.000
	0.600	−762	−194	2.027	805	−3.569	0.000
	0.700	−718	−170	1.956	704	−3.123	0.000
	0.800	−628	−130	1.781	537	−2.379	0.000
	0.900	−455	−73	1.364	302	−1.338	0.000
	1.000	0	0	0.000	0	0.000	0.000

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

Table IVb. Partial quantities for Cs in the stable phases at 280 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	−212	−8	0.727	34	−0.149	0.913	1.015
	0.800	−385	−32	1.260	134	−0.595	0.847	1.059
	0.700	−529	−73	1.627	302	−1.338	0.797	1.138
	0.600	−653	−130	1.868	537	−2.379	0.756	1.259
	0.500	−775	−203	2.045	838	−3.718	0.717	1.434
	0.400	−926	−292	2.265	1207	−5.354	0.672	1.680
	0.300	−1160	−397	2.723	1643	−7.287	0.608	2.026
	0.200	−1600	−519	3.864	2146	−9.518	0.503	2.514
	0.100	−2644	−656	7.099	2717	−12.046	0.321	3.212
	0.000	$-\infty$	−810	∞	3354	−14.871	0.000	4.223

Reference state: Cs(bcc)

Table IVc. Partial quantities for Rb in the stable phases at 280 K.

Phase	x_{Rb}	ΔG_{Rb} [J/mol]	ΔH_{Rb} [J/mol]	ΔS_{Rb} [J/(mol·K)]	$G^{\mathrm{E}}_{\mathrm{Rb}}$ [J/mol]	$S^{\mathrm{E}}_{\mathrm{Rb}}$ [J/(mol·K)]	a_{Rb}	γ_{Rb}
bcc	0.000	$-\infty$	−810	∞	3354	−14.871	0.000	4.223
	0.100	−2644	−656	7.099	2717	−12.046	0.321	3.212
	0.200	−1600	−519	3.864	2146	−9.518	0.503	2.514
	0.300	−1160	−397	2.723	1643	−7.287	0.608	2.026
	0.400	−926	−292	2.265	1207	−5.354	0.672	1.680
	0.500	−775	−203	2.045	838	−3.718	0.717	1.434
	0.600	−653	−130	1.868	537	−2.379	0.756	1.259
	0.700	−529	−73	1.627	302	−1.338	0.797	1.138
	0.800	−385	−32	1.260	134	−0.595	0.847	1.059
	0.900	−212	−8	0.727	34	−0.149	0.913	1.015
	1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Rb(bcc)

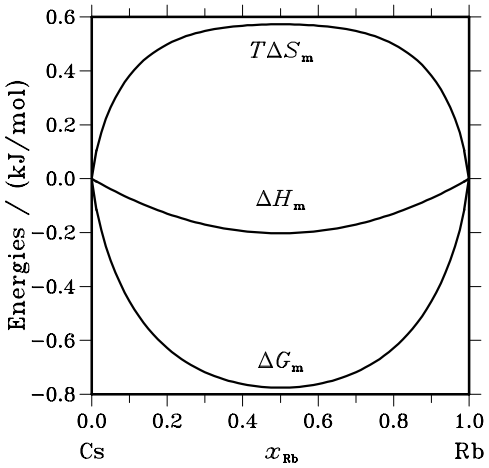

Fig. 4. Integral quantities of the stable phases at T=280 K.

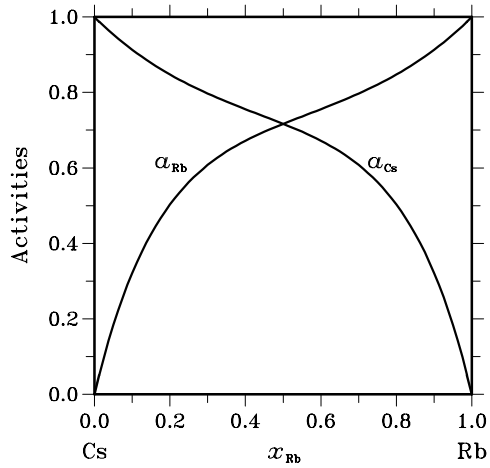

Fig. 5. Activities in the stable phases at T=280 K.

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