Pt – Rh (Platinum – Rhodium)

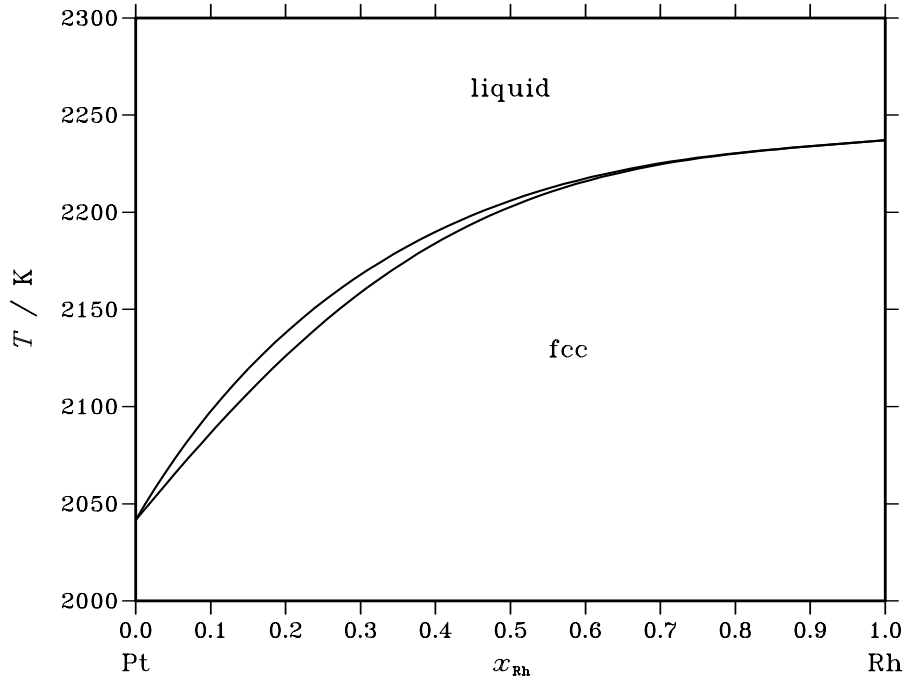

Fig. 1. Calculated phase diagram for the system Pt-Rh.

The Pt-Rh system displays a complete range of liquid and fcc solid solutions [91Oka]. A miscibility gap in the solid state with a critical point at ca. 1033 K was predicted by Rau [59Rau] based on the difference in the melting points of Pt and Rh. Jacob *et al.* [98Jac] determined the activity of Rh in solid Pt-Rh alloys in the temperature range 900 to 1300 K using an EMF technique. The measurements may be subject to error because the electronegativities of the 2 component elements are very similar, but the results indicated negative departure from ideality of all solid state thermodynamic values. The predicted solid state miscibility gap was not confirmed. The present assessment [98Spe] assumes zero enthalpy of mixing in the liquid and provides solid state activity values and enthalpies of mixing displaying small negative departures from ideality.

Table I. Phases, structures and models.

Phase	Struktur-bericht	Prototype	Pearson symbol	Space group	SGTE name	Model
liquid					LIQUID	$(Pt,Rh)_1$
fcc	$A1$	Cu	$cF4$	$Fm\overline{3}m$	FCC_A1	$(Pt,Rh)_1$

Table IIa. Integral quantities for the liquid phase at 2300 K.

x_{Rh}	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	−6217	0	2.703	0	0.000	0.000
0.200	−9569	0	4.161	0	0.000	0.000
0.300	−11682	0	5.079	0	0.000	0.000
0.400	−12870	0	5.596	0	0.000	0.000
0.500	−13255	0	5.763	0	0.000	0.000
0.600	−12870	0	5.596	0	0.000	0.000
0.700	−11682	0	5.079	0	0.000	0.000
0.800	−9569	0	4.161	0	0.000	0.000
0.900	−6217	0	2.703	0	0.000	0.000
1.000	0	0	0.000	0	0.000	0.000

Reference states: Pt(liquid), Rh(liquid)

Table IIb. Partial quantities for Pt in the liquid phase at 2300 K.

x_{Pt}	ΔG_{Pt} [J/mol]	ΔH_{Pt} [J/mol]	ΔS_{Pt} [J/(mol·K)]	$G_{\mathrm{Pt}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Pt}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Pt}	γ_{Pt}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	−2015	0	0.876	0	0.000	0.900	1.000
0.800	−4267	0	1.855	0	0.000	0.800	1.000
0.700	−6821	0	2.966	0	0.000	0.700	1.000
0.600	−9769	0	4.247	0	0.000	0.600	1.000
0.500	−13255	0	5.763	0	0.000	0.500	1.000
0.400	−17523	0	7.619	0	0.000	0.400	1.000
0.300	−23024	0	10.010	0	0.000	0.300	1.000
0.200	−30778	0	13.382	0	0.000	0.200	1.000
0.100	−44033	0	19.145	0	0.000	0.100	1.000
0.000	$-\infty$	0	∞	0	0.000	0.000	1.000

Reference state: Pt(liquid)

Table IIc. Partial quantities for Rh in the liquid phase at 2300 K.

x_{Rh}	ΔG_{Rh} [J/mol]	ΔH_{Rh} [J/mol]	ΔS_{Rh} [J/(mol·K)]	$G_{\mathrm{Rh}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Rh}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Rh}	γ_{Rh}
0.000	$-\infty$	0	∞	0	0.000	0.000	1.000
0.100	−44033	0	19.145	0	0.000	0.100	1.000
0.200	−30778	0	13.382	0	0.000	0.200	1.000
0.300	−23024	0	10.010	0	0.000	0.300	1.000
0.400	−17523	0	7.619	0	0.000	0.400	1.000
0.500	−13255	0	5.763	0	0.000	0.500	1.000
0.600	−9769	0	4.247	0	0.000	0.600	1.000
0.700	−6821	0	2.966	0	0.000	0.700	1.000
0.800	−4267	0	1.855	0	0.000	0.800	1.000
0.900	−2015	0	0.876	0	0.000	0.900	1.000
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Rh(liquid)

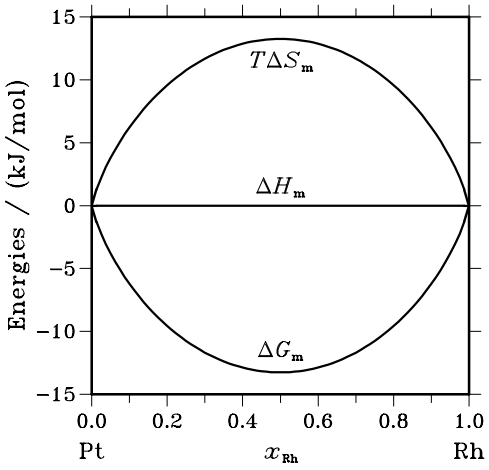

Fig. 2. Integral quantities of the liquid phase at T=2300 K.

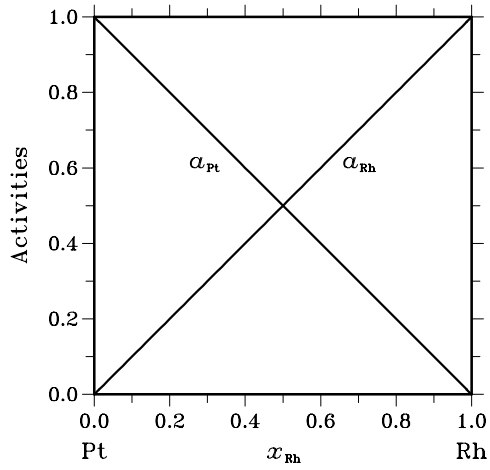

Fig. 3. Activities in the liquid phase at T=2300 K.

Table IIIa. Integral quantities for the stable phases at 1800 K.

Phase	x_{Rh}	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)]
fcc	0.000	0	0	0.000	0	0.000	0.000
	0.100	−5185	−320	2.703	−320	0.000	0.000
	0.200	−8025	−536	4.161	−536	0.000	0.000
	0.300	−9804	−662	5.079	−662	0.000	0.000
	0.400	−10780	−708	5.596	−708	0.000	0.000
	0.500	−11061	−688	5.763	−688	0.000	0.000
	0.600	−10684	−612	5.596	−612	0.000	0.000
	0.700	−9636	−494	5.079	−494	0.000	0.000
	0.800	−7833	−344	4.161	−344	0.000	0.000
	0.900	−5041	−176	2.703	−176	0.000	0.000
	1.000	0	0	0.000	0	0.000	0.000

Reference states: Pt(fcc), Rh(fcc)

Table IIIb. Partial quantities for Pt in the stable phases at 1800 K.

Phase	x_{Pt}	ΔG_{Pt} [J/mol]	ΔH_{Pt} [J/mol]	ΔS_{Pt} [J/(mol·K)]	$G^{\mathrm{E}}_{\mathrm{Pt}}$ [J/mol]	$S^{\mathrm{E}}_{\mathrm{Pt}}$ [J/(mol·K)]	a_{Pt}	γ_{Pt}
fcc	1.000	0	0	0.000	0	0.000	1.000	1.000
	0.900	−1630	−54	0.876	−54	0.000	0.897	0.996
	0.800	−3538	−198	1.855	−198	0.000	0.789	0.987
	0.700	−5748	−410	2.966	−410	0.000	0.681	0.973
	0.600	−8309	−664	4.247	−664	0.000	0.574	0.957
	0.500	−11311	−938	5.763	−938	0.000	0.470	0.939
	0.400	−14919	−1206	7.619	−1206	0.000	0.369	0.923
	0.300	−19464	−1446	10.010	−1446	0.000	0.272	0.908
	0.200	−25719	−1632	13.382	−1632	0.000	0.179	0.897
	0.100	−36202	−1742	19.145	−1742	0.000	0.089	0.890
	0.000	$-\infty$	−1750	∞	−1750	0.000	0.000	0.890

Reference state: Pt(fcc)

Table IIIc. Partial quantities for Rh in the stable phases at 1800 K.

Phase	x_{Rh}	ΔG_{Rh} [J/mol]	ΔH_{Rh} [J/mol]	ΔS_{Rh} [J/(mol·K)]	$G^{\mathrm{E}}_{\mathrm{Rh}}$ [J/mol]	$S^{\mathrm{E}}_{\mathrm{Rh}}$ [J/(mol·K)]	a_{Rh}	γ_{Rh}
fcc	0.000	$-\infty$	−3750	∞	−3750	0.000	0.000	0.778
	0.100	−37174	−2714	19.145	−2714	0.000	0.083	0.834
	0.200	−25975	−1888	13.382	−1888	0.000	0.176	0.881
	0.300	−19268	−1250	10.010	−1250	0.000	0.276	0.920
	0.400	−14487	−774	7.619	−774	0.000	0.380	0.950
	0.500	−10811	−438	5.763	−438	0.000	0.486	0.971
	0.600	−7861	−216	4.247	−216	0.000	0.591	0.986
	0.700	−5424	−85	2.966	−85	0.000	0.696	0.994
	0.800	−3362	−22	1.855	−22	0.000	0.799	0.999
	0.900	−1578	−1	0.876	−1	0.000	0.900	1.000
	1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Rh(fcc)

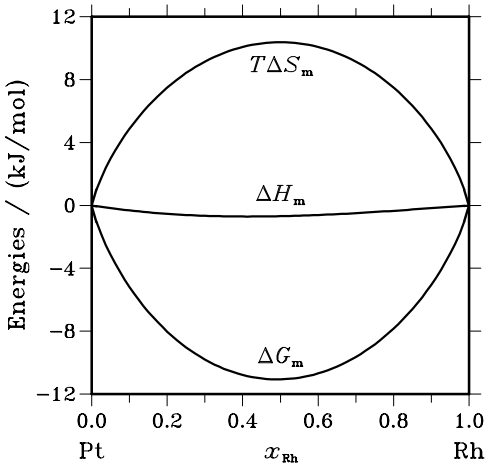

Fig. 4. Integral quantities of the stable phases at T=1800 K.

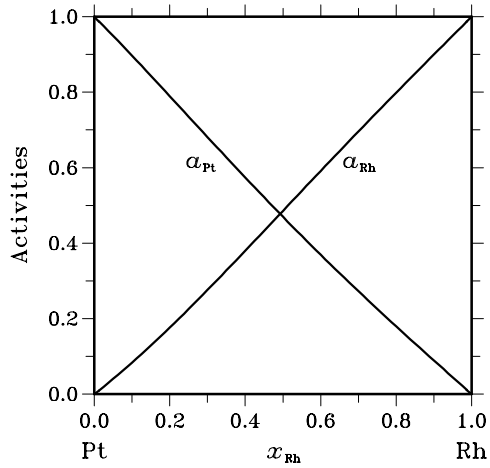

Fig. 5. Activities in the stable phases at T=1800 K.

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