Ir – Pd (Iridium – Palladium)

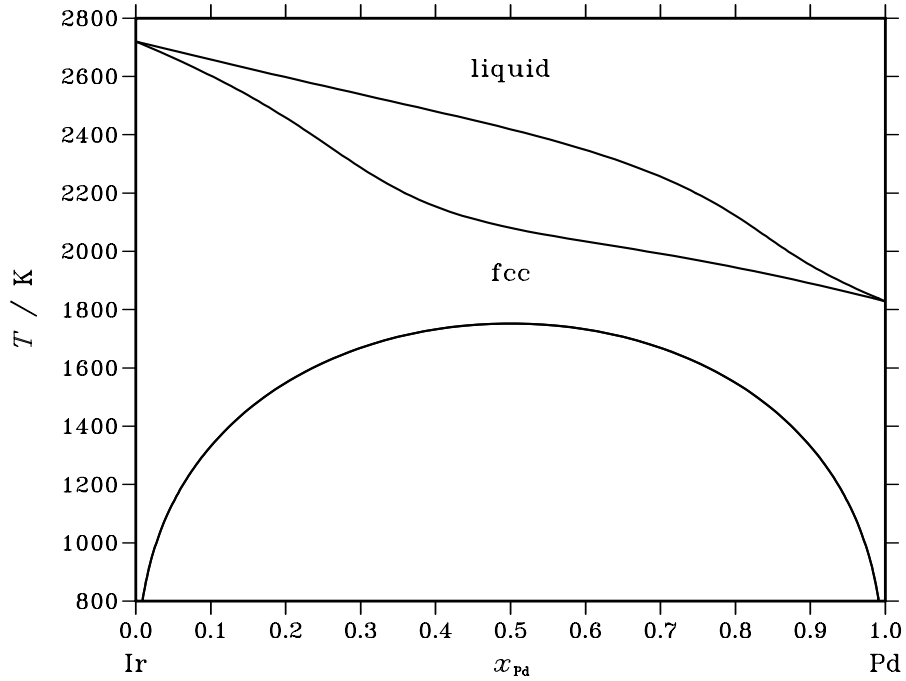

Fig. 1. Calculated phase diagram for the system Ir-Pd.

The available experimental phase diagram information for the Ir-Pd system has been reviewed by Tripathi *et al.* [91Tri]. The system displays a wide solidus-liquidus gap and a miscibility gap extending to 1752 K in the fcc solid solution phase. The published phase diagram review has been used by Spencer [98Spe] to derive thermodynamic properties of mixing for the liquid and fcc phases. As expected from the nature of the phase diagram, enthalpies of mixing and component activities show strong positive departures from ideality.

Table I. Phases, structures and models.

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

Table II. Invariant reactions.

Reaction	Type	T / K	Compositions / x_{Pd}			$\Delta_{\mathrm{r}}H$ / (J/mol)
fcc $\rightleftharpoons$ fcc′ + fcc″	critical	1751.9	0.500	0.500	0.500	0

Table IIIa. Integral quantities for the liquid phase at 2800 K.

x_{Pd}	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	−5557	2768	2.973	2012	0.270	0.000
0.200	−8074	4920	4.641	3576	0.480	0.000
0.300	−9528	6458	5.709	4694	0.630	0.000
0.400	−10304	7380	6.316	5364	0.720	0.000
0.500	−10549	7688	6.513	5588	0.750	0.000
0.600	−10304	7380	6.316	5364	0.720	0.000
0.700	−9528	6458	5.709	4694	0.630	0.000
0.800	−8074	4920	4.641	3576	0.480	0.000
0.900	−5557	2768	2.973	2012	0.270	0.000
1.000	0	0	0.000	0	0.000	0.000

Reference states: Ir(liquid), Pd(liquid)

Table IIIb. Partial quantities for Ir in the liquid phase at 2800 K.

x_{Ir}	ΔG_{Ir} [J/mol]	ΔH_{Ir} [J/mol]	ΔS_{Ir} [J/(mol·K)]	$G_{\mathrm{Ir}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Ir}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Ir}	γ_{Ir}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	−2229	308	0.906	224	0.030	0.909	1.010
0.800	−4301	1230	1.975	894	0.120	0.831	1.039
0.700	−6292	2768	3.236	2012	0.270	0.763	1.090
0.600	−8316	4920	4.727	3576	0.480	0.700	1.166
0.500	−10549	7688	6.513	5588	0.750	0.636	1.271
0.400	−13286	11070	8.699	8046	1.080	0.565	1.413
0.300	−17078	15068	11.480	10952	1.470	0.480	1.601
0.200	−23165	19680	15.302	14304	1.920	0.370	1.849
0.100	−35502	24908	21.575	18104	2.430	0.218	2.176
0.000	$-\infty$	30750	∞	22350	3.000	0.000	2.612

Reference state: Ir(liquid)

Table IIIc. Partial quantities for Pd in the liquid phase at 2800 K.

x_{Pd}	ΔG_{Pd} [J/mol]	ΔH_{Pd} [J/mol]	ΔS_{Pd} [J/(mol·K)]	$G_{\mathrm{Pd}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Pd}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Pd}	γ_{Pd}
0.000	$-\infty$	30750	∞	22350	3.000	0.000	2.612
0.100	−35502	24908	21.575	18104	2.430	0.218	2.176
0.200	−23165	19680	15.302	14304	1.920	0.370	1.849
0.300	−17078	15068	11.480	10952	1.470	0.480	1.601
0.400	−13286	11070	8.699	8046	1.080	0.565	1.413
0.500	−10549	7688	6.513	5588	0.750	0.636	1.271
0.600	−8316	4920	4.727	3576	0.480	0.700	1.166
0.700	−6292	2768	3.236	2012	0.270	0.763	1.090
0.800	−4301	1230	1.975	894	0.120	0.831	1.039
0.900	−2229	308	0.906	224	0.030	0.909	1.010
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Pd(liquid)

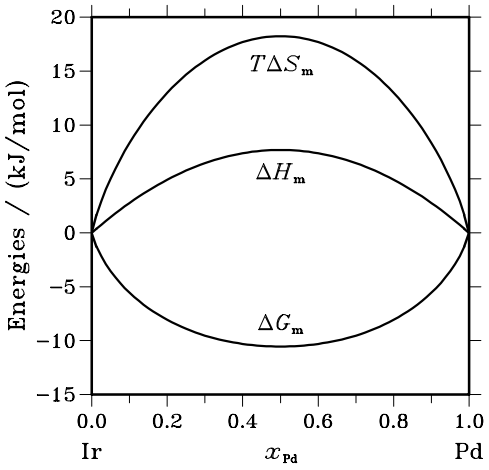

Fig. 2. Integral quantities of the liquid phase at T=2800 K.

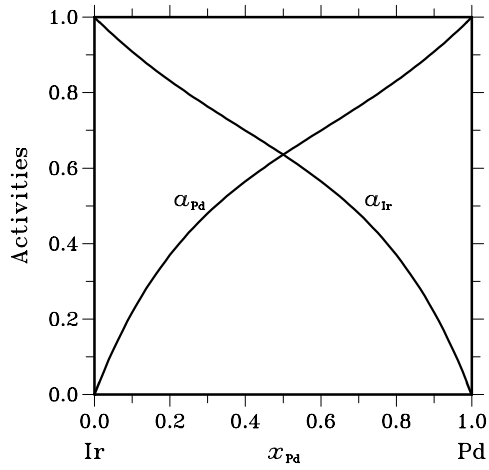

Fig. 3. Activities in the liquid phase at T=2800 K.

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

Phase	x_{Pd}	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	−2255	3096	2.973	2610	0.270	0.000
	0.200	−2849	5504	4.641	4640	0.480	0.000
	0.300	−3052	7224	5.709	6090	0.630	0.000
	0.400	−3112	8256	6.316	6960	0.720	0.000
	0.500	−3124	8600	6.513	7250	0.750	0.000
	0.600	−3112	8256	6.316	6960	0.720	0.000
	0.700	−3052	7224	5.709	6090	0.630	0.000
	0.800	−2849	5504	4.641	4640	0.480	0.000
	0.900	−2255	3096	2.973	2610	0.270	0.000
	1.000	0	0	0.000	0	0.000	0.000

Reference states: Ir(fcc), Pd(fcc)

Table IVb. Partial quantities for Ir in the stable phases at 1800 K.

Phase	x_{Ir}	ΔG_{Ir} [J/mol]	ΔH_{Ir} [J/mol]	ΔS_{Ir} [J/(mol·K)]	$G^{\mathrm{E}}_{\mathrm{Ir}}$ [J/mol]	$S^{\mathrm{E}}_{\mathrm{Ir}}$ [J/(mol·K)]	a_{Ir}	γ_{Ir}
fcc	1.000	0	0	0.000	0	0.000	1.000	1.000
	0.900	−1287	344	0.906	290	0.030	0.918	1.020
	0.800	−2180	1376	1.975	1160	0.120	0.864	1.081
	0.700	−2728	3096	3.236	2610	0.270	0.833	1.191
	0.600	−3005	5504	4.727	4640	0.480	0.818	1.363
	0.500	−3124	8600	6.513	7250	0.750	0.812	1.623
	0.400	−3273	12384	8.699	10440	1.080	0.804	2.009
	0.300	−3809	16856	11.480	14210	1.470	0.775	2.584
	0.200	−5527	22016	15.302	18560	1.920	0.691	3.456
	0.100	−10971	27864	21.575	23490	2.430	0.480	4.804
	0.000	$-\infty$	34400	∞	29000	3.000	0.000	6.943

Reference state: Ir(fcc)

Table IVc. Partial quantities for Pd in the stable phases at 1800 K.

Phase	x_{Pd}	ΔG_{Pd} [J/mol]	ΔH_{Pd} [J/mol]	ΔS_{Pd} [J/(mol·K)]	$G^{\mathrm{E}}_{\mathrm{Pd}}$ [J/mol]	$S^{\mathrm{E}}_{\mathrm{Pd}}$ [J/(mol·K)]	a_{Pd}	γ_{Pd}
fcc	0.000	$-\infty$	34400	∞	29000	3.000	0.000	6.943
	0.100	−10971	27864	21.575	23490	2.430	0.480	4.804
	0.200	−5527	22016	15.302	18560	1.920	0.691	3.456
	0.300	−3809	16856	11.480	14210	1.470	0.775	2.584
	0.400	−3273	12384	8.699	10440	1.080	0.804	2.009
	0.500	−3124	8600	6.513	7250	0.750	0.812	1.623
	0.600	−3005	5504	4.727	4640	0.480	0.818	1.363
	0.700	−2728	3096	3.236	2610	0.270	0.833	1.191
	0.800	−2180	1376	1.975	1160	0.120	0.864	1.081
	0.900	−1287	344	0.906	290	0.030	0.918	1.020
	1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Pd(fcc)

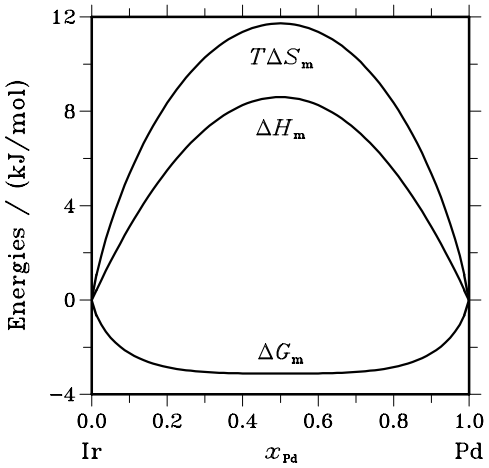

Fig. 4. Integral quantities of the stable phases at T=1800 K.

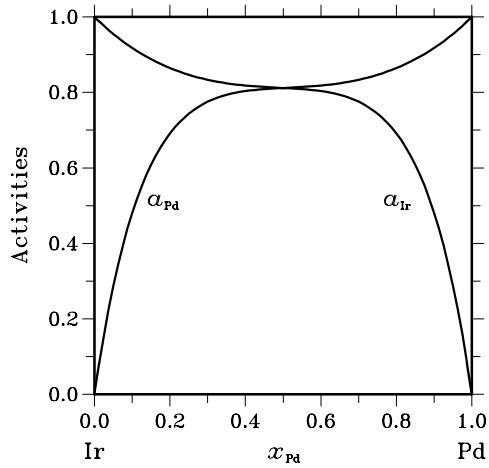

Fig. 5. Activities in the stable phases at T=1800 K.

References

[91Tri] S.N. Tripathi, S.R. Bharadwaj, M.S. Chandrasekharaiah: J. Phase Equilibria **12** (1991) 603–605.

[98Spe] P.J. Spencer: unpublished assessment, 1998.