Cu – Ir (Copper – Iridium)

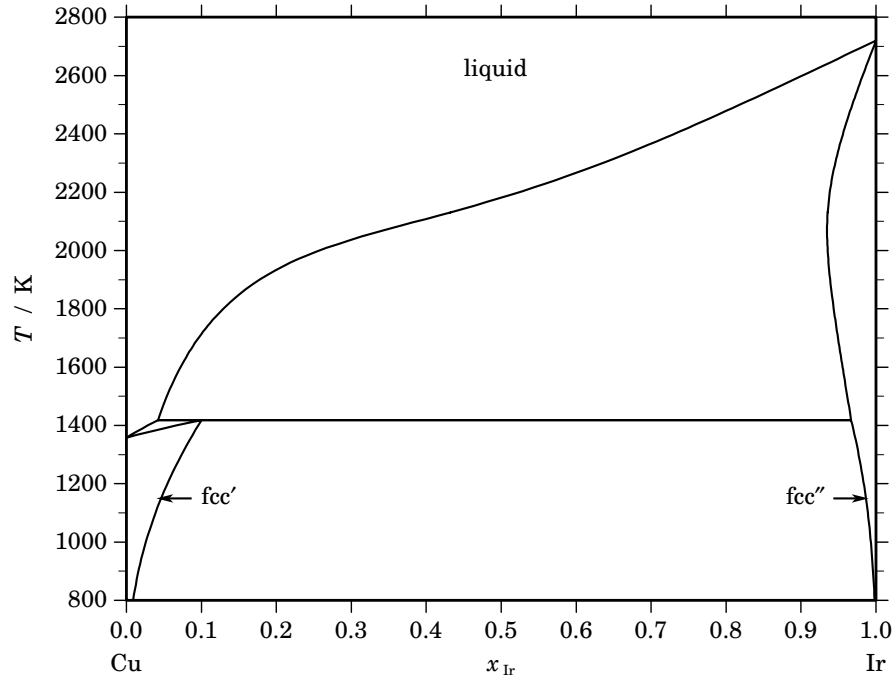

Fig. 1. Calculated phase diagram for the system Cu-Ir.

The thermodynamic description of the Cu-Ir system is based on the only reported phase diagram study below 1473 K [1969Rau]. The higher temperature part of the diagram (above 1473 K) was estimated from calculations based on thermodynamic modelling of the experimental phase diagram data. The equilibrium phases of the Cu-Ir system are the liquid, miscible in all proportions and stable down to the melting point of Cu, the fcc solid solution based on Cu, which has a maximum solubility of about 8 at.% Ir at the peritectic temperature and the fcc solid solution based on Ir, which has a maximum solubility of 6.3 at.% Cu at 2123 K [1987Cha]. According to [1969Rau] the peritectic temperature is 1411±5 K, and the corresponding compositions of the liquid, fcc', and fcc" phases are 4, 8, 97 at.% Ir, respectively. This behaviour can be reproduced well by the calculations. The calculated Cu-Ir phase diagram indicates a good agreement with published experimental data [1987Cha].

Table I. Phases, structures and models.

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

Table II. Invariant reactions.

Reaction	Type	T / K	Compositions / x_{Ir}			$\Delta_{\mathrm{r}}H$ / (J/mol)
liquid + fcc″ $\rightleftharpoons$ fcc′	peritectic	1418.6	0.042	0.967	0.100	−10622

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

x_{Ir}	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	−4682	1492	2.205	2886	−0.498	0.000
0.200	−6724	2448	3.276	4926	−0.885	0.000
0.300	−8025	2943	3.917	6196	−1.162	0.000
0.400	−8895	3056	4.268	6774	−1.328	0.000
0.500	−9401	2863	4.380	6735	−1.383	0.000
0.600	−9510	2441	4.268	6159	−1.328	0.000
0.700	−9102	1867	3.917	5120	−1.162	0.000
0.800	−7954	1218	3.276	3696	−0.885	0.000
0.900	−5605	570	2.205	1964	−0.498	0.000
1.000	0	0	0.000	0	0.000	0.000

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

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

x_{Cu}	ΔG_{Cu} [J/mol]	ΔH_{Cu} [J/mol]	ΔS_{Cu} [J/(mol·K)]	$G_{\mathrm{Cu}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Cu}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Cu}	γ_{Cu}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	−2017	281	0.821	436	−0.055	0.917	1.019
0.800	−3554	1022	1.634	1641	−0.221	0.858	1.073
0.700	−4841	2069	2.468	3463	−0.498	0.812	1.160
0.600	−6147	3268	3.362	5746	−0.885	0.768	1.280
0.500	−7800	4465	4.380	8337	−1.383	0.715	1.431
0.400	−10249	5507	5.627	11083	−1.991	0.644	1.610
0.300	−14200	6240	7.300	13829	−2.710	0.543	1.811
0.200	−21046	6510	9.842	16423	−3.540	0.405	2.025
0.100	−34896	6164	14.664	18709	−4.480	0.223	2.234
0.000	$-\infty$	5047	∞	20536	−5.531	0.000	2.416

Reference state: Cu(liquid)

Table IIIc. 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}
0.000	$-\infty$	17860	∞	33348	−5.531	0.000	4.189
0.100	−28669	12391	14.664	24936	−4.480	0.292	2.919
0.200	−19406	8150	9.842	18063	−3.540	0.434	2.172
0.300	−15456	4984	7.300	12574	−2.710	0.515	1.716
0.400	−13017	2740	5.627	8315	−1.991	0.572	1.429
0.500	−11003	1262	4.380	5134	−1.383	0.623	1.247
0.600	−9017	398	3.362	2876	−0.885	0.679	1.131
0.700	−6917	−7	2.468	1387	−0.498	0.743	1.061
0.800	−4681	−106	1.634	514	−0.221	0.818	1.022
0.900	−2350	−52	0.821	103	−0.055	0.904	1.004
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Ir(liquid)

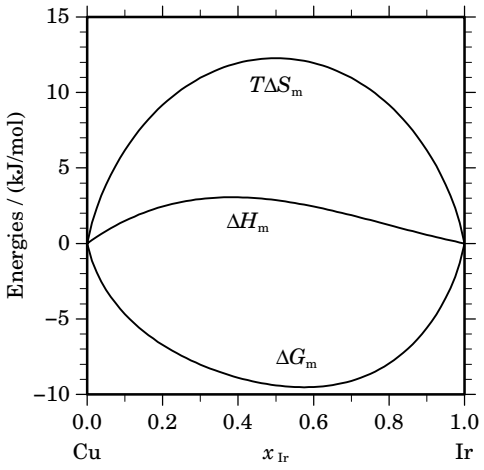

Fig. 2. Integral quantities of the liquid phase at T=2800 K.

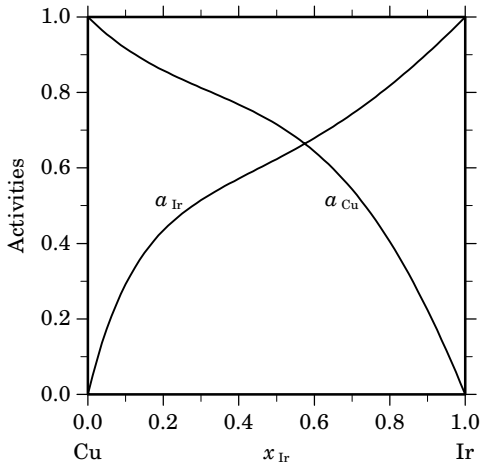

Fig. 3. Activities in the liquid phase at T=2800 K.

References

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[1987Cha] D.J. Chakrabarti, D.E. Laughlin: Bull. Alloy Phase Diagrams **8** (1987) 132–136.
[2004Kor] J. Korb, unpublished assessment, GTT-Technologies, 2004.