Au – Co (Gold – Cobalt)

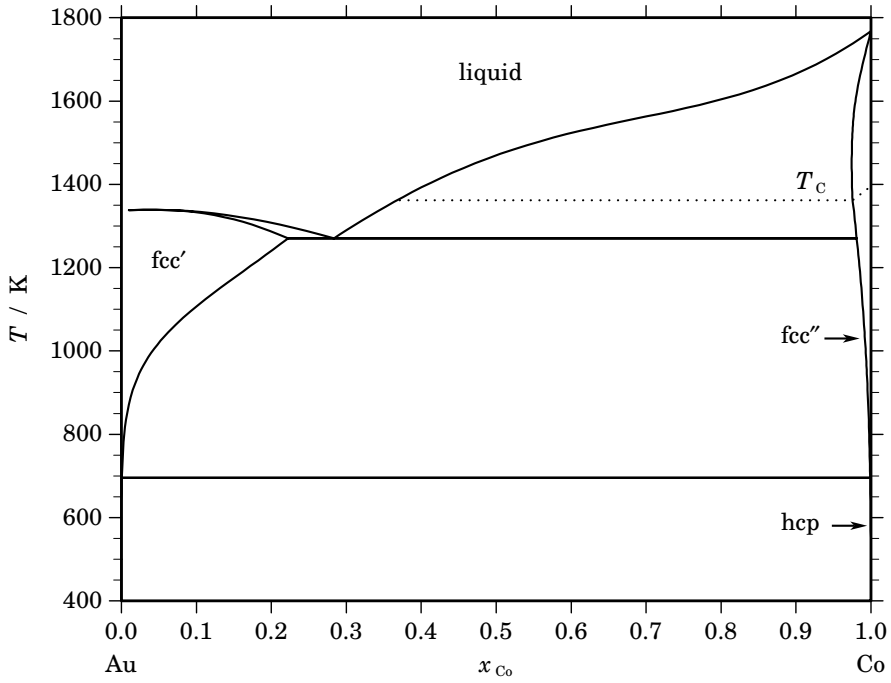

Fig. 1. Calculated phase diagram for the system Au-Co.

The equilibrium phases of the Au-Co system are: the liquid, the fcc solid solution which is separated by a large miscibility gap into a gold-rich phase dissolving up to 22 at.% Co and a Co-rich phase with an Au-solubility of less than 2 at.%, and the hcp-Co based phase containing less than 0.05 at.% Au. The thermodynamic descriptions for the Au-Co system has been obtained by Korb [2004Kor]. The assessed phase boundaries are based mainly on the experimental data of [1950Rau] and [1984Tas]. The liquidus boundary in equilibrium with Co-rich alloys is based on the results of [1984Tas]. The calculated phase diagram is in good agreement with the critical review of [1987Oka].

Table I. Phases, structures and models.

Phase	Struktur-bericht	Prototype	Pearson symbol	Space group	SGTE name	Model
liquid					LIQUID	$(Au,Co)_1$
fcc	$A1$	Cu	$cF4$	$Fm\overline{3}m$	FCC_A1	$(Au,Co)_1$
hcp	$A3$	Mg	$hP2$	$P6_3/mmc$	HCP_A3	$(Au,Co)_1$

Table II. Invariant reactions.

Reaction	Type	T / K	Compositions / x_{Co}			$\Delta_r H$ / (J/mol)
liquid $\rightleftharpoons$ fcc′ + fcc″	eutectic	1270.7	0.284	0.222	0.981	−7702
fcc′ + fcc″ $\rightleftharpoons$ hcp	peritectoid	695.4	0.001	0.999	0.999	−422

Table IIIa. Integral quantities for the liquid phase at 1800 K.

x_{Co}	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	−4152	1527	3.155	714	0.452	0.000
0.200	−5963	2754	4.843	1526	0.682	0.000
0.300	−6802	3667	5.816	2340	0.737	0.000
0.400	−7013	4250	6.257	3060	0.661	0.000
0.500	−6785	4490	6.264	3589	0.500	0.000
0.600	−6242	4370	5.895	3831	0.299	0.000
0.700	−5453	3876	5.183	3689	0.104	0.000
0.800	−4421	2993	4.119	3068	−0.042	0.000
0.900	−2995	1706	2.612	1870	−0.091	0.000
1.000	0	0	0.000	0	0.000	0.000

Reference states: Au(liquid), Co(liquid)

Table IIIb. Partial quantities for Au in the liquid phase at 1800 K.

x_{Au}	ΔG_{Au} [J/mol]	ΔH_{Au} [J/mol]	ΔS_{Au} [J/(mol·K)]	$G_{\mathrm{Au}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Au}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Au}	γ_{Au}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	−1642	147	0.994	−65	0.118	0.896	0.996
0.800	−3472	609	2.267	−132	0.412	0.793	0.991
0.700	−5347	1415	3.757	−9	0.791	0.700	0.999
0.600	−7147	2595	5.412	498	1.165	0.620	1.034
0.500	−8793	4178	7.206	1581	1.443	0.556	1.111
0.400	−10280	6196	9.154	3433	1.535	0.503	1.258
0.300	−11772	8677	11.361	6247	1.350	0.455	1.518
0.200	−13872	11652	14.180	10215	0.799	0.396	1.979
0.100	−18931	15151	18.934	15530	−0.211	0.282	2.823
0.000	−∞	19202	∞	22385	−1.768	0.000	4.463

Reference state: Au(liquid)

Table IIIc. Partial quantities for Co in the liquid phase at 1800 K.

x_{Co}	ΔG_{Co} [J/mol]	ΔH_{Co} [J/mol]	ΔS_{Co} [J/(mol·K)]	$G_{\mathrm{Co}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Co}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Co}	γ_{Co}
0.000	−∞	16714	∞	6324	5.772	0.000	1.526
0.100	−26736	13941	22.599	7724	3.454	0.168	1.676
0.200	−15928	11334	15.146	8159	1.764	0.345	1.725
0.300	−10198	8921	10.622	7821	0.611	0.506	1.686
0.400	−6811	6734	7.525	6902	−0.094	0.634	1.586
0.500	−4777	4801	5.321	5596	−0.442	0.727	1.453
0.600	−3550	3152	3.723	4096	−0.524	0.789	1.315
0.700	−2745	1818	2.535	2593	−0.431	0.832	1.189
0.800	−2059	828	1.604	1281	−0.252	0.871	1.089
0.900	−1225	212	0.798	352	−0.078	0.921	1.024
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Co(liquid)

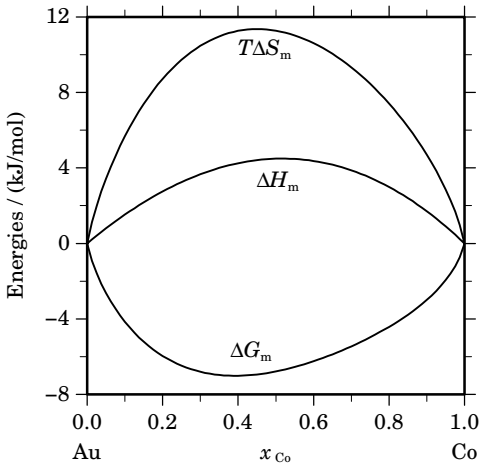

Fig. 2. Integral quantities of the liquid phase at T=1800 K.

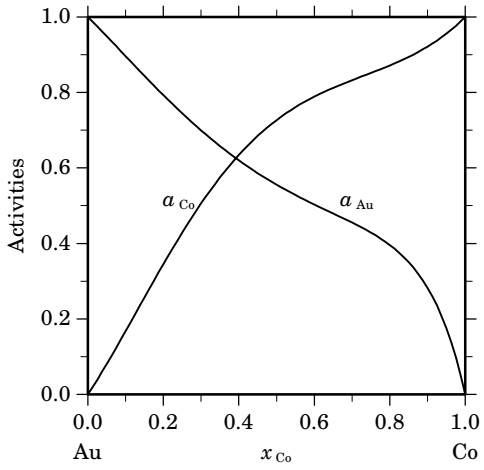

Fig. 3. Activities in the liquid phase at T=1800 K.

Table IVa. Integral quantities for the stable phases at 1270 K.

Phase	x_{Co}	ΔG_m [J/mol]	ΔH_m [J/mol]	ΔS_m [J/(mol·K)]	G_m^E [J/mol]	S_m^E [J/(mol·K)]	ΔC_P [J/(mol·K)]
fcc′	0.000	0	0	0.000	0	0.000	0.000
	0.100	−1838	6193	6.323	1595	3.620	−1.404
	0.200	−2067	10445	9.852	3217	5.692	−2.806
	0.222	−2027	11142	10.369	3562	5.968	−3.113
fcc″	0.981	−225	925	0.905	782	0.113	1.395
	1.000	0	0	0.000	0	0.000	0.000

Reference states: Au(fcc), Co(fcc)

Table IVb. Partial quantities for Au in the stable phases at 1270 K.

Phase	x_{Au}	ΔG_{Au} [J/mol]	ΔH_{Au} [J/mol]	ΔS_{Au} [J/(mol·K)]	G_{Au}^E [J/mol]	S_{Au}^E [J/(mol·K)]	a_{Au}	γ_{Au}
fcc′	1.000	0	0	0.000	0	0.000	1.000	1.000
	0.900	−1149	1012	1.701	−37	0.825	0.897	0.997
	0.800	−2319	3714	4.751	37	2.895	0.803	1.003
	0.778	−2554	4482	5.540	95	3.455	0.785	1.009
fcc″	0.019	−2554	48730	40.382	39130	7.559	0.785	40.679
	0.000	$-\infty$	47080	∞	41882	4.093	0.000	52.791

Reference state: Au(fcc)

Table IVc. Partial quantities for Co in the stable phases at 1270 K.

Phase	x_{Co}	ΔG_{Co} [J/mol]	ΔH_{Co} [J/mol]	ΔS_{Co} [J/(mol·K)]	G^{E}_{Co} [J/mol]	S^{E}_{Co} [J/(mol·K)]	a_{Co}	γ_{Co}
fcc′	0.000	$-\infty$	72457	∞	15352	44.965	0.000	4.280
	0.100	−8039	52821	47.922	16275	28.777	0.467	4.670
	0.200	−1059	37370	30.259	15935	16.878	0.905	4.523
	0.222	−179	34495	27.303	15719	14.784	0.983	4.431
fcc″	0.981	−179	−16	0.128	27	−0.034	0.983	1.003
	1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Co(fcc)

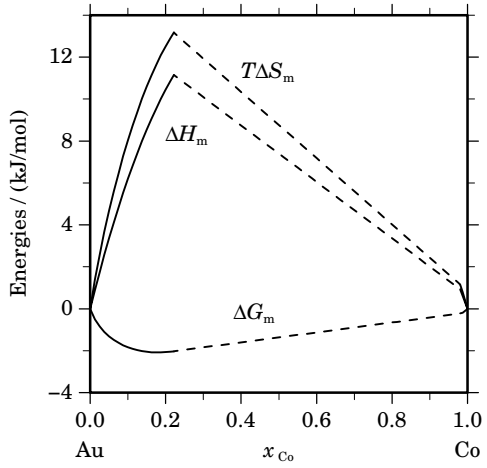

Fig. 4. Integral quantities of the stable phases at T=1270 K.

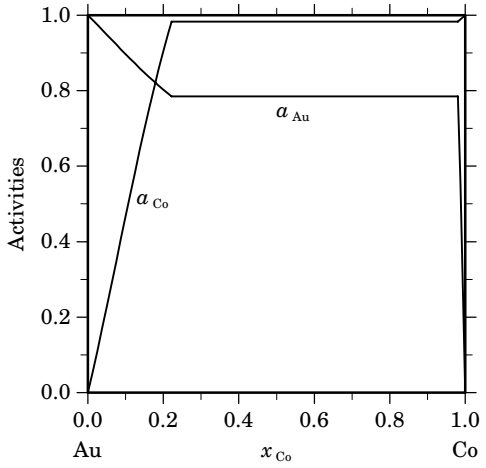

Fig. 5. Activities in the stable phases at T=1270 K.

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