Ir – Ni (Iridium – Nickel)

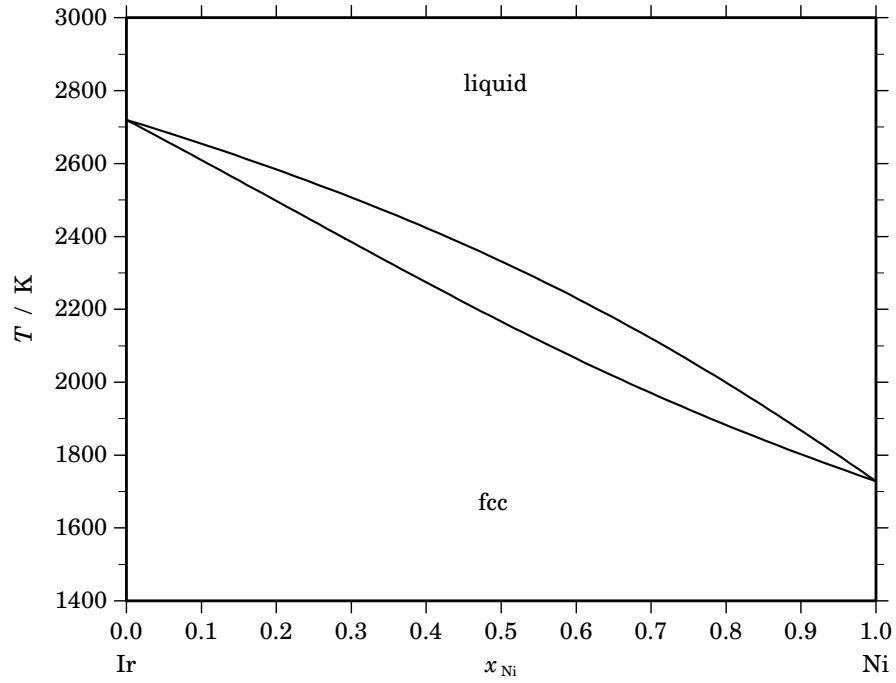

Fig. 1. Calculated phase diagram for the system Ir-Ni.

The thermodynamic description of the Ir-Ni system was established by Korb [2004Kor]. The equilibrium phases of the Ir-Ni system are the liquid and the fcc continuous solid solution. The Ir-Ni system was determined by [1970Rau] using X-ray diffraction (XRD) and optical microscopy. A continuous series of solid solutions was found, and no decomposition reaction or formation of superlattice phase was detected [1991Yan]. The same conclusion was confirmed by [1970Buc] on the basis of XRD, specific heat, magnetic susceptibility, and Debye temperature measurements. No changes in structure occurred after annealing alloys for several days in the temperature range from 773 to 1373 K [1970Buc]. The Curie temperatures of the fcc alloys were determined by [1960Cra]. The data show a linear dependence of Curie temperature on composition. The calculated phase diagram shows good agreement with published experimental data [1991Yan].

Table I. Phases, structures and models.

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

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

x_{Ni}	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	−7618	−50	2.703	−50	0.000	0.000
0.200	−11739	−89	4.161	−89	0.000	0.000
0.300	−14338	−117	5.079	−117	0.000	0.000
0.400	−15802	−134	5.596	−134	0.000	0.000
0.500	−16276	−139	5.763	−139	0.000	0.000
0.600	−15802	−134	5.596	−134	0.000	0.000
0.700	−14338	−117	5.079	−117	0.000	0.000
0.800	−11739	−89	4.161	−89	0.000	0.000
0.900	−7618	−50	2.703	−50	0.000	0.000
1.000	0	0	0.000	0	0.000	0.000

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

Table IIb. 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	−2458	−6	0.876	−6	0.000	0.900	1.000
0.800	−5217	−22	1.855	−22	0.000	0.799	0.999
0.700	−8354	−50	2.966	−50	0.000	0.698	0.998
0.600	−11981	−89	4.247	−89	0.000	0.598	0.996
0.500	−16276	−139	5.763	−139	0.000	0.497	0.994
0.400	−21532	−200	7.619	−200	0.000	0.397	0.991
0.300	−28302	−273	10.010	−273	0.000	0.297	0.988
0.200	−37825	−356	13.382	−356	0.000	0.197	0.985
0.100	−54057	−451	19.145	−451	0.000	0.098	0.981
0.000	$-\infty$	−557	∞	−557	0.000	0.000	0.976

Reference state: Ir(liquid)

Table IIc. Partial quantities for Ni in the liquid phase at 2800 K.

x_{Ni}	ΔG_{Ni} [J/mol]	ΔH_{Ni} [J/mol]	ΔS_{Ni} [J/(mol·K)]	$G_{\mathrm{Ni}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Ni}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Ni}	γ_{Ni}
0.000	$-\infty$	−557	∞	−557	0.000	0.000	0.976
0.100	−54057	−451	19.145	−451	0.000	0.098	0.981
0.200	−37825	−356	13.382	−356	0.000	0.197	0.985
0.300	−28302	−273	10.010	−273	0.000	0.297	0.988
0.400	−21532	−200	7.619	−200	0.000	0.397	0.991
0.500	−16276	−139	5.763	−139	0.000	0.497	0.994
0.600	−11981	−89	4.247	−89	0.000	0.598	0.996
0.700	−8354	−50	2.966	−50	0.000	0.698	0.998
0.800	−5217	−22	1.855	−22	0.000	0.799	0.999
0.900	−2458	−6	0.876	−6	0.000	0.900	1.000
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Ni(liquid)

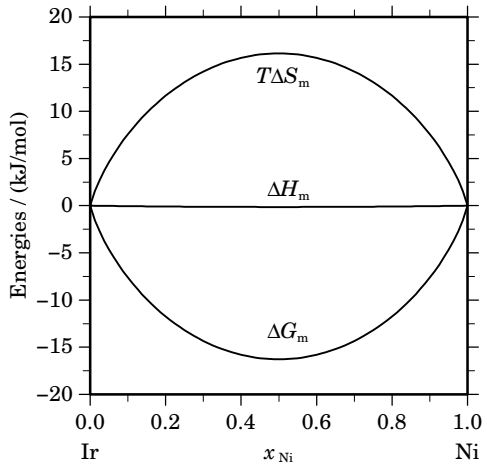

Fig. 2. Integral quantities of the liquid phase at T=2800 K.

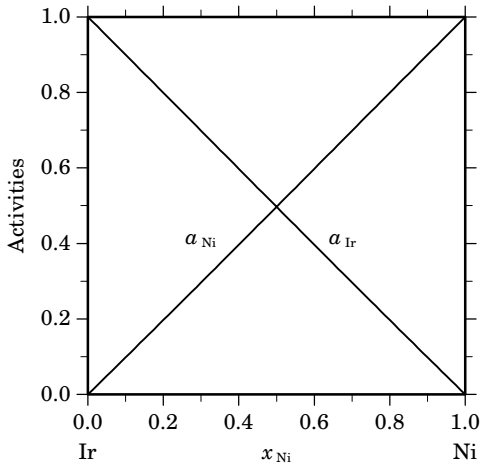

Fig. 3. Activities in the liquid phase at T=2800 K.

Table IIIa. Integral quantities for the stable phases at 1600 K.

Phase	x_{Ni}	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)]
fcc	0.000	0	0	0.000	0	0.000	0.000
	0.100	−4193	133	2.703	132	0.001	−0.003
	0.200	−6423	236	4.162	234	0.001	−0.006
	0.300	−7819	310	5.081	307	0.002	−0.009
	0.400	−8602	355	5.598	351	0.002	−0.011
	0.500	−8855	371	5.766	366	0.003	−0.014
	0.600	−8602	357	5.599	352	0.003	−0.016
	0.700	−7819	313	5.082	308	0.003	−0.017
	0.800	−6422	240	4.164	235	0.003	−0.015
	0.900	−4192	136	2.705	132	0.002	−0.010
	1.000	0	0	0.000	0	0.000	0.000

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

Table IIIb. Partial quantities for Ir in the stable phases at 1600 K.

Phase	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}
fcc	1.000	0	0	0.000	0	0.000	1.000	1.000
	0.900	−1387	15	0.876	15	0.000	0.901	1.001
	0.800	−2910	58	1.855	58	0.000	0.804	1.004
	0.700	−4614	131	2.966	131	0.000	0.707	1.010
	0.600	−6562	234	4.247	234	0.000	0.611	1.018
	0.500	−8856	366	5.764	365	0.000	0.514	1.028
	0.400	−11663	528	7.620	526	0.001	0.416	1.040
	0.300	−15300	722	10.014	717	0.003	0.317	1.055
	0.200	−20473	950	13.389	937	0.008	0.215	1.073
	0.100	−29443	1213	19.160	1189	0.015	0.109	1.093
	0.000	$-\infty$	1516	∞	1471	0.028	0.000	1.117

Reference state: Ir(fcc)

Table IIIc. Partial quantities for Ni in the stable phases at 1600 K.

Phase	x_{Ni}	ΔG_{Ni} [J/mol]	ΔH_{Ni} [J/mol]	ΔS_{Ni} [J/(mol·K)]	$G^{\mathrm{E}}_{\mathrm{Ni}}$ [J/mol]	$S^{\mathrm{E}}_{\mathrm{Ni}}$ [J/(mol·K)]	a_{Ni}	γ_{Ni}
fcc	0.000	$-\infty$	1472	∞	1462	0.006	0.000	1.116
	0.100	−29447	1194	19.151	1185	0.006	0.109	1.093
	0.200	−20474	946	13.387	937	0.006	0.215	1.073
	0.300	−15299	727	10.016	718	0.006	0.317	1.055
	0.400	−11662	537	7.624	528	0.005	0.416	1.040
	0.500	−8854	375	5.768	367	0.005	0.514	1.028
	0.600	−6560	242	4.252	235	0.004	0.611	1.018
	0.700	−4612	138	2.969	133	0.003	0.707	1.010
	0.800	−2909	62	1.857	59	0.002	0.804	1.004
	0.900	−1387	16	0.877	15	0.001	0.901	1.001
	1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Ni(fcc)

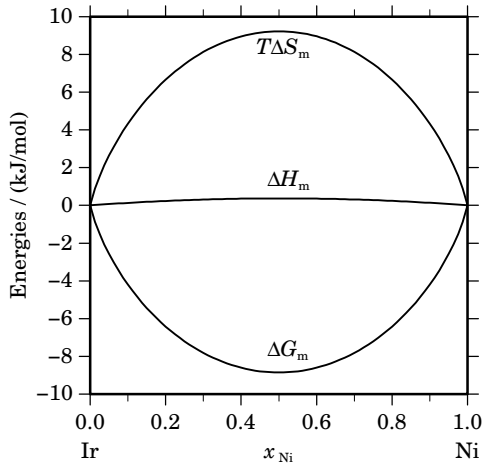

Fig. 4. Integral quantities of the stable phases at T=1600 K.

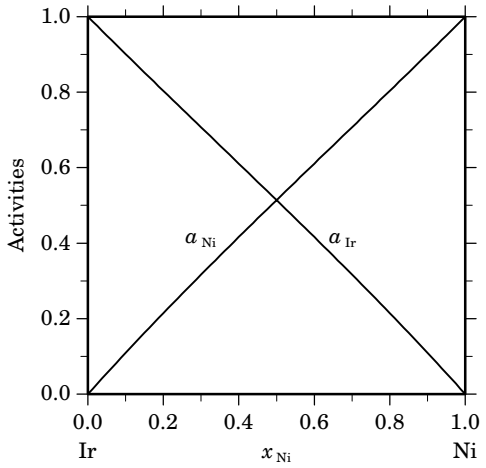

Fig. 5. Activities in the stable phases at T=1600 K.

References

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