Gd – Li (Gadolinium – Lithium)

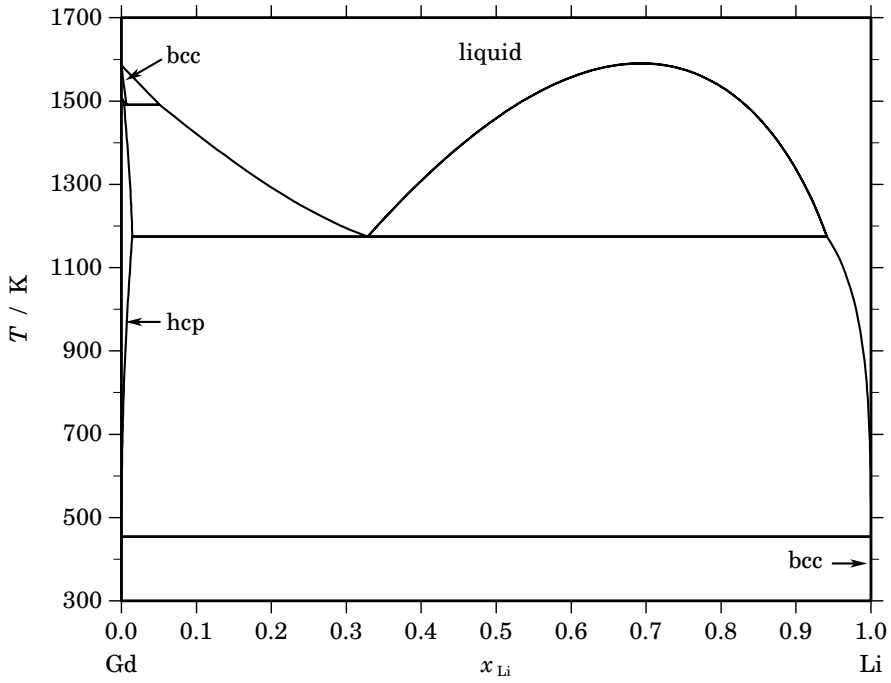

Fig. 1. Calculated phase diagram for the system Gd-Li.

Lithium is a common addition for magnesium alloys in order to decrease their density and to improve the ductility. Rare Earth metals can enable precipitation hardening of magnesium alloys and enhance the castability. Only very few data have been reported about the Gd-Li system. At 473 K no mutual solubility of the elements could be observed [1989Pav]. In DTA experiments [1998Gan] only two invariant temperatures have been detected, a eutectic almost degenerate on the Li-side, and a monotectic at higher temperatures. The existence of the miscibility gap has been verified experimentally [2001Kev] and in the course of an assessment of the ternary system Gd-Li-Mg, the dataset for the binary Gd-Li has been optimised as well [2001Kev].

Table I. Phases, structures and models.

Phase	Struktur-bericht	Prototype	Pearson symbol	Space group	SGTE name	Model
liquid					LIQUID	$(Gd,Li)_1$
bcc	$A2$	W	$cI2$	$Im\overline{3}m$	BCC_A2	$(Gd,Li)_1$
hcp	$A3$	Mg	$hP2$	$P6_3/mmc$	HCP_A3	$(Gd,Li)_1$

Table II. Invariant reactions.

Reaction	Type	T / K	Compositions / x_{Li}			$\Delta_{\mathrm{r}}H$ / (J/mol)
liquid $\rightleftharpoons$ liquid′ + liquid″	critical	1589.4	0.693	0.693	0.693	0
bcc $\rightleftharpoons$ hcp + liquid′	metatectic	1491.4	0.007	0.004	0.051	−2682
liquid′ $\rightleftharpoons$ hcp + liquid″	monotectic	1174.5	0.329	0.014	0.941	−11438
hcp + liquid″ $\rightleftharpoons$ bcc	peritectic	453.7	0.000	1.000	1.000	−2994

Table IIIa. Integral quantities for the liquid phase at 1600 K.

x_{Li}	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	−3183	1141	2.703	1141	0.000	0.000
0.200	−4327	2330	4.161	2330	0.000	0.000
0.300	−4674	3452	5.079	3452	0.000	0.000
0.400	−4556	4397	5.596	4397	0.000	0.000
0.500	−4171	5050	5.763	5050	0.000	0.000
0.600	−3654	5299	5.596	5299	0.000	0.000
0.700	−3095	5032	5.079	5032	0.000	0.000
0.800	−2523	4134	4.161	4134	0.000	0.000
0.900	−1830	2495	2.703	2495	0.000	0.000
1.000	0	0	0.000	0	0.000	0.000

Reference states: Gd(liquid), Li(liquid)

Table IIIb. Partial quantities for Gd in the liquid phase at 1600 K.

x_{Gd}	ΔG_{Gd} [J/mol]	ΔH_{Gd} [J/mol]	ΔS_{Gd} [J/(mol·K)]	$G_{\mathrm{Gd}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Gd}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Gd}	γ_{Gd}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	−1444	−42	0.876	−42	0.000	0.897	0.997
0.800	−2988	−19	1.855	−19	0.000	0.799	0.999
0.700	−4450	295	2.966	295	0.000	0.716	1.022
0.600	−5669	1126	4.247	1126	0.000	0.653	1.088
0.500	−6521	2700	5.763	2700	0.000	0.613	1.225
0.400	−6948	5242	7.619	5242	0.000	0.593	1.483
0.300	−7040	8977	10.010	8977	0.000	0.589	1.964
0.200	−7280	14131	13.382	14131	0.000	0.579	2.893
0.100	−9701	20930	19.145	20930	0.000	0.482	4.823
0.000	$-\infty$	29600	∞	29600	0.000	0.000	9.254

Reference state: Gd(liquid)

Table IIIc. Partial quantities for Li in the liquid phase at 1600 K.

x_{Li}	ΔG_{Li} [J/mol]	ΔH_{Li} [J/mol]	ΔS_{Li} [J/(mol·K)]	$G_{\mathrm{Li}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Li}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Li}	γ_{Li}
0.000	$-\infty$	10800	∞	10800	0.000	0.000	2.252
0.100	−18838	11794	19.145	11794	0.000	0.243	2.427
0.200	−9686	11725	13.382	11725	0.000	0.483	2.414
0.300	−5198	10819	10.010	10819	0.000	0.677	2.255
0.400	−2887	9302	7.619	9302	0.000	0.805	2.012
0.500	−1821	7400	5.763	7400	0.000	0.872	1.744
0.600	−1458	5338	4.247	5338	0.000	0.896	1.494
0.700	−1404	3341	2.966	3341	0.000	0.900	1.285
0.800	−1333	1635	1.855	1635	0.000	0.905	1.131
0.900	−955	446	0.876	446	0.000	0.931	1.034
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Li(liquid)

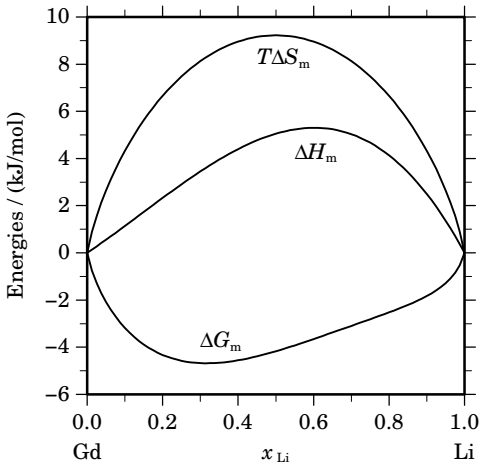

Fig. 2. Integral quantities of the liquid phase at T=1600 K.

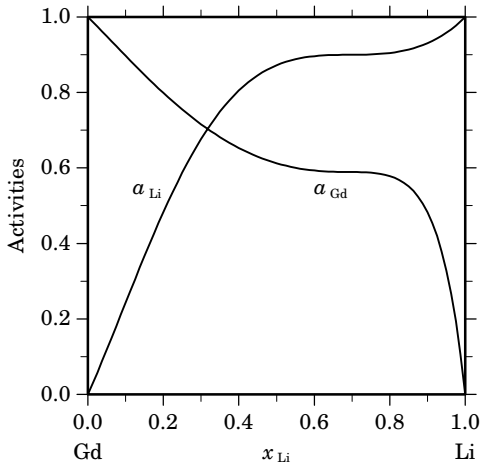

Fig. 3. Activities in the liquid phase at T=1600 K.

References

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