Os – Si (Osmium – Silicon)

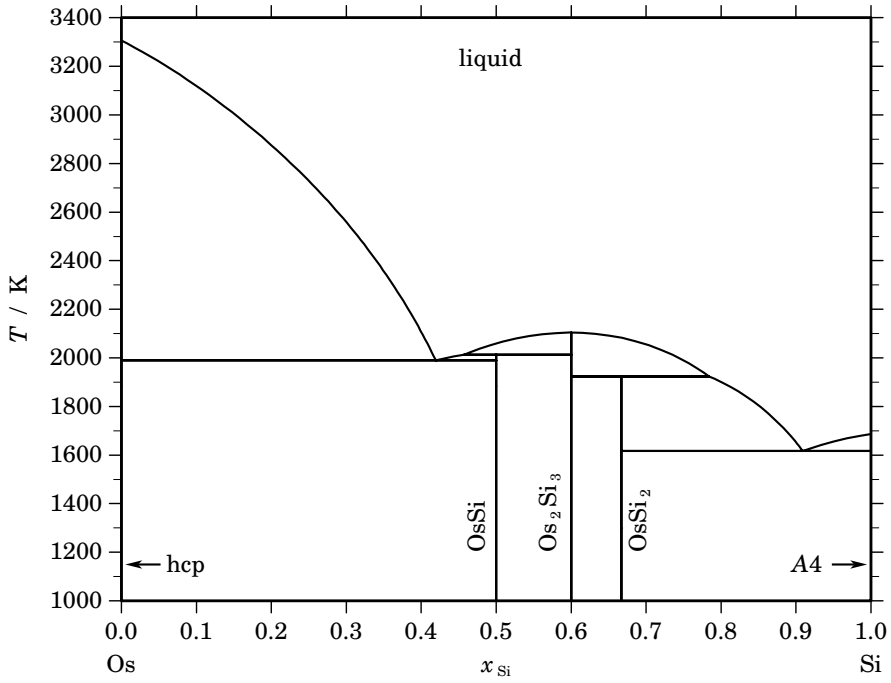

Fig. 1. Calculated phase diagram for the system Os-Si.

A survey on the literature of the Os-Si system and a thermodynamic assessment has been reported in [2001Liu]. The complete phase diagram of the system has been investigated by [1988Sch]. In addition to these data [2001Liu] have selected results from [1962Fin, 1983Mas]. Except for the enthalpy of formation of Os_2Si_3 [1998Mes] no other thermodynamic data have been determined experimentally.

Table I. Phases, structures and models.

Phase	Struktur-bericht	Prototype	Pearson symbol	Space group	SGTE name	Model
liquid					LIQUID	$(Os,Si)_1$
hcp	$A3$	Mg	$hP2$	$P6_3/mmc$	HCP_A3	$(Os,Si)_1$
OsSi	$B20$	FeSi	$cP8$	$P2_13$	OSSI	Os_1Si_1
Os_2Si_3	$\cdots$	$\cdots$	$oP40$	$Pbcn$	OS2SI3	Os_2Si_3
$OsSi_2$	$\cdots$	$FeSi_2$	$oC48$	$Cmca$	OSSI2	Os_1Si_2
$A4$	$A4$	C(diamond)	$cF8$	$Fd\overline{3}m$	DIAMOND_A4	Si_1

Table II. Invariant reactions.

Reaction	Type	T / K	Compositions / x_{Si}			$\Delta_r H$ / (J/mol)
liquid $\rightleftharpoons$ Os_2Si_3	congruent	2103.9	0.600	0.600		−45530
liquid + Os_2Si_3 $\rightleftharpoons$ OsSi	peritectic	2013.0	0.457	0.600	0.500	−26309
liquid $\rightleftharpoons$ hcp + OsSi	eutectic	1990.3	0.419	0.000	0.500	−36247
Os_2Si_3 + liquid $\rightleftharpoons$ $OsSi_2$	peritectic	1923.2	0.600	0.784	0.667	−18032
liquid $\rightleftharpoons$ $OsSi_2$ + $A4$	eutectic	1616.3	0.909	0.667	1.000	−44778

Table IIIa. Integral quantities for the liquid phase at 3400 K.

x_{Si}	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	−11585	−9343	0.659	−2395	−2.043	0.000
0.200	−18082	−17492	0.174	−3936	−3.987	0.000
0.300	−22012	−24116	−0.619	−4743	−5.698	0.000
0.400	−23963	−28884	−1.447	−4938	−7.043	0.000
0.500	−24235	−31466	−2.127	−4640	−7.890	0.000
0.600	−22997	−31531	−2.510	−3972	−8.106	0.000
0.700	−20321	−28747	−2.478	−3053	−7.557	0.000
0.800	−16150	−22785	−1.952	−2004	−6.112	0.000
0.900	−10136	−13313	−0.934	−946	−3.637	0.000
1.000	0	0	0.000	0	0.000	0.000

Reference states: Os(liquid), Si(liquid)

Table IIIb. Partial quantities for Os in the liquid phase at 3400 K.

x_{Os}	ΔG_{Os} [J/mol]	ΔH_{Os} [J/mol]	ΔS_{Os} [J/(mol·K)]	$G_{\mathrm{Os}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Os}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Os}	γ_{Os}
1.000	0	0	0.000	0	0.000	1.000	1.000
0.900	−3426	−542	0.848	−447	−0.028	0.886	0.984
0.800	−7936	−2609	1.567	−1628	−0.288	0.755	0.944
0.700	−13384	−6862	1.918	−3301	−1.047	0.623	0.890
0.600	−19664	−13963	1.677	−5224	−2.570	0.499	0.831
0.500	−26751	−24574	0.640	−7156	−5.123	0.388	0.776
0.400	−34758	−39357	−1.352	−8855	−8.971	0.292	0.731
0.300	−44117	−58972	−4.369	−10081	−14.380	0.210	0.700
0.200	−56089	−84082	−8.233	−10591	−21.615	0.138	0.688
0.100	−75237	−115349	−11.798	−10144	−30.943	0.070	0.698
0.000	$-\infty$	−153434	∞	−8499	−42.628	0.000	0.740

Reference state: Os(liquid)

Table IIIc. Partial quantities for Si in the liquid phase at 3400 K.

x_{Si}	ΔG_{Si} [J/mol]	ΔH_{Si} [J/mol]	ΔS_{Si} [J/(mol·K)]	$G_{\mathrm{Si}}^{\mathrm{E}}$ [J/mol]	$S_{\mathrm{Si}}^{\mathrm{E}}$ [J/(mol·K)]	a_{Si}	γ_{Si}
0.000	$-\infty$	−98296	∞	−28623	−20.492	0.000	0.363
0.100	−85017	−88552	−1.040	−19925	−20.185	0.049	0.494
0.200	−58665	−77025	−5.400	−13167	−18.782	0.126	0.628
0.300	−42144	−64376	−6.539	−8109	−16.549	0.225	0.751
0.400	−30412	−51266	−6.134	−4509	−13.752	0.341	0.853
0.500	−21720	−38359	−4.894	−2125	−10.657	0.464	0.928
0.600	−15157	−26314	−3.282	−716	−7.529	0.585	0.975
0.700	−10123	−15794	−1.668	−40	−4.633	0.699	0.999
0.800	−6165	−7461	−0.381	143	−2.236	0.804	1.005
0.900	−2902	−1975	0.273	76	−0.603	0.902	1.003
1.000	0	0	0.000	0	0.000	1.000	1.000

Reference state: Si(liquid)

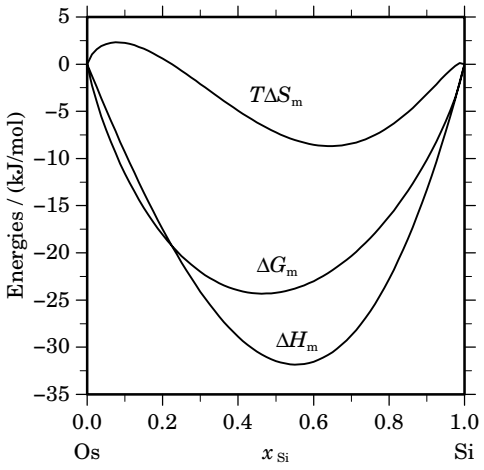

Fig. 2. Integral quantities of the liquid phase at T=3400 K.

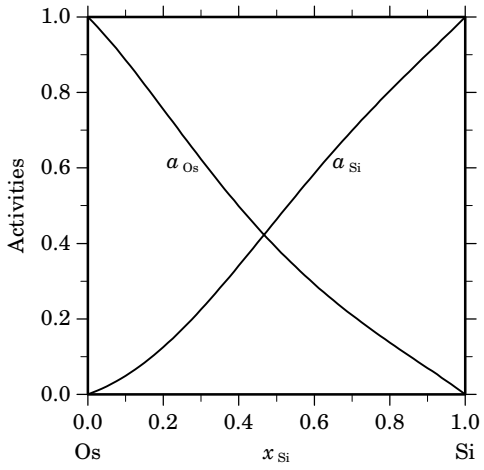

Fig. 3. Activities in the liquid phase at T=3400 K.

Table IV. Standard reaction quantities at 298.15 K for the compounds per mole of atoms.

Compound	x_{Si}	$\Delta_f G^\circ$ / (J/mol)	$\Delta_f H^\circ$ / (J/mol)	$\Delta_f S^\circ$ / (J/(mol·K))	$\Delta_f C_P^\circ$ / (J/(mol·K))
Os_1Si_1	0.500	−25045	−25415	−1.242	0.000
Os_2Si_3	0.600	−29912	−30450	−1.805	0.000
Os_1Si_2	0.667	−28148	−28745	−2.001	0.000

References

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