

Pd-Si (Palladium-Silicon)

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The Pd-Si phase diagram in [Massalski2] was assessed by [1989Cha]. The phase diagram was revised by [1993Mas], as reported by [1993Oka].

Figure 1 shows the Pd-Si phase diagram thermodynamically assessed by [2006Du] primarily based on the work of [1993Mas]. Figure 2 shows the detail of Fig. 1 from 10 to 25 at.% Si. Special points in these figures are summarized in Table 1.

Although the calculated phase diagram appears to be a good presentation of numerous experimental data points, the following points must be confirmed.

- Stability of α Pd₂Si, Pd₃₉Si₂₀, and Pd₁₉Si₁₀: It is unlikely that two or more compounds with closely comparable compositions exist over a wide temperature range.
- Curvature of the Pd₂₁Si₄/(Pd₂₁Si₄ + Pd₅Si) phase boundary: A smooth extrapolation of this boundary to the low-temperature side appears to lead to a transition of Pd₅Si to Pd₂₁Si₄ on cooling, which is unlikely.

Table 2 summarizes Pd-Si crystal structure data given in [1989Cha] and [Pearson3].

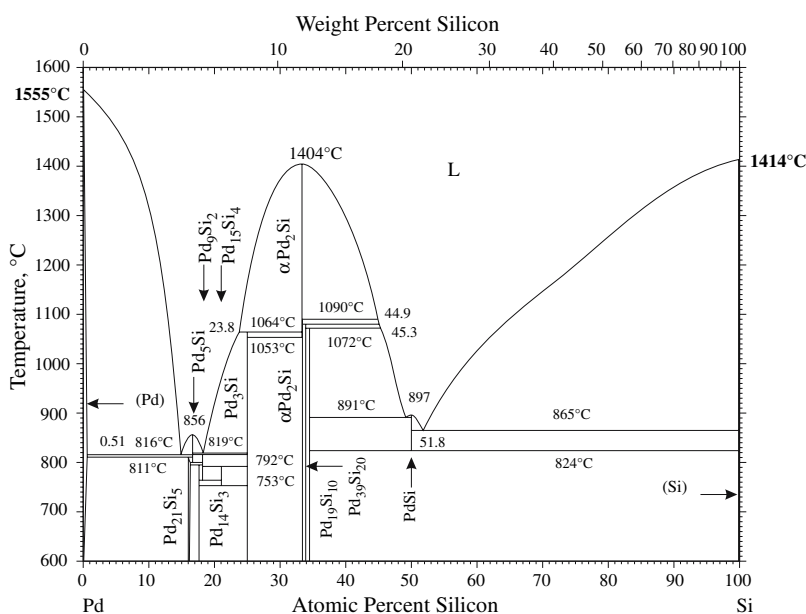


Fig. 1 Pd-Si phase diagram

Section III: Supplemental Literature Review

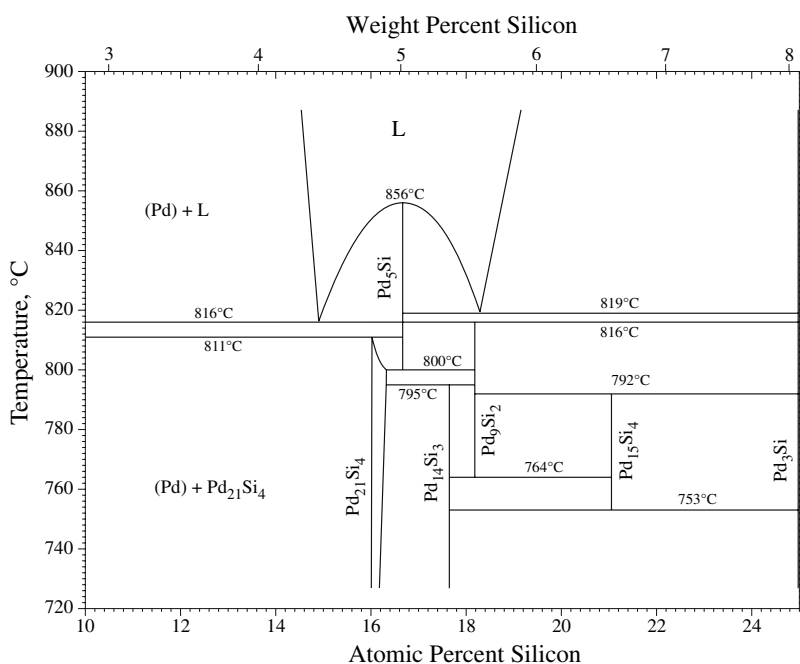


Fig. 2 Detail of Fig. 1 in the range 10-25 at.% Si

Table 1 Special points of the Pd-Si system

Reaction	Composition, at.% Si		Temperature, °C	Reaction type	
L = (Pd)	0		1555	Melting	
L = (Pd) + Pd ₅ Si	14.9	0.51	16.7	816	Eutectic
(Pd) + Pd ₅ Si = Pd ₂₁ Si ₅	0.51	16.7	16.0	811	Peritectoid
L = Pd ₅ Si	16.7		856	Congruent	
Pd ₅ Si = Pd ₂₁ Si ₅ + Pd ₉ Si ₂	16.7	16.3	18.2	805	Eutectoid
Pd ₂₁ Si ₅ + Pd ₉ Si ₂ = Pd ₁₄ Si ₃	16.3	18.2	17.6	795	Peritectoid
L = Pd ₅ Si + Pd ₃ Si	18.3	16.7	25	819	Eutectic
Pd ₅ Si + Pd ₃ Si = Pd ₉ Si ₂	16.7	25	18.2	819	Peritectoid
Pd ₉ Si ₂ = Pd ₁₄ Si ₃ + Pd ₁₅ Si ₄	18.2	17.6	21.1	764	Eutectoid
Pd ₉ Si ₂ + Pd ₃ Si = Pd ₁₅ Si ₄	18.2	25	21.1	792	Peritectoid
Pd ₁₅ Si ₄ = Pd ₁₄ Si ₃ + Pd ₃ Si	21.1	17.6	25	753	Eutectoid
L + βPd ₂ Si = Pd ₃ Si	23.8	33.3	25	1064	Peritectic
L = βPd ₂ Si	33.3		1404	Congruent	
βPd ₂ Si = Pd ₃ Si + αPd ₂ Si	33.3	25	33.4	1053	Eutectoid
L + βPd ₂ Si = αPd ₂ Si	44.9	33.3	33.4	1090	Peritectic
L + αPd ₂ Si = Pd ₃₉ Si ₂₀	45.1	33.4	33.9	1080	Peritectic
L + Pd ₃₉ Si ₂₀ = Pd ₁₉ Si ₁₀	45.3	33.9	34.5	1072	Peritectic
L = Pd ₁₉ Si ₁₀ + PdSi	49.3	34.5	50	891	Eutectic
L = PdSi	50		897	Congruent	
PdSi = Pd ₁₉ Si ₁₀ + (Si)	50	34.5	100	824	Eutectoid
L = PdSi + (Si)	51.8	50	100	865	Eutectic
L = (Si)	100		1414	Melting	

Table 2 Pd-Si crystal structure data

Phase	Composition, at.% Si	Pearson symbol	Space group	Strukturbericht designation	Prototype
(Pd)	0-0.51	<i>cF4</i>	<i>Fm</i> $\bar{3}$ <i>m</i>	<i>A1</i>	Cu
Pd ₂₁ Si ₅	16-16.3	...	...	...	...
Pd ₅ Si	16.7	<i>mP24</i>	<i>P2</i> ₁	...	...
Pd ₁₄ Si ₃	17.6	...	...	...	...
Pd ₉ Si ₂	18.2	<i>oP44</i>	<i>Pnma</i>	...	...
Pd ₁₅ Si ₄	21.1	<i>aP20</i>	<i>P1</i>	...	...
Pd ₃ Si	25	<i>oP16</i>	<i>Pnma</i>	<i>D0</i> ₁₁	Fe ₃ C
βPd ₂ Si	33.3	...	...	...	...
αPd ₂ Si	33.4	<i>hP9</i>	<i>P</i> $\bar{6}$ <i>2m</i>	<i>C22</i>	Fe ₂ P
Pd ₃₉ Si ₂₀	33.9	...	...	...	...
Pd ₁₉ Si ₁₀	34.5	...	...	...	...
PdSi	50	<i>oP8</i>	<i>Pnma</i>	<i>B31</i>	MnP
(Si)	100	<i>cF8</i>	<i>Fd</i> $\bar{3}$ <i>m</i>	<i>A4</i>	C(diamond)

References

- 1989Cha:** M.S. Chandrasekharaiah, The Pd-Si (Palladium-Silicon) Binary System, *J. Alloy Phase Diagr.*, 1989, **5**(2), p 105-116
- 1993Mas:** R. Massara and P. Feschotte, The Pd-Si Binary System, *J. Alloy Comp.*, 1993, **190**, p 249-254, in French
- 1993Oka:** H. Okamoto, Pd-Si (Palladium-Silicon), *J. Phase Equilib.*, 1993, **14**(4), p 536-537
- 2006Du:** Z. Du, C. Guo, X. Yang, and T. Liu, A Thermodynamic Description of the Pd-Si-C System, *Intermetallics*, 2006, **14**, p 560-569