Co-Pr (Cobalt-Praseodymium)

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The Co-Pr phase diagram in [Massalski2] was adopted from [74Ray] and included nine intermetallic compounds: $Co_{17}Pr_2$, Co_5Pr, $Co_{19}Pr_5$, Co_7Pr_2, Co_3Pr, Co_2Pr, $Co_{1.7}Pr_2$, Co_2Pr_5, and $CoPr_3$. [92Wu] reinvestigated the Co-Pr system and observed eight intermetallic compounds: $Co_{17}Pr_2$, Co_5Pr, $Co_{19}Pr_5$, Co_7Pr_2, Co_3Pr, Co_2Pr, Co_3Pr_4, and $CoPr_3$. The Co-Pr phase diagram shown in Fig. 1 is redrawn from [92Wu] with some modifications as described below.

Table 1 compares the melting temperatures of the intermetallic compounds as reported by [74Ray] and [92Wu]. They are mostly in good agreement except for the type of melting of $Co_{17}Pr_2$ and the presence or absence of Co_2Pr_5. Table 2 shows crystal structures of compounds listed in [Pearson3] plus Co_3Pr_4 reported by [92Wu].

Because is crystal structure is known, stable Co_2Pr_5 may exist in a temperature range not studied by [92Wu]. A dashed line is added in Fig. 1 at the composition of Co_2Pr_5.

According to [92Oka], it is unlikely that two compounds with very similar compositions exist in a wide temperature range. $Co_{19}Pr_5$ may be a high-temperature phase such as $Co_{19}Sm_5$ in the Co-Sm system (see [Massalski2]). The low-temperature region of

$Co_{19}Pr_5$ is not shown in Fig. 1, in order to emphasize this possibility.

Co_7Pr_2 may be dimorphic with crystal structures shown in Table 2. The structure type of the high-temperature phase may be rhombohedral [70Bus] or hexagonal [74Kha]. XRD results of [92Wu]

Table 1 Melting Temperatures of Intermetallic Compounds

Compound	[74Ray]	[92Wu]
$Co_{17}Pr_2$	1271	1352(a)
Co_5Pr	1229	1231
$Co_{19}Pr_5$	1125	1130
Co_7Pr_2	1118	1120
Co_3Pr	1057	1065
Co_2Pr	931	938
Co_3Pr_4	598(b)	588
Co_2Pr_5	558	Not observed
$CoPr_3$	558(a)	579(a)

Note: Temperatures are in °C. (a) Congruent melting. Others are peritectic. (b) For $Co_{1.7}Pr_2$.
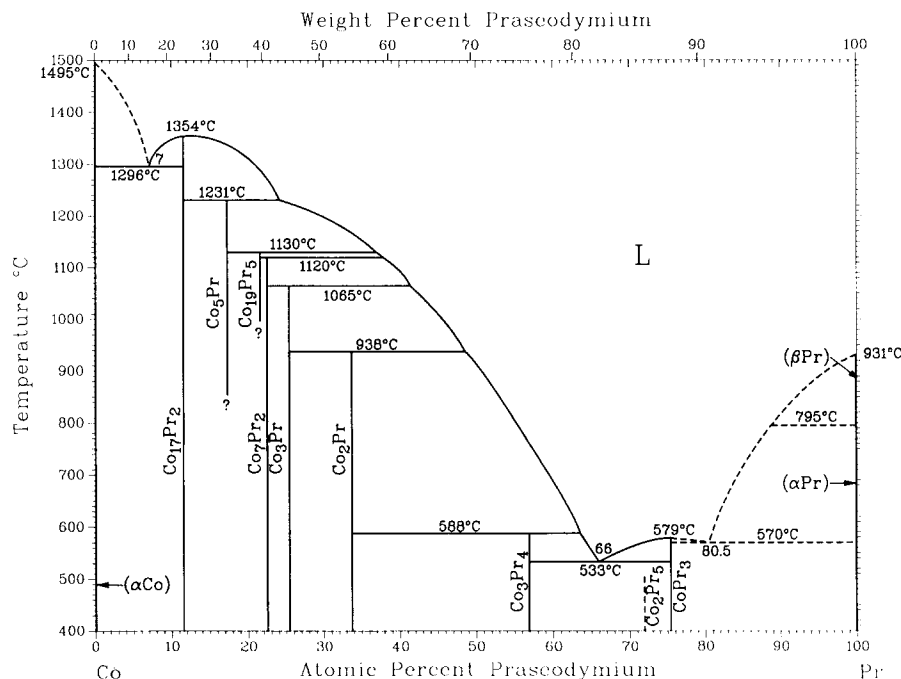

Fig. 1 Co-Pr phase diagram.

Table 2   Co-Pr Crystal Structure Data

Phase	Composition, at.% Pr	Pearson symbol	Space group	Strukturbericht designation	Prototype
(αCo)	0	cF4	Fm3̄m	A1	Cu
(εCo)	0	hP2	P6₃/mmc	A3	Mg
Co₁₇Pr₂	10.5	hR19	R3̄m	...	Th₂Zn₁₇
Co₅Pr	16.7	hP6	P6/mmm	D2_d	CaCu₅
Co₁₉Pr₅	20.8	hR24	R3̄m	...	Co₁₉Ce₅
Co₇Pr₂	22.2	hR18	R3̄m	...	Co₇Er₂
		hP36	P6₃/mmc	...	Ni₇Ce₂
Co₃Pr	25	hR12	R3̄m	...	Be₃Nb
Co₂Pr	33.3	cF24	Fd3̄m	C15	Cu₂Mg
Co₃Pr₄	57.1	hP14	...	...	Co₃Nd₄
Co₂Pr₅	71.4	mC28	C2/c	...	Pd₅B₂
CoPr₃	75	oP16	Pnma	DO₁₁	Fe₃C
(βPr)	100	cI2	Im3̄m	A2	W
(αPr)	100	hP4	P6₃/mmc	A3′	αLa

disagreed with the view of [74Kha]. The polymorphic transformation temperature, if it exists, is still unknown.

Cited References

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74Kha: Y. Khan, *Acta Crystallogr. B*, **30**, 1533-1537 (1974).

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92Oka: H. Okamoto and T.B. Massalski, submitted to *J. Phase Equilibria* (1992).

92Wu: C.H. Wu, Y.C. Chuang, X.M. Jin, and X.H. Guan, *Z. Metallkd.*, **83**(1), 32-34 (1992).

Er-Lu (Erbium-Lutetium)

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The Er-Lu phase diagram in [Massalski2] was redrawn from [Moffatt]. The liquid and solid phases were separated by a single, straight line based on the qualitative feature of intra-rare earth systems reported by [85Gsc]. The L + (Er,Lu) two-phase field was believed to be very narrow.

[91Oka] showed that the two-phase field of an intra-rare earth system is indeed narrow when the difference in the melting points of two elements is small, as in the Er-Tm system (16 °C difference). However, the two-phase field may be discernible in the Er-Lu system (134 °C difference).

Figure 1 shows a calculated Er-Lu phase diagram. Both liquid and solid solutions were assumed to be ideal. The lattice stability pa-

rameters used are given in Table 1. The maximum separation between the liquidus and solidus is expected to be ~2 at.%, which may not be negligible.

Table 1   Er-Lu Thermodynamic Data

G^0 (Er,L) = 0 J/mol
G^0 (Lu,L) = 0 J/mol
G^0 (Er,cph) = −19 900 + 11.042 J/mol
G^0 (Lu,cph) = −18 650 + 9.633 J/mol