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Supplemental Literature Review of Binary Phase Diagrams: Au-Ce, B-Pr, Bi-Gd, Bi-Ho, Cd-Sr, Ga-Ti, Gd-Pb, Gd-Ti, Mg-Mn, Mn-Nd, Nd-Ni, and Ni-Ti

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Introduction

Binary Alloy Phase Diagrams, 2nd edition, a comprehensive collection of alloy phase diagrams for 2159 binary systems, was published in 1990 (T.B. Massalski, H. Okamoto, P.R. Subramanian, and L. Kacprzak., ASM International, Materials Park, OH [Massalski2]). This review intends to provide more recent information on the binary phase diagrams for the Au-Ce, B-Pr, Bi-Gd, Bi-Ho, Cd-Sr, Ga-Ti, Gd-Pb, Gd-Ti, Mg-Mn, Mn-Nd, Nd-Ni, and Ni-Ti systems that have become available after 1990. The criteria for selecting such information for inclusion in this review are (1) systems for which no phase diagram was given in [Massalski2], (2) complete diagrams that are substantially different from the earlier version, and (3) partial diagrams that alter or clarify the earlier version. Thermodynamic consistency of the new phase diagrams was checked based on phase rules and the diagrams were modified if necessary. However, each updated phase diagram has not gone through the ordinary evaluation process. Accordingly, a newer phase diagram is not always a better diagram, especially when there is too little published data on a system. For convenience, reaction tables and crystal structure data have been added when new information was available.

Au-Ce (Gold-Cerium)

The Au-Ce phase diagram in [1990Mas] was redrawn from [1987Gsc]. This phase diagram was thermodynamically analyzed by [2013Don]. The result is shown in Fig. 1. The Au_4Ce_3 phase was added by [2013Don] by referring to the work of [2001Bou]. However, no information is found on this phase in [2001Bou]. Crystal structure data are not found either in [2007Vil] database. Therefore, this phase is tentatively shown with a dashed line in Fig. 1.

References

1987Gsc: K.A. Gschneidner, Jr., F.W. Calderwood, H. Okamoto, and T.B. Massalski, The Au-Ce (Gold-Cerium)

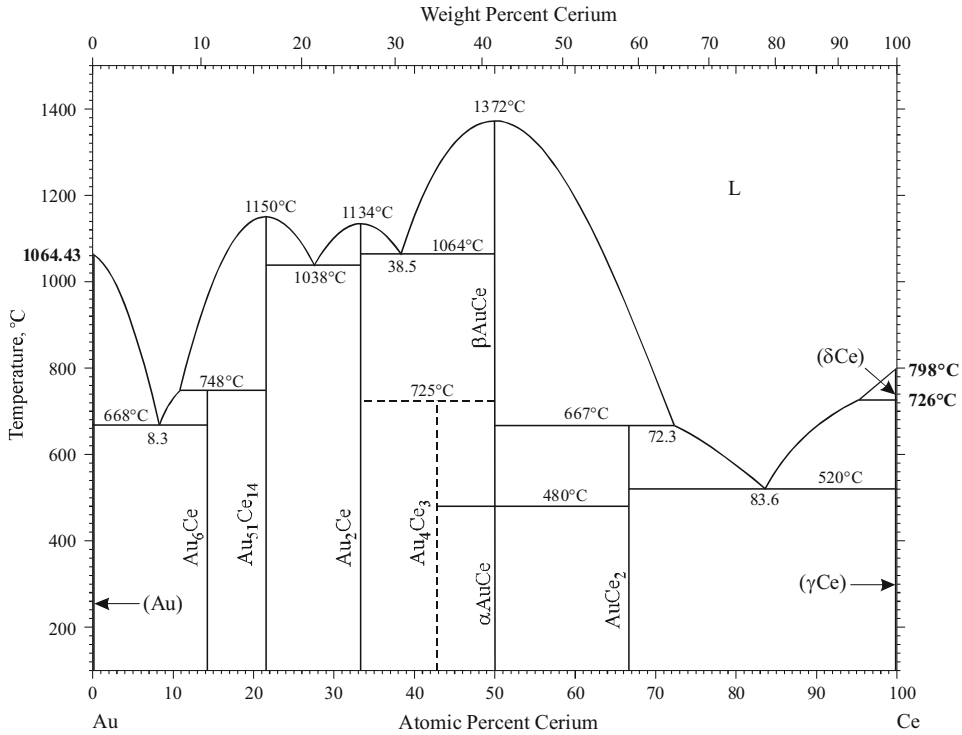

Fig. 1 Au-Ce phase diagram [2013Don]

System, *Phase Diagrams of Binary Gold Alloys*, H. Okamoto and T.B. Massalski, ed, Metals Park, OH, 1987, p 57-60

1990Mas: T.B. Massalski, H. Okamoto, P.R. Subramanian, and L. Kacprzak, ed., Au-Ce (Gold-Cerium), *Binary Alloy Phase Diagrams*, 2nd ed., ASM International, Materials Park, OH, 1990, p 352-353

2001Bou: P. Boulet, D. Mazzone, H. Noël, P. Rogl, and R. Ferro, Phase Equilibria and Magnetic Studies in the Ternary System Ce-Au-Sn, J. Alloys Compd., 2001, **317-318**, p 350-356

2007Vil: P. Villars and K. Cenzual, *Pearson's Crystal Data CD-ROM*, Release 2007/8, ASM International, OH, 2007

2013Don: H.Q. Dong, X.M. Tao, T. Laurila, V. Vuorinen, and M. Paulasto-Kröckel, Thermodynamic Modeling of Au-Ce-Sn Ternary System, Calphad, 2013, **42**, p 38-50

B-Pr (Boron-Praseodymium)

The B-Pr system was reviewed by [1990Lia]. Three intermediate phases, B_6Pr (13.5-15 at.% Pr), B_4Pr (20 at.% Pr), and B_xPr (28 at.% Pr) were shown in the assessed phase diagram. This system was thermodynamically analyzed by [2013Wan]. Figure 2 shows the B-Pr phase diagram mostly based on [2013Wan]. According to the phase diagram shown by [2013Wan], the B_6Pr phase has a constant solubility range from 10 to 14.3 at.% Pr below 2027.2 °C. This feature is very unlikely. In the table showing the calculated result, [2013Wan] indicates that the composition of B_6Pr is the stoichiometric composition of 14.3 at.% Pr. No experimental data are available with regard to the solubility range of this phase.

B_xPr in [1990Lia] was found later to be B_5Pr_2 [2003Kuz]. B-Pr crystal structure data are summarized in Table 1.

References

1990Lia: P.K. Liao and K.E. Spear, B-Pr (Boron-Praseodymium), *Binary Alloy Phase Diagrams*, 2nd ed., T.B. Massalski, H. Okamoto, P.R. Subramanian, and L. Kacprzak, ed., ASM International, Materials Park, OH, 1990, p 519, 521-522

2003Kuz: Y.B. Kuz'ma, V.S. Babizhetskii, R. Guérin, and S.I. Mikhalenko, Crystal Structure of Pr_2B_5 Boride, *Kristallografiya*, 2003, **48**, p 619-623 [in Russian]

2013Wan: C.P. Wang, Y. Shi, D. Wang, Y. Lu, D.L. Zhao, and X.J. Liu, Thermodynamic Assessment of the B-Ce and B-Pr Systems, Calphad, 2013, **41**, p 150-155

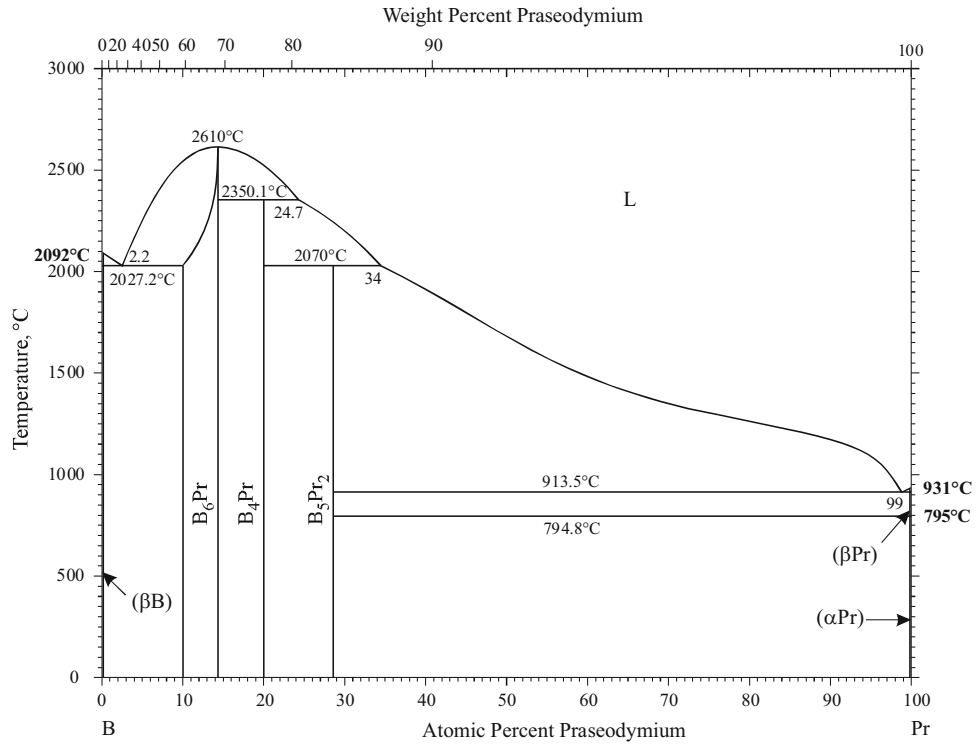

Fig. 2 B-Pr phase diagram

Table 1 B-Pr crystal structure data

Phase	Composition, at.% Pr	Pearson symbol	Space group	Strukturbericht designation	Prototype
(βB)	0	*hR*108	*R* $\bar{3}$*m*	…	…
B_6Pr	14.3	*cP*7	*Pm* $\bar{3}$*m*	$D2_1$	CaB_6
B_4Pr	20	*tP*20	*P*4/*mbm*	$D1_e$	B_4Th
B_5Pr_2	28.6	*mC*56	*C*12/c1	…	…
(βPr)	100	*cI*2	*Im* $\bar{3}$*m*	*A*2	W
(αPr)	100	*hP*4	$P6_3/mmc$	*A*3′	αLa

Bi-Gd (Bismuth-Gadolinium)

The Bi-Gd phase diagram in [1990Mas] was adopted from [1989Gsc], which was primarily based on the work of [1967Gam].

This phase diagram was modified by [1993Abu], as a new phase Bi_2Gd was discovered. [2013Wan] carried out thermodynamic assessment of this system and obtained a phase diagram shown in Fig. 3. The stability of Bi_2Gd must be confirmed because [1993Abu] could not obtain this phase in a homogeneous form and could not determine its crystal structure, as already reviewed by [1994Oka].

References

1967Gam: R.J. Gambino, Rare-Earth-Sb and -Bi Compounds with the Gd_4Bi_3 (anti-Th_3P_4) Structure, J. Less-Common Met., 1967, **12**, p 344-352

1989Gsc: K.A. Gschneidner Jr. and F.W. Calderwood, The Bi-Gd (Bismuth-Gadolinium) System, Bull. Alloy Phase Diagrams, 1989, **10**(4a), 436-438

1990Mas: T.B. Massalski, H. Okamoto, P.R. Subramanian, and L. Kacprzak, ed., Bi-Gd (Bismuth-Gadolinium), *Binary Alloy Phase Diagrams*, 2nd ed., ASM International, Materials Park, OH, 1990, p 738, 740

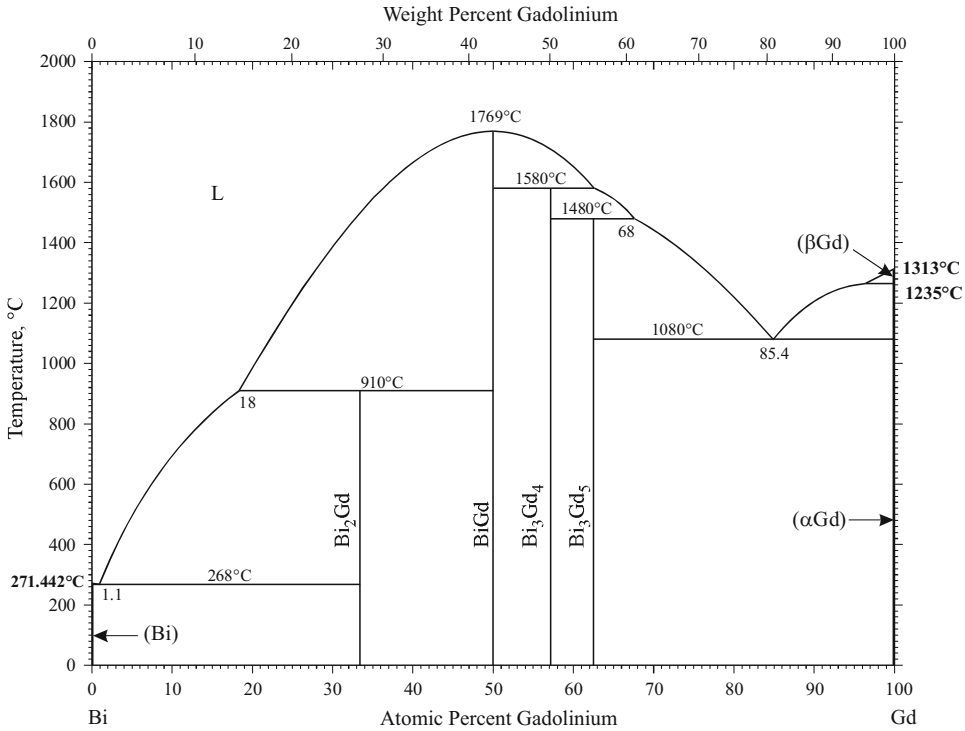

Fig. 3 Bi-Gd phase diagram [20013Wan]

1993Abu: V.D. Abulkhaev, Gd-Bi Phase Diagram, Russ. Metall., 1993, (1), p 152-155
1994Oka: H. Okamoto, "Comment on Bi-Gd (Bismuth-Gadolinium)," *J. Phase Equilib.*, 1994, **15**(6), p 650-651
2013Wan: J. Wang, C. Li, C. Guo, Z. Du, and B. Wu, Thermodynamic Assessment of the Gd-Bi and Ho-Bi Systems, Calphad, 2013, **41**, p 1-5

Bi-Ho (Bismuth-Holmium)

The original form of the Bi-Ho phase diagram in [1990Mas] was proposed by [1975Yos]. The existence of BiHo and Bi_3Ho_{5+x} was known, but the liquidus boundaries were speculative. [1994Abu] determined the Bi-Ho phase diagram based on DTA data, and [1994Oka] modified it into a more plausible form. Figure 4 shows the Bi-Ho phase diagram determined by thermodynamic analysis by [2013Wan]. The calculated result is in good agreement with [1994Oka].

References

1975Yos: K. Yoshihara, J.B. Taylor, L.D. Calvert, and J.G. Despault, Rare-Earth Bismuthides, J. Less-Common Met., 1975, **41**(2), p 329-337
1990Mas: T.B. Massalski, H. Okamoto, P.R. Subramanian, and L. Kacprzak, ed., Bi-Ho (Bismuth-Holmium), *Binary Alloy Phase Diagrams*, 2nd ed., ASM International, Materials Park, OH, 1990, p 744, 746
1993Abu: V.D. Abulkhaev, The Ho-Bi Phase Diagram, Russ. Metall., 1993, (2), p 169-172
1994Oka: H. Okamoto, Comment on Bi-Ho (Bismuth-Holmium), *J. Phase Equilib.*, 1994, **15**(6), p 651-652
2013Wan: J. Wang, C. Li, C. Guo, Z. Du, and B. Wu, Thermodynamic Assessment of the Gd-Bi and Ho-Bi Systems, Calphad, 2013, **41**, p 1-5

Cd-Sr (Cadmium-Strontium)

The Cd-Sr phase diagram in [1990Mas] was based on [1965Kos] with Cd_3Sr_5 modified from $CdSr_2$ according to [1978Bru].

Figure 5 shows the Cd-Sr phase diagram thermo dynamically assessed by [2013Zha]. Cd_9Sr_2 in [1990Mas] has been changed to $Cd_{58}Sr_{13}$ according to [1972Bru].

Cd-Sr crystal structure data shown in Table 2 have been updated according to [2007Vil].

References

1965Kos: W. Köster and J. Meixner, Construction of the Systems of Europium with Silver, Cadmium, and Indium As Well As the Cadmium-Strontium System, Z. Metallkd., 1965, **56**, p 695-703 [in German]
1972Bru: G. Bruzzone The Ca-Cd and Ba-Cd Systems, *Gazz. Chim. Ital.*, 1972, **102**, p 234-242 [in Italian]
1978Bru: G. Bruzzone, E. Franceschi, and F. Merlo, M_5X_3 Intermediate Phases Formed by Ca, Sr, and Ba, *J. Less Common Met.*, 1978, **60**(1), p 59-63

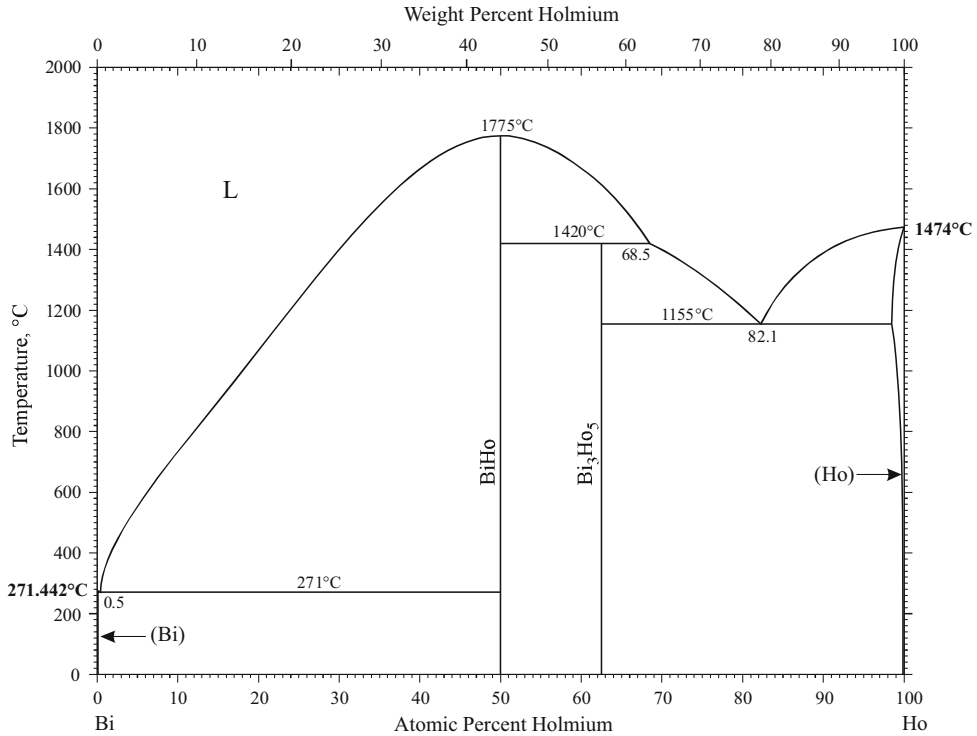

Fig. 4 Bi-Ho phase diagram [2013Wan]

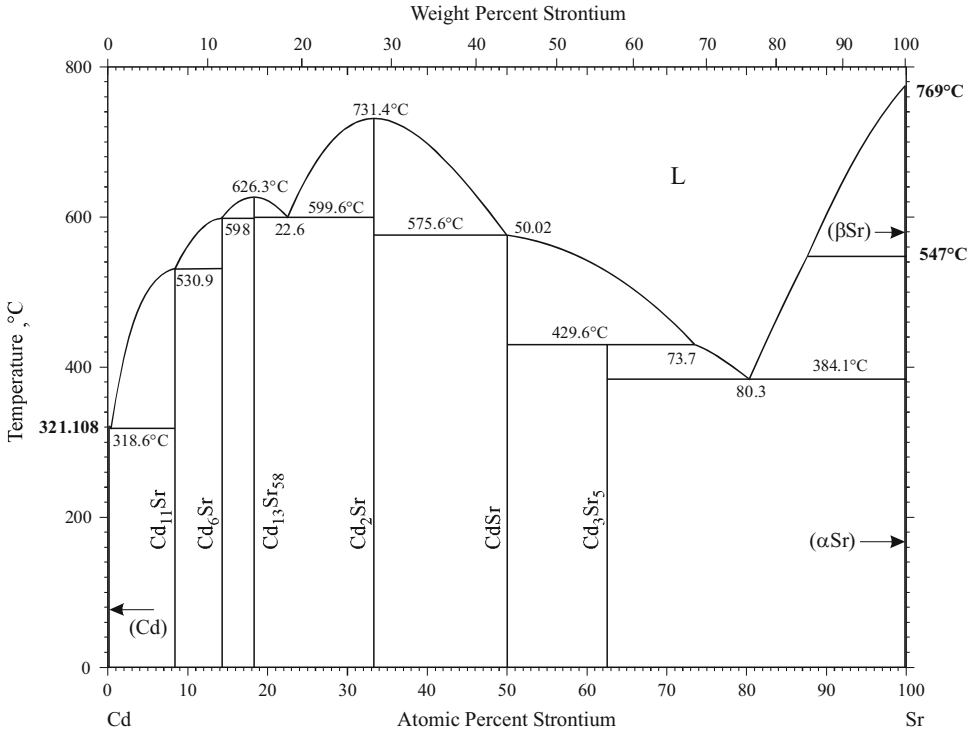

Fig. 5 Cd-Sr phase diagram [2013Zha]

Table 2 Cd-Sr crystal structure data

Phase	Composition, at.% Sr	Pearson symbol	Space group	Strukturbericht designation	Prototype
(Cd)	0	*hP*2	$P6_3/mmc$	*A*3	Mg
$Cd_{11}Sr$	8.3	*tI*48	$I4_1/amd$	…	$BaCd_{11}$
Cd_6Sr	14.3	*cI*184	$Im\bar{3}$	…	Cd_6Y
$Cd_{58}Sr_{13}$	18.3	*hP*142	$P6_3/mmc$	…	$Gd_{13}Zn_{58}$
Cd_2Sr	33.3	*oI*12	*Imma*	…	KHg_2
CdSr	50	*cP*2	$Pm\bar{3}m$	*B*2	CsCl
Cd_3Sr_5	62.5	*tI*32	*I*4/*mcm*	$D8_l$	Cr_5B_3
(βSr)	100	*cI*2	$Im\bar{3}m$	*A*2	W
(αSr)	100	*cF*4	$Fm\bar{3}m$	*A*2	Cu

1990Mas: T.B. Massalski, H. Okamoto, P.R. Subramanian, and L. Kacprzak, ed., Cd-Sr (Cadmium-Strontium), *Binary Alloy Phase Diagrams*, 2nd ed., ASM International, Materials Park, OH, 1990, p 1030-1031

2007Vil: P. Villars and K. Cenzual, *Pearson's Crystal Data CD-ROM*, Release 2007/8, ASM International, OH, 2007

2013Zha: C. Zhang, K. Cheng, W. Wang, X. Li, B. Hu, S. Liu, and Y. Du, Thermodynamic Assessment of the Cd-X (X = Sr, Ti, B, V) Systems, Calphad, 2013, **42**, p 6-12

Ga-Ti (Gallium-Titanium)

[2005Oka] compared two Ga-Ti phase diagrams reported by [2001Ant] and [2003Li]. The latter was preferred because problems in the diagram of [2001Ant] pointed out by [2002Oka] had been solved. Figure 6 shows the Ga-Ti phase diagram calculated by [2013Liu] using a more updated thermodynamic model. The diagram is in good agreement with [2003Li]. The only remarkable difference between [2003Li] and [2013Liu] is that the (βTi) shows a

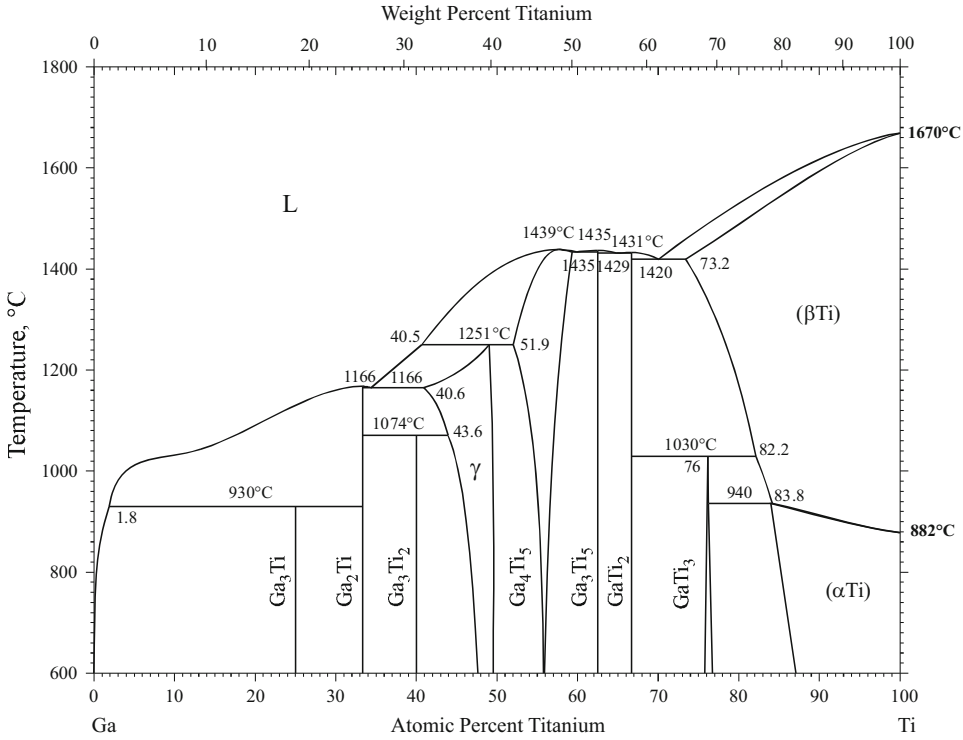

Fig. 6 Ga-Ti phase diagram [2013Liu]

maximum melting point according to the calculation of [2003Li], whereas the diagram of [2003Liu] (Fig. 6) does not show such a peak. No conclusive experimental data are available.

References

2001Ant: N.V. Antonova and L.A. Tretyachenko, Phase Diagram of the Ti-Ga System, *J. Alloys Compd.*, 2001, **317-318**, p 398-405

2002Oka: H. Okamoto, Ga-Ti (Gallium-Titanium), *J. Phase Equilib.*, 2002, **23**(5), p 457-458

2003Li: J.B. Li, J.C. Tedenac, M.C. Record, Thermodynamic Analysis of the Ga-Ti System, *J. Alloys Compd.*, 2003, **358**, p 133-141

2005Oka: H. Okamoto, Ga-Ti (Gallium-Titanium), *J. Phase Equilib. Diffus.*, 2005, **26**(4), p 398

2013Liu: Y. Liu, J.C. Tedenac, X.P. Su, C. Colinet, and J.H. Wang, An Updated Thermodynamic Modeling of the Ga-Ti System, *Calphad*, 2013, **41**, p 140-149

Gd-Pb (Gadolinium-Lead)

The Gd-Pb phase diagram in [1990Mas] was adopted from [1991Pal]. [2013Cui] optimized the phase boundary data using a random solution model and an associate model for the liquid phase. They discovered that the phase diagram calculated with the associate model fits better with the experimental data of [1991Pal]. Figure 7 shows the calculated phase diagram.

References

1990Mas: T.B. Massalski, H. Okamoto, P.R. Subramanian, and L. Kacprzak, ed., Gd-Pb (Gadolinium-Lead), *Binary Alloy Phase Diagrams*, 2nd ed., ASM International, Materials Park, OH, 1990, p 1906-1907

1991Pal: A. Palenzona and S. Cirafici, The Gd-Pb (Gadolinium-Lead) System, *J. Phase Equilib.*, 1991, **12**(6), p 686-690

2013Cui: J. Cui, C. Guo, C. Li, and Z. Du, Thermodynamic Optimization of the Gd-Pb System Using Random Solution and Associate Models, Calphad, 2013, **42**, p 1-5

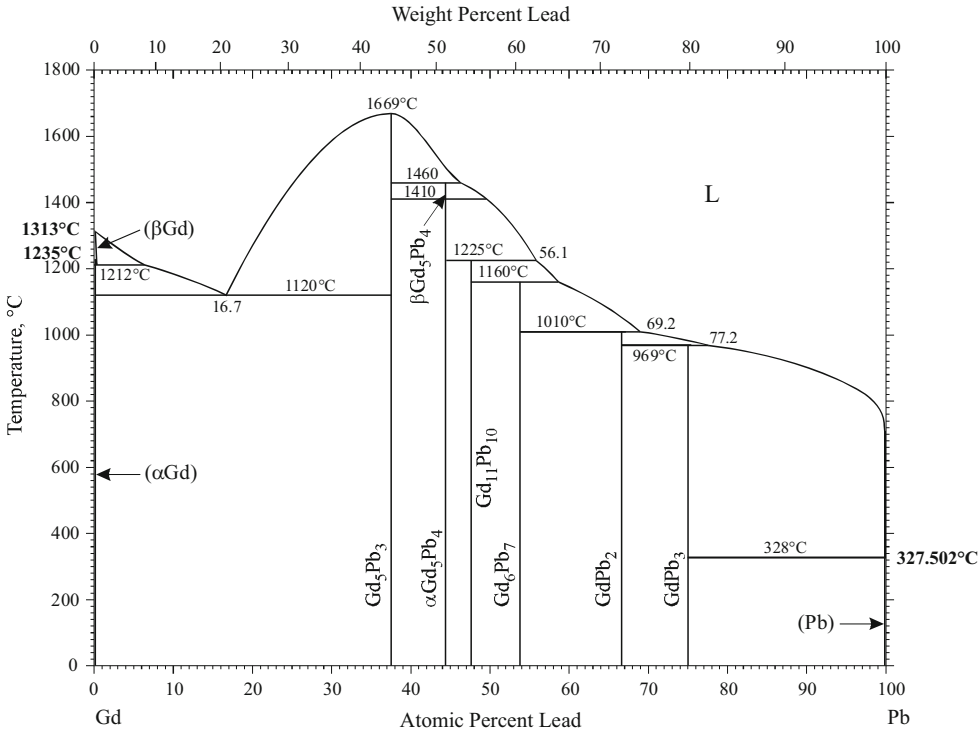

Fig. 7 Gd-Pb phase diagram [2013Cui]

Gd-Ti (Gadolinium-Titanium)

The Gd-Ti phase diagram in [1990Mas] was accepted from [1987Mur]. The assessed phase diagram was monotectic type based on thermodynamic consideration although [1961Cro] and [1962Sav] reported eutectic type phase diagrams.

The monotectic type Gd-Ti phase diagram was supported by [2010Sch], but [2012Oka] questioned the form of the miscibility gap as it is displaced far to the Ti rich side and noticed significant mismatch between [1987Mur] and [2010Sch].

In order to clarify these problems, [2013Mat] studied this system experimentally by combining electrostatic levitation of the melt with high energy synchrotron in situ x-ray diffraction at elevated temperatures. Figure 8 shows the Gd-Ti phase diagram obtained by thermodynamic calculation based on the experimental results. The critical temperature of the miscibility gap turned out to be much higher than that reported in earlier reports, i.e., 1515 °C [1987Mur] or ~1600 °C [2010Sch].

References

1961Cro: J.G. Croeni, S.C. Rhoads, C.E. Armantrout, and H. Kato, *Titanium-Gadolinium Phase Diagram*, U.S. Bur. Mines, Rep. Invest. 5796, 1961, 14 p

1962Sav: E.M. Savitskii and G.S. Burkhanov, Equilibrium Diagram of the Gadolinium-Titanium System, *Russ. J. Inorg. Chem.*, 1962, **7**, p 358-359

1987Mur: J.L. Murray, The Gd-Ti (Gadolinium-Titanium) System. *Phase Diagrams of Binary Titanium Alloys*, J.L. Murray, ed., ASM International, Metals Park, OH, 1987, p 225-228

1990Mas: T.B. Massalski, H. Okamoto, P.R. Subramanian, and L. Kacprzak, ed., Gd-Ti (Gadolinium-Titanium), *Binary Alloy Phase Diagrams*, 2nd ed., ASM International, Materials Park, OH, 1990, p 1935, 1937

2010Sch: S. Schmitz, H.G. Lindenkreuz, N. Mattern, W. Loser, B. Buchner, Liquid Phase Separation in Gd-Ti and Gd-Zr Melts, *Intermetallics*, 2010, **18**, p 1941-1945

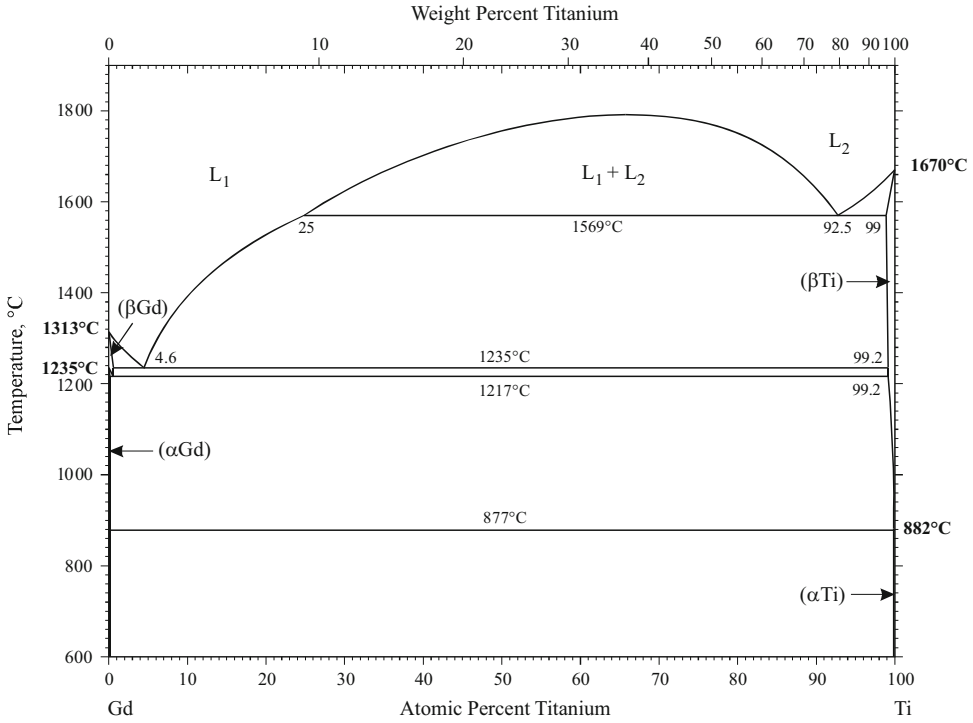

Fig. 8 Gd-Ti phase diagram [2013Mat]

2012Oka: H. Okamoto, Gd-Ti (Gadolinium-Titanium), *J. Phase Equilib. Diffus.*, 2012, **33**(5), p 422

2013Mat: N. Mattern, J.H. Han, O. Fabrichnaya, M. Zinkevich, W. Löser, J. Werner, R. Nowak, I. Kaban, O. Shuleshova, D. Holland-Moritz, J. Bednarĉik, N. Sobczak, and J. Eckert, Experimental and Thermodynamic Assessment of the Gd-Ti System, Calphad, 2013, **42**, p 19-26

Mg-Mn (Magnesium-Manganese)

[2012Oka] introduced the Mg-Mn phase diagram reported by [2005Gro]. This phase diagram showed the miscibility gap of the liquid phase below 1400 °C. [2013Gho] re-optimized the data of [2005Gro] and calculated the miscibility gap up to the critical temperature. The result is shown in Fig. 9.

References

2005Gro: J. Gröbner, D. Mirkovic, M. Ohno, R. Schmid-Fetzer, Experimental Investigation and Thermodynamic Calculation of Binary Mg-Mn Phase Equilibria, *J. Phase Equilib. Diffus.*, 2005, **26**(3), p 234-239

2012Oka: H. Okamoto, Mg-Mn (Magnesium-Manganese), *J. Phase Equilib. Diffus.*, 2012, **33**(6), 496

2013Gho: P. Ghosh and M. Medraj, Thermodynamic Calculation of the Mg-Mn-Zn and Mg-Mn-Ce Systems and Re-optimization of Their Constitutive Binaries, Calphad, 2013, **41**, p 89-107

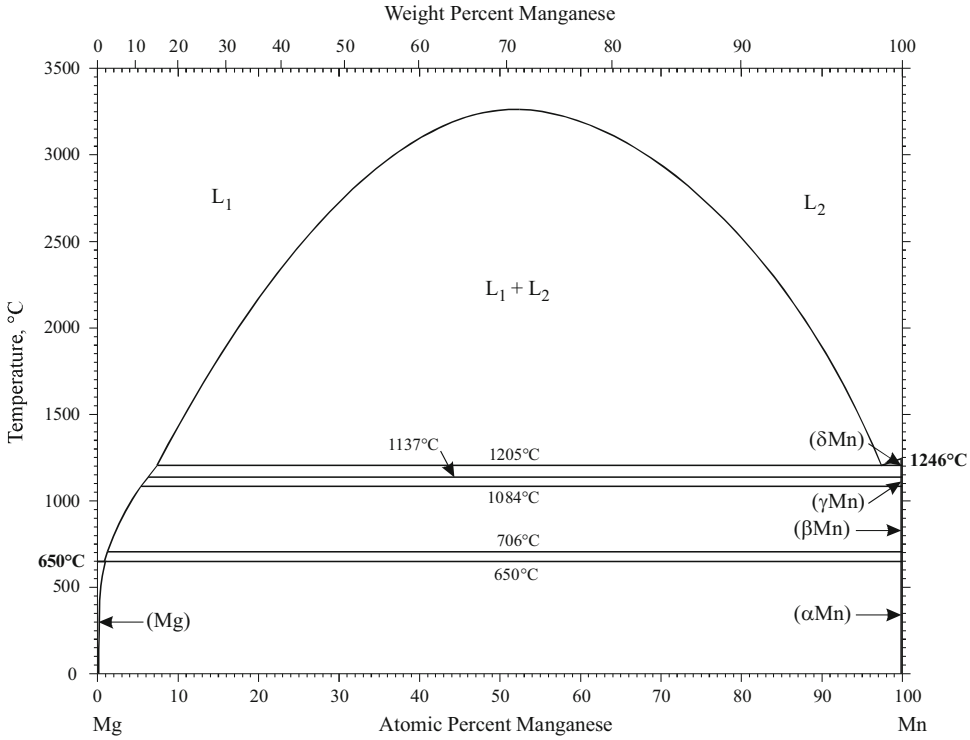

Fig. 9 Mg-Mn phase diagram [2013Gho]

Mn-Nd (Manganese-Neodymium)

[2013Oka] introduced an updated phase diagram for the Mn-Nd system reported by [2012Kim]. This phase diagram is revised in Fig. 10, as [2013Mos] confirmed the existence of a new phase $Mn_{17}Nd_2$ using EPMA and XRD.

Mn-Nd crystal structure data are summarized in Table 3.

References

2012Kim: J. Kim and I.H. Jung, Critical Systematic Evaluation and Thermodynamic Optimization of the Mn-RE System: RE = La, Ce, Pr, Nd, and Sm, *J. Alloys Compd.*, 2012, **552**, p 191-202

2013Mos: A.O. Mostafa, A.E. Gheribi, D. Kevorkov, Md. Mezbahul-Islam, and M. Medraj, Experimental Investigation and First-Principle Calculations Coupled with Thermodynamic Modeling of the Mn-Nd Phase Diagram, Calphad, 2013, **42**, p 27-37

2013Oka: H. Okamoto, Supplemental Literature Review of Binary Phase Diagrams: Cd-Se, Cu-Hg, Cu-Ho, Eu-Mg, H-Sr, Hf-Si, La-Mn, Mn-Nd, Nb-Y, Ni-Y, Pb-Se, and Sc-Sr, *J. Phase Equilib. Diffus.*, 2013, **34**(5), p 430-436

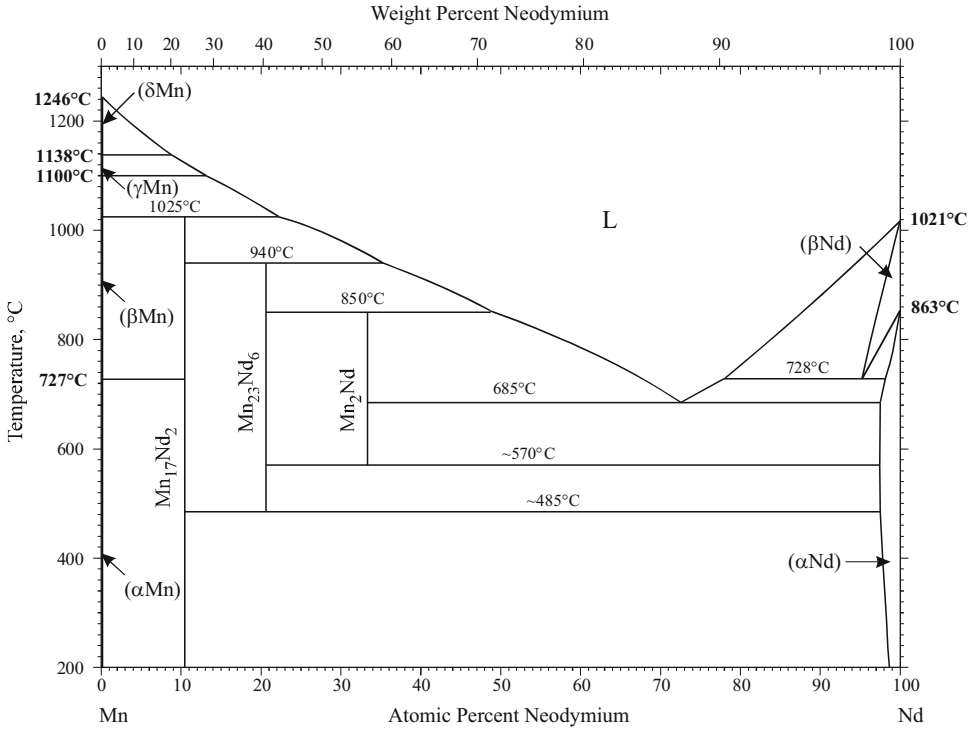

Fig. 10 Mn-Nd phase diagram [2013Mos]

Table 3 Mn-Nd crystal structure data

Phase	Composition, at.% Nd	Pearson symbol	Space group	Strukturbericht designation	Prototype
(δMn)	0	*cI*2	*Im* $\bar{3}$*m*	*A*2	W
(γMn)	0	*cF*4	*Fm* $\bar{3}$*m*	*A*1	Cu
(βMn)	0	*cP*20	$P4_132$	*A*13	βMn
(αMn)	0	*cI*58	*I* $\bar{4}$3*m*	*A*12	αMn
$Mn_{17}Nd_2$	10.5	*hP*38	$P6_3/mmc$	…	Th_2Ni_{17}
$Mn_{23}Nd_6$	20.7	*cF*116	*Fm* $\bar{3}$*m*	$D8_a$	$Mn_{23}Th_6$
Mn_2Nd	33.3	*hP*12	$P6_3/mmc$	*C*14	$MgZn_2$
(βNd)	95.3-100	*cI*2	*Im* $\bar{3}$*m*	*A*2	W
(αNd)	97.5-100	*hP*4	$P6_3/mmc$	*A*3′	αLa

Nd-Ni (Neodymium-Nickel)

According to the latest update on the Nd-Ni system by [2006Oka], invariant reaction temperatures in the Nd-Ni phase diagram reported by [2005Hua] are generally higher (~50 °C) than those reported by [1996Du]. [2013Hus] examined these two reports and derived a thermodynamic model more consistent with experimental thermodynamic data. The calculated phase diagram shown in Fig. 11 is generally consistent with [2005Hua].

The dimorphic transformation of Nd_2Ni_7 at 1171 °C in Fig. 11 has been added based on the thermal effect observed by [2005Hua].

References

1996Du: Y. Du and N. Clavaguera, Thermodynamic Calculation of the Nd-Ni System, *Calphad*, 1996, **20**(3), p 289-296

2005Hua: M. Huang, R.W. McCallum, and T.A. Lograsso, Experimental Investigation and Thermodynamic Modeling of the Nd-Ni System, *J. Alloys Compd.*, 2005, **398**, p 127-132

2006Oka: H. Okamoto, Nd-Ni (Neodymium-Nickel), *J. Phase Equilib. Diffus.*, 2006, **27**(5), p 562

2013Hus: A. Hussain, M.A. Van Ende, J. Kim, and I.H. Jung, Critical Thermodynamic Evaluation of the Co-Nd, Cu-Nd, and Nd-Ni Systems, Calphad, 2013, **41**, p 26-41

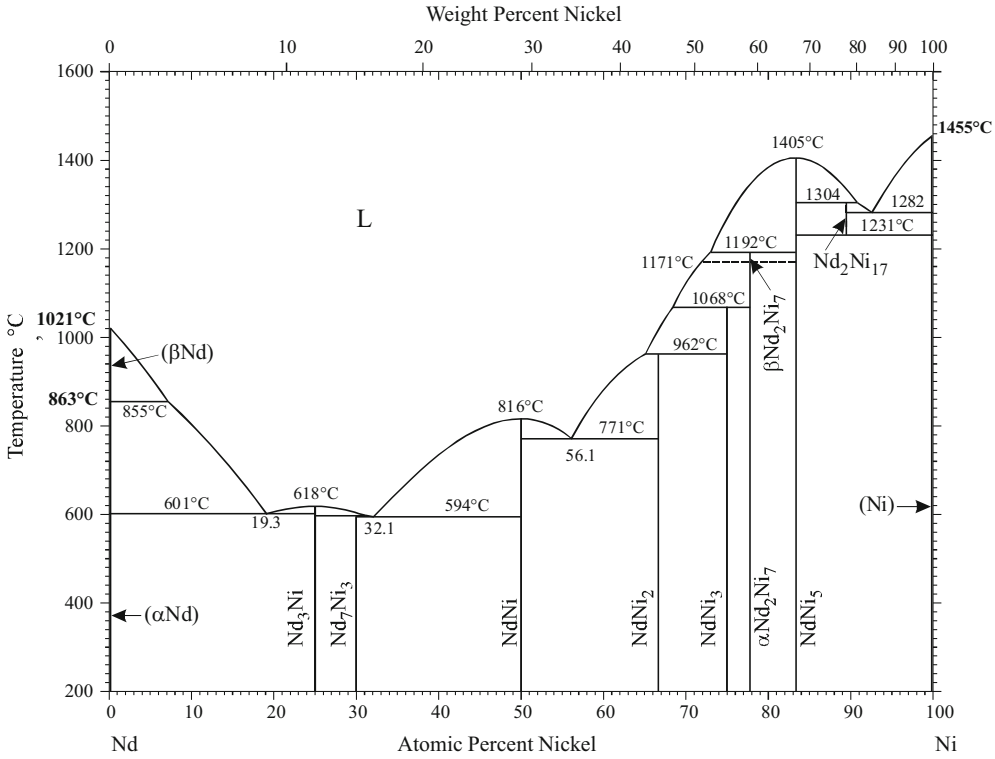

Fig. 11 Nd-Ni phase diagram [2013Hus]

Ni-Ti (Nickel-Titanium)

The Ni-Ti phase diagram in [1990Mas] was adopted from [1987Mur]. The high-temperature NiTi phase was shown to decompose into Ni_3Ti and Ni_2Ti at ~630 °C by a eutectoid reaction. However, the existence of a martensitic form of NiTi at room temperature was reported by [1981Mic] and confirmed by other investigators [2007Vil]. Figure 12 shows the Ni-Ti phase diagram calculated by [2013Pov] including the low-temperature phase. A similar phase diagram was reported by [1999Tan]. The β/α transition temperature of NiTi estimated by [1999Tan] was 93 °C. [1987Mur] viewed the αNiTi phase as metastable.

Table 4 shows Ni-Ti crystal structure data.

References

1981Mic: G.M. Michal and R. Sinclair, The Structure of TiNi Martensite, *Acta Crystallogr. B*, 1981, **37**, p 1803-1807

1987Mur: J.L. Murray, The Ni-Ti (Nickel-Titanium) System, *Phase Diagrams of Binary Titanium Alloys*, J.L. Murray, ed., ASM International, Metals Park, OH, 1987, p 197-211

1990Mas: T.B. Massalski, H. Okamoto, P.R. Subramanian, and L. Kacprzak, ed., Ni-Ti (Nickel-Titanium), *Binary Alloy Phase Diagrams*, 2nd ed., ASM International, Materials Park, OH, 1990, p 2874-2876

1999Tan: W. Tang, B. Sundman, R. Sandström, and C. Qiu, New Modeling of the B2 Phase and its Associated Martensitic Transformation in the Ti-Ni System, *Acta Mater.*, 1999, **47**(12), p 3457-3468

2007Vil: P. Villars and K. Cenzual, *Pearson's Crystal Data CD-ROM*, Release 2007/8, ASM International, OH, 2007

2013Pov: E. Povoden-Karadeniz, D.C. Cirstea, P. Lang, T. Wojcik, and E. Kozeschnik Thermodynamics of Ti-Ni Shape Memory Alloys, *Calphad*, 2013, **41**, p 128-139

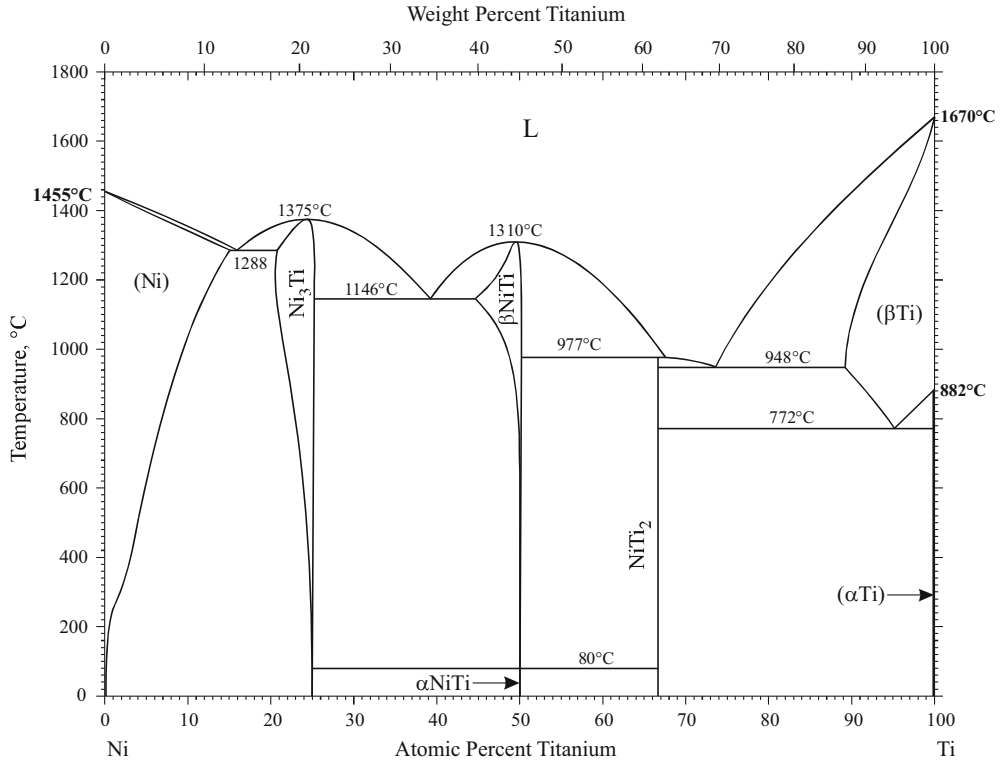

Fig. 12 Ni-Ti phase diagram [2013Pov]

Table 4 Ni-Ti crystal structure data

Phase	Composition, at.% Ti	Pearson symbol	Space group	Strukturbericht designation	Prototype
(Ni)	0-15	*cF*4	*Fm* $\bar{3}$*m*	*A*1	Cu
Ni_3Ti	20.5-25	*hP*16	$P6_3/mmc$	$D0_{24}$	Ni_3Ti
βNiTi	45-50	*cP*2	*Pm* $\bar{3}$*m*	*B*2	CsCl
αNiTi	50	*mP*4	$P12_1/m1$	*B*19′	NiTi
$NiTi_2$	66.7	*cF*96	*Fd* $\bar{3}$*m*	…	…
(βTi)	89-100	*cI*2	*Im* $\bar{3}$*m*	*A*2	W
(αTi)	100	*hP*2	$P6_3/mmc$	*A*3	Mg