

ON THE BINDING IN $A^n A_M^{10}$ PHASES

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Summary

In the $A^n A_M^{10}$ mixture class two types of mixtures are found, mixtures with non-Ekmanian electron count and mixtures with Ekmanian count. The Ekman boundary separating these types is about $A^{7.10} A_M^{10}$. For $A^{n < 7} A_M^{10}$ the distances of the peripheral d electrons of A^n are markedly greater than the distances of the peripheral d electrons of the A^{10} elements, while for $A^{n > 7} A_M^{10}$ these distances are essentially equal. The $A^{3...7} A_M^{10}$ mixtures display a rich variety of interesting structure types permitting to analyse the binding, they may be named pseudo brass-like as the place number ratios $N_{p''}^{p'} = 4...16$ occur like as in truly brass-like alloys. An important difference to brass-like phases is caused by the great volume of the $A^{3...7}$ components in pseudo brasses as compared to the $B^{2...5}$ components in brasses; another difference lies in the fact that Hund insertion begins with A^6 here, and with B^5 in truly brass like alloys. The mixtures $A^{7...10} A_M^{10}$ on the right of the Ekman boundary must be considered as truly brass like, the b electron concentration is not quite variable and therefore the structural aspect is uniform and poor.

Introduction.

The mixture class $A^n A_M^{10}$ is rich in phases and permits therefore a good test for the electron count assumptions. The d electrons of $A^{n<7}$ form the \underline{b} correlation while A^{10} contributes essentially no \underline{b} electrons. This non Ekmanian count causes brass-like bindings (XX2) to occur and the corresponding phases may be considered as pseudo brass-like as shall become clear below. However, it should be kept in mind that, say, the four valued Ti which is also usual in inorganic chemistry is no more four valued when it is alloyed with say Si, as it obeys there the Ekmanian count.

When in the following analysis comparison is made with the binding of a phase which does not belong to the present mixture class then the earlier papers of this series should be consulted. To appreciate the bindings in the table it is very helpful if not indispensable to draw the $\underline{d}_b(N_2^-)$ and $\underline{d}_c(N_2^-)$ diagram (\underline{d} =electron distance, N_2^- =mole fraction of the second component) and the $\underline{N}_{P''}^{\underline{P}}(N_2^-)$ diagram ($\underline{N}_{P''}^{\underline{P}}$ =number of \underline{c} places per \underline{b} place).

Chemists sometimes find difficulty in the concept of a correlation. They should appreciate that this concept is only a moderate generalisation of the usual concept of a distribution of covalent bonds. While the latter concept suffers from the serious defect that the interaction of the bonds is neglected, the concept of a correlation avoids this shortcoming. Furthermore the covalent bond concept neglects the correlation of the valence electrons to the core electrons, also this has been taken into account by the two-correlations model. Therefore the model is more appropriate than earlier ones, to rationalize the stability of metallic phases in a first and therefore qualitative manner. The model is a logical continuation of the work of earlier crystallographers who studied the influence of atomic or ionic radius ratios and electric charges on stability. These earlier stability arguments are conserved in the present approach and should always be taken for granted. The new stability arguments add to our understanding of inorganic phases numerous rules which could be formulated with the concepts of the model.

Some readers ask how a classification in a binding represents a stability argument; they should remember that the existence of a lattice like spatial correlation is an indication of a low energy and so are the simple commensurabilities $\underline{b}^{-1}\underline{a}$, $\underline{c}^{-1}\underline{a}$, $\underline{c}^{-1}\underline{b}$. The present-time lack of valence rules for $A^n A_M^{10}$ alloys may be confirmed from 73 Nic e.g.

$A_{M}^{1,10}$ phases. The homologous mixture class of $A_{M}^{1,10}$ contains following present knowledge at normal conditions only the phase $NaPt_2$ (MgCu₂ type) stabilized by a CF2 binding with the place number ratio $N_{p''}^{P'}=32$. The reason for this weak alloying tendency lies in the expansion of only one b electron of the A^1 atoms into the direction of the A^{10} atoms which also may have a b electron contribution of less than one electron per atom. That the phase forms with Pt, corresponds to the additional energy of formation afforded by Pt because of the high density of its core electrons.

$A_{M}^{2,10}$ phases. In $A_{M}^{2,10}$ mixtures more intermediate phases are formed, as here two b electrons per A^2 tend to expand. Let us begin with the phase $CaNi_2$ (MgCu₂) containing a BF2 binding yielding $N_{p''}^{P'}=16$. It is homeodesmic to $NaPt_2$ (MgCu₂, CF2), and its equilibrium with Ca.h(Cu) containing CB2 and $N_{p''}^{P'}=16$ represents a plateau of $N_{p''}^{P'}$. The phases $CaNi_3$ (PuNi₃, R3.9), $CaNi_{3.5}$ (GdCo_{3.5}, R4.14), and $CaNi_5$ (CaCu₅) are homeotypic to $CaNi_2$ (MgCu₂) (74Bus, 59Cro) by simple substitution of Ni for Ca and shears parallel (001)_{CaNi5}. It appears that all phases have the same c correlation but show different b correlations which are in good commensurability to c (note $(4 \times 4) / 7 \approx 2.3$). The assumption that Ni does not contribute b electrons leads to the great value $N_{p''}^{P'}=32$ for $CaNi_5$; the congruent melting of this phase is compatible with the CF2 binding; however, BF2 requiring b contribution by Ni is more probable; clearly these assumptions require corroboration by magnetic measurements.

Just as $CaNi_2$ formed a plateau with Ca.h, it appears that Mg_2Ni (H12.6) forms a plateau with Mg(H2). Contrary to $CaNi_2$ it must be assumed that $MgNi_2$ contains a little positive b contribution by Ni, this would solve the old problem of the heterotypism $MgNi_2$ - $CaNi_2$.

Leaving aside Mg_6Pd and Mg_4Pd the simple Mg_3Pd (Na_3As) permits HCH/3 with $N_{p''}^{P'}=12.5$, and the same binding in different commensurability to a stabilizes Mg_5Pd_2 (Co_2Al_5). $MgPd$ (CsCl) permits UF2 with $N_{p''}^{P'}=13.0$, and it is gratifying that $Mg_{0.9}Pd_{1.1}$ (CuAu) puts the tetragonal binding in evidence. It is very conspicuous that $MgPd_3$ (Cu_3Au , #B2) forms only at lower temperatures, probably Pd has there the binding $a=b_B(1)=c_B(\sqrt{8}; 2.8)$.

The heterotypism $CaPd$ (CsCl) - $SrPd$ (TII) is interpreted by the remark that the greater Sr causes a greater $N_{p''}^{P'}$.

The phase $MgPt_7$ (F1.7), when it exists, might have a CB2 binding, and the distances fit well to the other values. The mixture $CaPt_M$ is another example with a non-monotonous $N_{p''}^{P'}(N_2)$ function. While for Ca.h (W, FUU2) $N_{p''}^{P'}=14$, for Ca_5Pt_3 (W_5Si_3) is found a UF2 binding with $N_{p''}^{P'}=13$; it must be assumed that the Pt atoms have a contractive influence on the b electrons of Ca.h. The Er_3C

A1A10M

NaNiM(probably nic, see E)
KNiM(prob.nic, see S)
RbNiM
CsNiM
NaPdM(prob.nic, see HA)
KPdM
RbPdM
CsPdM
NaPt.p(see HA)
NaPt2(MgCu2,71Eck)7.48A=bC(2)=cF(4)
KPtM(prob.nic, see HA)
RbPtM
CsPtM

A2A10M

Mg2Ni(H12.6,SR15.95,46.72)H5.216;13.20A=bUH(2;6/2)=cCH($\sqrt{12}$;21/3) N=24,156
MgNi2(H8.16,SR3.31,46.96)H4.824;15.826A=bH($\sqrt{3}$;5/2)=cFH(4;16/3) N=16,224 cmp
CaNi2(MgCu2,SR40.103)7.256A=BB(2)=cF(4) N=16,224 phdM
CaNi3(PuNi3,SR40.103)H5.030;24.27A=bUH($\sqrt{2}$.3;8/3)=cFH(4;24/3) N=18,342
Ca2Ni7(Gd2Co7,SR40.103)H5.009;36.06A=bH($\sqrt{2}$.3;11)=cFH(4;35/3) N=24,516
CaNi5(CaCu5,SR11.59)H4.960;3.948A=BBH(1;4/3)=cFH(4;4/3) N=2,58 cmp
SrNi phdM
BaNiM(nic, phdM)
Mg6Pd(F84.14,SR38.120)20.108A+H14.2;34.8A=bCH($\sqrt{19}$;26/3)=cH($\sqrt{171}$;32) N=672,3248
Mg4Pd(,SR23.176) phdS
Mg3Pd(Na3 As,SR23.176)H4.613;8.410A=bH(2;3.7)=cCH($\sqrt{12}$;16/3) N=12,68
Mg5 Pd2(Co2Al5,H2O.8,SR33.110)H8.660;8.169A=bH($\sqrt{13}$;3.4)=cCH($\sqrt{39}$;14/3) N=40,240
MgPd(CsCl,SR23.175)3.16A=bU(1;1.2)=cF(2)
Mg0.9Pd1.1(CuAu,SR24.173)3.03;3.42A=hdmMgPd cmp
MgPd3(Cu3Au?,SR23.175)3.907A=bH($\sqrt{2}$;1.6)=cB($\sqrt{8}$;2.8) cmp
CaPd(CsCl,SR39.109,46.126)3.522A=idmMgPd
CaPd2(MgCu2,SR22.75)7.665A=idmCaNi2 BF2
SrPd(Tl1,JLCM38.1974.1)4.19;11.31;4.52A=bC(0.93x) $\sqrt{2}$;3.5; $\sqrt{2}$ =cB($\sqrt{8}$;7) N=8,72
SrPd2(MgCu2,SR21.137)7.800A=idmCaNi2 BF2
SrPd5(CaCu5,SR21.137)H5.411;4.416A=idmCaNi5 BF2
BaPd(Tl1,JLCM38.1974.1)4.35;11.79;4.68A=idmSrPd phdM
BaPd2(MgCu2,SR22.75)7.953A=idmCaNi2
BaPd5(CaCu5,71Eck)H5.494;4.344A=idmCaNi5
Mg6Pt(Mg6Pd,SR24.174)20.11A=idmMg6Pd CHH3
Mg3Pt(Na3As,SR24.174)H4.577;8.322A=idmMg3Pd HCH $\sqrt{3}$
MgPt(FeSi,SR26.225)4.86A+H6.88;8.42A=bCH(2;6/3)=cFH(6;9/3)
MgPt3(Cu3Au,SR27.322)3.906A=idmMgPd3 HTB2
MgPt7(F1.7,SR27.322)7.824A=bC($\sqrt{2}$;1)=cB($\sqrt{32}$;5.6)
Ca5Pt2(Mn5C2,JLCM78.1981.P49)M97.47⁰16.154;6.627;7.662A
Ca5Pt3(W5Si3, ibid)11.563;5.753A=bU($\sqrt{10}$;2)=cF($\sqrt{40}$;6/2) N=40,280
Ca3Pt2(Er3Ni2, ibid)H8.786;16.786A=bH(3;6)=cCH($\sqrt{27}$;24)
CaPt2(MgCu2,SR27.322)7.629A=idmCaNi2 BF2
Ca2Pt7(Ce2Ni7,SR27.324)H5.349;26.30A=bH(1;2;4/3)=cFH(4;24/3) N=16,344
CaPt5(CaCu5,SR27.322)H5.322;4.368A=idmCaNi5 BF2
Sr9Pt(F ,JLCM78.1981.P49)6.091A
SR7Pt3(0 , ibid)7.937;24.333;7.109A
Sr3Pt2(Er3Ni2, ibid)H9.337;17.762A=idmCa3Pt2
Sr5Pt4(Pu5Rh4, ibid)7.879;15.606;8.147A
SrPt2(MgCu2,SR22.75)7.777A=idmCaNi2
SrPt3

Ni₂(R9.6,SR40.64) structure of Ca₃Pt₂ permits a HCH√3 binding with $N_{Pu}^{P'}=12.5$. The phases CaPt₂(MgCu₂), Ca₂Pt₇(Ce₂Ni₇) and CaPt₅(CaCu₅) are homeotypic and homeodesmic.

$A_M^{3,10}$ phases. While in the previous class $A_M^{2,10}$ the electron count was not a problem, in $A_M^{3,10}$ an Ekmanian or non-Ekmanian count may be chosen (see 83Sch). The observed crystal structures appear to suggest the non-Ekmanian count $Sc^{3,8}Ni_M^{0,10}$, but sometimes a little \underline{b} contribution by Ni might be possible. The Ti₂Ni type of Sc₂Ni occurs mainly in $A_M^{4,10}$ phases, a HTU√2 binding appears possible here, but in Ti₂Ni the binding FU2 will be found. For ScNi the HH2 binding of NiAl appears to apply although the BB2 binding of CuZn might be considered too. The phase ScNi₂(MgCu₂) is not isodesmic to CaNi₂(MgCu₂), as binding appears possible HTFU2 with place ratio $N_{Pu}^{P'}=9.8$. The radius ratio r_{A3}/r_{A10} fosters in ScNi₂ and its homologous isotypes the coalescence of hexagonal atom layers with √4 and √3 commensurability of the atom nets to the crystal mesh, and the large atom in the √3 mesh expels additionally a small atom from the neighbouring √4 mesh so that a double replacement by A^3 occurs (64Sch). The members of this structural family are numerous and in the present example they have, as TAB $A_M^{3,10}$ shows, all the same \underline{c} correlation but differ in the \underline{b} correlation.

Y₃Ni(Fe₃C) is a DI-homeotype of Cu₃Au and permits a HH√3 binding. Y₃NiC (T48.32) yields a HTC2 binding with $N_{Pu}^{P'}=7.0$ and YNi(FeB) permits a HH2 binding with $N_{Pu}^{P'}=8$. This brass-like binding is expected in brass-like phases near the \underline{b} electron concentration 1.5 (generalized Hume-Rothery rule). In the present mixture class the occupation ratio of the \underline{c} correlation is for A^3 rich phases only 0.50 of the ratio in brass-like phases, therefore the XX2 binding may occur at greater \underline{b} electron concentrations (see Y₃Pd₂). The difference in \underline{c} occupation is the cause of the striking phenomenon that the present pseudo brass-like alloys are structurally quite different from the truly brass-like alloys. The small occupation of the \underline{c} correlation is caused by the large volume of the A^3 atoms. In the phase with the greatest mole fraction $N_{Ni}^{A^1}$ Y₂Ni₁₇(Th₂Ni₁₇) the \underline{c} occupation is 0.93 as in many brass-like phases, but the \underline{b} electron concentration $N_D^A=0.345$ is too small as the place number ratio became $N_{Pu}^{P'}=32$ which is equal to the value 32 for the A^1 elements (82aSch). Therefore the stability of YNi_{8.5} suggests the ionisation of Ni¹⁰ electrons; it is easily found from the data of $A_M^{3,10}$ that $d_b=2.6\text{\AA}$ in YNi_{8.5} while in Y it is near 2.3\text{\AA}. Another feature confirming the binding proposal is the high

SrPt5(CaCu5,SR21.137)H5.397;4.364A=idmCaNi5
BaPt2(MgCu2,SR22.75)7.920A=idmCaNi2 phdM
BaPt5(CaCu5,SR13.31,35.27)H5.505;4.342A=idmCaNi5 cmp

A3A10M

Sc2Ni(Ti2Ni,SR27.342)12.29A=bHT($\sqrt{32}$;6.5/2)=cU(8;10) N=192,832
ScNi(CsCl,SR27.342)3.17A=bHT($\sqrt{2}$;1.6/2)=cHTK'(2)
ScNi2(MgCu2,SR26.236)6.926A=bHT($\sqrt{8}$;3.3)=cF(4) N=24,224
Sc2Ni7(Ce2Ni7,JLCM16.441)H4.74;22.56A=bH(2;9)=cFH(4;24/3) N=24,344
ScNi5(CaCu5,JLCM16.441)H4.74;3.76A=bCH($\sqrt{1.8}$;2.6)=cFH(4;3.9/3) phdE
Y3Ni(Fe3C,BuTSocFrMiCr90.311)6.92;9.49;6.36A=bHO(3;4;1.5)=cHO(3;7;4.8) N=36,136
Y3Ni2(T48,32,SR43.85)7.104;36.597A=bHT(3;16/2)=cC(6;3 1) N=144,703
YNi(FeB,SR24.198)4.124;7.156;5.521A=bHT(2/1;3;2.3)=cHT(4;6;4.6) N=12,72
YNi2(MgCu2,SR24.198)7.181A=idmScNi2 HTFU2 N=24,224
YNi3(PuNi3,R3.9,SR24.198)H5.00;24.30A=bH(2;10)=cFH(4;24/3) N=27,342
Y2Ni7.h(Gd2Co7,SR34.140,35.122)H4.949;36.23A=bBH(1;36/3)=cFH(4;36/3) N=36,516
Y2Ni7.r(Ce2Ni7,JLCM18.59)H4.928;24.11A=hdmY2Ni7.h
YNi5(CaCu5,SR24.198)H4.883;3.967A=idmScNi5 CHFH3
Y2Ni17(Th2Ni17,SR24.198)H8.34;8.08A=bCH($\sqrt{32}$;5/3)=cFH($\sqrt{4}$;8;8/3) N=12,372
La3Ni(Fe3C,BuTSocFrMiCr90.311)7.22;10.24;6.60A=idmY3Ni HHV/3 phdM
La7Ni3(Th7Fe3,SR39.117)H10.140;6.383A=bUH(4;3/2)=cFH($\sqrt{48}$;5.4/3) N=42,172
LaNi(TlI,SR30.150)3.907;10.810;4.396A=bB(0.9 $\sqrt{2}$;3.5 $\sqrt{2}$)=cB(0.9 $\sqrt{8}$;7; $\sqrt{8}$) N=12,72
La2Ni3(Q4.6,SR42.104)5.114;9.732;7.908A
LaNi2(MgCu2,SR11.87)7.262A=idmScNi2 HTFU2 N=18,168
LaNi3(PuNi3,SR34.140)H5.086;25.01A=idmYNi3 HFH2
La2Ni7.h(Gd2Co7,JLCM18.59)H5.056;36.98A=idmY2Ni7.h
La2Ni7.r(Ce2Ni7,SR35.95,39.117)H5.058;24.71A=idmY2Ni7.r
LaNi5(CaCu5,SR11.59)H5.016;3.982A=idmScNi5 CHFH3
Sc4Pd
Sc2Pd(Ti2Ni,SR27.342)12.427A=idmSc2Ni phdM
ScPd(CsCl,SR27.342)3.283A=idmScNi HTHT2 cmp
ScPd2
ScPd3(Cu3Au,SR26.165)3.981A=bF($\sqrt{2}$;2.25;2.1/2)=cB(3) N=3,38
Y3Pd(Fe3C,JLCM72.P17)7.063;9.734;6.453A=idmY3Ni HHV/3 phdM
Y5Pd2(Dy5Pd2,SR40.114)13.625A=bHT($\sqrt{32}$;6.5)=cU(8;10) N=204,824
Y3Pd2(Er3Ni2,SR43.105)H8.750;16.468A=bH($\sqrt{13}$;6.5)=cH($\sqrt{52}$;13) N=81,396
YPd.h
YPd.r
Y3Pd4(Pu3Pd4,SR40.114)H13.147;5.697A=bH(5;2.2)=cUH(10;5/2) N=54,384
Y2Pd3.h
Y2Pd3.r
YPd2
YPd3(Cu3Au,SR26.165)4.074A=idmScPd3 FUB2 cmp
La3Pd
La7Pd3(Th7Fe3,SR39.117)H10.387;6.552A=idmLa7Ni3 UHFHV/3
LaPd(TlI,ThermChimAct12.267)3.945;11.032;4.660A=bU(0.8 $\sqrt{2}$;4; $\sqrt{2}$)=cUHK'(2)
La3Pd4(Pu3Pd4,SR40.111)H13.860;5.848A=idmY3Pd4 HUH2
LaPd3(Cu3Au,SR26.165)4.235A=idmScPd3 FUB2
ScPt(Ni2Si,SR45.106)6.592;4.491;8.206A=bF(2;1.3;2.5)=cFK'(2)
ScPt(CsCl,SR27.342)3.270A=bHT($\sqrt{2}$;1.6/2)=cHTK(2)
ScPt2(MgCu2,79Ia)
ScPt3(Cu3Au,SR26.165)3.958A=idmScPd3 FUB2
Y3Pt(Fe3C,SR45.85)7.101;9.584;6.454A=idmYNi3 HHV/3
Y7Pt3(Th7Fe3,PhyRevA137.119)H9.864;6.299A=bUH(4;3/2)=cFH($\sqrt{48}$;5.5/3) N=42,172
Y2Pt(Ni2Si,SR44.120)7.141;4.764;8.753A=bF(2;1.3;2.5)=cC($\sqrt{32}$;...) N=44,104
Y5Pt3(Mn5Si3,SR44.120)H8.370;6.276A=bUH($\sqrt{12}$;3/2)=cH($\sqrt{48}$;5.2) N=30,140

melting temperature $T_f(\text{YNi}_5) = 1490^\circ\text{C}$ (see 65E11) which is near to $T_f(\text{Y}) = 1500^\circ\text{C}$; this temperature is caused by the energetic favourable c_{FH} correlation of YNi_5 : though Ti is cubic and F1 is cubic the first element of the commensurability matrix 3 yields parallel axes of b and c so that nowhere the correlations need to deform each other as it occurs in bindings which are factorial only in one plane.

The isotypic phases $\text{ScPd}_3(\text{Cu}_3\text{Au})$, YPd_3 , LaPd_3 are quite stable as YPd_3 has a very high melting temperature, and this confirms the FB2 binding. A R-homeotype of Ti_2Ni is $\text{Y}_5\text{Pd}_2(\text{Dy}_5\text{Pd}_2, \text{F18.7})$, a $\text{HTU}\sqrt{2}$ binding might apply. The $\text{Er}_3\text{Ni}_2(\text{R9.6, SR40.64})$ structure of Y_3Pd_2 permits a HH2 binding with $N_{p_n}^{\text{P1}} = 8.0$. For $\text{Y}_3\text{Pd}_4(\text{Pu}_3\text{Pd}_4, \text{R 6.8})$ a HUH2 binding is possible with $N_{p_n}^{\text{P1}} = 9.2$ and $\text{LaPd}(\text{T11})$ is with UU2 surprisingly heterodesmic to $\text{LaNi}(\text{T11, BB2})$. Furthermore it is astonishing that in A^3Pd_2 no MgCu_2 type appears to occur.

In $\text{Sc}_2\text{Pt}(\text{Ni}_2\text{Si, FF2})$ a strong shift of the XX2 binding to A^{10} poorer compositions is found. $\text{ScPt}(\text{CsCl})$ might be isodesmic to $\text{ScNi}(\text{CsCl})$, like as $\text{Y}_2\text{Pt}(\text{Ni}_2\text{Si})$ to Sc_2Pt . It may be understood from this that the binding in first line steers the stability while the structure depends also on radius ratio etc. A remarkable phenomenon is the heterotypism $\text{ScPt} - \text{YPt} - \text{LaPt}$; the number of c places per atom $N_{p_n}^{\text{A}}$ is 16, 13.5, 12.5 conforming to the place number rule; it may therefore be said that the place number rule causes the heterotypism.

$\text{A}^4\text{A}_M^{10}$ phases. $\text{Ti}_2\text{Ni}(\text{F16.8})$ is a RLI-homeotype of W . The difference to the homeotype $\text{NiSi}_2(\text{CaF}_2)$ lies in the possibility of formation of Ni clusters in Ti_2Ni , which is favourable here as the Ni-Ni core interaction is stronger than the Ti-Ni core interaction (83Sch). The binding cannot be FB2 as the melting point of Ti_2Ni is relatively low and not congruent; it is FU2 and must therefore be twinned in the crystal. For $\text{TiNi.h}(\text{CsCl})$ a FF2 binding fits, the famous room temperature structures may have to do with a split of the Ti^4 electrons into two correlations. In $\text{TiNi}_3.r(\text{H4.12})$ a hexagonal homeotype of Cu_3Au , four close packed atom layers parallel to the hexagonal basal plane are stacked in the sequence ABAC . The high and congruent melting point of $\text{TiNi}_3.r$ suggests a favourable binding, and the $\text{FHCH}/3$ binding of TAB.4 permits a preferred fit of b to the \underline{a} cell. The dipole assessment of 64Sch favours the shear when c_{CH} is somewhat deformed.

During a study of TiNi_MCu_M alloys (68Pfe) high temperature homeotypes of TiNi_3 have been found, for increasing \underline{b} electron concentration the sequence of the phases was L4, L10, L9, L21 where L4 means a structure with 4 layers per cell. Similar sequences of structures have been found in brass-like mixtures

Y5Pt4(Pu5Rh4,SR44.92)7.46;14.55;7.52A=bFU(3;8)=cFUK'(2) N=60,320
Ypt(FeB,SR30.164)7.01;4.47;5.55A=bUH(2.7; $\sqrt{3}$;2.5/2)=cUHK'(2)
YPt2(MgCu2,SR23.215)7.59+H5.37;13.15A=idmScNi2 BHFH/12
YPt3(Cu3Au,SR26.165)4.075A=idmScPd3 FUB2
YPt5(012.60,JLCM12.63)5.24;9.12;26.53A=bCH($\sqrt{478}$;17/3)=cFH(4;25/3)
La3Pt($\sqrt{791}$ an)
La7Pt3(Th7Fe3,SR39.117)H10.336;6.516A=idmY7Pt3 UHFH/3
La3Pt2(Er3Ni2,SR43.104)H9.096;17.303A=bUH($\sqrt{12}$;7.6)=cUH/ $\sqrt{48}$;15/2) N=81,396
LaPt(TlI,SR30.150)3.974;11.037;4.558A=idmLaNi BB2 N=12,72
La3Pt4(Pu3Pd4,SR43.104)H13.860;5.848A=idmY3Pd4 HUH2 N=54,384
LaPt2(MgCu2,SR23.216)7.77+H5.50;13.45A=idmScNi2 BHFH/12 N=78,168
LaPt3(Cu3Au,71Eck)4.074A=bF(1)=cB/8;2.8N=3,38
LaPt5(CaCu5,SR26.239)H5.386;4.378A=idmScNi5 CHFH3 N=3,58

A4A10M

Ti2Ni(F16.8,SR23.195)11.278A=bF(4)=cU(8;10) N=256,832 phdHA
TiNi.h(CsCl,SR13.91)2.986A=bF(1)=cF(2) N=4,18
TiNi.r(Z6.6,H5.5,Z3.3,SR38.131)
TiNi2.h(homeotype of TiNi3 with 21 layers)
Ti30Ni70.h(9 layers)
Ti27Ni73.h(10 layers)
TiNi3(H4.12,SR7.14)H5.159;8.319A=bFH(2;4/3)=cCH($\sqrt{12}$;15/3) N=16,152
Zr2Ni(CuAl2,SR27.297)6.477;5.241A=bFU(3;3,5/2)=cU($\sqrt{18}$;4) N=32,104 phdM cmp
ZrNi(TlI,SR27.297)3.268;9.937;4.101A=bFU($\sqrt{2}$;6.1/2;1.25 $\sqrt{2}$)=cFUK'(2) N=16,72 cmp
Zr9Ni11.h(U9.11,SR45.97)9.88;6.61A=bB($\sqrt{13}$;2.4)=cBK'(2) N=72,364
Zr7Ni10(Q14.20,SR27.298)12.386;9.156;9.211A=bHT(4;6)=cHT(8;12) N=112,624
Zr2Ni5(O $\sqrt{SR26.207}$ 6.5;10.1;12.1A
ZrNi3(Ni3Sn,SR45.97)H5.309;4.303A=bH(2;1.6)=cCH($\sqrt{12}$;7/3) N=8,76 cmp
Zr2Ni7(N4.14,SR38.132)M95.83⁰4.698;8.235;12.193A=bBH(1;13/3)=cFH(4;13/3)N=32,344
ZrNi5(Be5Pd,SR21.158)6.706A=bB(2)=cF(4) N=16,232
Hf2Ni(CuAl2,SR38.6)6.405;5.252A=idmZr2Ni phdM
HfNi.h
HfNi.r(TlI,SR27.232)3.220;9.820;4.120A=idmZrNi
Hf9Ni11(Zr9Ni11,SR26.206)9.79;6.53A=idmZr9Ni11
Hf7Ni10(Zr7Ni10,SR27.232)12.275;9.078;9.126A=idmZr7Ni10
Hf3Ni7.h(Z6.14,SR44.69)
Hf8Ni21.h(Z8.21,SR44.69)
HfNi3.h(BaPb3,R3.9,SR44.69)H5.279;19.232A=hdmTiNi3
HfNi3.r(Ta, Rh, Pd)3, H10.30, SR44.69)H5.282;21.392A=hdmTiNi3
Hf2Ni7(Zr2Ni7,SR39.68)M95.509⁰4.657;8.191;12.102A=idmZr2Ni7
HfNi5(Be5Pd,SR26.207)6.68A=idmZrNi5
Ti4Pd(Cr3Si,71Eck)5.055A=bHT($\sqrt{8}$;3.2)=cB(4) N=26,68 phdM
Ti2Pd(Zr2Cu,SR27.234)3.090;10.054A=bB($\sqrt{2}$;4.5)=cFU($\sqrt{8}$;13) N=16,52
TiPd.h(CsCl,70Don)3.18A=idmTiNi.h FF2
TiPd.r(AuCd,SR30.163)4.56;2.81;4.89A=bH($\sqrt{1.75}$;2.1)cCHK'(2) N=8,36 cmp
Ti2Pd3(Q4.6,SR33.126)4.61;14.33;4.64A=bFU(2;8/2)=cFU(4;18/2) N=32,184
Ti3Pd5(T3.5,SR33.127)3.263;11.436A=bHT($\sqrt{2}$;6/2)=cFU($\sqrt{8}$;7) N=12,74
TiPd1.7(MoSi2,71Eck)3.24;8.48A=bHT($\sqrt{2}$;4.3/2)=cFU($\sqrt{8}$;10.5/2) N=9,55
TiPd2(DhtpMoSi2,71Eck)3.41;3.07;8.56A
TiPd2.9(TiNi3,SR22.181)H5.489;9.964A=idmTiNi3 FHCH/3 cmp
TiPd4(Cu3Au,68Kra)40A=bFU($\sqrt{2}$;2/2)=cB($\sqrt{8}$;2.8) N=3-2,39
Zr2Pd(Zr2Cu,SR27.227)3.297;10.92A=idmTi2Pd phdM
ZrPd cmp
Zr4Pd5(tetr,)10.25;6.68A=idmZr9Ni11 BB2
ZrPd2(MoSi2,SR27.227)3.407;8.597A=idmTiPd1.7 HTFU2
ZrPd3(TiNi3,SR27.227)H5.623;9.254A=idmTiNi3 FHCH/3 cmp

(58Weg) and in the mixture $\text{TiNi}_3(\text{NbNi}_3)_M(66\text{Vuc})$. Several structure proposals (71Bha) refer to a substructure, they do not correspond to results of (58Weg) and need therefore confirmation. It appears probable that a change of \underline{b} electron concentration alters the stacking sequence, but a full interpretation is yet to be worked out.

The phase $\text{Zr}_2\text{Ni}(\text{CuAl}_2)$ has a FU2 binding like $\text{Ti}_2\text{Ni}(\text{F16.8})$ and the heterotypism $\text{Ti}_2\text{Ni}-\text{Zr}_2\text{Ni}$ obeys the place number rule: $N_{p''}^A(\text{Ti}_2\text{Ni})=13.3$, $N_{p''}^A(\text{Zr}_2\text{Ni})=12$. It becomes clear now why the Ti_2Ni type is stabilized by small amounts of N ($\text{Zr}_2\text{NiN}_{0.5}$, see 71Eck) or O ($\text{Hf}_2\text{NiO}_{0.5}$ etc., SR24.133): the electrons of the atoms occupy \underline{c} places (82Sch) and increase therefore the $N_{p''}^A$ number so that the Ti_2Ni type becomes more favourable. The phase $\text{ZrNi}(\text{TiI})$ opens the brass plateau with FF2 and it is seen that there are enough \underline{c} places for the count $\text{Zr}^{4,8}\text{Ni}^{0,10}$. The phases $\text{Zr}_9\text{Ni}_{11}\text{.h}(\text{U9.11})$ and $\text{Zr}_7\text{Ni}_{10}(\text{Q14.20})$ with BB2 and HH2 binding complete the plateau. The phases $\text{Zr}_2\text{Ni}_7(\text{N4.14})$ and $\text{ZrNi}_5(\text{BePd}_5)$ belong to a BF2 plateau. The phases of HfNi_M are mostly isodesmic to ZrNi_M phases.

In TiPd_M a fairly smooth $N_{p''}^A(N_2)$ curve follows from the data of TAB.4. The FUB2 binding for $\text{TiPd}_4(\text{Cu}_3\text{Au})$ suggests that Pd contributes some \underline{b} electrons.

The CB/2 binding of $\text{Ti}_3\text{Pt}(\text{Cr}_3\text{Si})$ is closely homeotypic to the favourable FB2 binding occurring in $\text{V}_3\text{Ni}(\text{Cr}_3\text{Si})$. In $\text{TiPt.h}(\text{CsCl}, \text{FF2})$ the brass plateau begins which ends in $\text{Ti}_3\text{Pt}_5(\text{P6.10})$, a R-homeotype of TiAl_3 with a BB2 binding explaining the TiAl_3 shear by the electro dipole rule (64Sch). The FHCH/3 binding of $\text{TiPt}_{2.9}(\text{TiNi}_3)$ is probably responsible for the congruent melting point of TiPt_3 . The rare structure of $\text{TiPt}_8(\text{U1.8})$ corroborates the assumption that for sufficient small N_{Ti}^- the \underline{b} contribution of A^{10} becomes positive; the N_{Ni}^- independent value of $\underline{d}_b(N_{Ni}^-)$ suggests that the electron concentration becomes constant.

The phase $\text{Zr}_5\text{Pt}_3(\text{Mn}_5\text{Si}_3)$ permits the good HUH/3 binding, the other phases of the mixture are isodesmic to earlier phases, and the same is valid for HfPt_M .

$A_{AM}^{5,10}$ phases. It is remarkable that $\text{V}_3\text{Ni}(\text{Cr}_3\text{Si}, \text{FB2})$ has not a congruent melting point, but considering that the \underline{b} correlation is not fully occupied it becomes probable that the \underline{b} correlation is in fact a little strained and this spoils the high melting point. Compared with this assumption $\text{V}_3\text{Ni}_2(\text{U.h}, \text{FU2})$ has a better commensurability and remains stable at higher temperatures. $\text{VNi}_2(\text{MoPt}_2, \text{UU2})$ and $\text{VNi}_3(\text{TiAl}_3, \text{BB2})$ belong to the XX2 plateau and conforming to a rule the closer UU2 binding is stable at greater \underline{b} electron concentration.

The phase $\text{Nb}_5\text{Ni}(\text{F20.4})$, a homeotype of TiNi_2 , has not been traced in the phase diagram (see 69Shu). Since the well fitting BC2 binding permits 432 \underline{b}

HF2Pd(Zr2Cu,SR27.234)3.251;11.061A=idmTi2Pd BFU2 phdM
 HFPd
 HF3Pd4
 HFPd2.h(MoSi2,) cmp
 HFpd3(TiNi3,SR23.258)H5.595;9.192A=idmTiNi3 FHCH/3
 Ti3Pt(Cr3Si,SR16.100)5.033A=bC($\sqrt{8}$;2.8)=cB(4) N=24,68 phdE
 TiPt.h(CsCl,SR38.170)3.19A=idmTiNi.h FF2 cmp
 TiPt.r(AuCd,SR29.129)4.59;2.76;4.82A=idmTiPd.r HH2
 Ti3Pt5(P6.10,SR33.127)10.953;5.441;8.169A=bB(4;2;3)=cBK'(2) N=48,296
 TiPt2.9(TiNi3,SR29.129)H5.52,9.02A=idmTiNi3 FHCH/3
 TiPt3(Cu3Au,SR21.164)3.916A=bF(1)=cB($\sqrt{8}$;2.8) cmp
 TiPt8(U1.8,SR30.86)8.312;3.897A=bFU(3;2/2)=cU(6;3.5) N=8,176
 Zr2Pt(Zr5Ir3,ZMetKd55.704) phdE
 Zr5Pt3(Mn5Si3,ZMetKd58.558)H8.201;5.405A=bH(4;2.5)=cUH($\sqrt{48}$;5/2) N=40,140
 ZrPt.h(CsCl,SR29.130)3.31A=idmTiNi.h FF2
 ZrPt.r(TlI,SR30.164)3.409;10.315;4.277A=idmZrNi FF2
 Zr9Pt11(tetr.)10.29;6.88A=idmZr9Ni11.h BB2
 Zr7Pt10(tetr.)6.78;13.03A=idmZr7Ni10 HH2
 ZrPt3(TiNi3,SR9.116)H5.644;9.226A=idmTiNi3 FHCH/3
 ZrPt4(Cu3Au,)3.99A=idmTiPt3 FB/8
 ZrPt8(TiPt8,ZMetKd59.724)8.386;4.027A=idmTiPt8 FUU2
 HF2Pt(Ti2Ni,SR22.188)12.46A=idmTi2Ni
 HFPt(TlI,SR30.144)3.345;10.269;4.288A=idmZrNi FF2
 HFpt1.1(CsCl,ZMetKd55.704)3.23A=idmTiNi.h FF2
 HF2Pt3(MoSi2,SR29.119)3.43;8.73A=bFU($\sqrt{2}$;5/2)=cFUK'(2) N=9.6,55
 HFpt3(TiNi3,SR23.258)H5.636;9.208A=idmTiNi3 FHCH/3

A5A10M

V3Ni(Cr3Si,SR18.313)4.711A=bF(2)=cB(4) N=30,68 phdM
 V3Ni2(U.hf,T30,SR20.163)8.97;4.64A=bFU(5;3.7/2)=cU($\sqrt{50}$;4.5) N=90,264
 VNi2(MoPt2,P1.2,SR30.161)2.56;7.64;3.55A=bU(1;3;1.7)=cUK'(2)
 VNi3(TiAl3,SR16.124)3.54;7.21A=bB($\sqrt{2}$;3)=cBK'(2)
 VNi8(TiPt8,MatSci6.1971.1425)
 Nb5Ni?(F20.4,htpTi2Ni,Kristjal2.350)11.642A=bB(6)=cC(12) phdS
 NbNi(W6Fe7,SR27.287)H4.893;26.64A=bH($\sqrt{7}$;14.3)=cUH($\sqrt{21}$;28.6/2)
 NbNi3(Cu3Sb.h,SR22.173)5.11;4.54;4.25A=bCH($\sqrt{3}$;1.5;3.5/3)=cCHK'(2) N=10,76
 NbNi8(TiPt8,TransMet1SocAIME245.1969.345)7.6;3.6A=bFU(3;2/2)=cB(6;3.8) N=10,176
 Ta5Ni?(Nb5Ni,Kristjal2.350)11.635A=idmNb5Ni phdS
 Ta2Ni(CuAl2,SR27.294)6.216;4.872A=bHT($\sqrt{13}$;3.2/2)=cB($\sqrt{26}$;4)
 TaNi(W6Fe7,SR27.287)H4.921;26.905A=idmNbNi HUH/3
 TaNi2(MoSi2,SR29.69)3.154;7.905A=bF(1;5/2)=cFK'(2)
 TaNi3.h(TiAl3,SR29.127)3.627;7.455A=idmVNi3 BB2 cmp
 TaNi3.r(M12.36,SR30.160)M90.63⁵.11;4.54;25.50A=bCH($\sqrt{3}$;1.5;21/3)=cCHK'(2)N=60,456
 TaNi8(TiPt8,MetTrans1.1970.485)7.60;3.70A=idmNbNi8
 V3Pd(Cr3Si,SR22.182)4.816A=idmV3Ni FB2 phdE
 Vpd.r(htpCu,71Eck)3.83A
 Vpd2.r(MoPt2,SR29.129)2.750;8.250;3.751A=idmVNi2 UU2 N=10,56
 Vpd3.r(TiAl3,SR26.165)3.847;7.753A=idmVNi3 BB2
 Nb3Pd2.h(U.hf,SR20.75,29.125)9.89;5.11A=idmV3N2 FU2 phdE
 Nb2.9Pd2.r(NbRu,ZMetKd55.1964.619)4.30;4.23;3.65A=bFU(2;2.5/2)=cC(4;3.5) N=12,36
 NbPd.h?(Mn.r,71Eck)9.77A
 NbPd2(MoPt2,SR30.156)2.839;8.376;3.886A=idmVNi2 UU2
 NbPd3.h(O6.18,SR29.70)5.486;4.845;13.602A=bCH($\sqrt{3}$;1.5;10.5/3)=cCHK'(2) N=30,228
 NbPd3.r(TiAl3,71Eck)3.87;7.96A=idmVNi3 BB2
 Ta3Pd(U.hf,SR28.48)9.978;5.208A=bFU($\sqrt{29}$;4/2)=cU($\sqrt{58}$;4.8) N=112,256 phdM
 TaPd.h(Cu,MetTrans94.1978.643)

places while only 400 \underline{b} electrons are offered it might be that the phase is stabilized by atoms like oxygen. NbNi(W₆F₇, drawing 64Sch, p.157) is a neat representation of the $\sqrt{4}, \sqrt{3}$ coalescence; it enjoys a HUH $\sqrt{3}$ binding. NbNi₃ (Cu₃Sb.h, formerly named after the non-existent TiCu₃, drawing 64Schp.114) is RD-homeotypic to Mg and yields a CC2 binding. For NbNi₈ (TiPt₈) a non-vanishing \underline{b} contribution appears necessary and has in fact been confirmed by magnetic measurements (58Vog). However, the magneton numbers in the ordered state appear not to be known at present.

In TaNi_M following the rule of heavy components more phases occur than in NbNi_M. Interesting is the brass plateau consisting of TaNi₄(MoSi₂, FF2), TaNi₃.h (TiAl₃, BB2) and TaNi₃.r (M12.36, CC2).

The consideration of the phase diagrams of A⁵Pd_M mixtures shows that the characteristic crystal structures of intermediate phases frequently form in the solid state from a Cu type mixed crystal; this indicates a decrease of the influence of the electron correlation just as in the Ekman gap of AⁿB_M¹ alloys. The phase V₃Pd(Cr₃Si) forms at a relatively low temperature of 840°C for reasons mentioned at V₃Ni; it must be conjectured that partial substitution of V by Mo increases the maximum stability temperature essentially. The brass plateau phases VPd₂(MoPt₂, UU2) and VPd₃.r(TiAl₃, BB2) follow in the expected sequence with respect to the closeness of the binding.

In NbPd₃.h(06.18) a close packed structure is found with 6 layers in the stacking sequence ABCACB; since the \underline{c}_{CH} correlation has 21 layers, there are 7 electrons on a straight line parallel to \underline{a}_3 and these cause together with 6 atomic layers a system of electrical dipoles which presumably cause the rare stacking sequence. In TaPd.r(TiCu) perhaps a FF2 binding must be assumed.

The A⁵Pt_M phase diagrams once more display the weakness of \underline{b} electron correlation found in A⁵Ni_M and A⁵Pd_M, it may be conjectured that at high temperatures the Ekman count is valid. From the melting temperature of V₃Pt it may be concluded that V₄Pt is the most stable composition of V₃Pt(Cr₃Si) and just this composition fills the FB2 binding in the \underline{b} correlation. The HUH $\sqrt{3}$ binding of VPt(AuCd) favours the Mg type stacking of VPt(AuCd) as $K'_{33}=2$. The sequence UU2-BB2 for VPt₂(MoPt₂), VPt₃.r(TiAl₃) confirms the above mentioned rule.

The stacking homeotype MoPt₃.1(M12.36) of NbPt₃(Cu₃Sb.h₁) fulfills the rule that the structure tends to make K'_{33} integer.

TaPd.r(TiCu,SR28.48)3.279;6.036A=bFU($\sqrt{2.25;4/2}$)=cHT(3;6.4) N=10,36
TaPd2(MoPt2,SR30.77)2.896;8.397;3.790A=idmVNi2 UU2 cmp
TaPd3(TiAl3,SR28.48)3.880;7.978A=idmVNi3 BB2 cmp
V3Pt(Cr3Si,SR20.76)4.817A=idmV3Ni FB2 phdM
VPt.h(CuAu,SR29.129)3.81;3.88A=bHT(2;2.3)=cU($\sqrt{8;3.5}$) N=10,36
VPt(AuCd,SR29.130)4.42;2.69;4.76A=bH(2.2; $\sqrt{16/9}$)=cUH(4.4/2;4/ $\sqrt{3}$) N=10,36
VPt2(MoPt2,SR30.77)2.730;8.323;3.800A=idmVNi2 UU2
VPt3.h(Cu3Au,SR29.129)3.87A=bFU($\sqrt{2.5;2.2/2}$)=cFUK'(2) N=5,38
VPt3.r(TiAl3,SR26.165)3.861;7.824A=idmVNi3 BB2
Nb3Pt(Cr3Si,SR19.243)5.147A=idmV3Ni FB2 phdE
Nb2Pt(U.hf,SR20.75)9.89;5.11A=bFU($\sqrt{26;3.8}$)=cU($\sqrt{52;4.6}$)
NbPt(AuCd,SR29.70)2.780;4.983;4.611=idmVPt HUH3
NbPt2(MoPt2,SR29.125)2.801;8.459;3.951A=idmVNi2 UU2
NbPt3(Cu3Sb.h,SR29.125)5.534;4.564;4.873A=bH($\sqrt{5;3;19}$)=cH($\sqrt{21;3.8}$) N=10.76
NbPt3.1(M12.36,SR29.72)M90.533⁰4.870;5.537;27.33A=ndmNbPt3
Ta7Pt(Cr3Si,)=idmV3Ni FB2 phdM
Ta3Pt(U.h1,SR20.75)9.93;5.16A=idmTa3Pd FU2
TaPt.h
TaPt2.h
TaPt2.r(VAu2,Q2.4,SR29.129)8.403;4.785;4.744A= N=20.112
TaPt3.h(NbPt3.1,SR29.70)M90.54⁰4.869;5.537;27.33A=idmNbPt3.1 HH2
TaPt3.r(Cu3Sb.h1,SR30.163)5.538;4.869;4.560A
TaPt4(TiAl3,SR29.129)3.91;7.94A=idmVNi3 BB2

A6A10M

CrNi2(MoPt2,SR20.73,22.96)2.523;7.570;3.568A=bU(1;3;1.7)=cUK'(2) N=12,56 phdS
MoNi(O28.28,SR28.29)9f;9f;8.852A=bB($\sqrt{17;4}$)=cFU($\sqrt{68;12/2}$) N=174,504 phdS
MoNi3(Cu3Sb.h1,SR23.181)5.064;4.224;4.448A=bCH($\sqrt{3;3.5/3;1.5}$)=cCHK'(2) N=12,76
MoNi4(U1.4,SR9.110)5.683;3.592A=bB($\sqrt{5;1.4}$)=cBK'(2) N=12,96
WNi(U ,ScriptMet8.1974.1297)10.40;10.80A phdM
WNi(O ,ScriptMet8.1974.1297)7.76;12.48;7.10A
WNi3(Cu3Sb.h1,SR39.118)
WNi4(MoNi4,SR12.115)5.730;3.553A=idmMoNi4
CrPd(CuAu,SR18.115)3.879;3.801A phdHA
CrPd3(Cu3Au,)
MoPd.h(Mg,SR29.124)2.777;4.488A
MoPd2(MoPt2,71Eck)2.75;8.25;3.89A=idmCrNi2
WpM(nic,phdS)
Cr3Pt(Cr3Si,SR20.76)4.706A=bF(2)=cB(4) phdM
CrPt3(Cu3Au,SR19.109)3.874A
Mo4Pt.h(Cr3Si,SR29.124)4.987=idmCr3Pt phdM
Mo3Pt2(Ni3Sn.r,SR29.124)H5.59;4.51A
MoPt.h(Mg,ZMetk455.1964.619)H2.795;4.48A
MoPt.r(AuCd,71Eck)4.47;2.74;4.89A=hdmVPt
MoPt2(P1.2,SR20.29)2.748;8.238;3.915A=idmCrNi2 UU2
MoPt3(htpTiAl3,SR29.124)3.897;3.936A
WpT2(MoPt2,SR34.141)2.762;8.251;3.907A phdHA
WpT3

A7A10M

MnNi.h(CsC1,SR15.99)3.028A+H7.4;5.3A=bH(2;7/3)=cBHK'(2) phdHA
MnNi.r(CuAu,SR30.239)2.635;3.527A=bB(1;1.3)=cU(2;3;3)
MnNi3.r(Cu3Au,SR12.65)3.589A=bF(1)=cB($\sqrt{8;2.8}$)
TcNiM(nic,phdM)
ReNiM(nic,phdE)

$A^6 A_M^{10}$ phases. As judged from the phase diagram these mixtures belong to the Ekman boundary which divides the phases with non-Ekmanian count from the phases with Ekmanian count.

A curious change of electron count occurs in $CrNi_2(MoPt_2)$; if this phase is to be assumed isodesmic with $VNi_2(MoPt_2)$ then the electron count should be $Cr^{5,8}Ni^{0,10}$, one electron of Cr is in another correlation or Hund inserted.

Analogous observations may be made in $MoNi_M$. The BB2 binding of $MoNi_4(U1.4)$ yields $N_b^a = 14$ \bar{b} places per crystal cell, which may be accounted for by the electron count $Mo^{5,8}Ni_4^{0.5,9.5}$. On the other hand it appears that in $MoNi(0.28.28)$ Ni does no more contribute \bar{b} electrons according to Ekman rule. The variability of the electron count does not facilitate the binding analysis here. For instance $CrPt_3(Cu_3Au)$ is probably heterodesmic to $MoPt_3(hfpTiAl_3)$, a more thorough analysis should be supported by a better knowledge of the structures ($MoPt_3$ e.g.).

$A^7 A_M^{10}$ phases. It appears that the Ekman boundary has been passed, as none of the typical non-Ekmanian structures are stabilized in this mixture class, furthermore mixtures not containing Mn, do not form intermediate phases at all (Ekman gap).

$MnNi.h(CsCl)$ and $MnNi.r(CuAu)$ correspond to $NiZn.h(CsCl)$ and $NiZn.r(CuAu)$ ($51CoI$) so that the electron count may be taken as $Mn^{2,5}Ni^{0,10}$. However, it is seen from the heterotypic transformation h-r that the \bar{b} electron concentration depends on temperature: in $MnNi.h$ it is $N_b^A = 1.5$ while in $MnNi.r$ it is $N_b^A = 1.25$ following the assumed binding. In $MnNT_3.r(Cu_3Au)$ the N_b^A may equal 1 so that the phase is isodesmic to Cu (FUB2).

The phase $MnPd_3(ZrAl_3)$ cannot have the FUB2 binding because of its superstructure; the CFU2 binding assumed favours formally the $TiAl_3$ type by \bar{b} and the $ZrAl_3$ type by \bar{c} by the method of electrical dipoles (64Sch); an inspection to the commensurabilities in the tetragonal basal plane reveals that the influence of the \bar{c} correlation is preponderant in this case.

Summarizing, it may be said that all phases of the $A^7 A_M^{10}$ class may be interpreted using the Ekman count.

$A^8 A_M^{10}, A^9 A_M^{10}, A^{10} A_M^{10}$ phases. These mixtures form the so called mixing class of alloys: the components form uninterrupted series of mixed crystals with Cu structure. From the view of the binding this property is conceivable. The electron count is of the Ekman type, the peripheral d-electrons of both components form the \bar{c} correlation and in the \bar{b} correlation there are about 0.5 to 1 \bar{b} electron per atom. Therefore the binding is $BB/8$ or $CB2$ or $FB/8$.

MnPd.h(CsCl,SR18.216)3.174A=idmMnNi.h BB2 phdA
MnPd.r(CuAu,SR18.216)2.89;3.61A=idmMnNi.r BU2
Mn3Pd5(Pt5Ga3,SR38.122)8.072;7.279;4.044A
Mn32.1Pd67.9(Ni2S1,SR38.124)5.460;4.029;8.127A
Mn27.4Pd72.6(ZrA13,SR38.123)3.913;4x3.874A=bC($\sqrt{2.5;6/2}$)=cFU($\sqrt{10;18/2}$)
TcPdM(nic,phdM)
RePdM(nic,phdS)
Mn3Pt(Cu3Au,SR19.221)3.836A phdHA
MnPt.h(CsCl,SR19.221) =idmMnNi.h BB2
MnPt.r(CuAu,SR19.221)2.827;3.669A=idmMnNi.r BU2
MnPt3(Cu3Au,SR19.220)3.898A=idmMnNi3.r FUB2
TcPtM(nic,phdM)
RaPtM(nic,phdHA)

A8A10M

FeNiM.h(Cu,SR2.634) phdS
FeNi3(Cu3Au,SR17.197)3.559A
RuNiM(nic,phdS)
OsNiM(nic,phdM)
FePdM.h(Cu,SR7.188) phdM
FePd.r(CuAu,SR7.188)3.860;3.731A
FePd3.r(Cu3Au,SR28.46)3.84A
RuPd4.h?(see E)
OsPdM(nic,phdS)
FePtM.h(Cu,SR13.129) phdHA
Fe3Pt(Cu3Au,SR13.131)3.76A
FePt(CuAu,SR13.131)3.846;3.723A
FePt3(Cu3Au,SR27.254)3.87A
RuPtM(nic,phdM)
CsPtM(nic,phdM)

A9A10M

CoNiM.h(Cu,SR13.88) phdHA
CoNi3(Cu3Au?,)
RhNiM(Cu,SR29.199) phdM
IrNiM(Cu,) phdM
CoPdM(Cu,SR26.127) phdHA
RhPdM.h(Cu,SR23.203) phdE
IrPdM.h(Cu,SR21.136) phdE
CoPtM.h(Cu,SR8.58) phdHA
CoPt(CuAu,SR8.57)3.818;3.639A
CoPt3(Cu3Au,SR15.53)3.831A
RhPtM.h(Cu,SR23.207) phdM
IrPtM.h(Cu,SR20.122)

A10A10M

NiPdM.h(Cu,SR29.198) phdHA
Ni3Pd
NiPtM.h(Cu,SR9.112) phdHA
Ni3Pt(Cu3Au,SR12.114)3.65A
NiPt(CuAu,SR9.112)3.823;3.589A
PdPtM.h(Cu,SR23.207) phdM

As to be expected the analysis of the spatial correlation of electrons adds to our understanding of the $A_n A_M^{10}$ alloys.

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