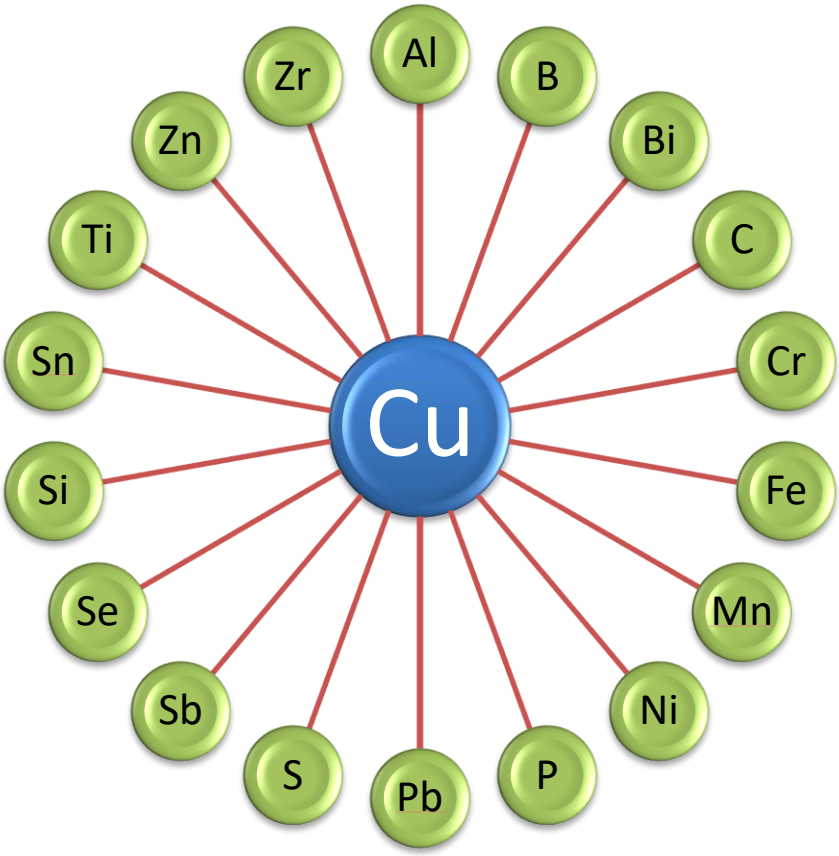
1. MDT Copper

Thermodynamic database for multi-component
Cu-rich alloys



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1.1 Components

Total of 19 components are included in the database as listed here:

Major alloy elements: **Cu**, Cr, Fe, Mn, Ni, Pb, Si, Sn, Zn

Minor alloy elements: Al, B, Bi, C, P, S, Sb, Se, Ti, and Zr

1.2 Suggested Composition Range

The suggested composition range for each element is listed in Table 1.1. It should be noted that this given composition range is rather conservative. It is derived from the chemistries of the multicomponent commercial alloys that have been used to validate the current database. In the subsystems, many of these elements can be applied to a much wider composition range. In fact, some subsystems are valid in the entire composition range as given in Section 1.4.

Table 1.1: Suggested composition range

Elements	Composition Range (wt.%)
Cu	50 ~ 100
Zn	0 ~ 45
Ni	0 ~ 35
Sn	0 ~ 14
Cr, Fe, Mn	0 ~ 10
Pb, Si	0 ~ 5
Al, Sb	0 ~ 3
Bi, P, Se, Zr	0 ~ 2
B, C, S, Ti	0 ~ 0.5

1.3 Phases

Total of 330 phases are included in the database and a few key phases are listed in Table 1.2. Information on all the other phases may be displayed through TDB viewer of Pandat and can be found at www.computherm.com.

Table 1.2: Phase name and related information

Name	Lattice Size	Constituent
Al2Cu	(0.667)(0.333)	(Al)(Al,Cu)
AlCu_Delta	(0.4)(0.6)	(Al)(Cu)
AlCu_Eps1	(0.4)(0.6)	(Al,Cu)(Al,Cu)
AlCu_Eps2	(0.5)(0.5)	(Al,Cu)(Cu)
AlCu_Eta	(0.5)(0.5)	(Al,Cu)(Cu)
AlCu_Zeta	(0.45)(0.55)	(Al)(Cu)
Bcc	(1)(3)	(Al,B,Bi,Cr,Cu,Fe,Mn,Ni,P,Pb,Si,Sn,Ti,Zn)(C,Va)
Cu3Se2	(3)(2)	(Cu)(Se)
Cu3Ti2	(0.6)(0.4)	(Cu)(Ti)
Cu41Sn11_LEE	(0.788)(0.212)	(Cu)(Sn)
Cu4Ti	(0.8)(0.2)	(Cu,Ti)(Cu,Ti)
Cu4Ti3	(0.571)(0.429)	(Cu)(Ti)
Cu56Si11	(0.835821)(0.164179)	(Cu,Zn)(Si)
CuInSn_Eta	(0.545)(0.122)(0.333)	(Cu)(Cu,Sn)(Sn)
Fcc	(1)(1)	(Al,B,Bi,Cr,Cu,Fe,Mn,Ni,P,Pb,Si,Sn,Ti,Zn)(C,Va)
Gammabrass	(1)	(Al,Cu,Fe,Ni,Si,Zn)
Hcp	(1)(0.5)	(Al,B,Bi,Cr,Cu,Fe,Mn,Ni,Pb,Si,Sn,Ti,Zn)(C,Va)
Laves_C15	(2)(1)	(Cr,Cu,Fe,Ni,Ti)(Cr,Cu,Fe,Ni,Ti)
Laves_C36	(2)(1)	(Cu,Ni,Ti)(Cu,Ni,Ti)
Liquid	(1)	(Al,B,Bi,Bi2Se3,C,Cr,CrSe,Cu,Cu2Se,Fe,FeSe,Mn,Ni,P,Pb,Se,MnSe,PbSe,Si,Sn,SeNi,SeSn,Se2Si,SeZn,Ti,Zn)

1.4 Key Elements and Subsystems

Key elements of the system are listed as: **Cu**-Cr-Fe-Mn-Ni-Pb-Si-Sn-Zn. The modeling status for all the constituent binaries and key ternaries are given in Table 1.3 and Table 1.4. The color represents the following meaning:

: Full description

: Full description for major phases

: Extrapolation

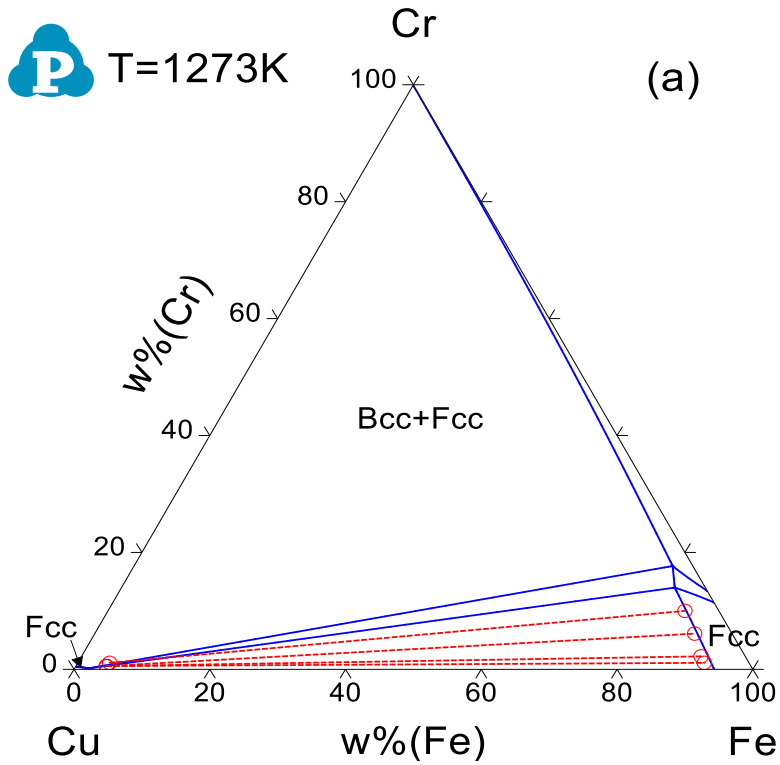
Table 1.3: Modeling status of constituent binary systems

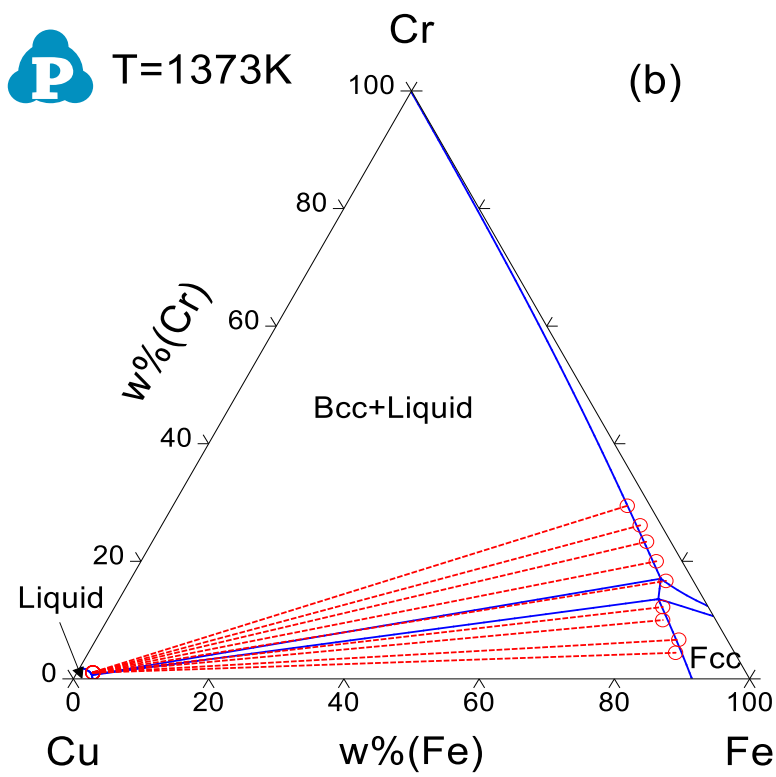
	B	Bi	C	Cr	Cu	Fe	Mn	Ni	P	Pb	S	Sb	Se	Si	Sn	Ti	Zn	Zr
Al																		
B																		
Bi																		
C																		
Cr																		
Cu																		
Fe																		
Mn																		
Ni																		
P																		
Pb																		
S																		
Sb																		
Se																		
Si																		
Sn																		
Ti																		
Zn																		

Table 1.4: Modeling status of constituent ternary systems

Al-Cu-Fe	Al-Cu-Ni	Al-Cu-Sb	Al-Cu-Si	Al-Si-Zn	B-Ni-Si	Bi-Cu-Ni	Bi-Cu-Pb
Bi-Cu-Sn	Bi-Cu-Zn	Bi-Cu-Se	Bi-Se-Zn	Bi-Sn-Zn	C-Cr-Fe	C-Cu-Fe	Cr-Cu-Ni
Cr-Cu-Si	Cr-Cu-Sn	Cr-Cu-Ti	Cr-Fe-Ni	Cr-Fe-S	Cr-Mn-S	Cr-Ni-Si	Cu-Fe-S
Cu-Fe-Ni	Cu-Fe-Sb	Cu-Fe-Si	Cu-Fe-Zn	Cu-Mn-Ni	Cu-Mn-Zn	Cu-Se-Zn	Cu-Ni-P
Cu-Ni-Si	Cu-Ni-Sn	Cu-Ni-Ti	Cu-Ni-Zn	Cu-P-Sn	Cu-Pb-Zn	Cu-Sb-Ni	Cu-Pb-S
Cu-Sb-Se	Cu-Sb-Sn	Cu-Si-Zn	Cu-Sn-Ti	Cu-Sn-Zn	Cu-Ti-Zn	Fe-Mn-Si	Fe-Mn-S
Fe-Ni-S	Ni-Si-Ti						

1.5 Database Validation





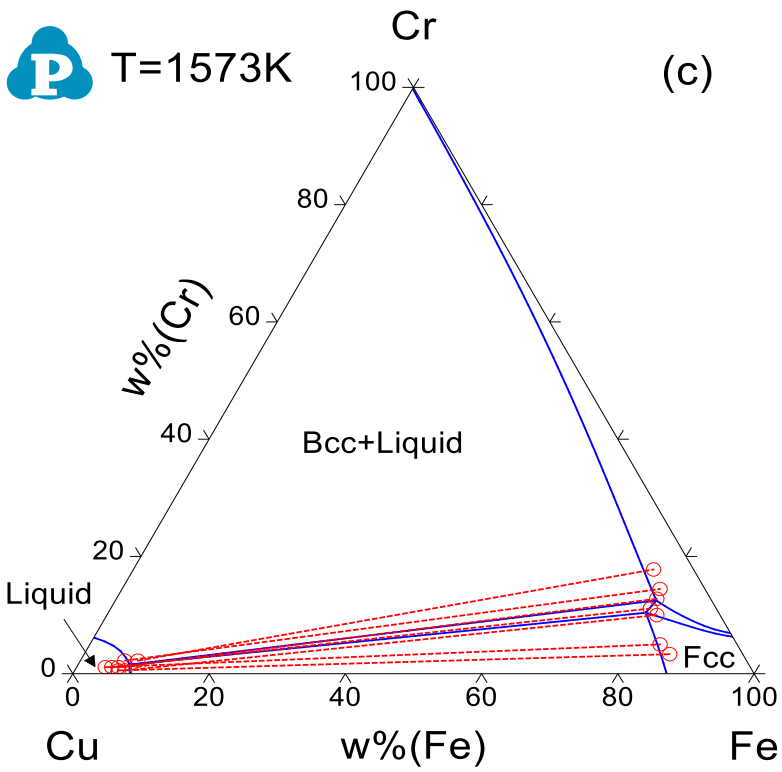
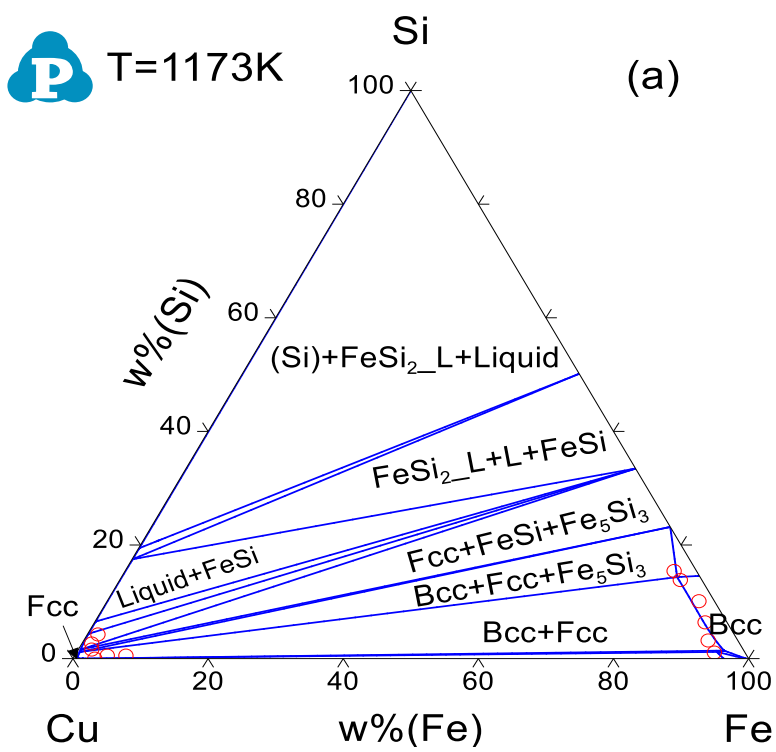


Figure 1.1: Calculated isothermal section diagrams of the Fe-Cu-Cr system at (a) 1273K, (b) 1373K, and (c) 1573K with the experimental data [1997Oht, 2002Wan]



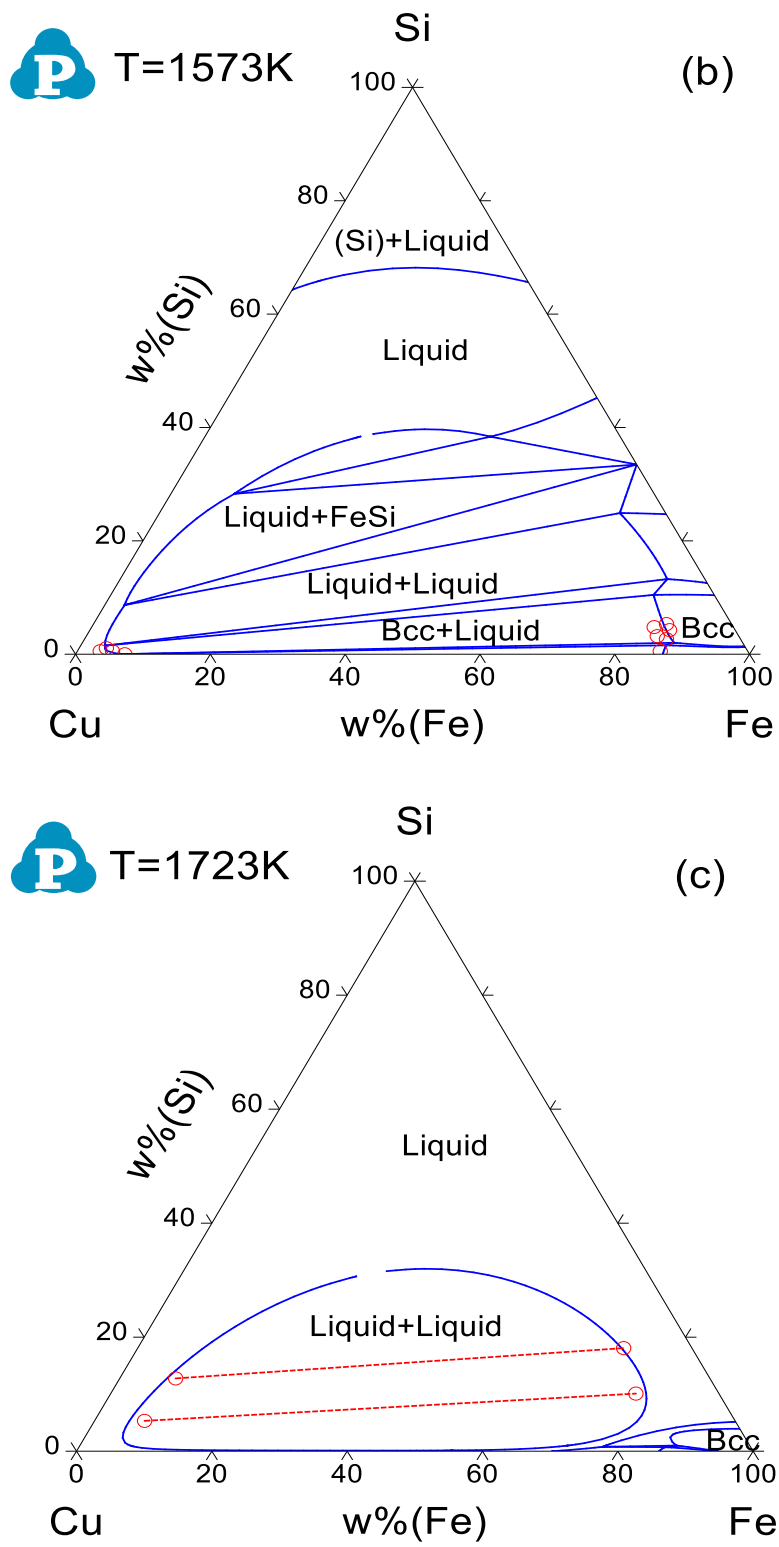


Figure 1.2: Calculated isothermal section diagrams of the Fe-Cu-Si system at (a) 1173K, (b) 1573K, and (c) 1723K with the experimental data [1997Oht, 1999Him, 2002Wan]

1.6 References

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