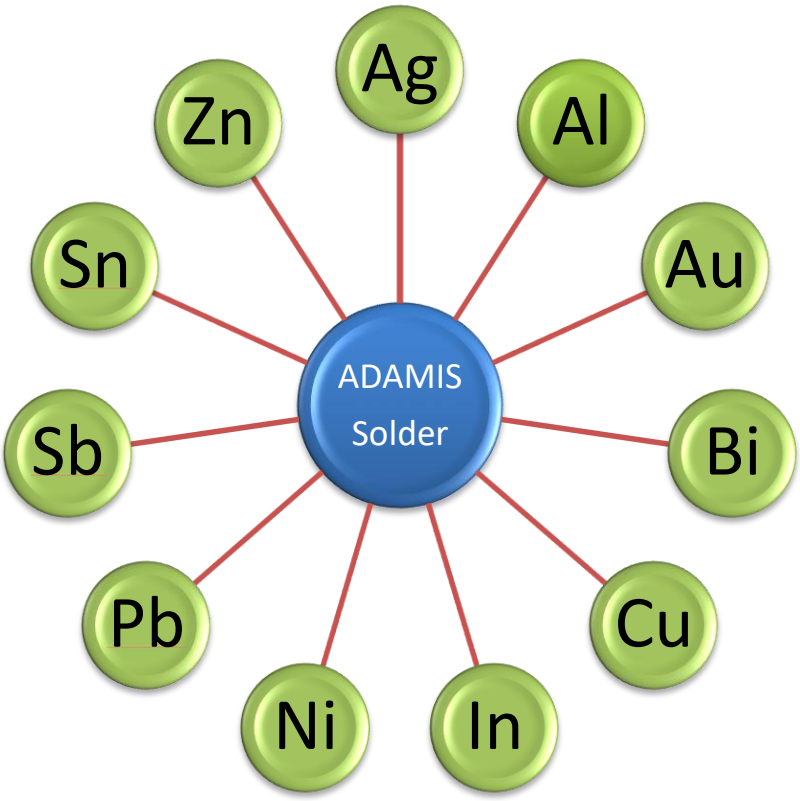
1. ADAMIS

Alloy Database for Micro-Solders



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1.1 Components

Total of 11 components are included in the ADAMIS database as listed below, which accounts for most of the alloying and micro-alloying elements appearing in commercial micro-soldering alloy system.

Ag-Al-Au-Bi-Cu-In-Ni-Pb-Sb-Sn-Zn

1.2 Suggested Composition Range

The suggested composition range for each element is listed in Table 1.1. It should be noted that the ADAMIS solder database has been tested with many commercial micro-soldering alloys, such as Sn-Ag-X, Sn-Cu-X, Sn-In-X, Sn-Zn-X based alloys, and also Cu-X-Y based alloy systems.

Table 1.1: Suggested composition range

Element	Composition range (wt%)
Ag	0-100
Al	0-100
Au	0-100
Bi	0-100
Cu	0-100
In	0-100
Ni	0-100
Pb	0-100
Sb	0-100
Sn	0-100
Zn	0-100

1.3 Phases

Total of 122 phases are included in the database, which account for most of the phases appearing in the commercial micro-soldering alloys. The name, the structure, and model type of major phases are given 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
Liquid	(1)	(Ag,Al,Au,Bi,Cu,In,Ni,Pb,Sb,Sn,Zn)
BCC_A2	(1)	(Ag,Al,Au,Bi,Cu,In,Ni,Pb,Sb,Sn,Zn)
BCT_A5	(1)	(Ag,Bi,Cu,In,Ni,Pb,Sb,Sn,Zn)
FCC_A1	(1)	(Ag,Al,Au,Bi,Cu,In,Ni,Pb,Sb,Sn,Zn)
HCP_A3	(1)	(Ag,Al,Au,Bi,Cu,In,Ni,Pb,Sb,Sn,Zn)
RhombohedralA7	(1)	(Ag,Au,Bi,Cu,In,Pb,Sb,Sn,Zn)
Tetragonal_A6	(1)	(Bi,In,Pb,Sb,Sn,Zn)
AgCuZn_Eps	(1)	(Ag,Al,Cu,Zn)
AgCuZn_Gamma	(0.15385)(0.15385) (0.23077)(0.46154)	(Ag,Cu,Zn)(Ag,Cu,Zn)(Ag,Cu)(Zn)
AgZn_Zeta	(1)	(Ag,Sn,Zn)
Ag3SnSb	(0.75)(0.25)	(Ag,Sb)(Ag,Bi,Sb,Sn)
BiInPbSn_Bea	(1)	(Bi,In,Pb,Sn)
Cu77InSn	(0.77)(0.23)	(Cu)(In,Sn)
Cu7In3	(0.7)(0.3)	(Cu)(In,Sn)
CuInSn_Eta	(0.545)(0.122)(0.333)	(Cu)(Cu,In,Sn)(In,Sn)
Cu3Sn	(0.75)(0.25)	(Cu)(In,Sn)
Cu41Sn11	(0.788)(0.212)	(Cu)(In,Sn)
Gama	(0.654)(0.115)(0.231)	(Cu)(Cu,In)(In,Sn)
InSn_Gamma	(1)	(Bi,In,Sb,Sn)
Sb1Sn1	(1)	(Pb,Sb,Sn)
AuIn	(0.5)(0.5)	(Au)(In,Sb,Sn)
AuIn2	(0.33333)(0.66667)	(Au)(In,Sb,Sn)
AlCu_GammaH	(0.3077)(0.0769)(0.6154)	(Al,Zn)(Al,Cu,Zn)(Ag,Cu)

1.4 Sub-System Information

Tohoku University started to carry out research and experiment for the solder-semiconductor systems since 1980's, and based on which the ADAMIS solder database was developed.

Table 1.3 lists all the 55 binary systems. Thermodynamic descriptions for all these binaries are critically assessed as colored by green. Table 1.4 lists all the ternary systems that are assessed for this system. Thermodynamic descriptions for the ternaries in green color are critically assessed; while those in yellow color are also developed, but are not yet fully validated.

ADAMIS database can be used to predict various thermodynamic properties for Sn-Ag-X, Sn-Cu-X, Sn-In-X, Sn-Zn-X based alloy, and also Cu-X-Y based alloy systems.

: Full description

: Full description for major phases

: Extrapolation

Table 1.3: Current Status of Binary Systems of ADAMIS database

	Al	Au	Bi	Cu	In	Ni	Pb	Sb	Sn	Zn
Ag										
Al										
Au										
Bi										
Cu										
In										
Ni										
Pb										
Sb										
Sn										

Table 1.4: Current Status of Ternary systems of ADAMIS database

Ag-Bi-Cu	Ag-Bi-In	Ag-Bi-Pb	Ag-Bi-Sb	Ag-Bi-Sn	Ag-Bi-Zn
Ag-Cu-In	Ag-Cu-Pb	Ag-Cu-Sb	Ag-Cu-Sn	Ag-Cu-Zn	Ag-In-Pb
Ag-In-Sb	Ag-In-Sn	Ag-In-Zn	Ag-Pb-Sb	Ag-Pb-Sn	Ag-Pb-Zn
Ag-Sb-Sn	Ag-Sb-Zn	Ag-Sn-Zn			
Bi-Cu-In	Bi-Cu-Pb	Bi-Cu-Sb	Bi-Cu-Sn	Bi-Cu-Zn	Bi-In-Pb
Bi-In-Sb	Bi-In-Sn	Bi-In-Zn	Bi-Pb-Sb	Bi-Pb-Sn	Bi-Pb-Zn
Bi-Sb-Sn	Bi-Sb-Zn	Bi-Sn-Zn			
Cu-In-Pb	Cu-In-Sb	Cu-In-Sn	Cu-In-Zn	Cu-Pb-Sb	Cu-Pb-Sn
Cu-Pb-Zn	Cu-Sb-Sn	Cu-Sb-Zn	Cu-Sn-Zn		
In-Pb-Sb	In-Pb-Sn	In-Pb-Zn	In-Sb-Sn	In-Sb-Zn	In-Sn-Zn
Pb-Sb-Sn	Pb-Sb-Zn	Pb-Sn-Zn			
Sb-Sn-Zn					

1.5 Database Validation

The current database is validated by the large amount of experimental work carried out at Tohoku University. Some calculated phase diagrams are compared with experimental data as shown in Figure 1.1 ~ Figure 1.5.

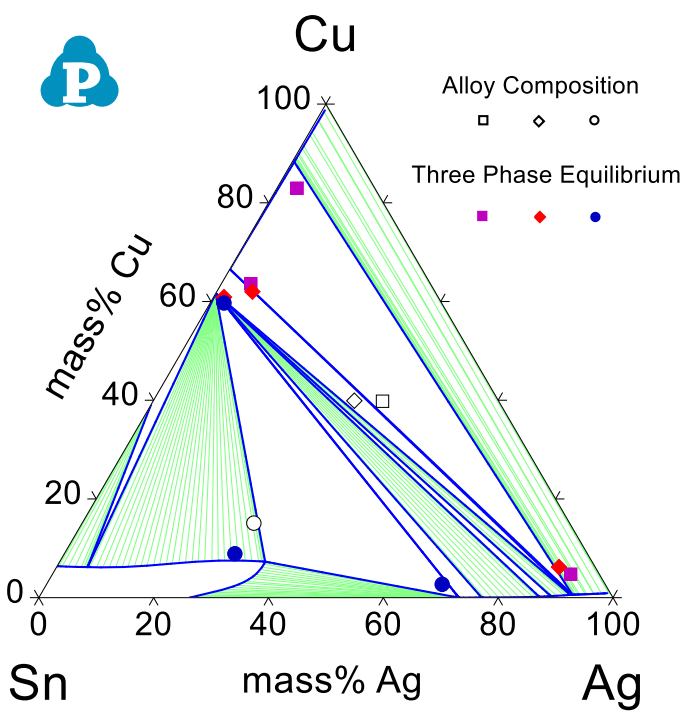

Figure 1.1: Ternary Sn-Ag-Cu 400°C isotherm with the experimental data [2000Ohn]

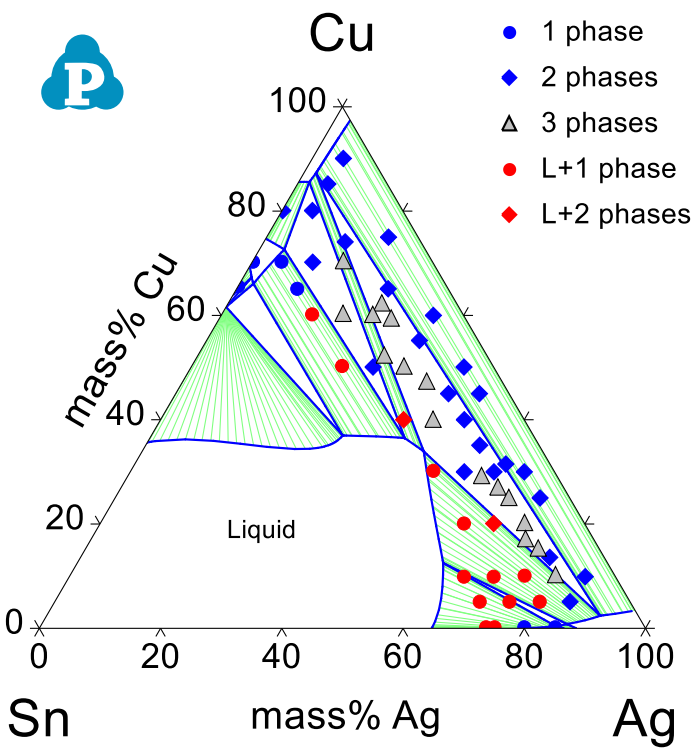

Figure 1.2: Ternary Sn-Ag-Cu 600°C isotherm with the experimental data [1959Geb]

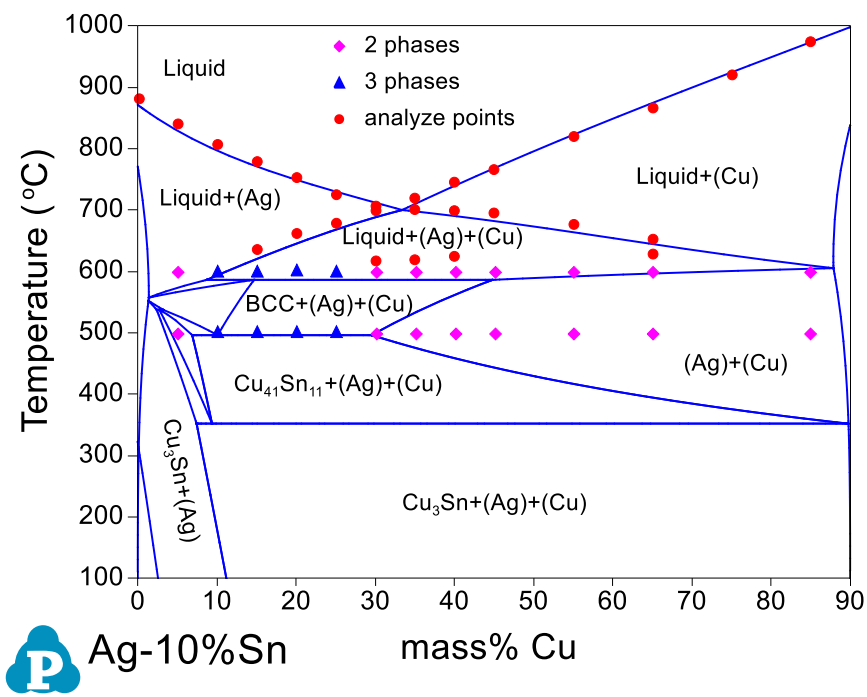

Figure 1.3: Vertical section diagram of the Ag-Cu-Sn ternary with 10 wt% Sn, the experimental data [1959Geb] are plotted for comparison

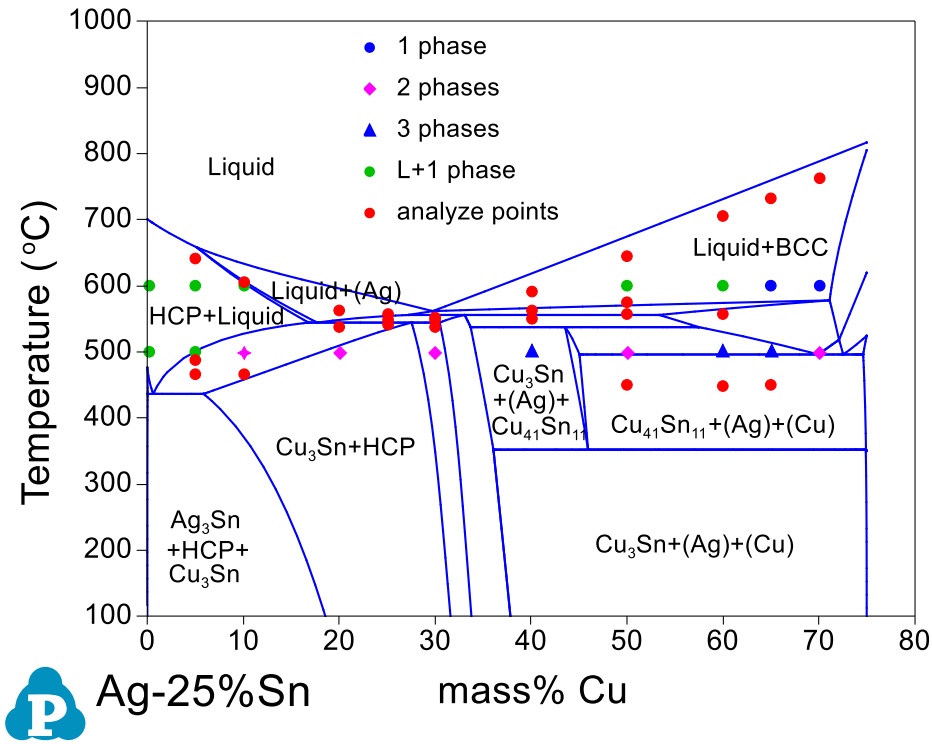

Figure 1.4: Vertical section diagram of the Ag-Cu-Sn ternary with 25 wt% Sn, the experimental data [1959Geb] are plotted for comparison

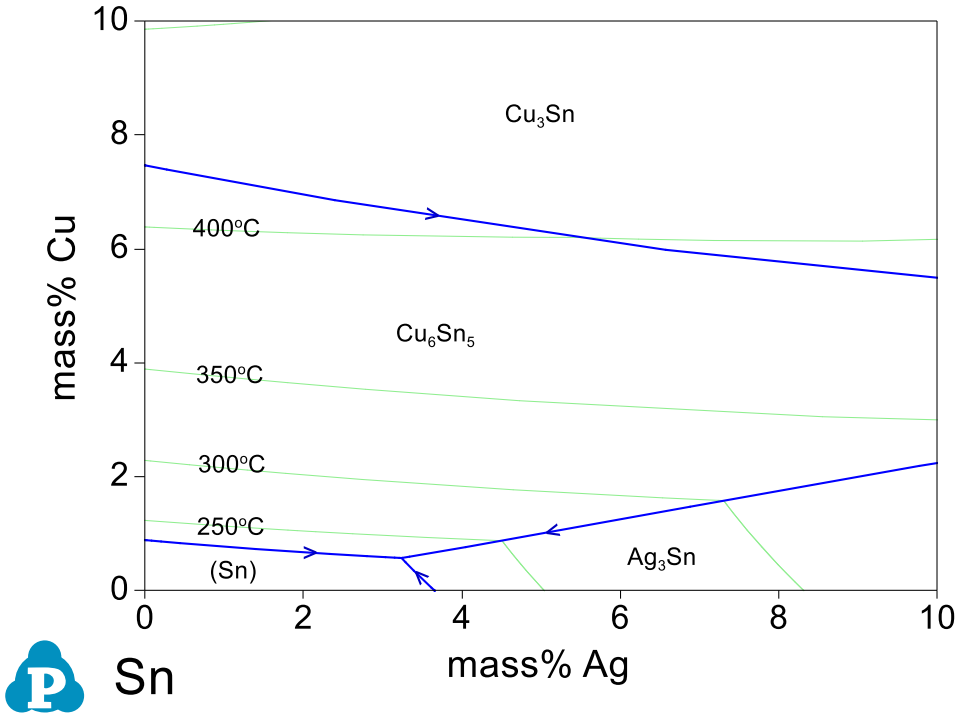

Figure 1.5: Projection of liquidus surface in Sn-rich portion of the Sn-Ag-Cu ternary system

1.6 Applications

Alloy design and processing optimization for micro-soldering alloys.

- Multi-component phase diagram calculations, such as liquidus projection, isothermal section and isopleth.
- Solidification sequence simulation using the Scheil model to predict the microstructure of multi-component solder alloys at the as-cast state.
- Equilibrium line calculation to predict the microstructure information, such as equilibrium phases, phase fraction, phase composition and phase transformation temperature.
- Thermodynamic property calculations, such as specific heat and latent heat.

1.7 References

[1959Geb] E. Gebhardt and G. Petzow, Z. Metallkd. 50 (1959)597-605.

[1999Ohn] I. Ohnuma, X.J. Liu, H. Ohtani, and K. Ishida, J. Electron. Mater. 28 (1999) 1164-1171.

[2000Ohn] I. Ohnuma, M. Miyashita, K. Anzai, X.J. Liu, H. Ohtani, R. Kainuma, and K. Ishida, J. Electron. Mater. 29 (2000) 1137-1144.