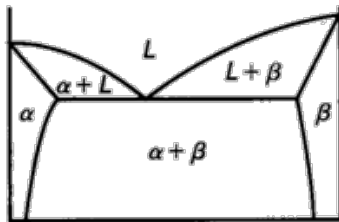
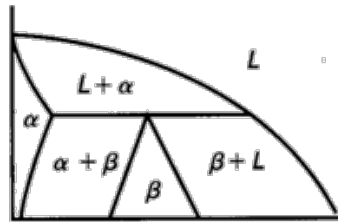


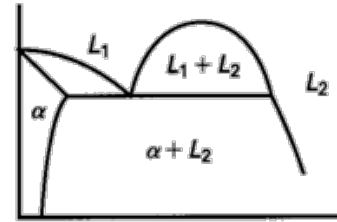
FD reálných binárních soustav



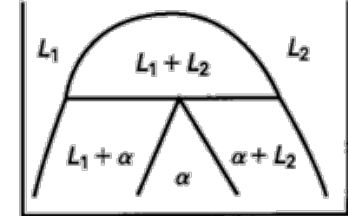
Eutectic
($L \rightarrow S_1 + S_2$)



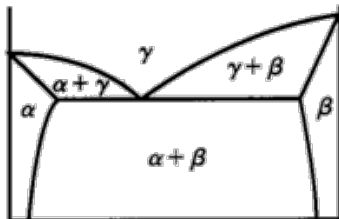
Peritectic
($L + S_1 \rightarrow S_2$)



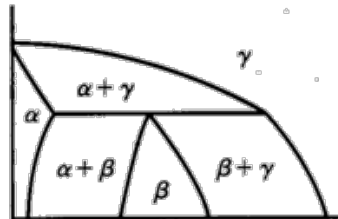
Monotectic
($L_1 \rightarrow S_1 + L_2$)



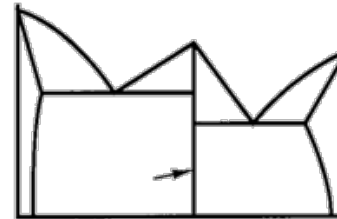
Syntectic
($L_1 + L_2 \rightarrow S_1$)



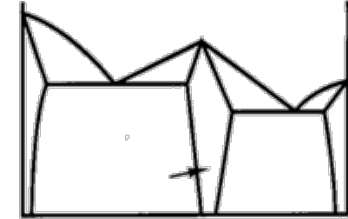
Eutectoid
($S_1 \rightarrow S_2 + S_3$)



Peritectoid
($S_1 + S_2 \rightarrow S_3$)

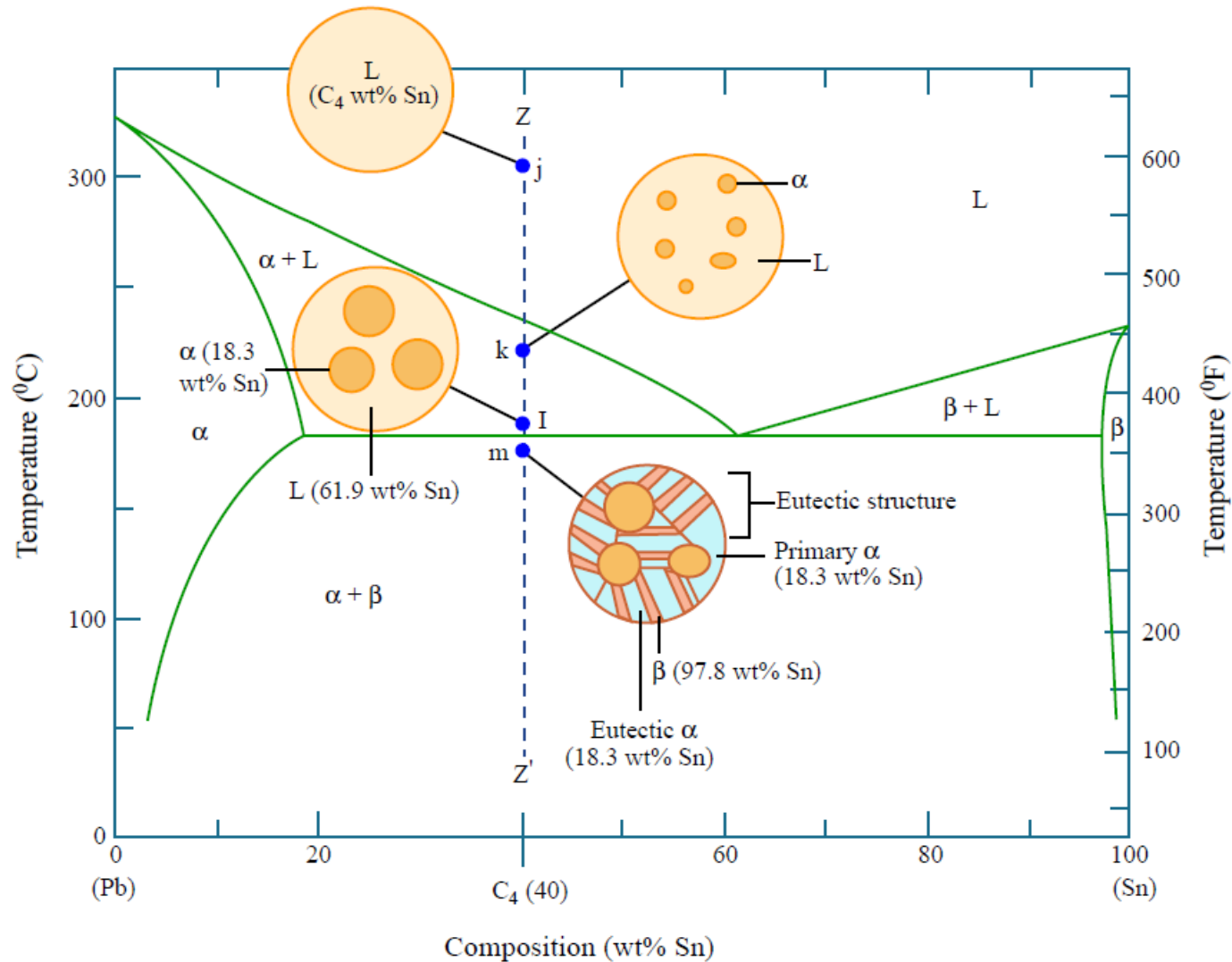


Stoichiometric
intermetallic compound

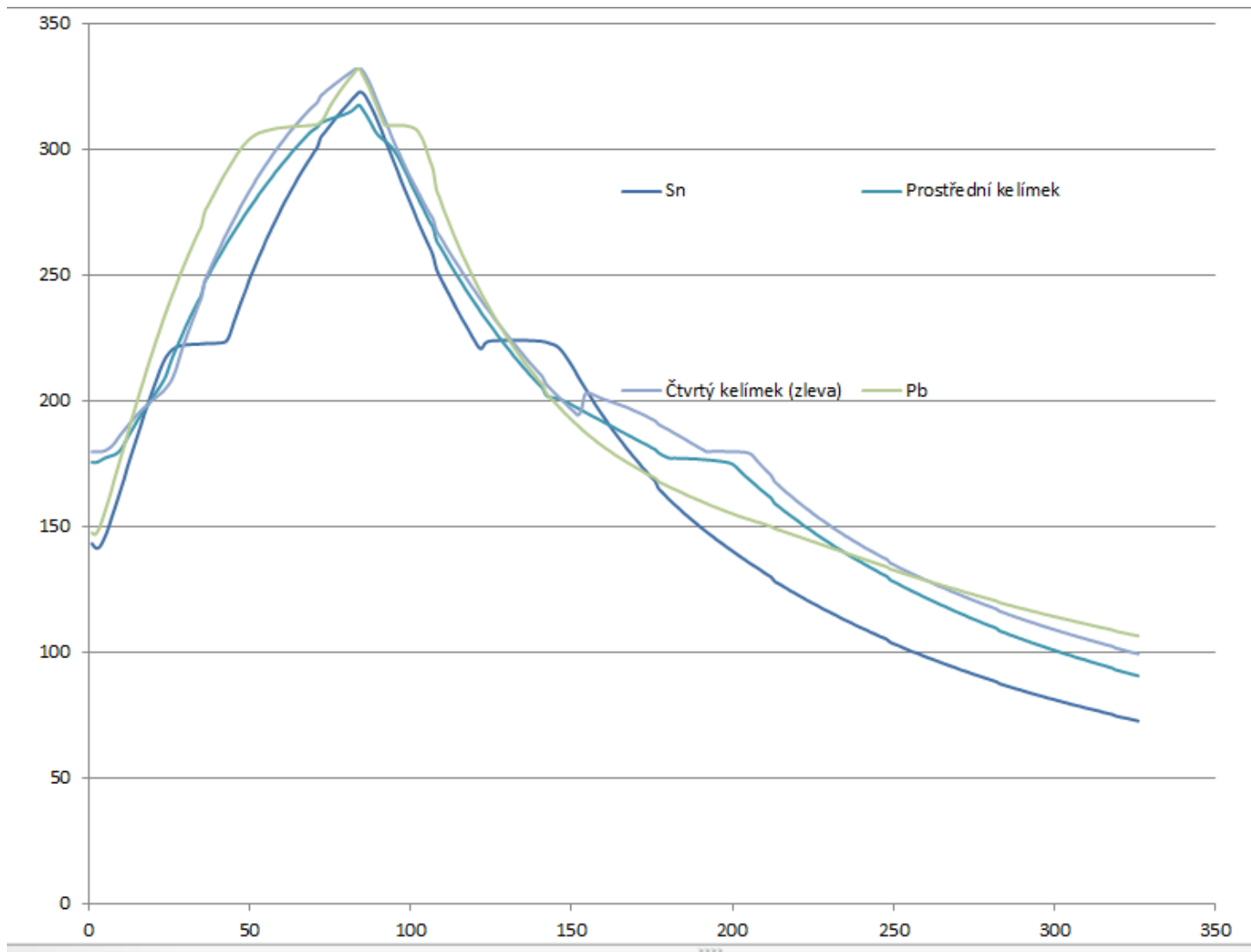


Non-stoichiometric
intermetallic compound

Eutectic phase diagram

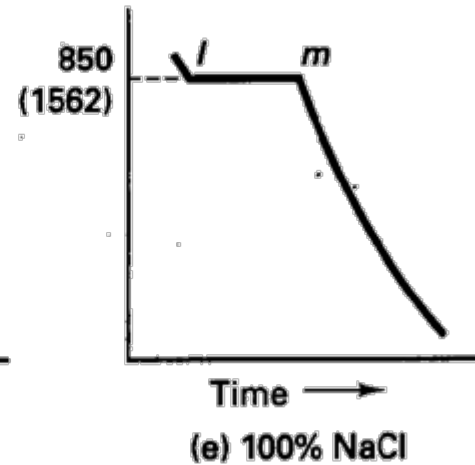
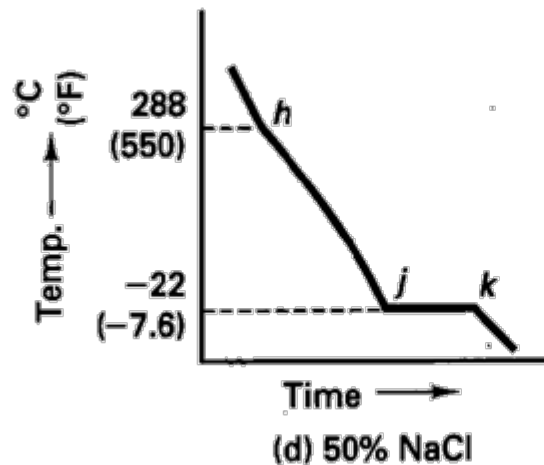
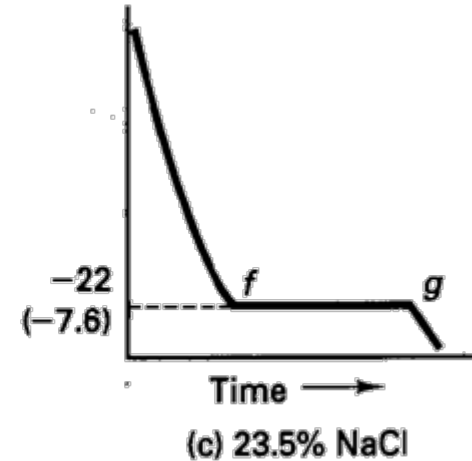
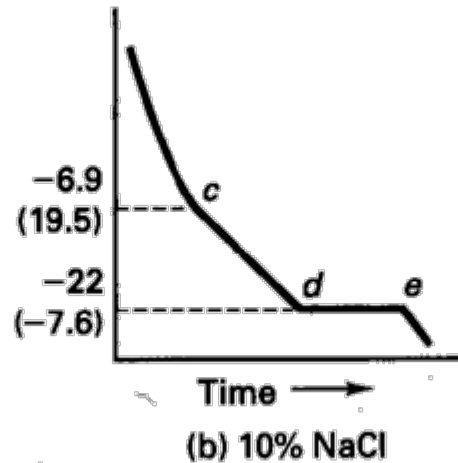
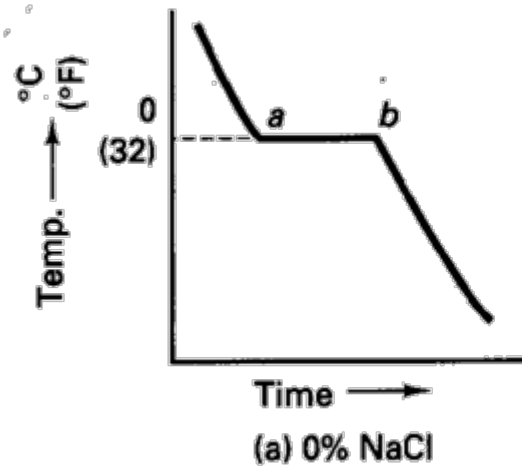


Cooling curves of SnPb

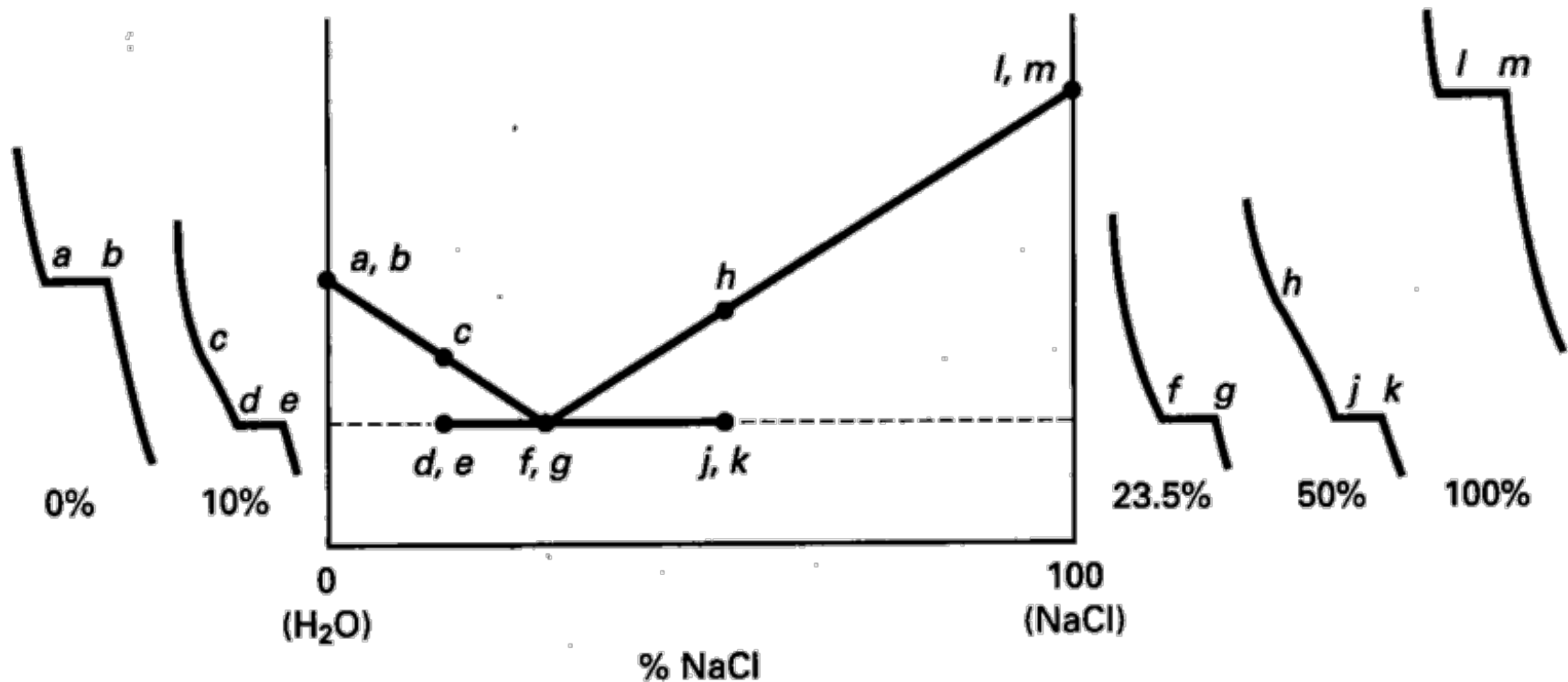


Křivky chladnutí

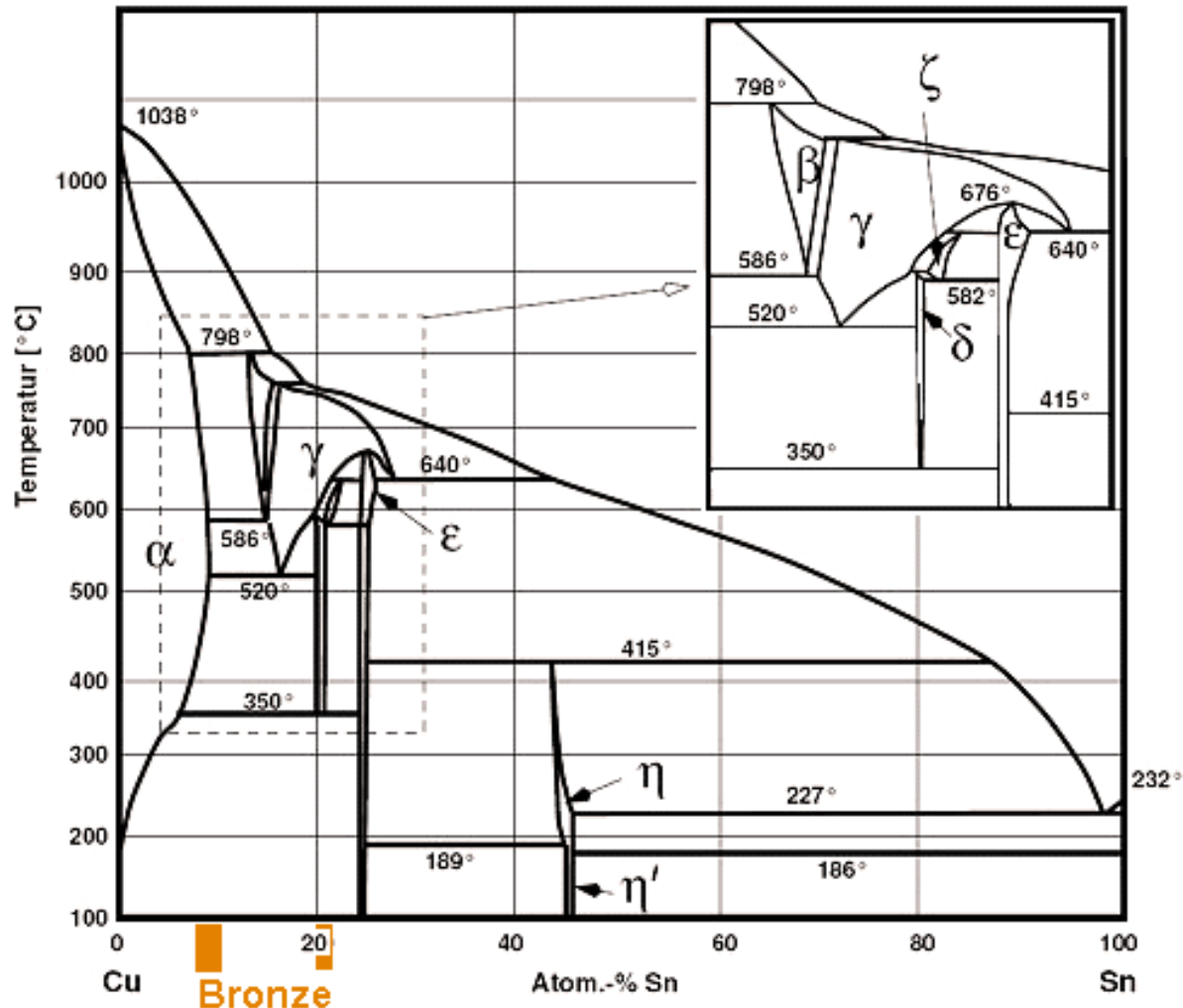
NaCl-H₂O



Stanovení FD z křivek chladnutí



Peritectics and eutectics in PD



Cu-Sn phase diagram

Demixing and spinodal decomposition

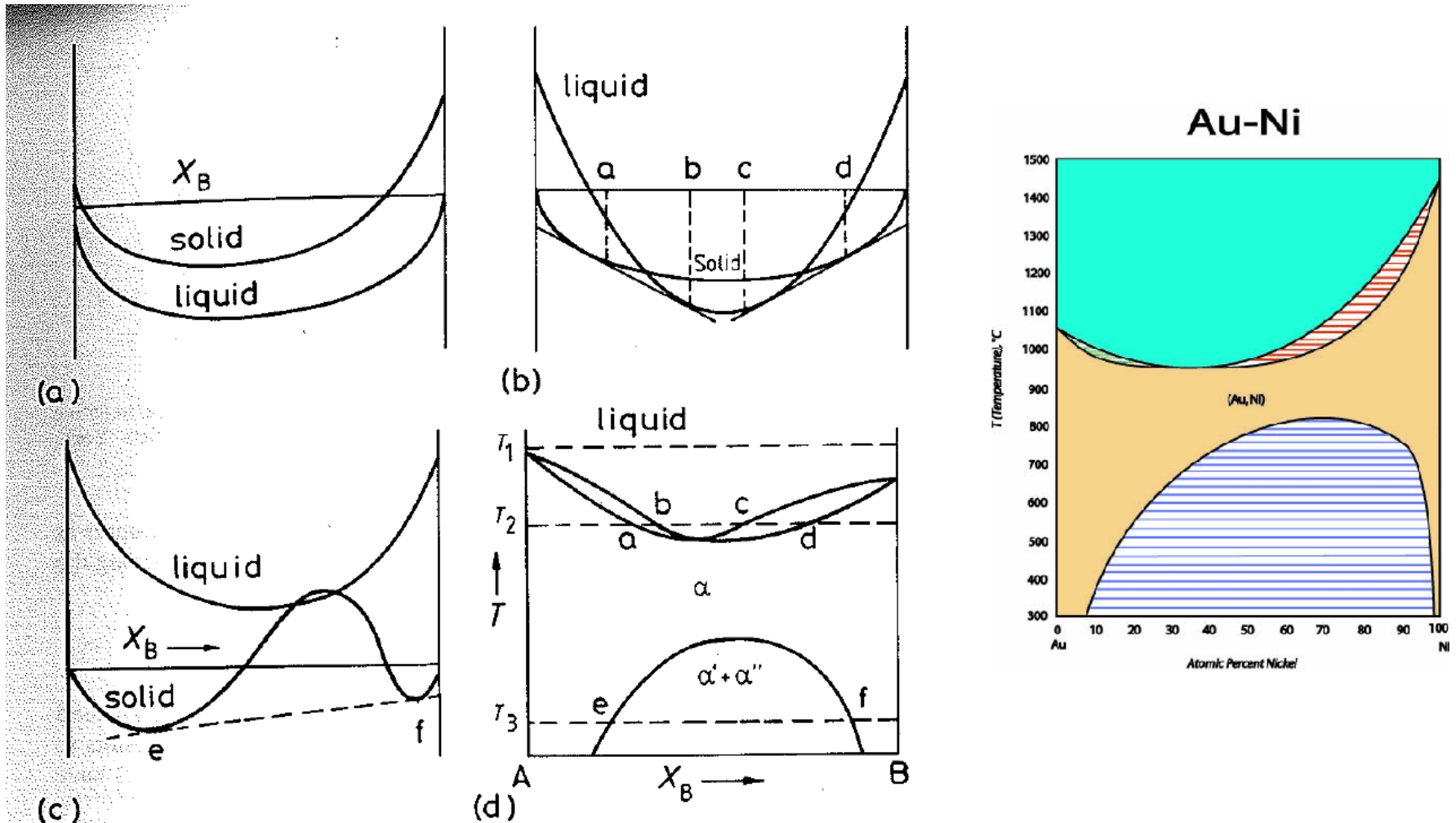
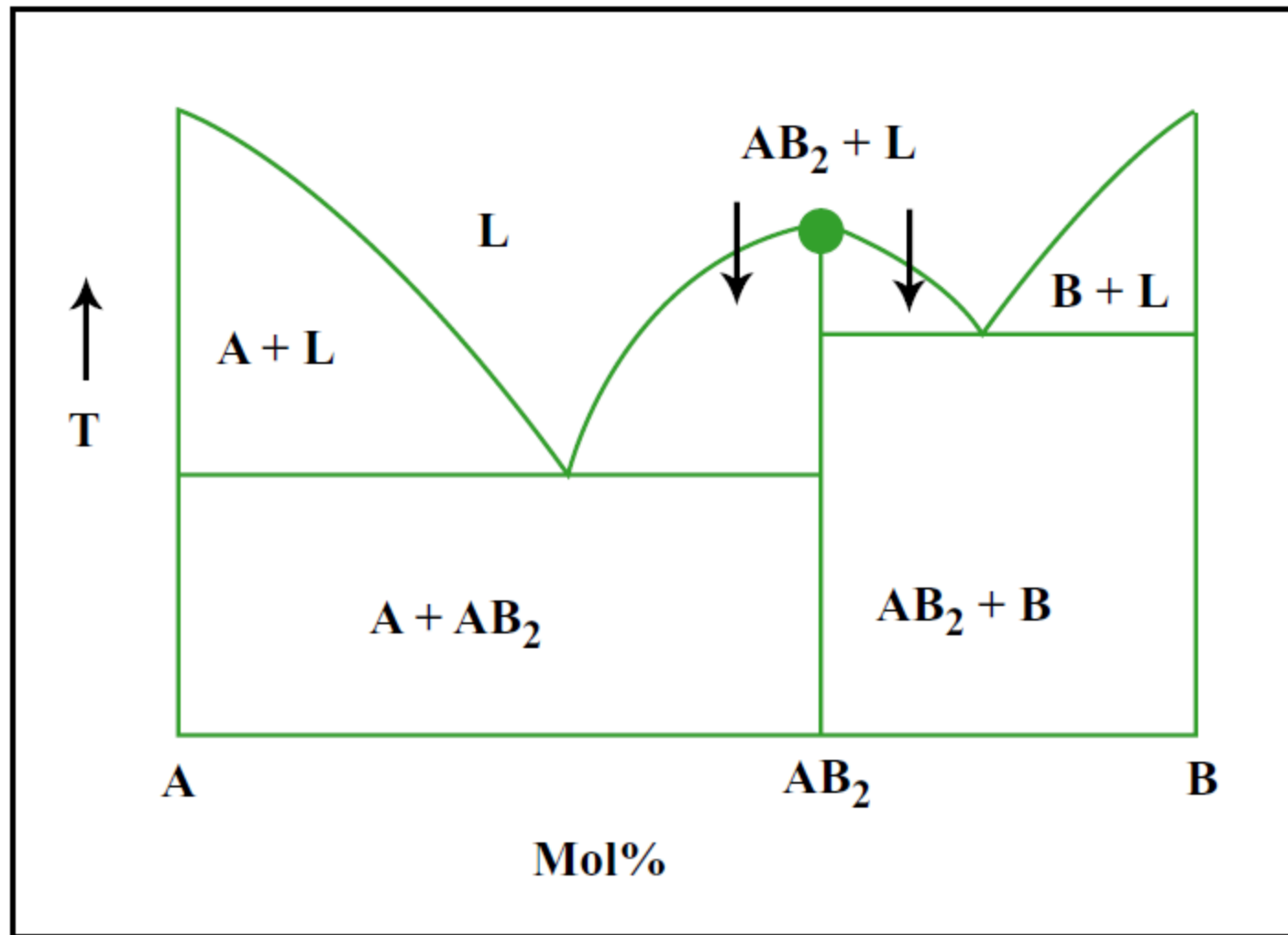
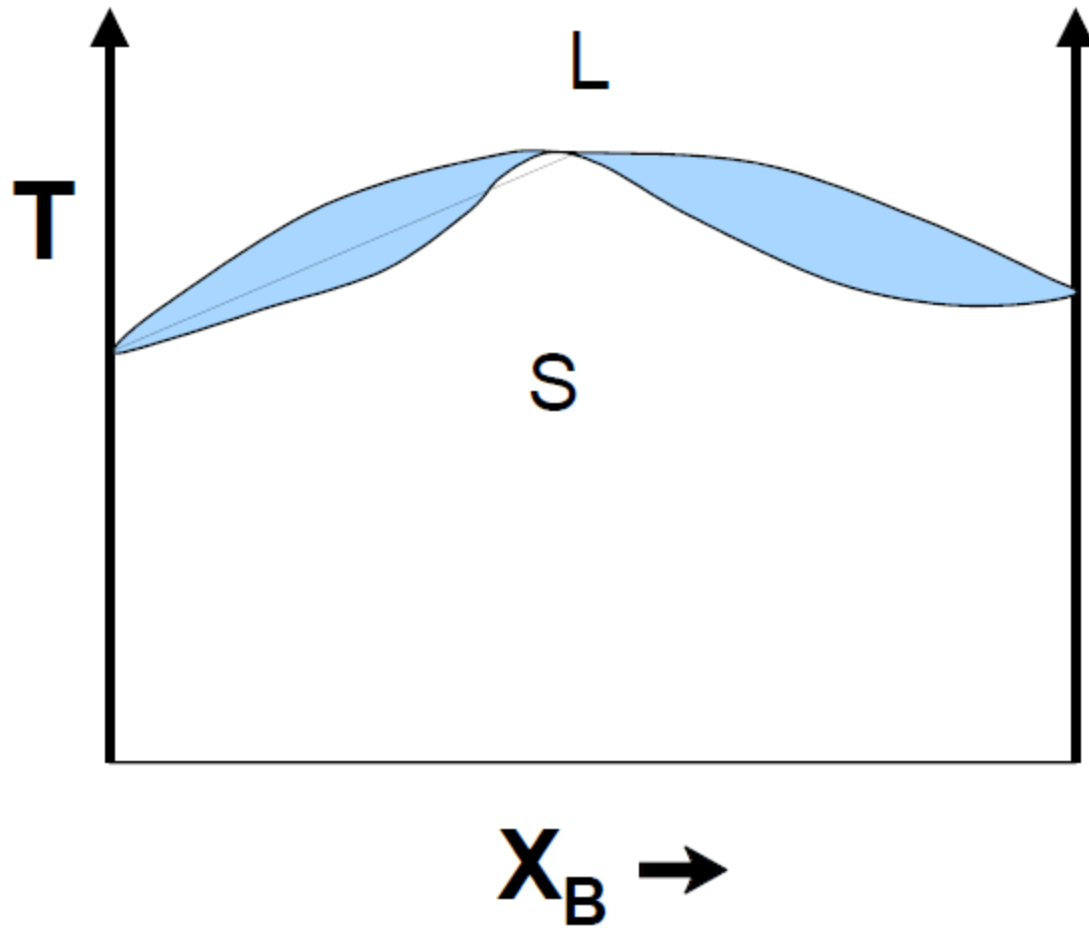


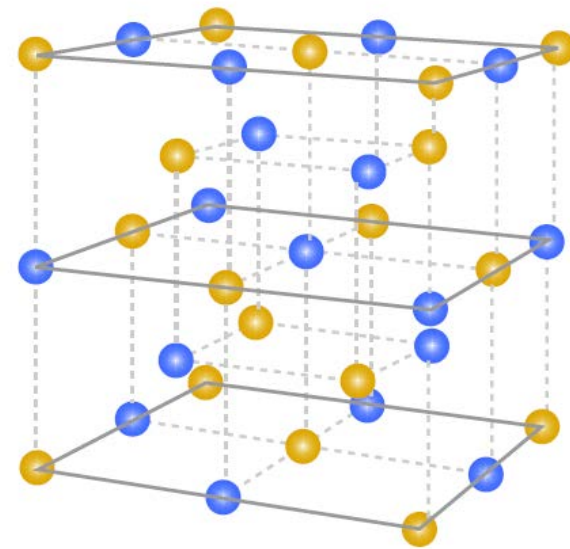
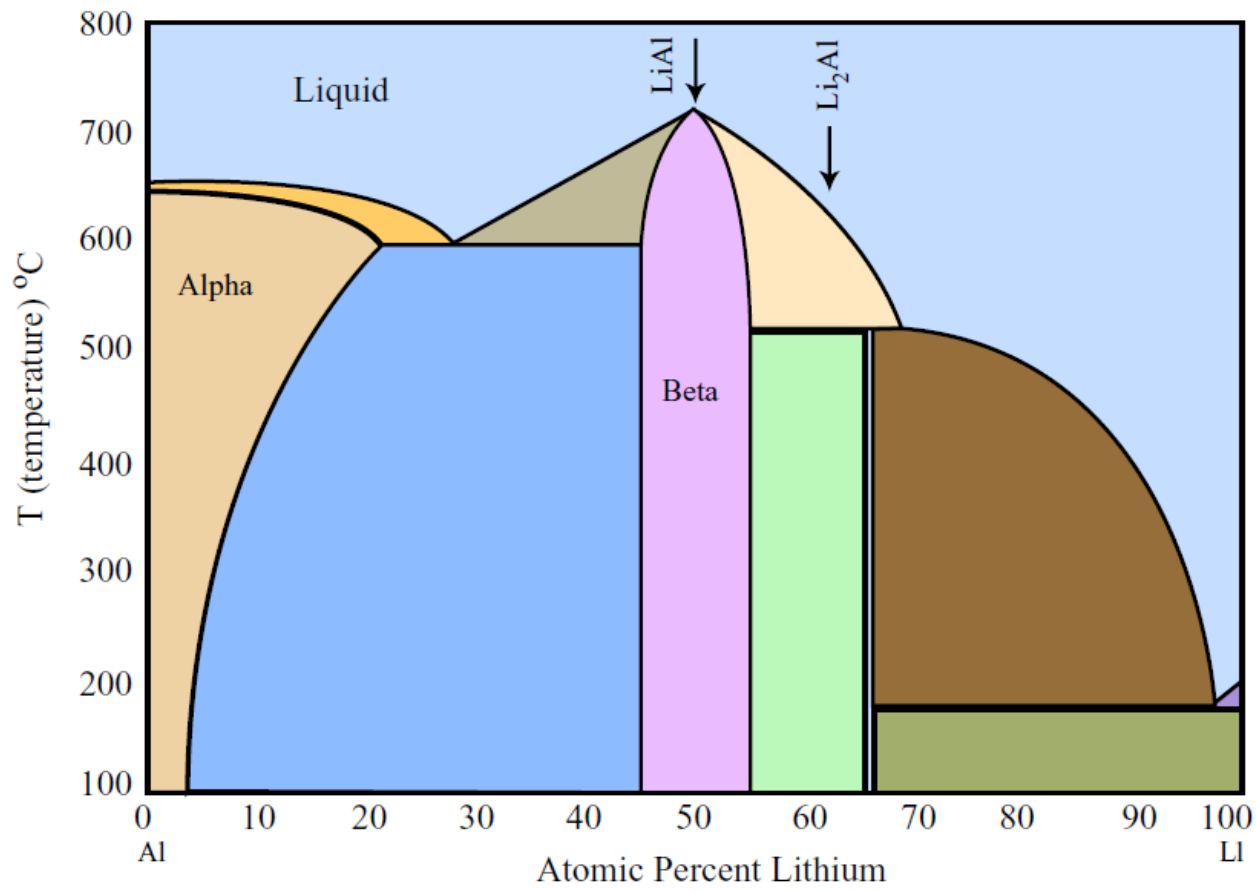
Fig. 1.30 The derivation of a phase diagram where $\Delta H_{mix}^S > \Delta H_{mix}^L = 0$. Free energy v. composition curves for (a) T_1 , (b) T_2 , and (c) T_3 .

systems- these are referred to as *intermediate compounds*.

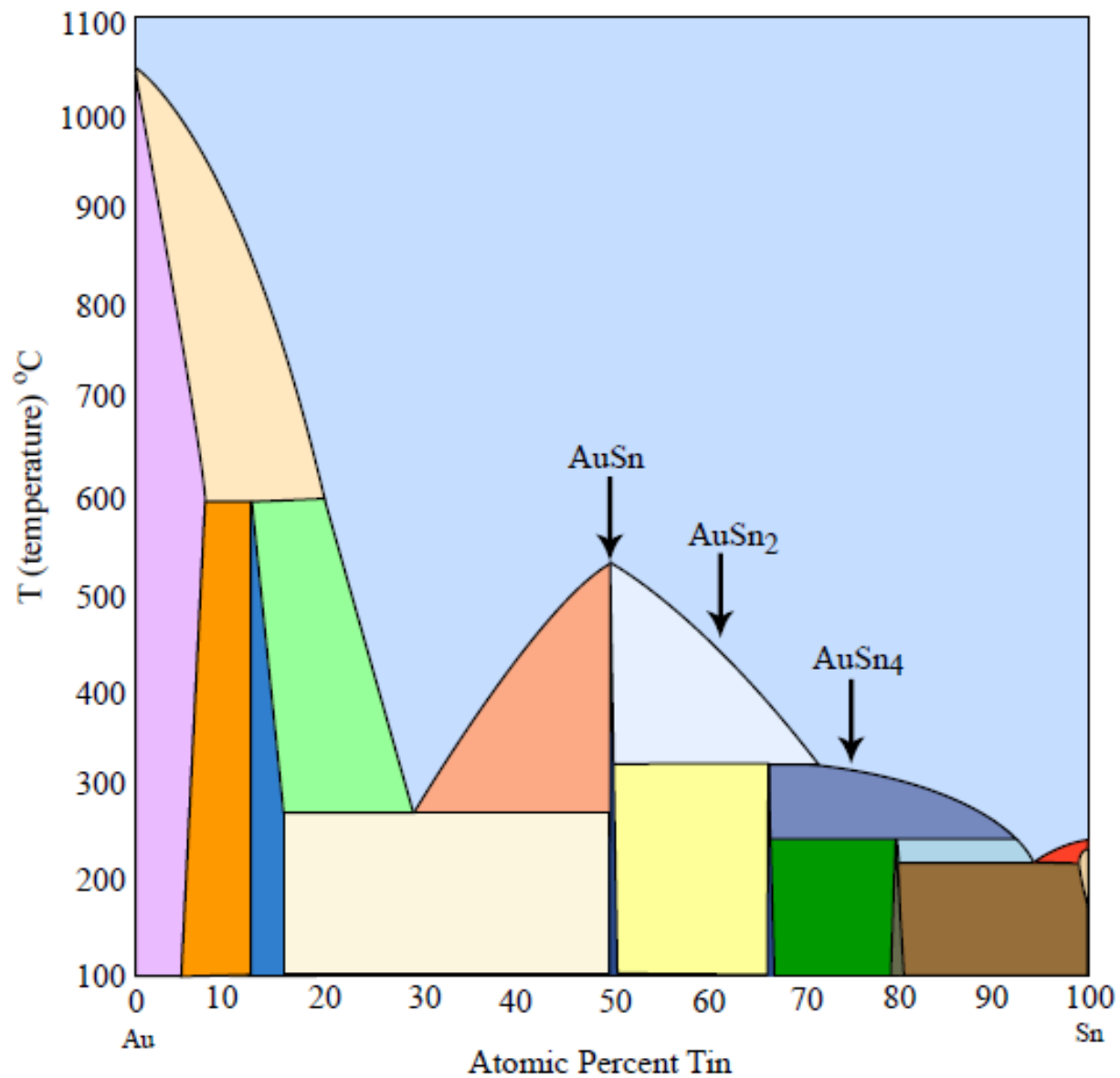


- ☐ Congruent phase transition: complete transformation





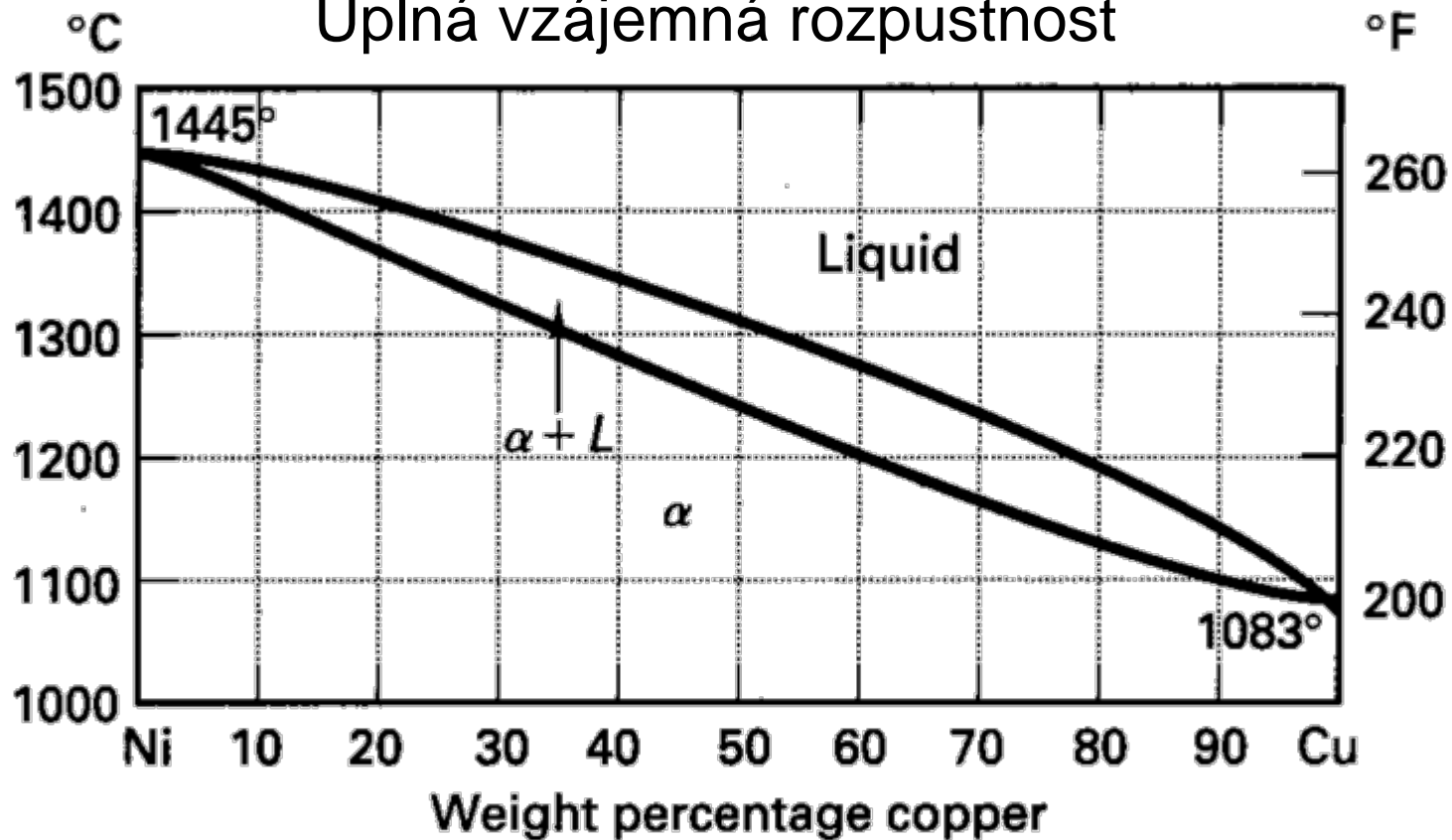
Zintl crystal Structure of LiAl (β phase)⁴



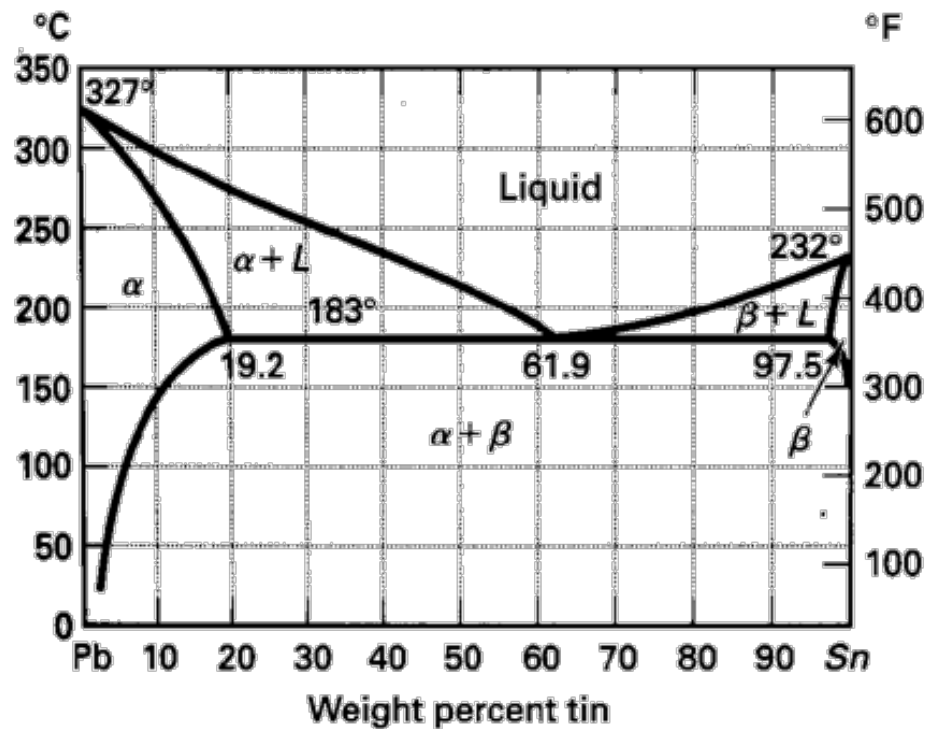
Phase diagram of Gold-Tin has seven distinct phases, three peritectics, two eutectics, and one eutectoid reactions.

Vzájemná rozpustnost

Úplná vzájemná rozpustnost



Částečná rozpustnost



Degree of solubility depends on temperature

At max. solubility, 183 C: lead holds up to 19.2 wt% tin in a single phase solution, and tin holds up to 2.5wt% lead and still be a single phase.

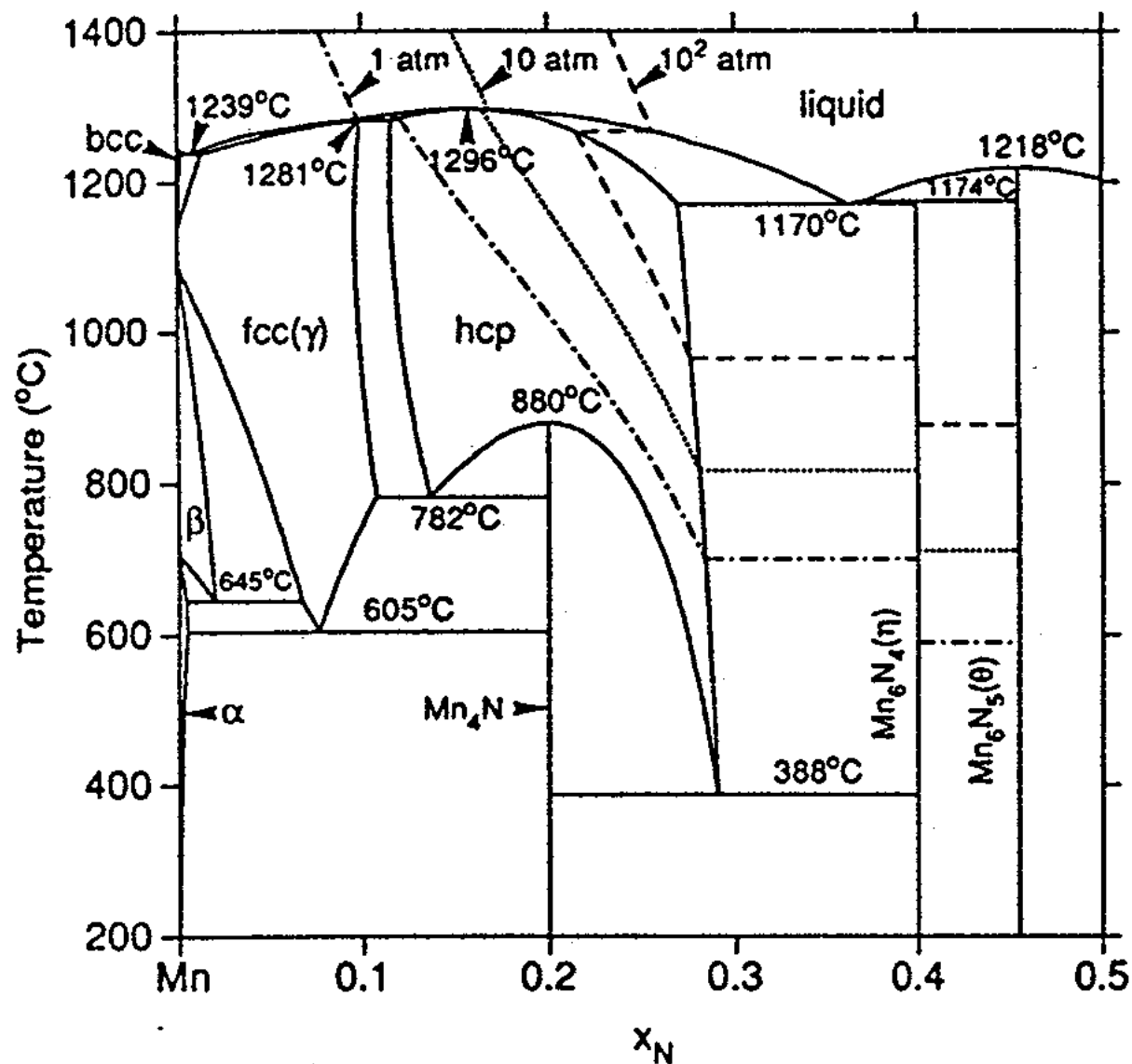
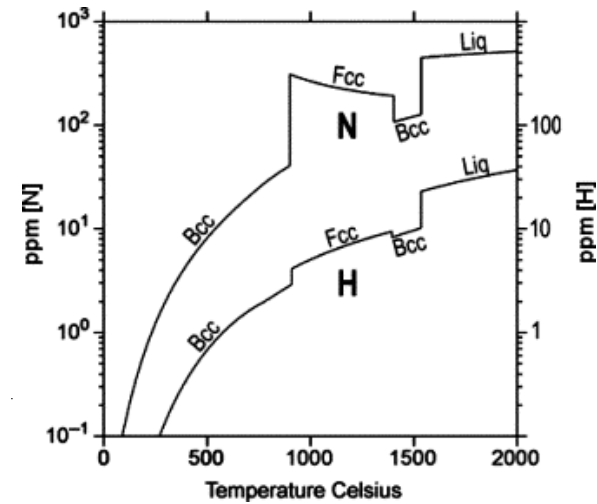
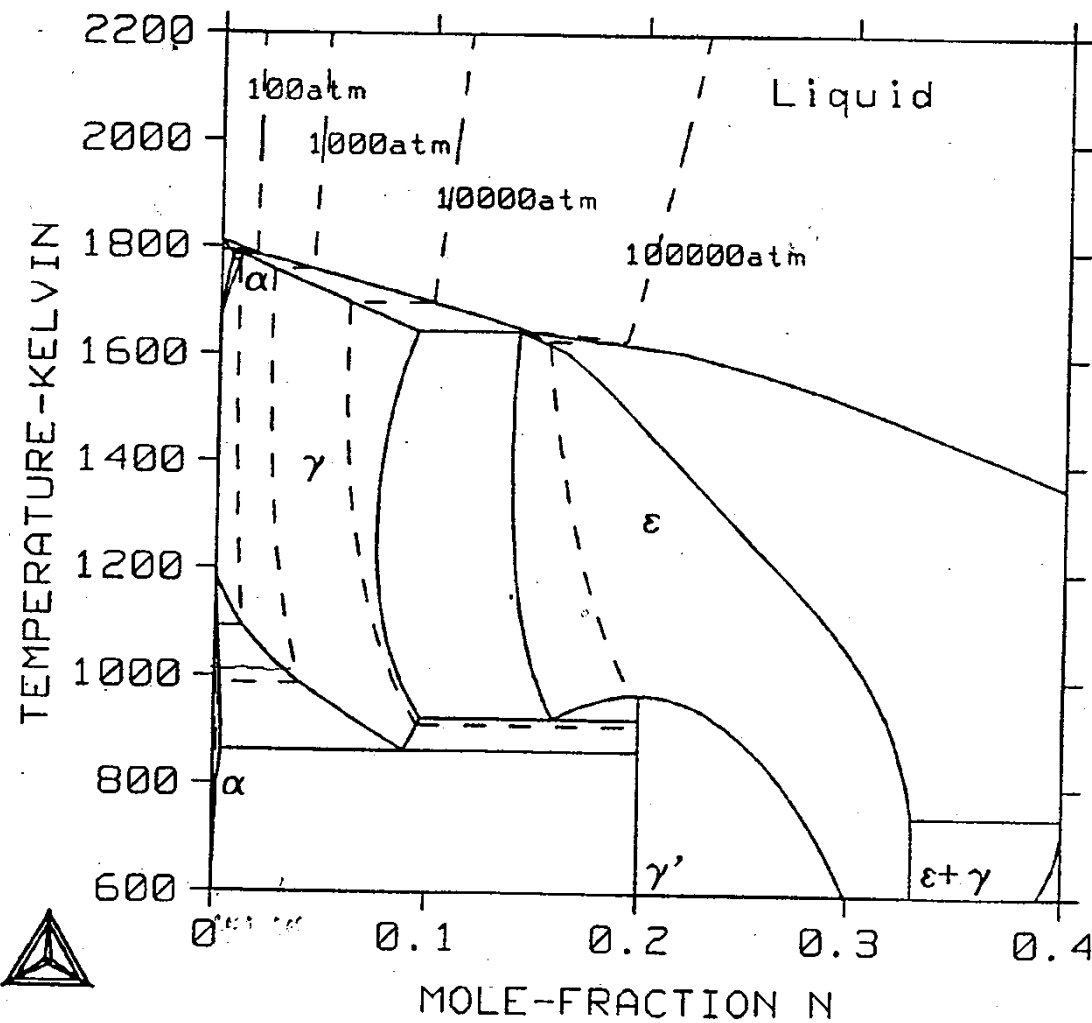


Fig. 20—The calculated Mn-N phase diagram assessed by Qiu and Fernández Guillermet,^[30] where N_2 gas is omitted but isobar lines are shown in dashed curves.

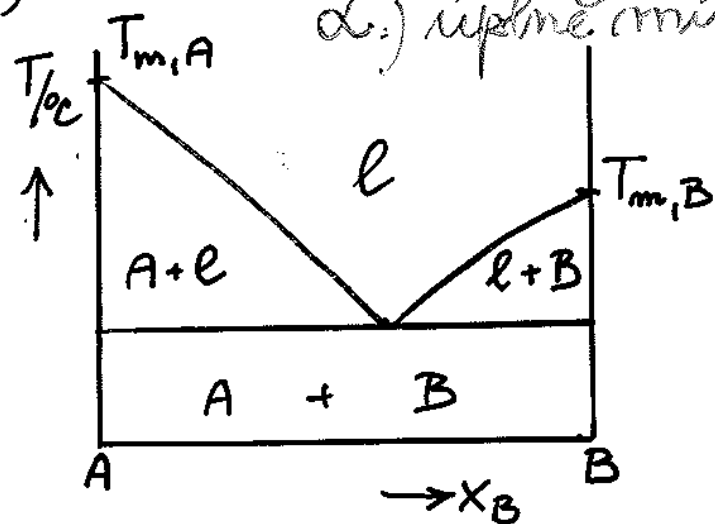


N and H solubility in
iron at 1Atm H₂ or N₂

Fig.16. The calculated Fe-N phase diagram.

Rovnováhy organických látek

Rovnováha kapaliná - pevná látka
 a) nemísitelné tuhé látky (Rooseboomova klasifikace;
 α.) úplně mísitelné v kapalné fázi



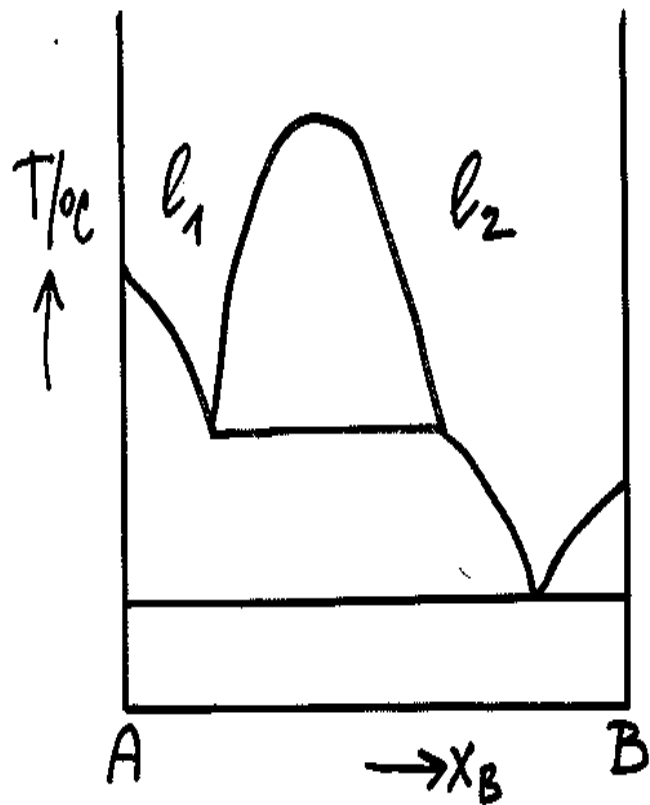
Eutektikum: $v = 0$.

Experimentální stanovení -
 termická analýza
 (křivky chlazení).

Pr.: Bi-Cd, naftalen-benzén

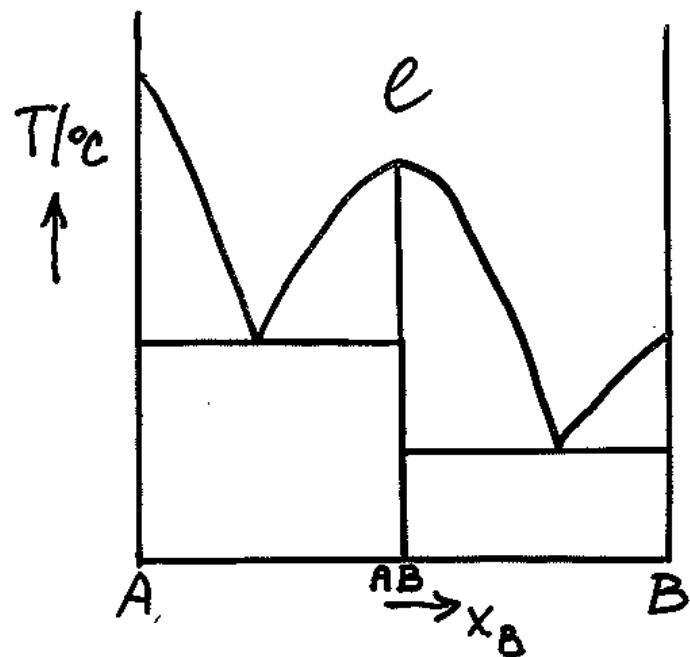
β.) omezeně mísitelné v kapalné fázi

β.) omezení množství kapalné fáze



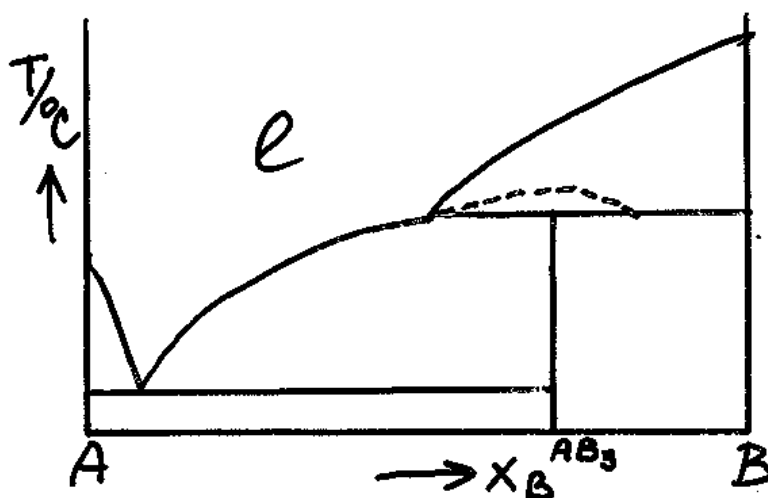
P_n : fenol-voda, Bi-Zn.

S₁ se sloučeninou, stálou při své teplotě



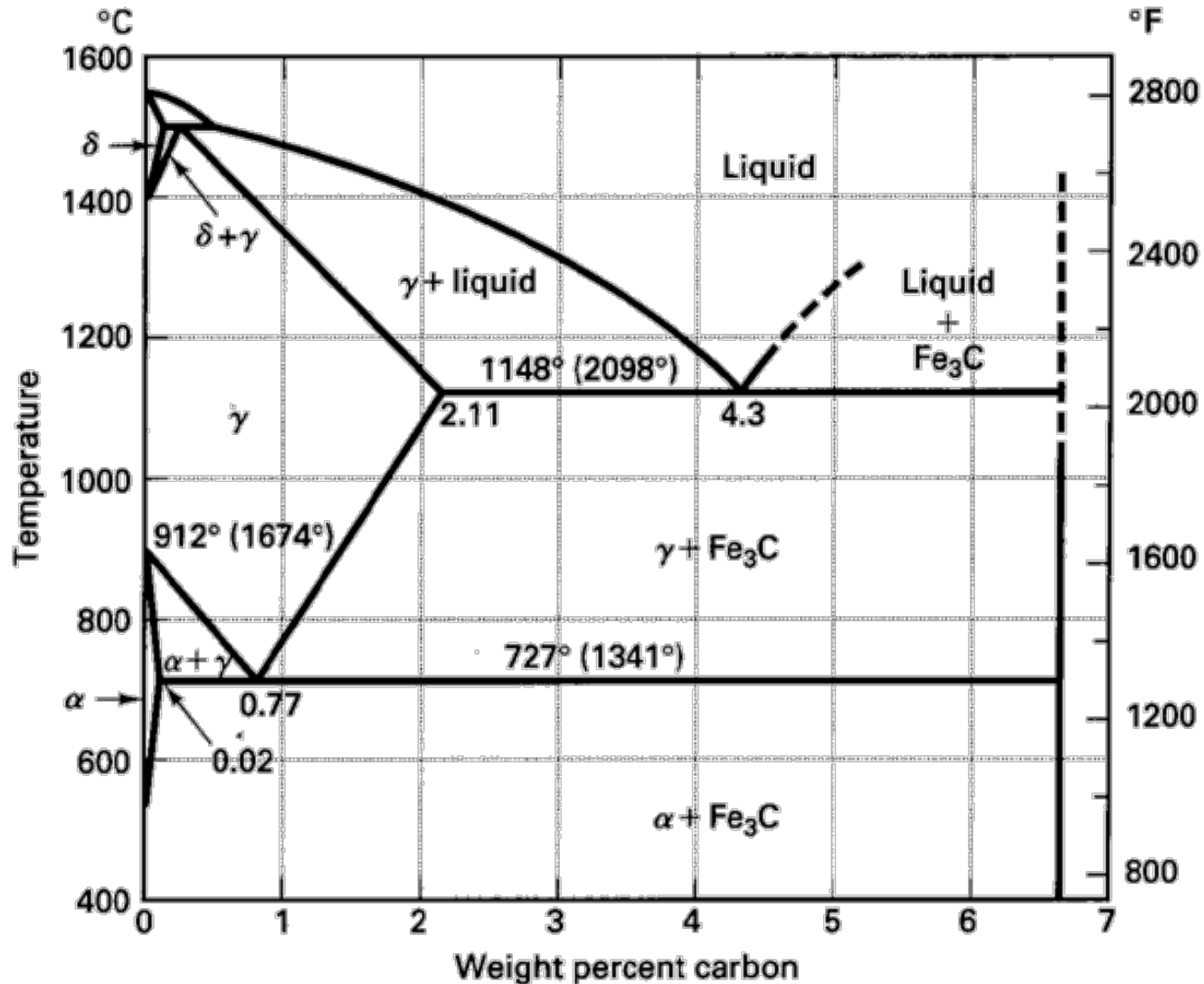
fenol - anilin
Př. voda - kys. dusičná

S₁ se sloučeninou, nestálou při své teplotě



Př.: SiO_2 - Al_2O_3
(A) (B)

Fázový diagram Fe-C



The Iron, Iron-Carbide Diagram and Basic Ferrous Heat Treating for Welders

Crystal Lattice Forms
and
Microscopic
Transformations
of
Iron

on Cooling from Liquid
on Heating from Ambient
Temperatures in deg. F, deg. C



Crystalline Structure of Iron Carbon Alloy from Ambient to Liquid

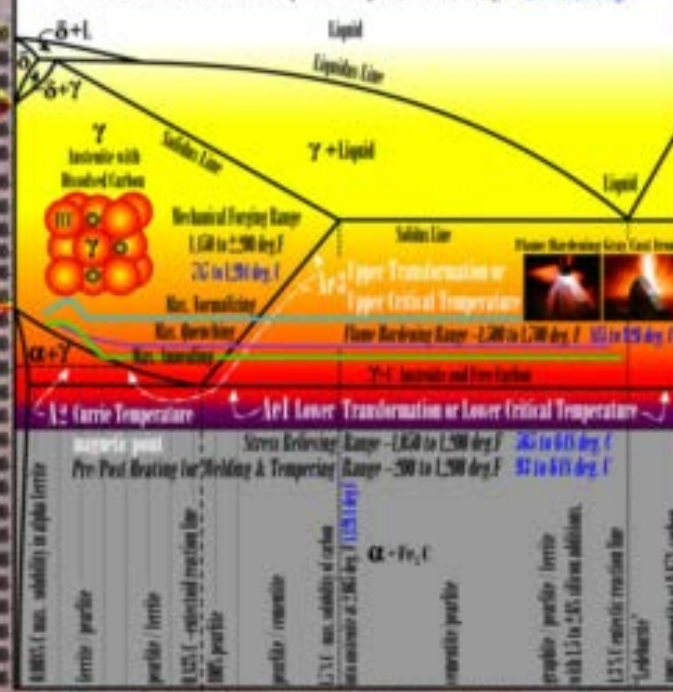
The heat values shown on the diagram were computer generated and are representative only.

The true location of transformation temperatures and reaction lines will vary due to the effect of alloying elements.

The steel microstructures shown below were obtained by annealing the steel samples at 1550 deg. F (845 deg. C) and furnace cooling.

The cast iron microstructures shown below are for the as-cast condition.

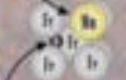
Fusion Weld and Heat Affected Zone Temperature Range -2,000 to 10,000 deg. F 1,100 to 5,500 deg. C



Alloying Elements
Commonly Used in Steel
by
Chemical Symbol
&
Atomic Number



Substitutional alloys are
usually metals and have
complete or very high
solubility in iron at all
temperatures.



Interstitial alloys are
usually non-metals, or
gases and have limited
solubility in iron at
room temp.



Hot Rolled Sheet Steel



"pearlitic"



© 2000 Thomas Sales

Structural Steel



"pearlitic"



AISI/SAE 1040



"pearlitic"



File Tool Steel



"pearlitic"



Gray Cast Iron



"pearlitic & graphitic"



Isolular Ductile Cast Iron



"pearlitic & graphitic"



Scale Graduations = 0.01mm

micrograph = actual size

Fáze soustavy Fe-C

δ – *ferrite* (present only at extreme temperatures)

Austenite, (FCC, high formability, high solubility of C, over 2%C can be dissolved in it, most of heat treatments begin with this single phase).

Ferrite, BCC, stable form of iron below 912 deg.C, only up to 0.02 wt% C in solid solution and leads to two phase mixture in most of steels.

Cementite (iron-carbide), stoichiometric intermetallic compound, hard, brittle, exact melting point unknown.

Currie point (770 deg. C), atomic level nonmagnetic-to-magnetic transition.

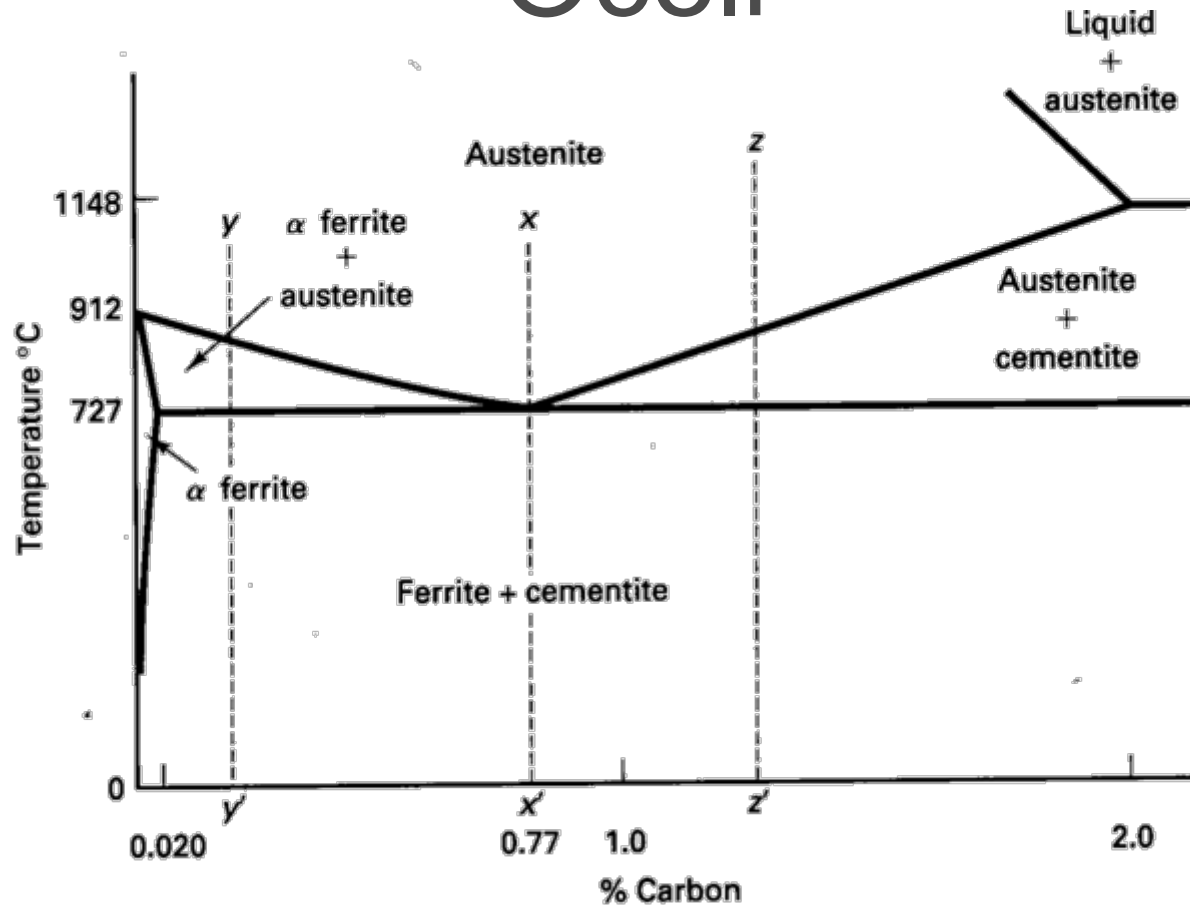
Fázové reakce Fe-C

Peritectic, at 1495 deg.C, with low wt% C alloys (almost no engineering importance).

Eutectic, at 1148 deg.C, with 4.3wt% C, happens to all alloys of more than 2.11wt% C and they are called **cast irons**.

Eutectoid, at 727 deg.C with eutectoid composition of 0.77wt% C, alloys below 2.11%C miss the eutectic reaction to create two-phase mixture. They are **steels**.

Oceli



4.5 Eutectoid Steel

At 0.77%C by cooling from austenite (FCC) changes to BCC-ferrite (max 0.02%C) and excess C forms intermetallic cementite.

Chemical crystalline solid separation gives fine mixture of ferrite and cementite. Pearlite (right), 1000X.

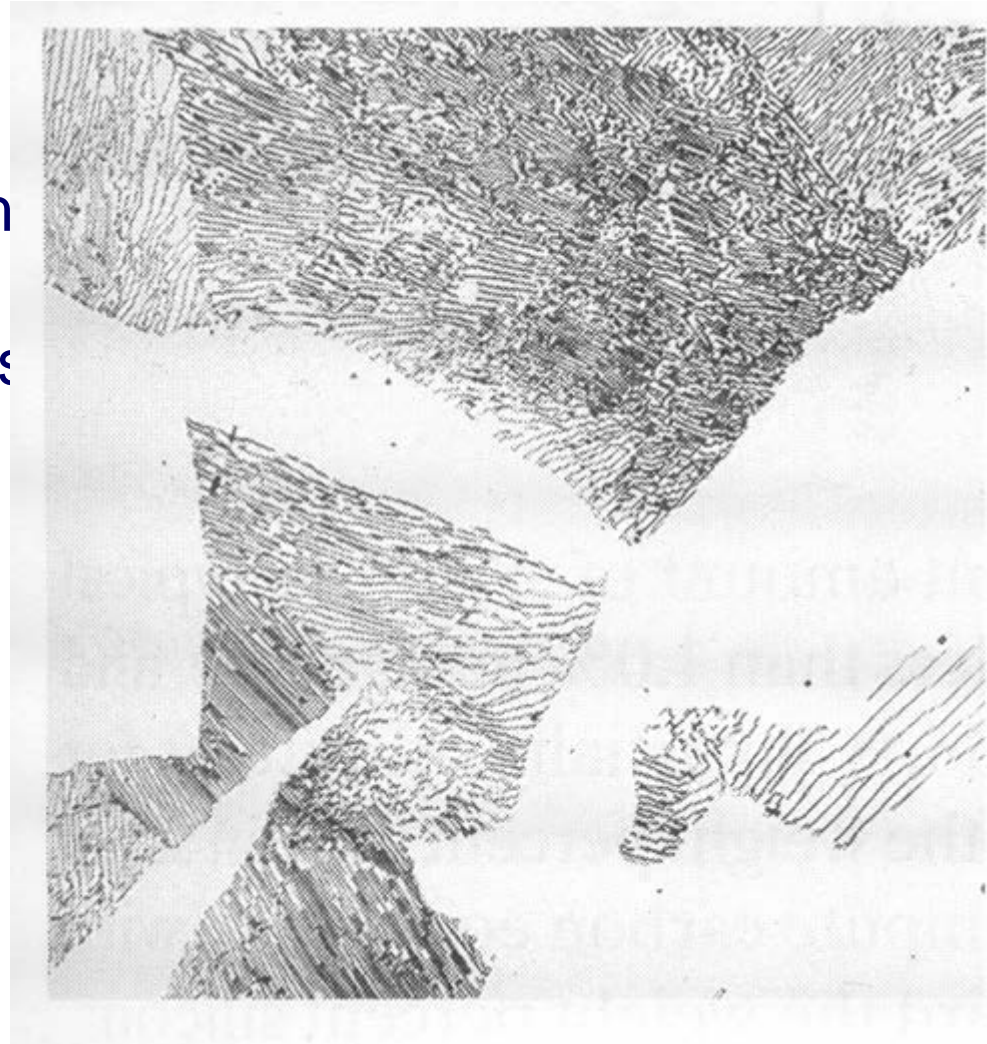


4.5 Hypoeutectoid Steel

With less than 0.77%C from austenite by cooling transformation leads to growth of low-C ferrite growth. At 727deg.C austenite transforms in to pearlite.

Mixture of **proeutectoid ferrite** (white) and regions of **pearlite** forms.

Magnification 500X.

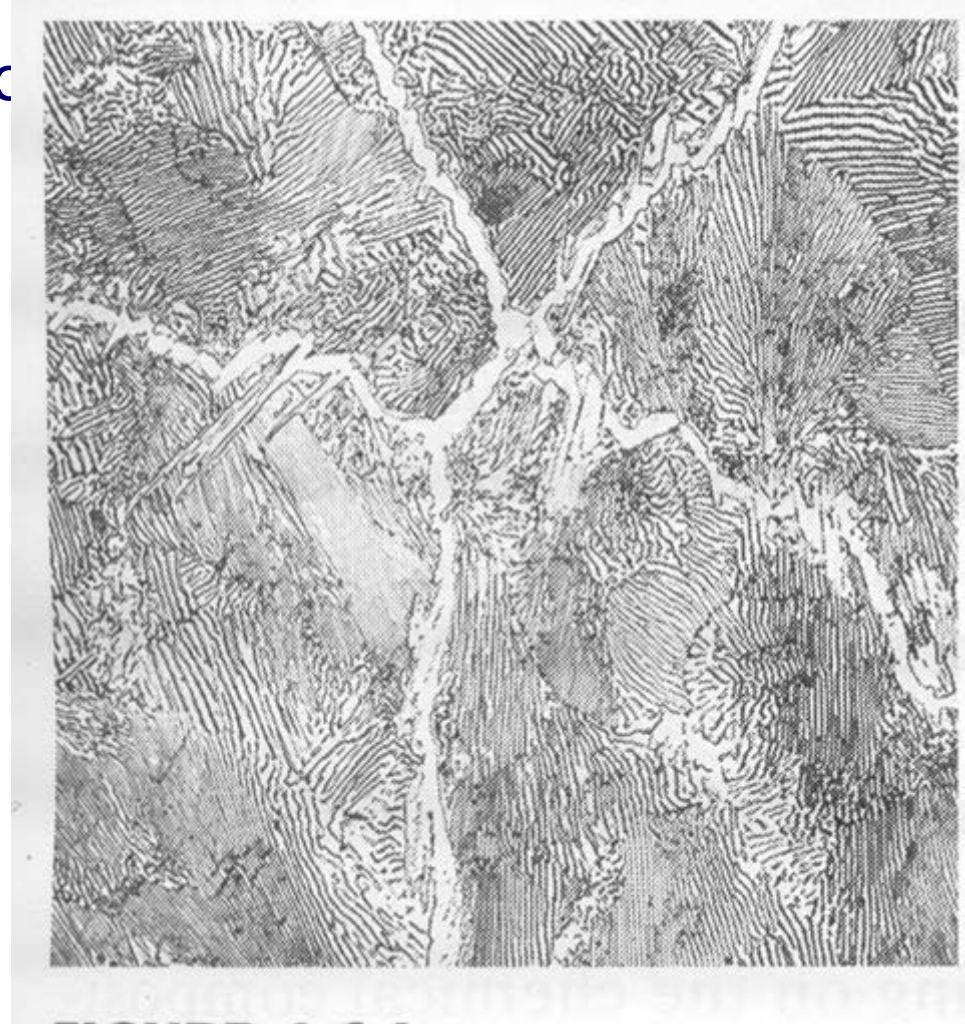


4.5 Hypereutectoid Steel

With more than 0.77%C, from austenite transformation leads to proeutectoid primary cementite and secondary ferrite. At 727 deg.C austenite changes to pearlite.

Structure of primary **cementite** and **pearlite** forms.

Magnification 500X.

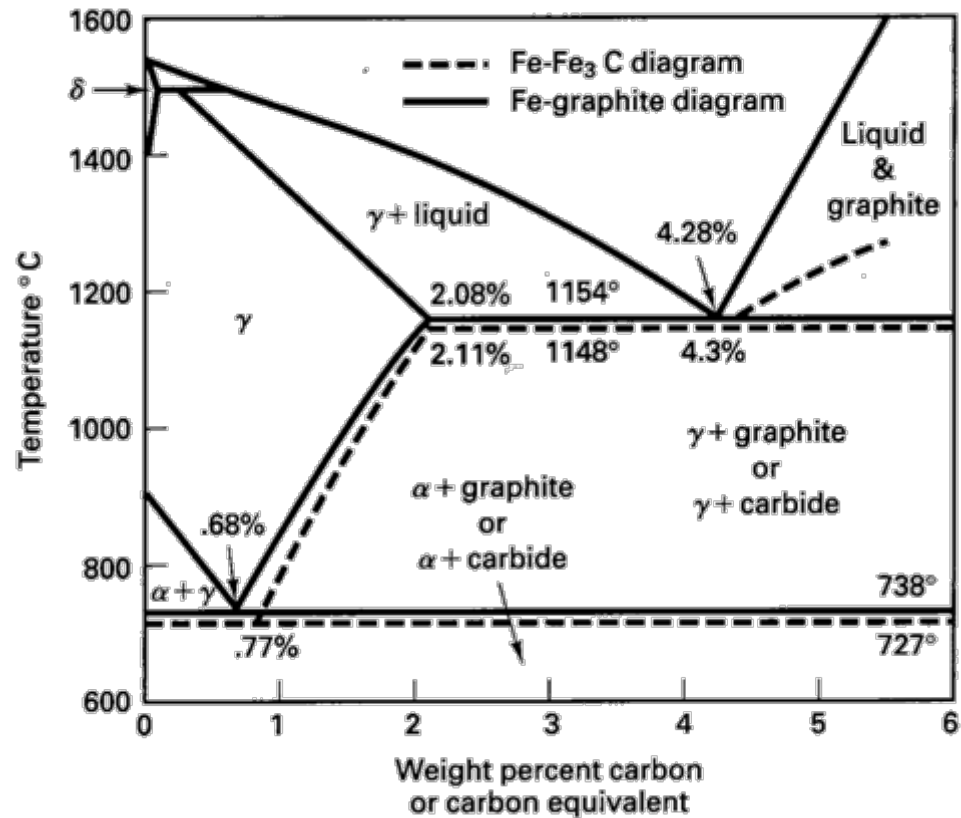


4.6 Cast Irons

Iron-Carbon alloys of 2.11%C or more are cast irons.

Typical composition: 2.0-4.0%C, 0.5-3.0% Si, less than 1.0% Mn and less than 0.2% S.

Si-substitutes partially for C and promotes formation of graphite as the carbon rich component instead Fe_3C .



4.6 Gray Cast Iron

Composes of: 2.5-4.0%C, 1.0-3.0%Si and 0.4-1.0% Mn.

Microstructure: 3-D graphite flakes formed during eutectic reaction. They have pointed edges to act as voids and crack initiation sites.

Sold by class (class 20 has min. tensile strength of 20,000 psi is a high C-equivalent metal in ferrite matrix). Class 40 would have pearlite matrix.



4.6 Gray Cast Iron

Properties: excellent compressive strength, excellent machinability, good resistance to adhesive wear (self lubrication due to graphite flakes), outstanding damping capacity (graphite flakes absorb transmitted energy), good corrosion resistance and it has good fluidity needed for casting operations.

It is widely used, especially for large equipment parts subjected to compressive loads and vibrations.

4.6 White Cast Iron

Composes of: 1.8-3.6%C, 0.5-1.9%Si and 0.25-0.8%Mn.

All of its carbon is in the form of iron-carbide (Fe_3C). It is called white because of distinctive white fracture surface.

It is very hard and brittle (a lot of Fe_3C).

It is used where a high wear resistance is dominant requirement (coupled hard martensite matrix and iron-carbide). Thin coatings over steel (mill rolls).

4.6 Malleable Cast Iron

Formed by extensive heat treatment around 900 degC, Fe_3C will dissociate and form irregular shaped graphite nodules. Rapid cooling restricts production amount to up to 5 kg. Less voids and notches.

Ferritic MCI: 10% EL, 35 ksi yield strength, 50 ksi tensile strength. Excellent impact strength, good corrosion resistance and good machinability.

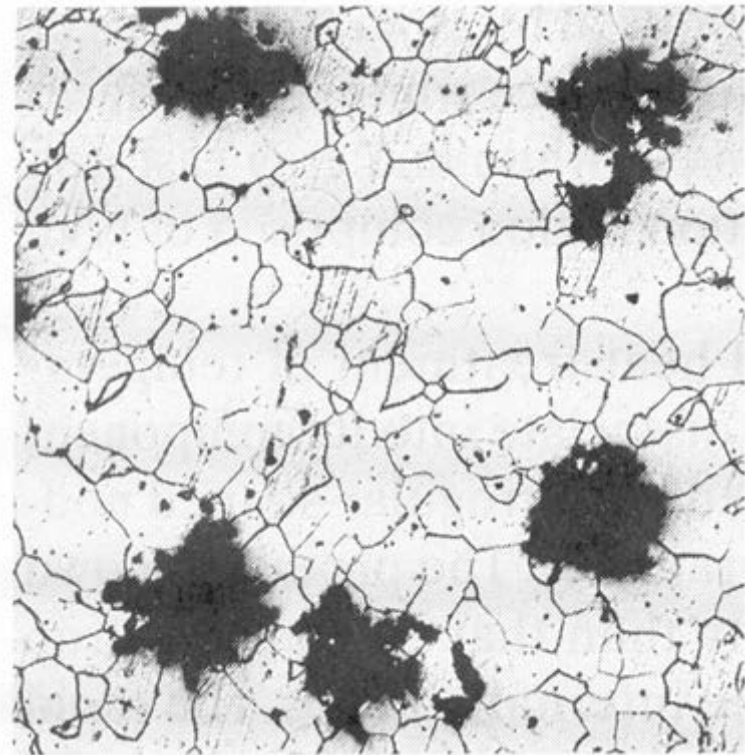


FIGURE 4.15 Ferritic malleable cast iron microstructure.

4.6 Pearlitic Malleable Cast Iron

Pearlitic MCI: by rapid cooling through eutectic transformation of austenite to pearlite or martensite matrix.

Composition: 1-4% EL, 45-85 ksi yield strength, 65-105 ksi tensile strength. Not as machinable as ferritic malleable cast iron.

Ductile Cast Iron

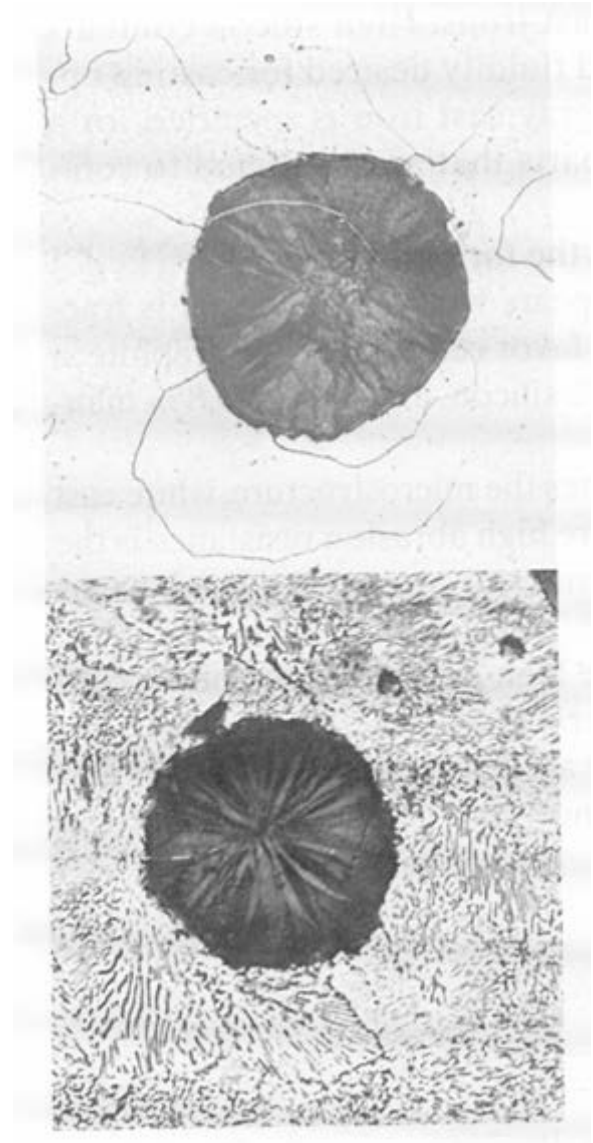
Without a heat treatment by addition of ferrosilicon (MgFeSi) formation of smooth spheres (nodules) of graphite is promoted.

Properties: 2-18% EL, 40-90 ksi yield strength, 60-120 ksi tensile strength.

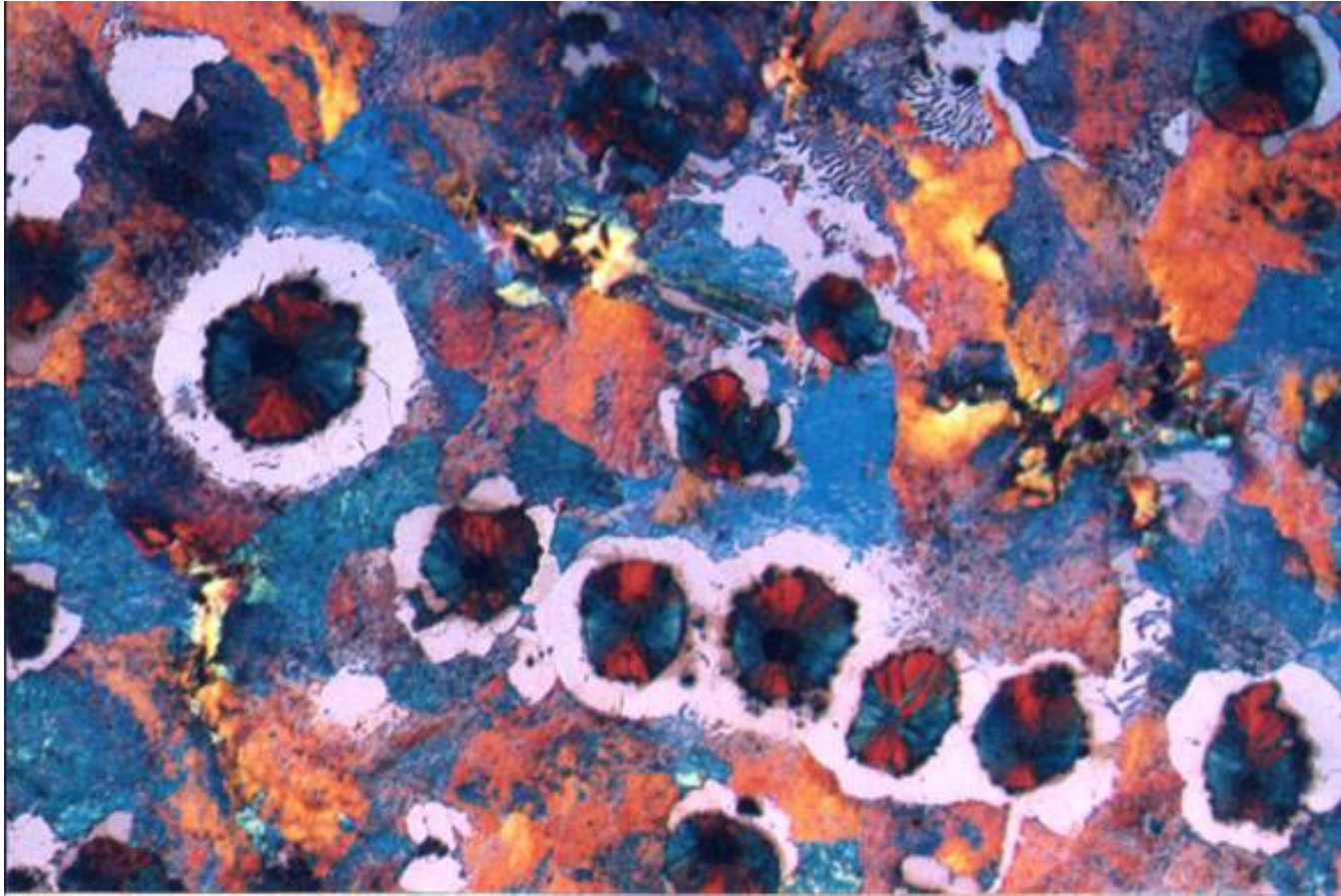
Attractive engineering material due to: good ductility, high strength, toughness, wear resistance, machinability and low melting point castability.

4.6 Malleable Cast Iron

Ductile iron with ferrite matrix (top) and pearlite matrix (bottom) at 500X. Spheroidal shape of the graphite nodule is achieved in each case.



Microstructure



Globular cast iron

Diskuse

[http://www.ironcarbon
diagram.com/product.
aspx?id=5](http://www.ironcarbon
diagram.com/product.
aspx?id=5)