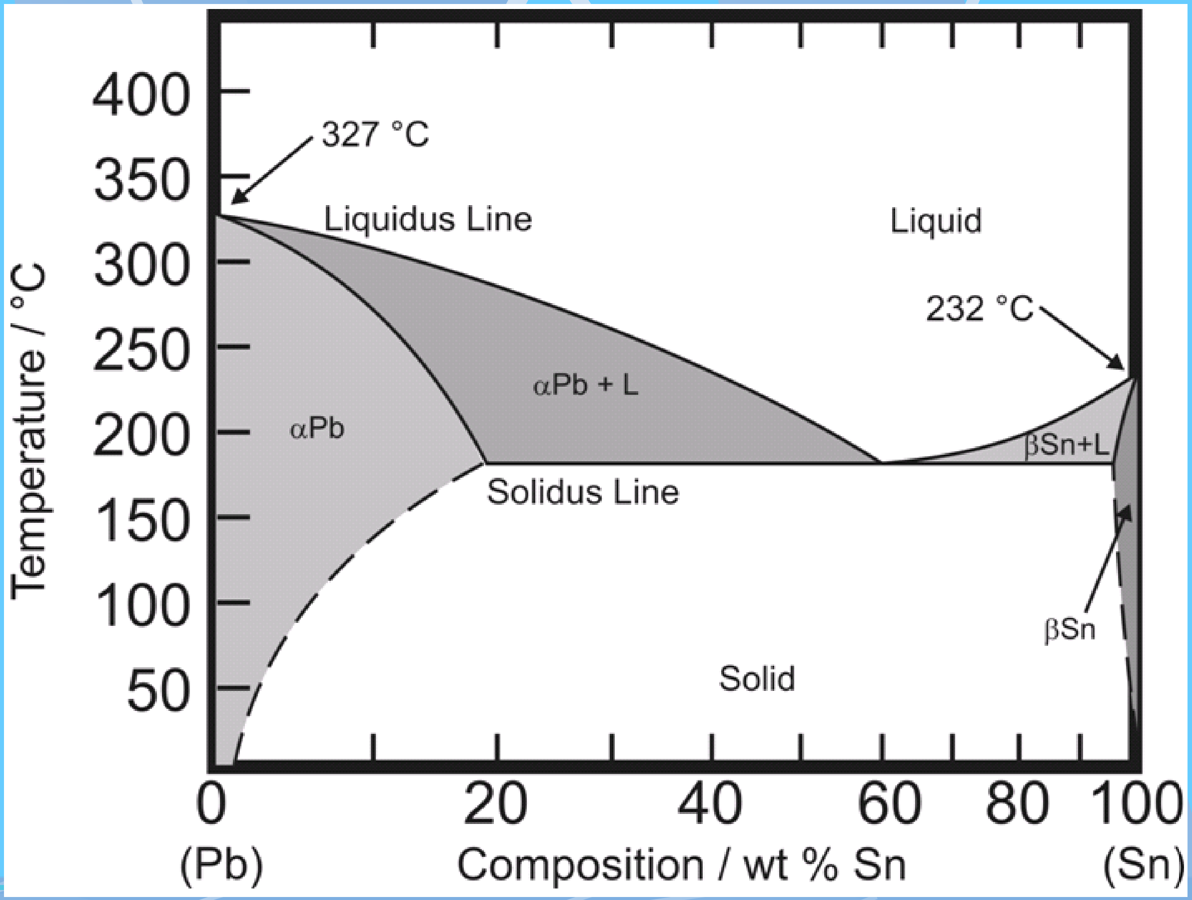
Fázové diagramy binárních soustav



Odmísemí a spinodální rozpad

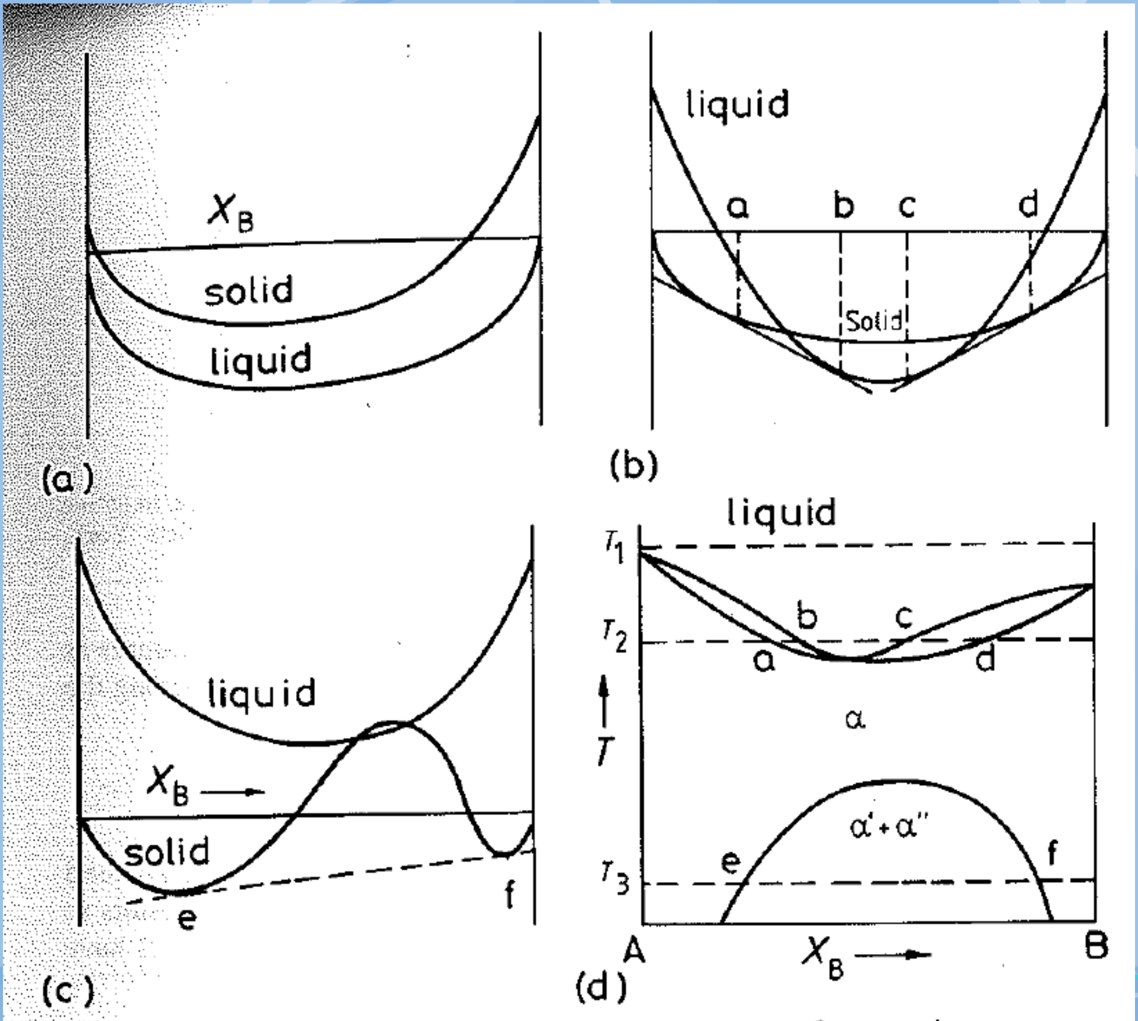
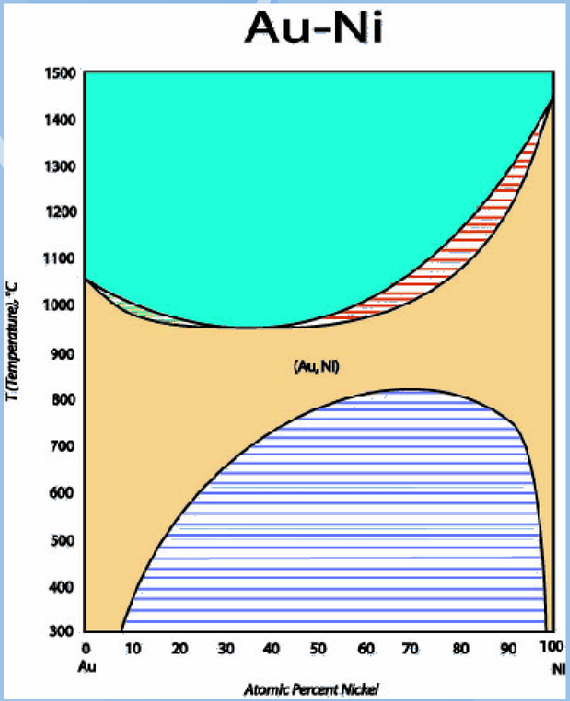


Fig. 1.30 The derivation of a phase diagram where $\Delta H^{S}_{mix} > \Delta H^{L}_{mix} = 0$. Free energy v. composition curves for (a) T_1, (b) T_2, and (c) T_3.



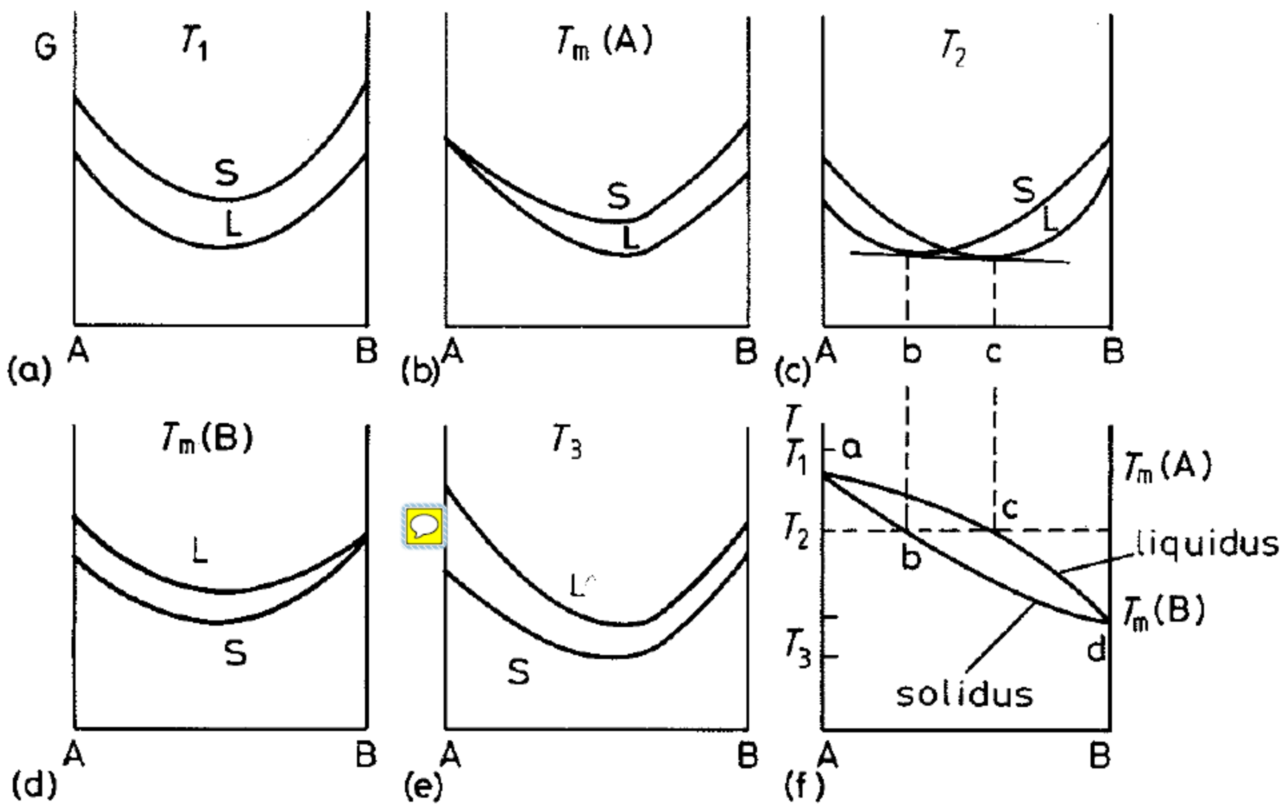


Fig. 1.29 The derivation of a simple phase diagram from the free energy curves for the liquid (L) and solid (S).

Aktivita složek v binárních diagramech

$$a_A^\alpha = a_A^\beta, \qquad a_B^\alpha = a_B^\beta \qquad (1.47)$$

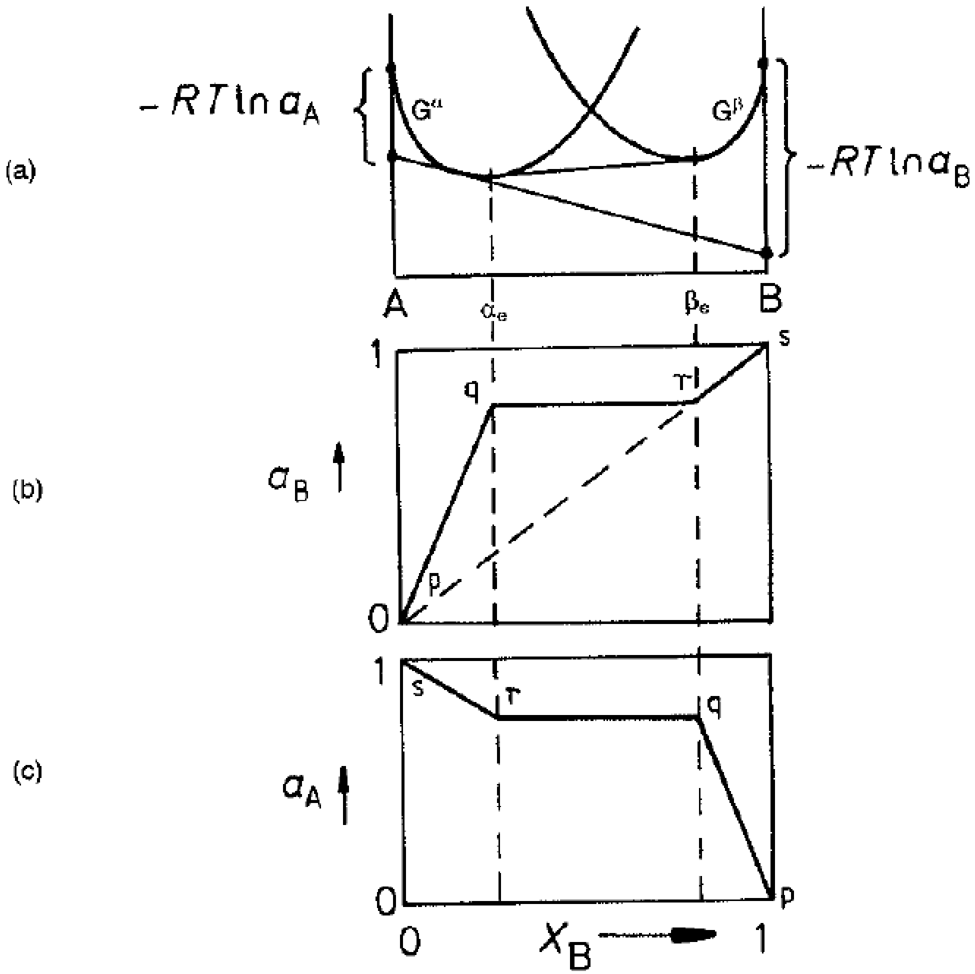
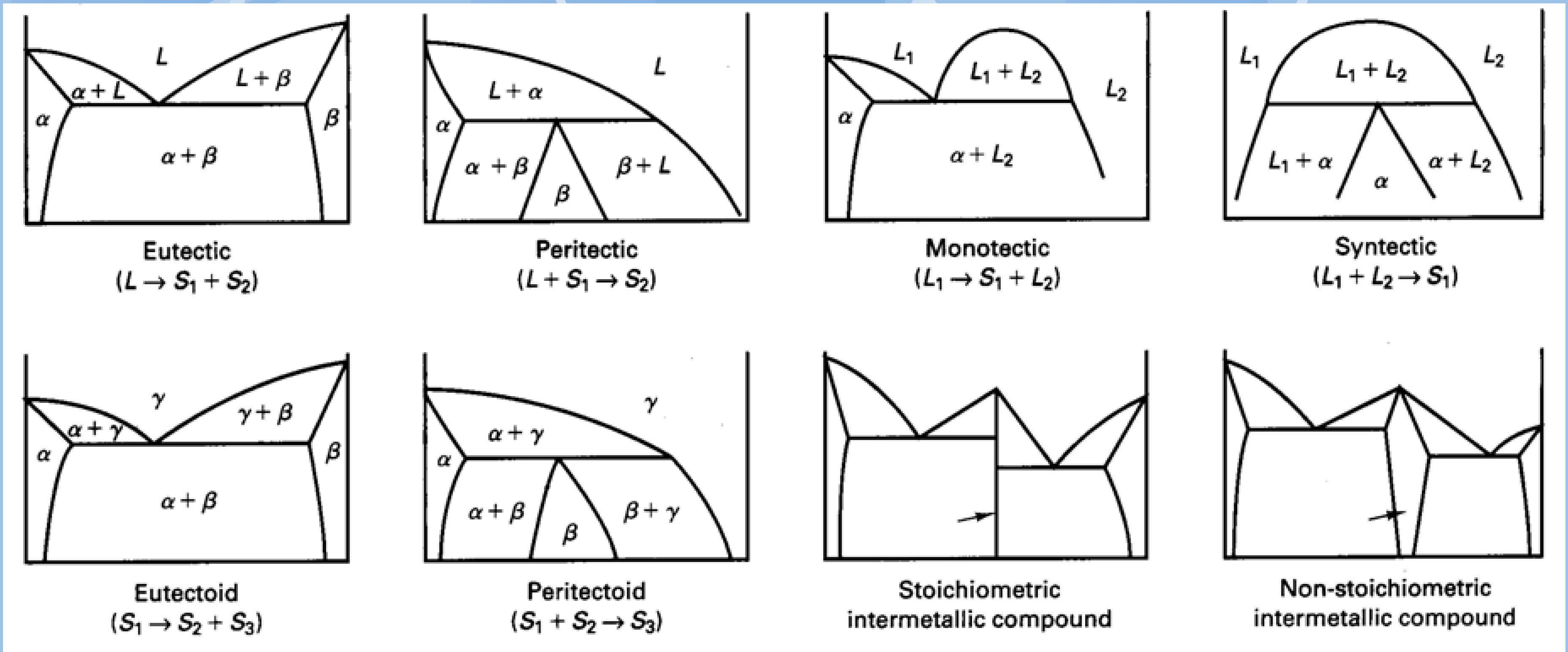
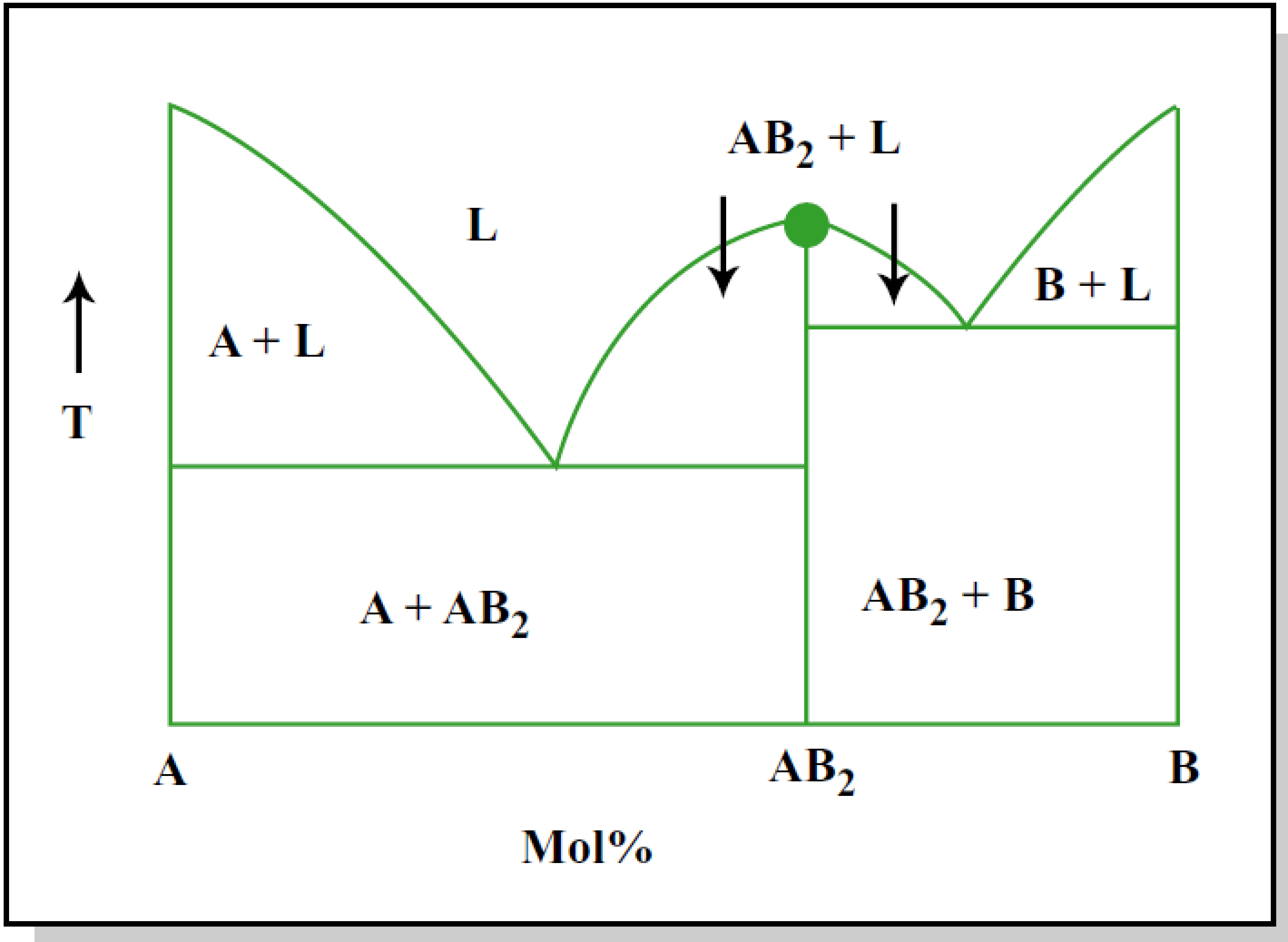


Fig. 1.28 The variation of a_A and a_B with composition for a binary system containing two ideal solutions, α and β.

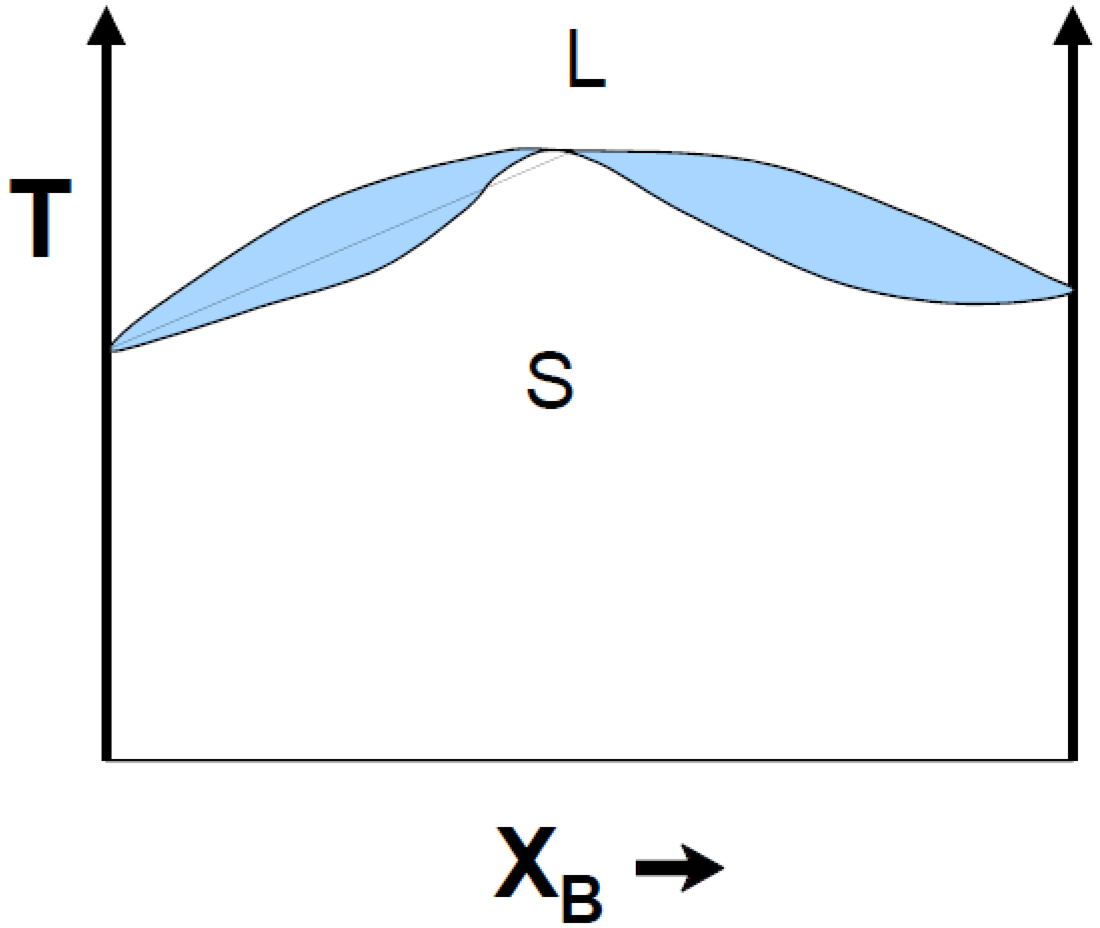
Fázové přeměny

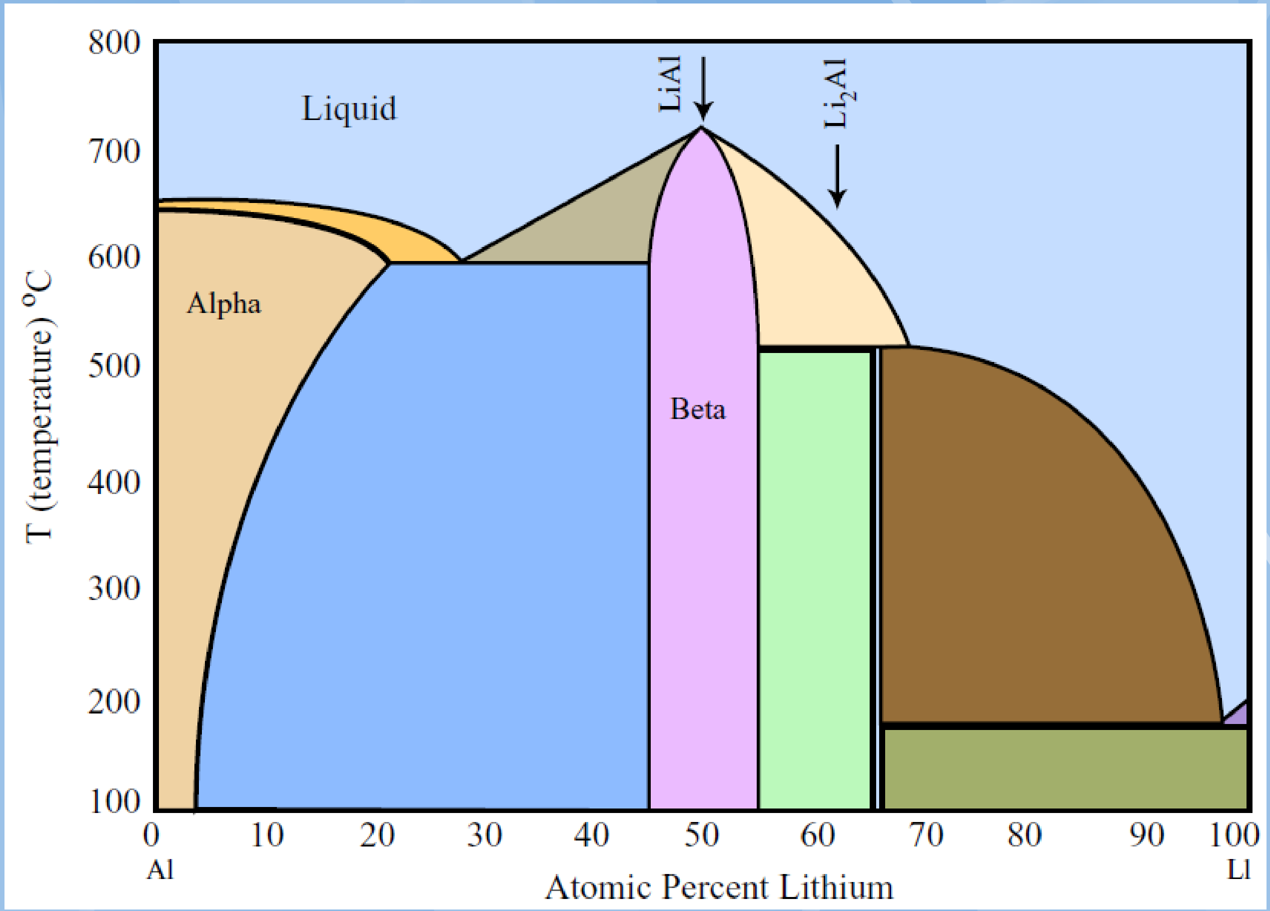


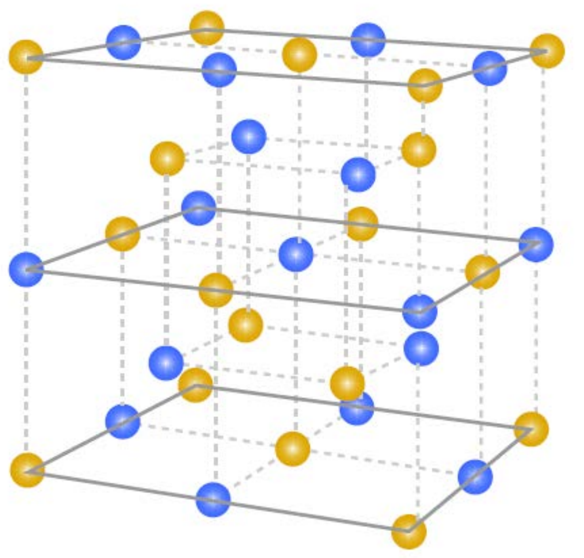
systems- these are referred to as ***intermediate compounds***.



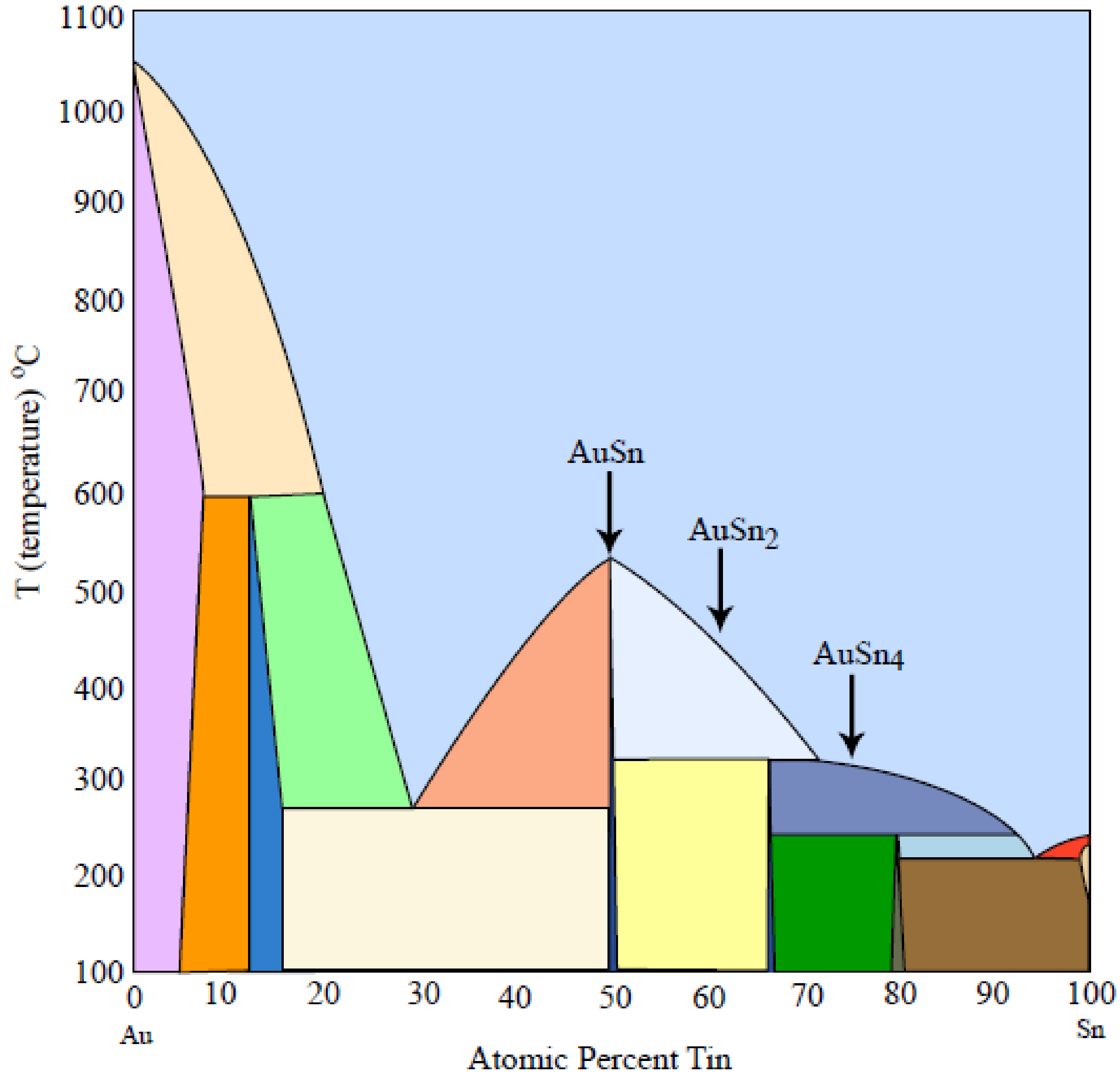
• **Congruent phase transition:** complete transformation



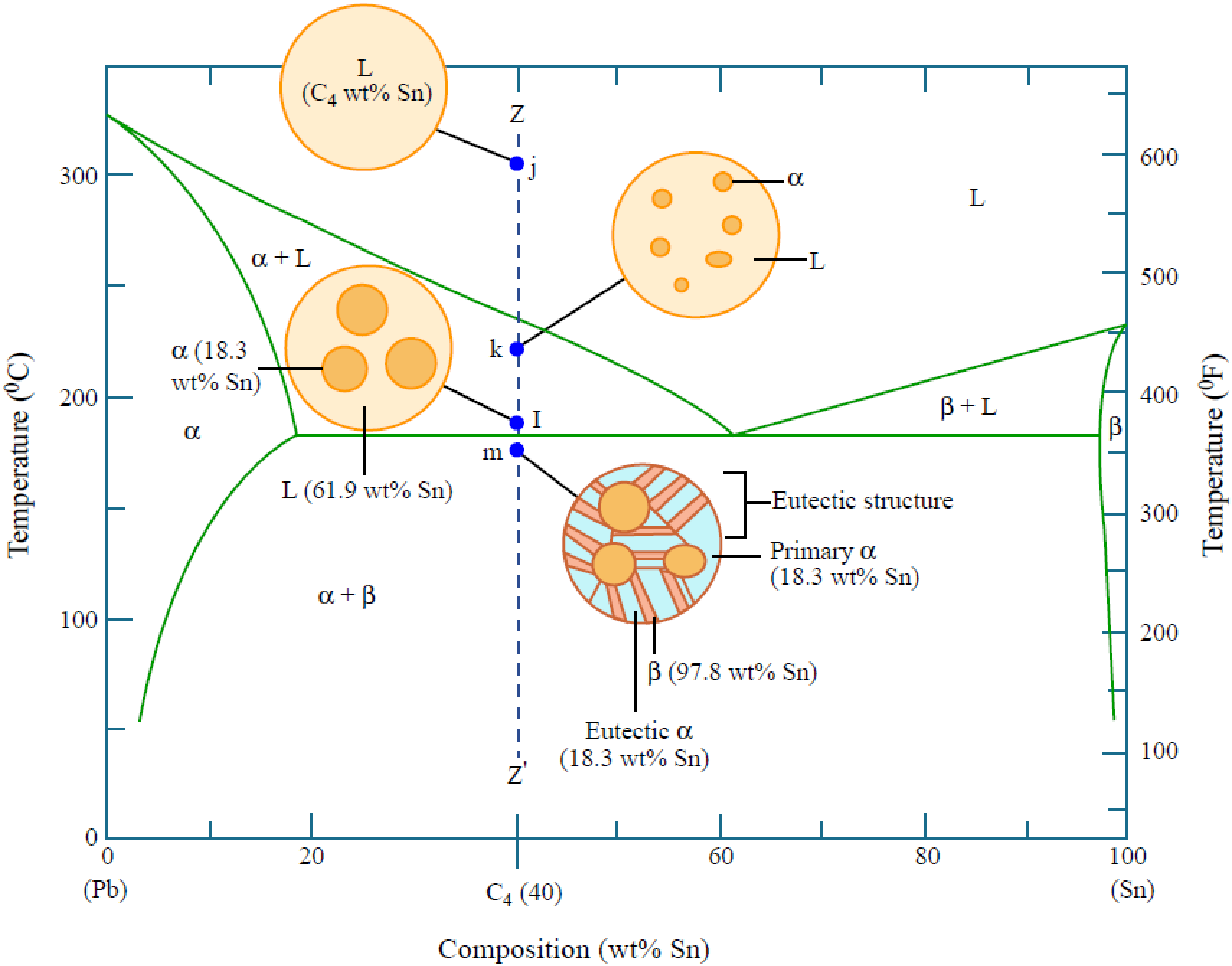




Zintl crystal Structure of LiAl (β phase)[4]



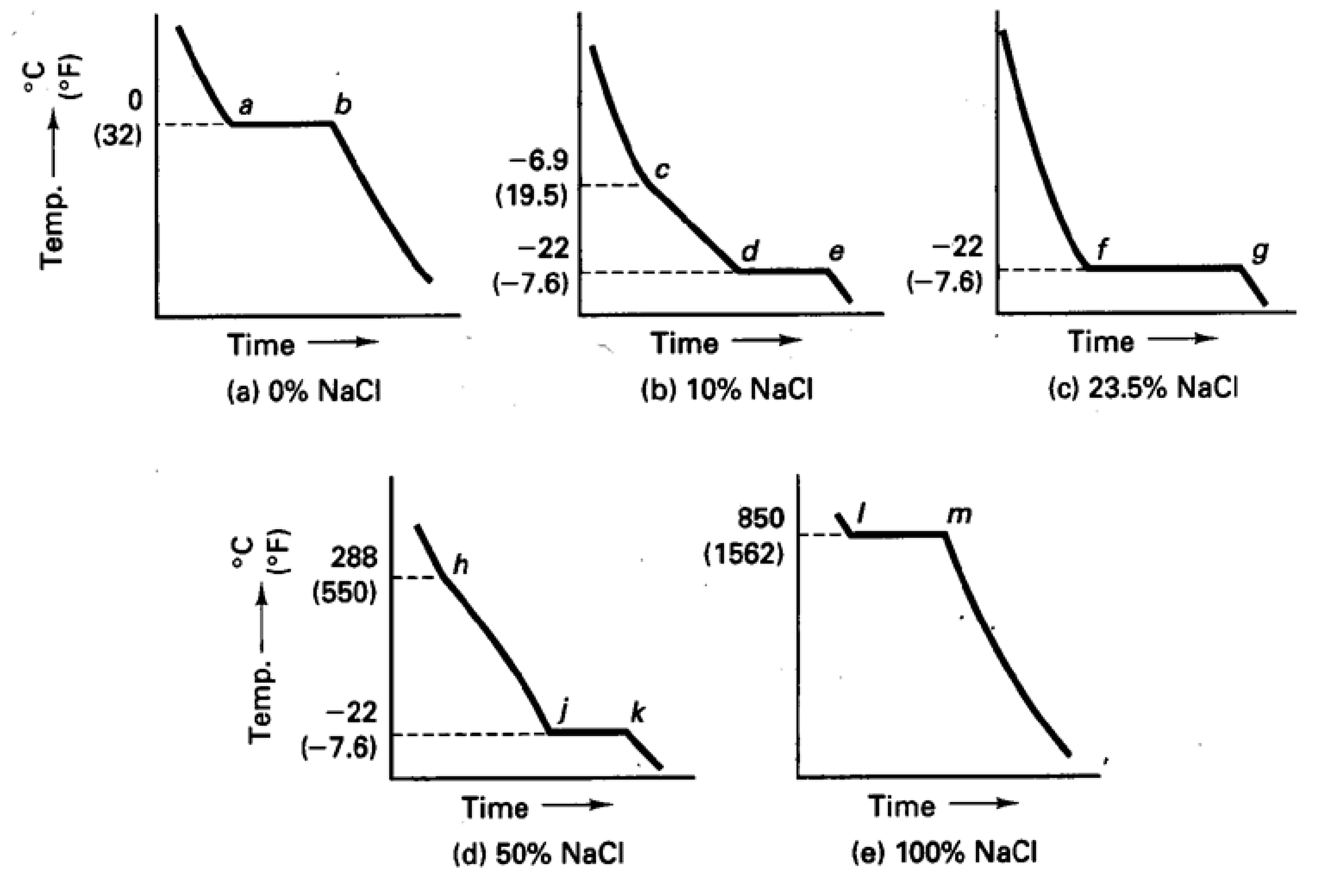
Phase diagram of Gold-Tin has seven distinct phases, three peritectics, two eutectics, and one eutectoid reactions.



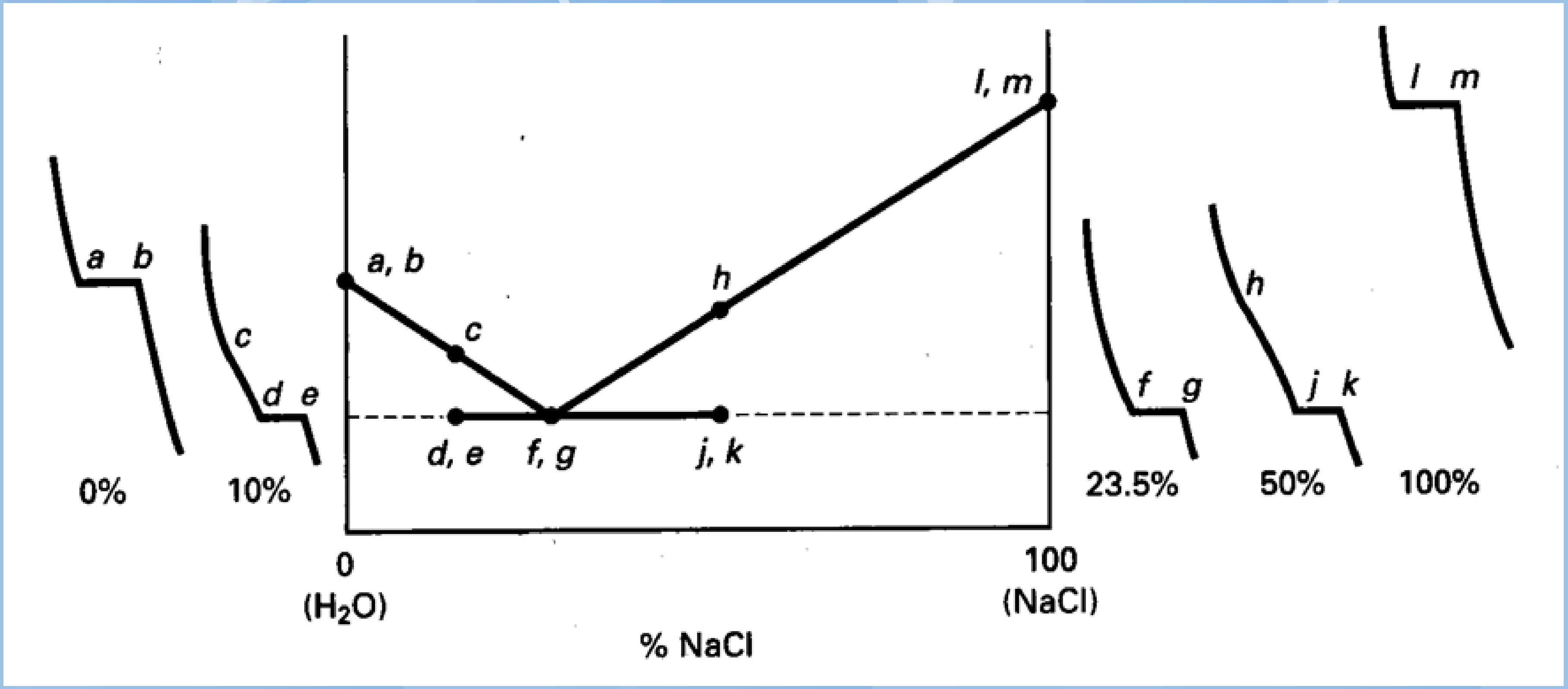
L
(C4 wt% Sn)
Z
j
α
L
L
α + L
k
α (18.3
wt% Sn)
200
I
α
m
L (61.9 wt% Sn)
β + L
β
Eutectic structure
Primary α
(18.3 wt% Sn)
α + β
β (97.8 wt% Sn)
Eutectic α
(18.3 wt% Sn)
Z'
300
100
0
600
500
400
300
200
100
Temperature (°C)
Temperature (°F)
0
(Pb)
20
C4 (40)
60
80
100
(Sn)
Composition (wt% Sn)

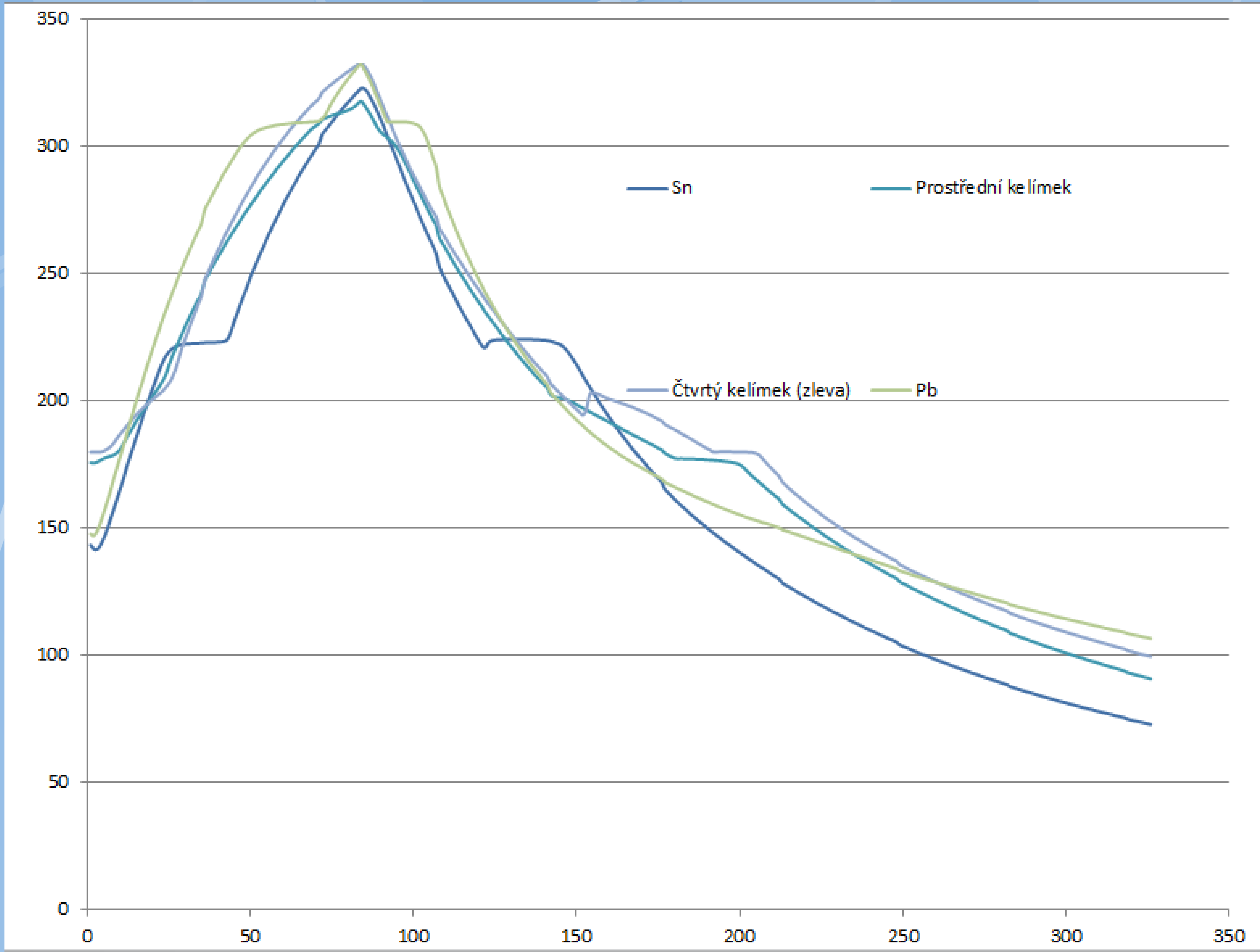
Křivky chladnutí

NaCl-H20



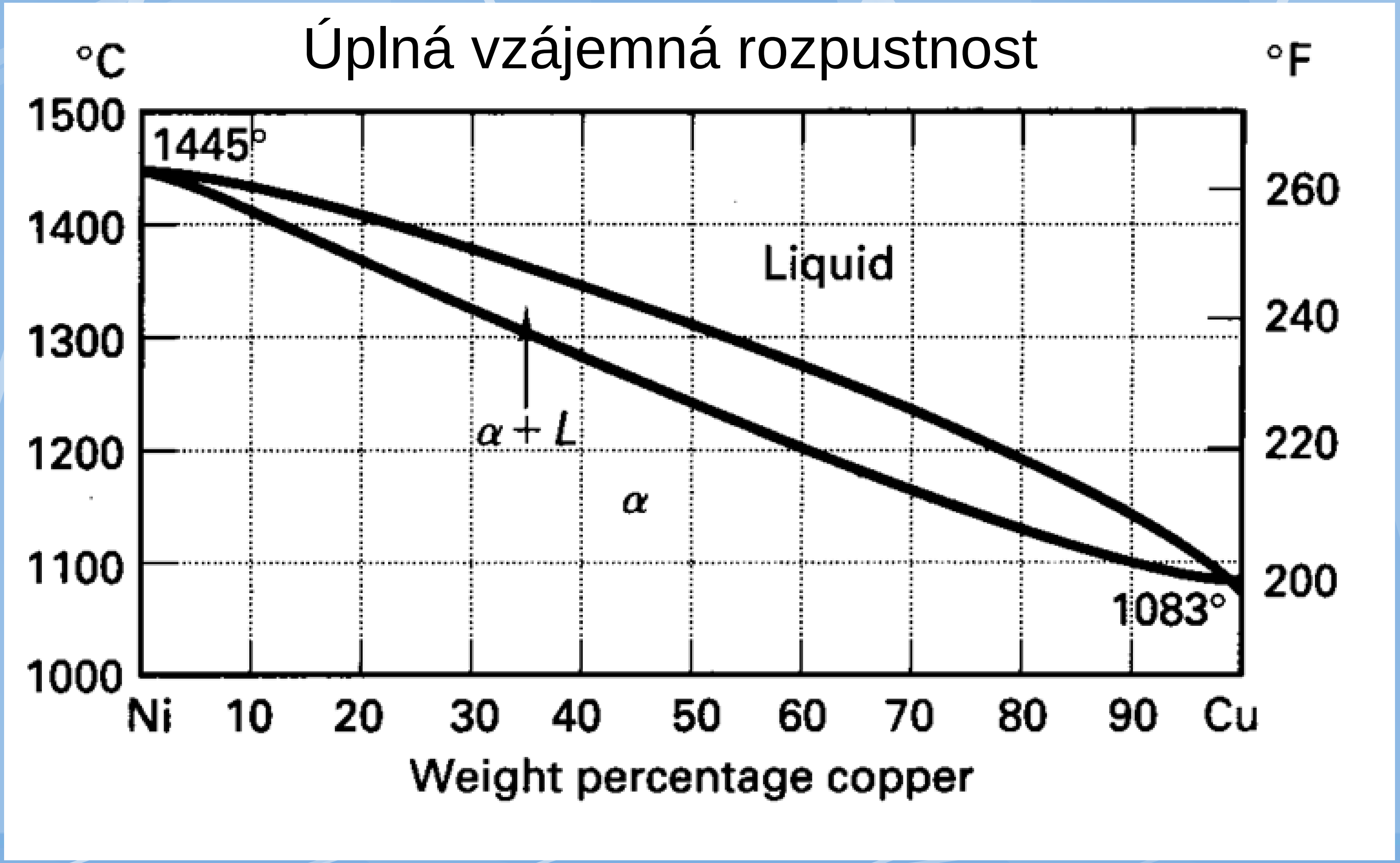
Stanovení FD z křivek chladnutí



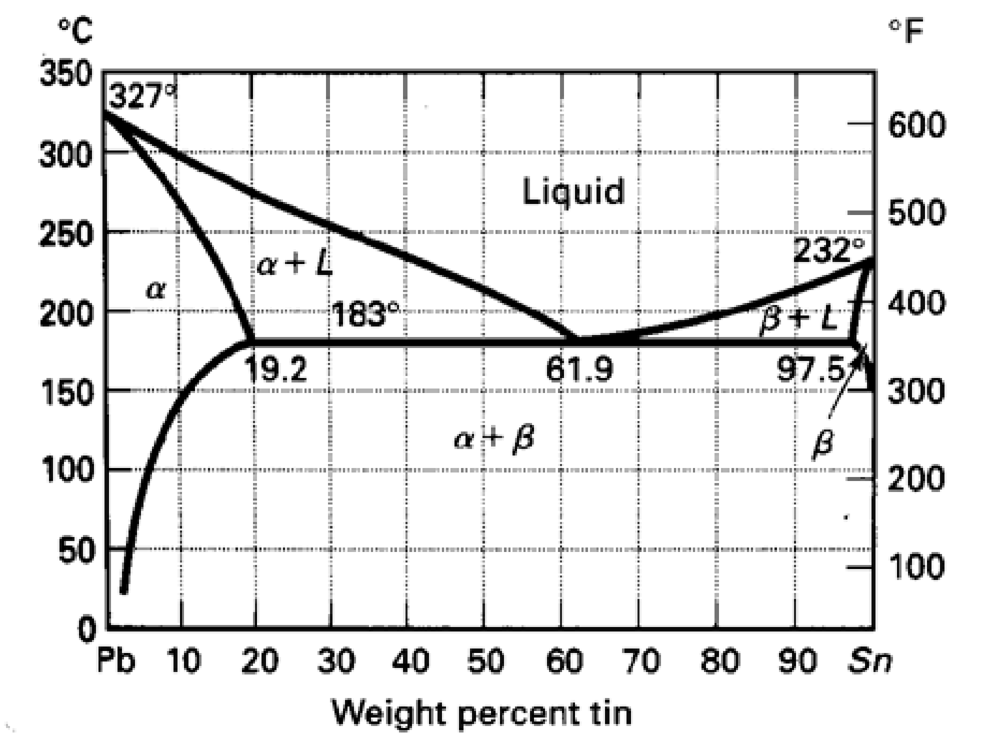


350
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
Sn
Prostřední kelímek
Čtvrtý kelímek (zleva)
Pb

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.

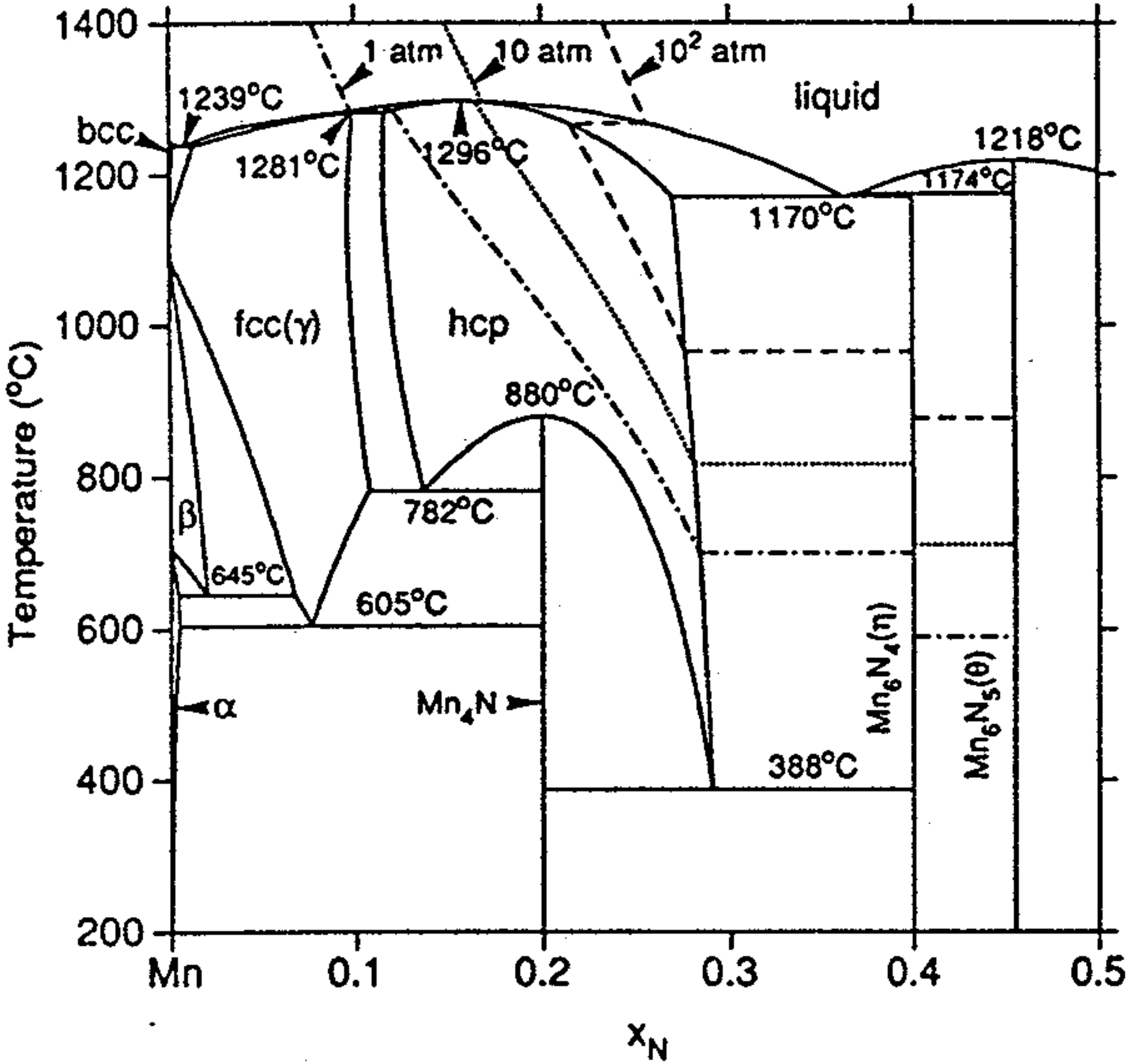


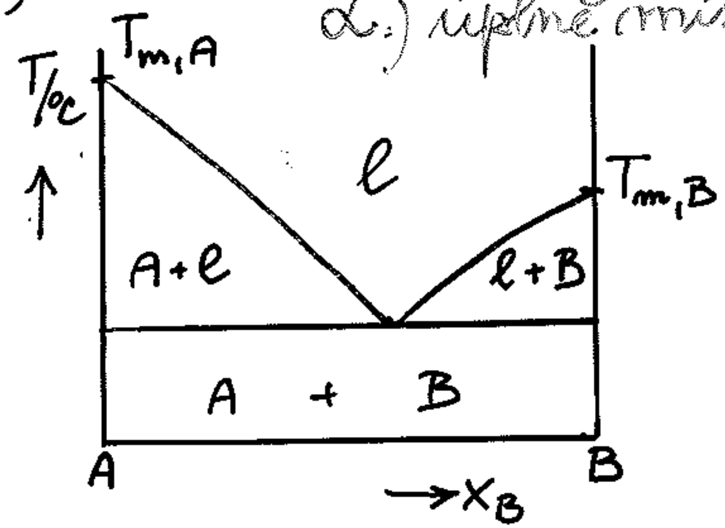
Fig. 20—The calculated Mn-N phase diagram assessed by Qiu and Fernández Guillermet,[30] where N_2 gas is omitted but isobar lines are shown in dashed curves.

Rovnováhy organických látek

Rovnováha kapalina – pevná látka

a) nemísitelné tuhé látky (Roozeboomova klasifikace)

α.) úplně mísitelné v kapalné fázi



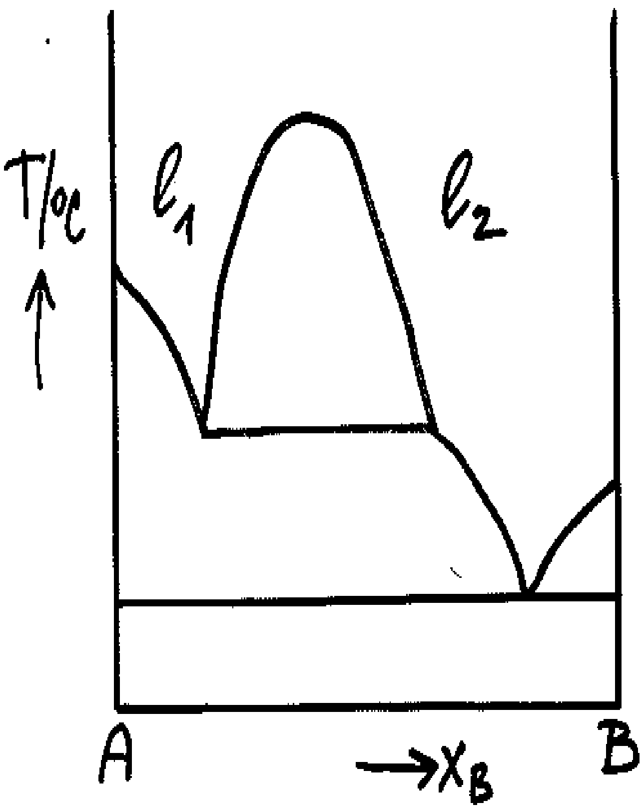
Eutektikum: $v = 0$.

Experimentální stanovení – termická analýza (křivky chladnutí).

Př.: Bi – Cd, naftalen-benzen

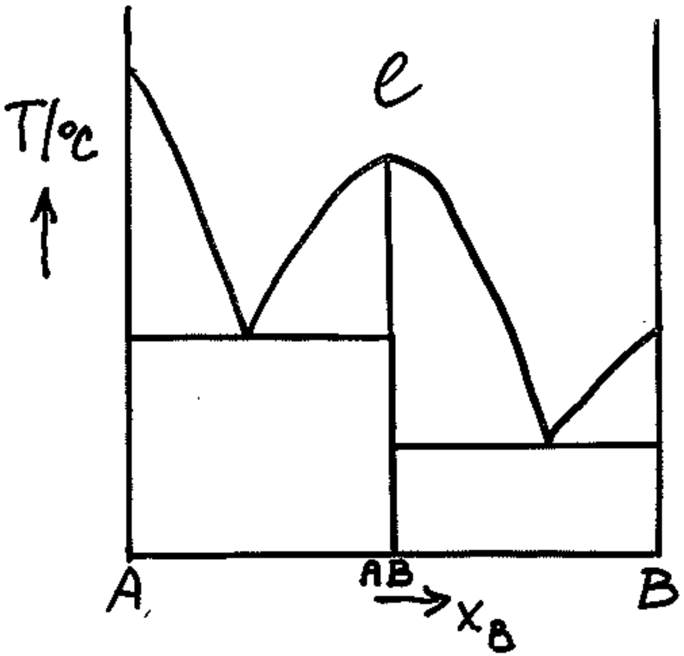
β.) omezeně mísitelné v kapalné fázi

β) omezená mísitelnost v kapalné fázi



Př.: fenol - voda, Bi - Zn.

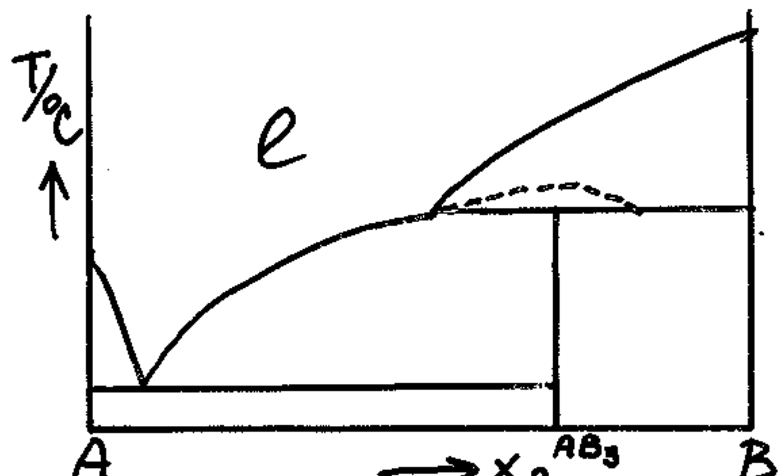
S. je sloučeninou, stálou při své t. tání



fenol - anilin

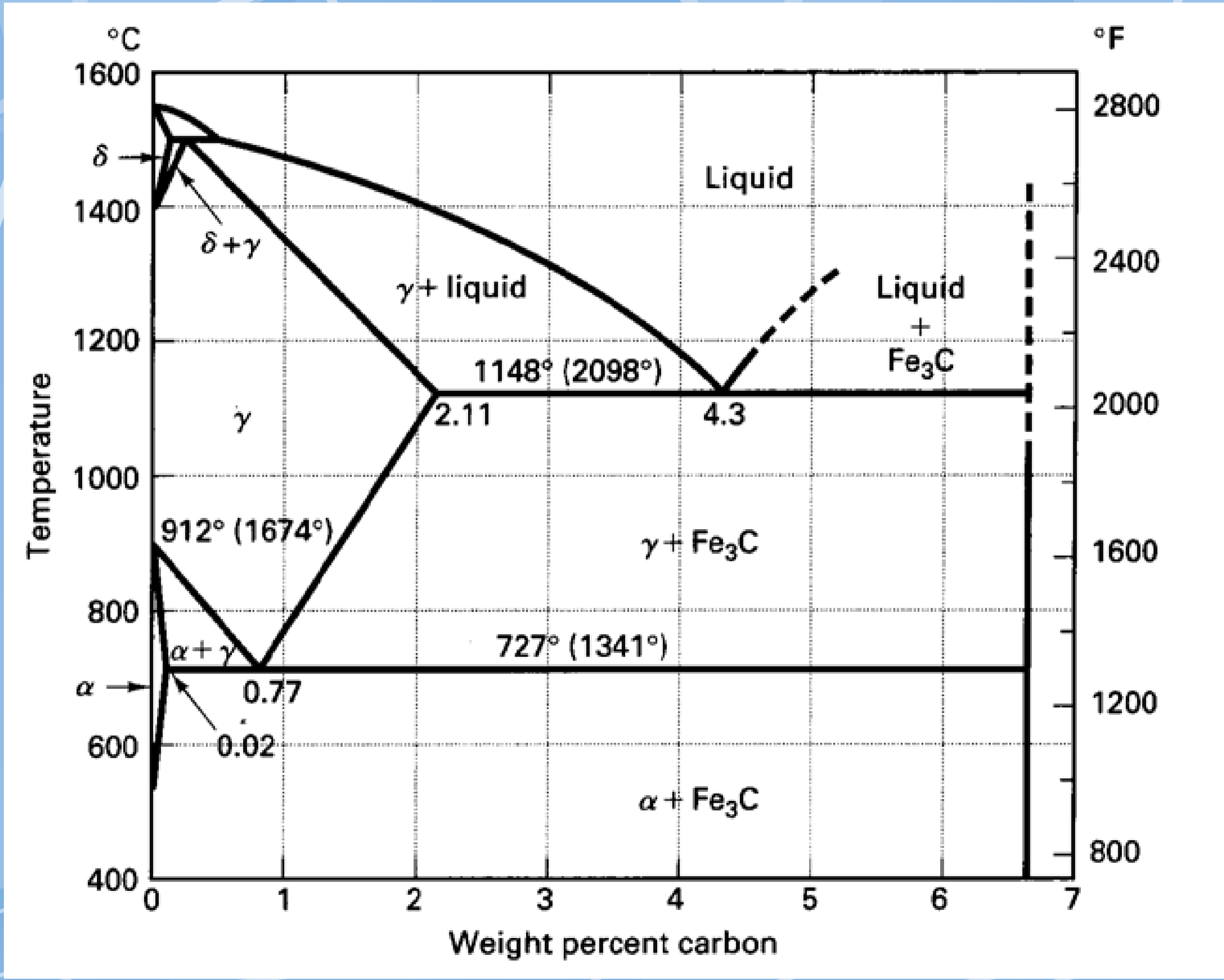
Př. voda - kys. dusičná

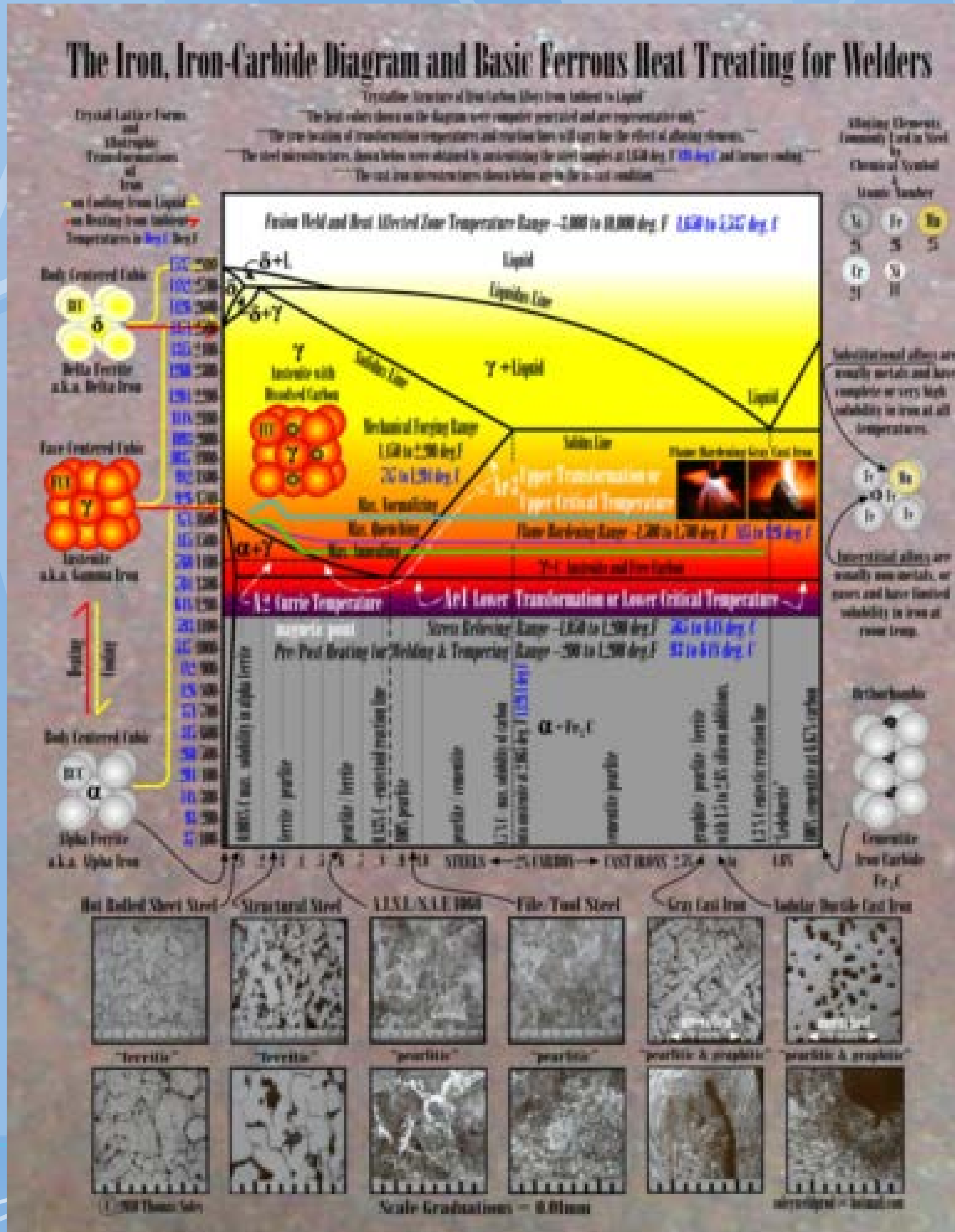
S. je sloučeninou, nestálou při své T tání



Př.: $SiO_2 - Al_2O_3$
(A) (B)

Fázový diagram Fe-C




The Iron, Iron-Carbide Diagram and Basic Ferrous Heat Treating for Welders
Liquid
Liquidus Line
Solidus Line
γ + Liquid
Body Centered Cubic
Delta Ferrite
a.k.a. Delta Iron
Face Centered Cubic
Austenite
a.k.a. Gamma Iron
Alpha Ferrite
a.k.a. Alpha Iron
Orthorhombic
Cementite
Iron Carbide
Mechanical Forging Range
Upper Transformation or
Upper Critical Temperature
Lower Transformation or Lower Critical Temperature
Curie Temperature
Flame Hardening Range
Stress Relieving Range
Pre/Post Heating for Welding & Tempering Range
Hot Rolled Sheet Steel
Structural Steel
File/Tool Steel
Gray Cast Iron
Nodular Ductile Cast Iron
"ferritic"
"pearlitic"
"pearlitic & graphitic"
Scale Graduations

Fáze soustavy Fe-C

$\delta - ferrite$, (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.

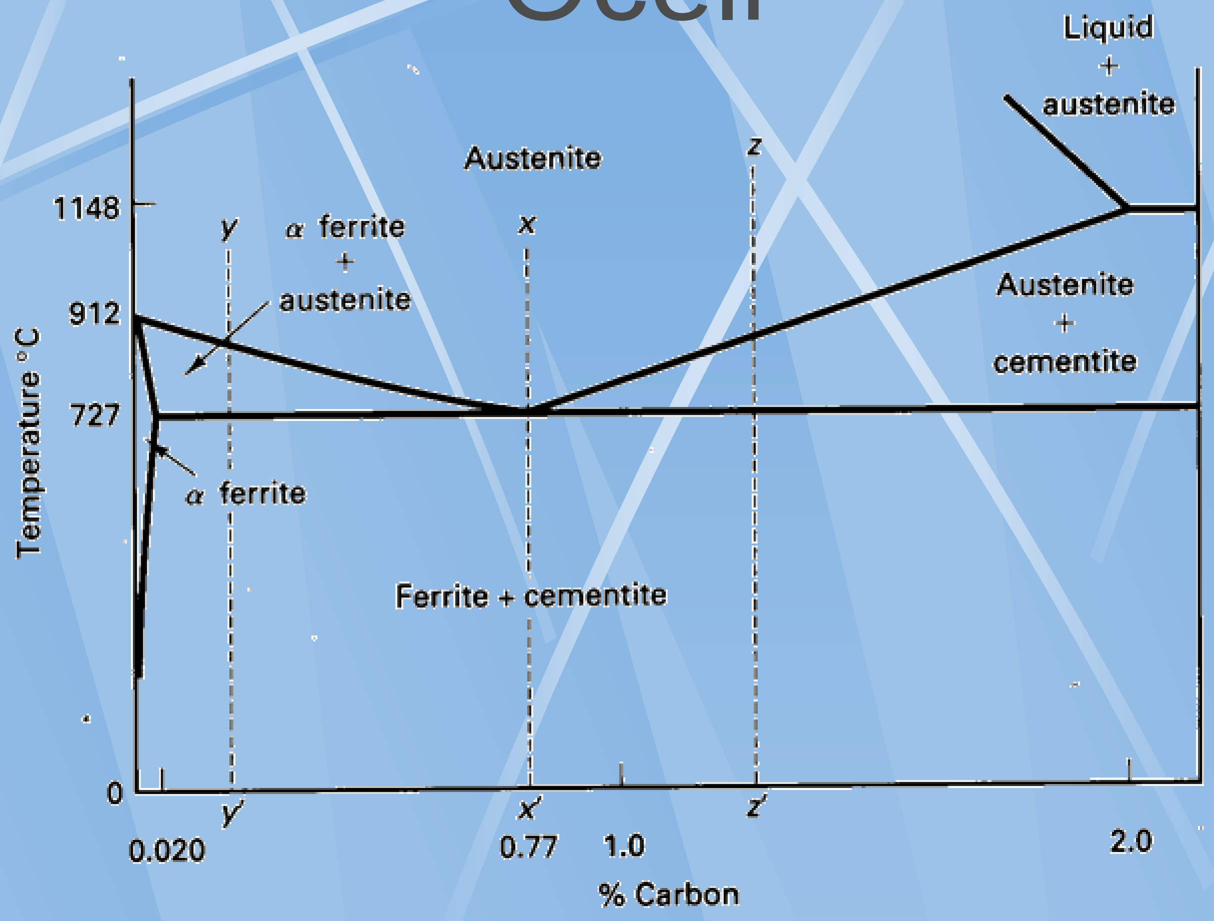
Cementite (iron-carbide), stoichiometric intermetalic compound, hard, brittle, exact melting point unknown.

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, hapends 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 bellow 2.11%C miss the eutectic reaction to create two-phase mixture. They are steels.

Oceli

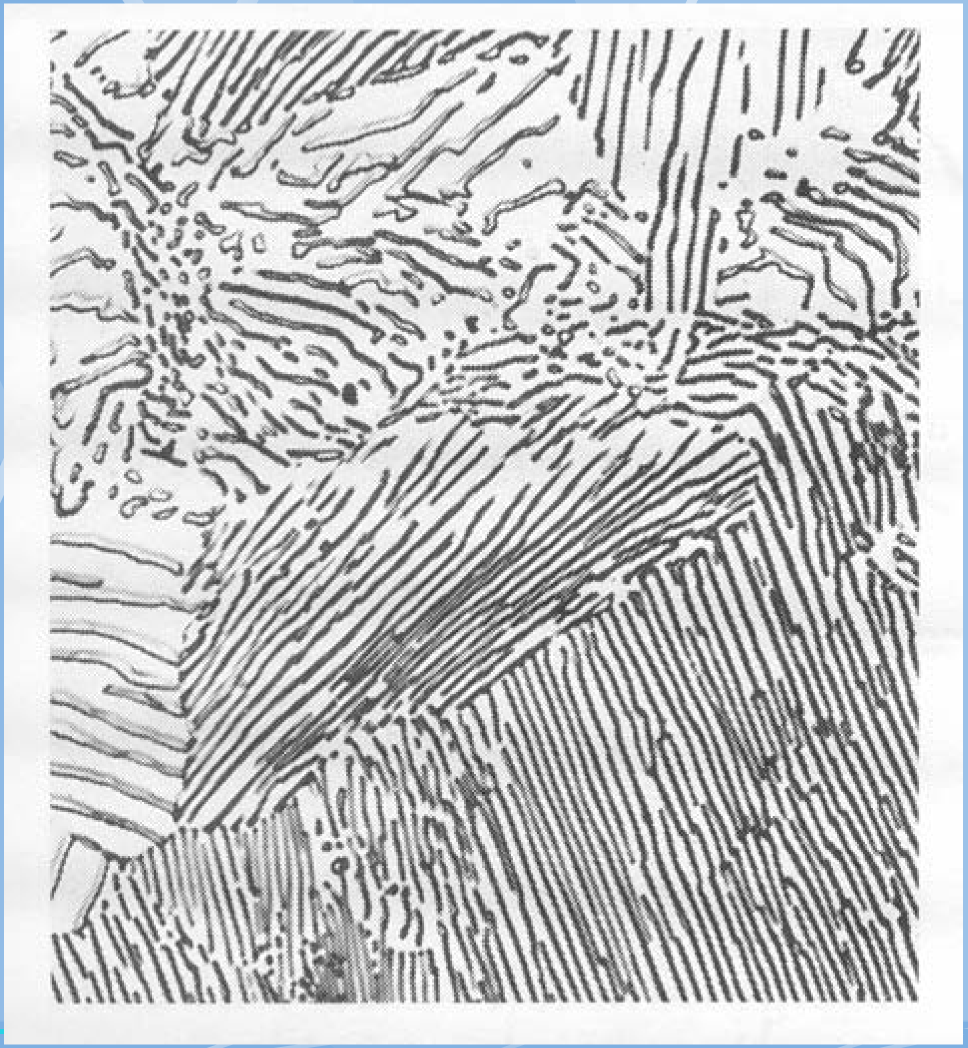


$$Austenite_{0.77\%C;FCC} \rightarrow Ferrite_{0.02\%C;BCC} + Cementite_{6.67\%C}$$

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 intermetalic cementite.

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

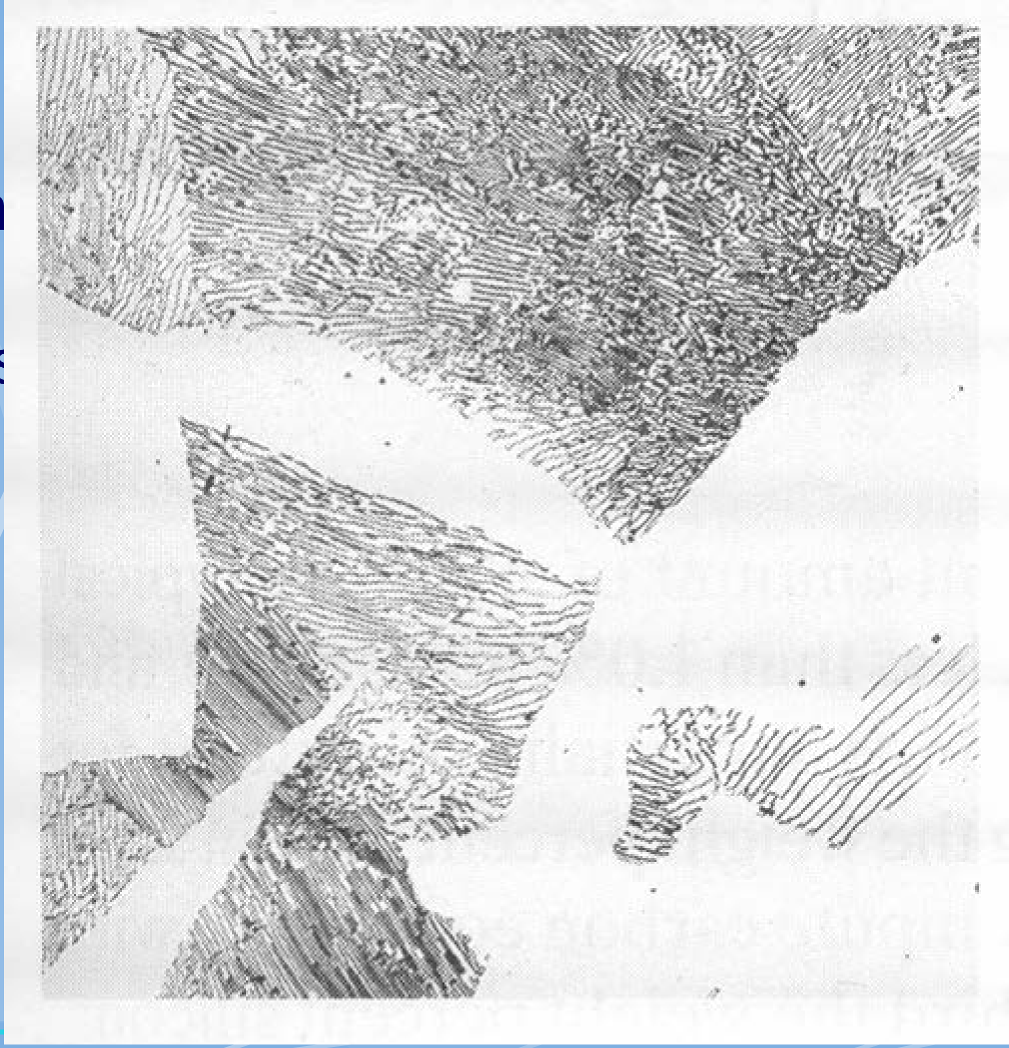


4.5 Hypoeutectoid Steel

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.

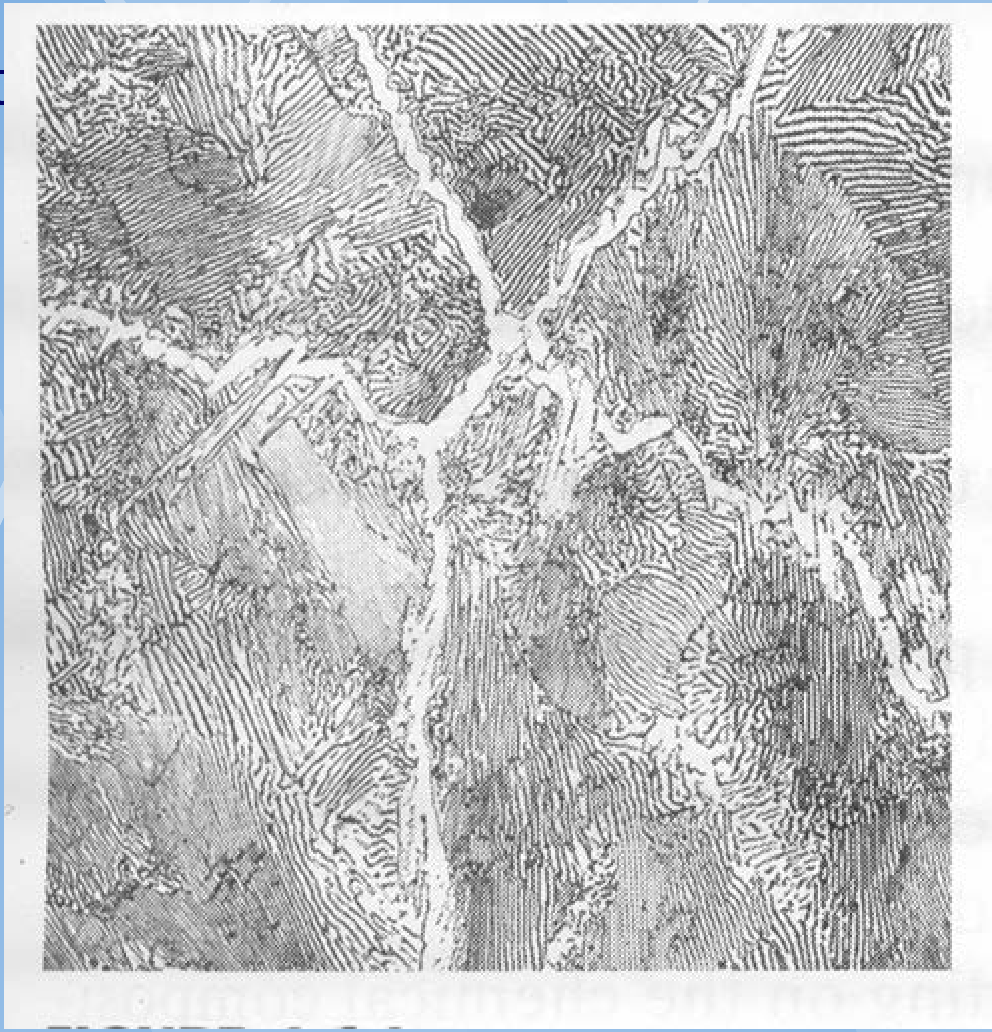


4.5 Hypereutectoid Steel

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.

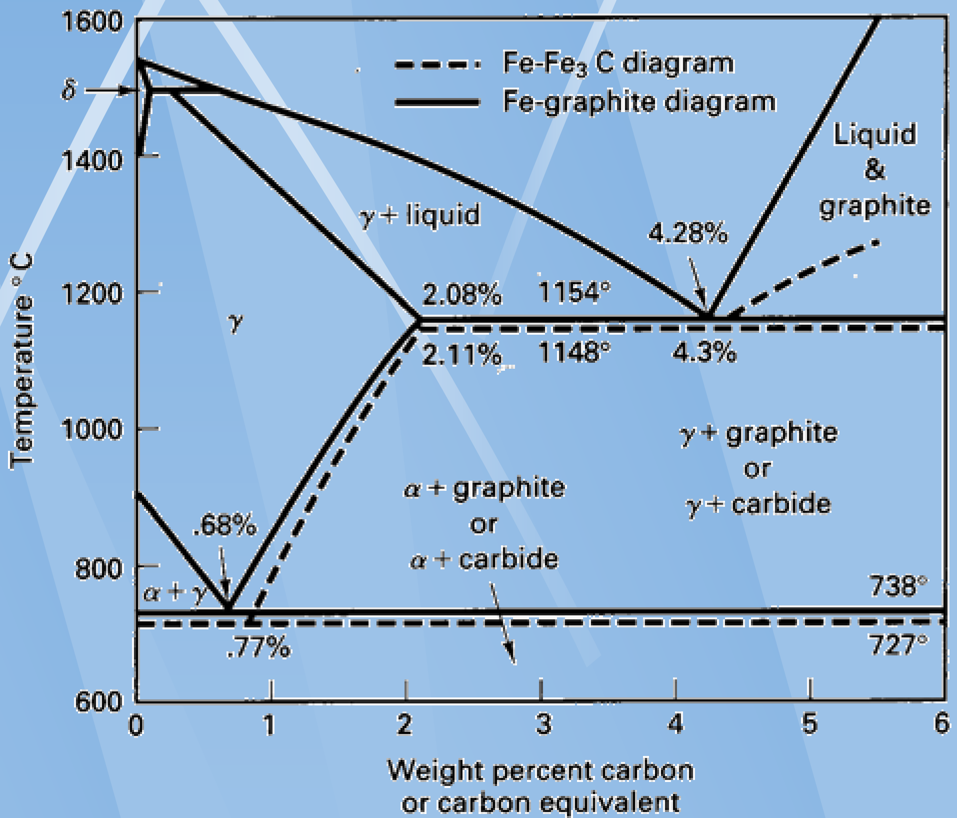


4.6 Cast Irons

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 Fe3C.

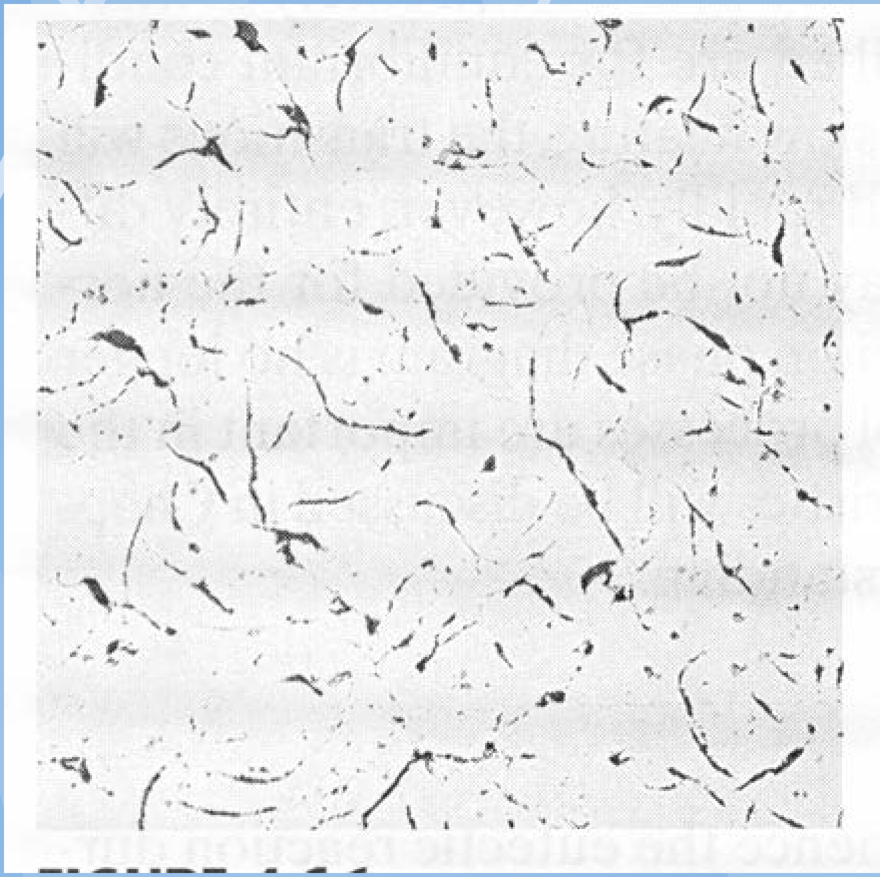


4.6 Gray Cast Iron

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.

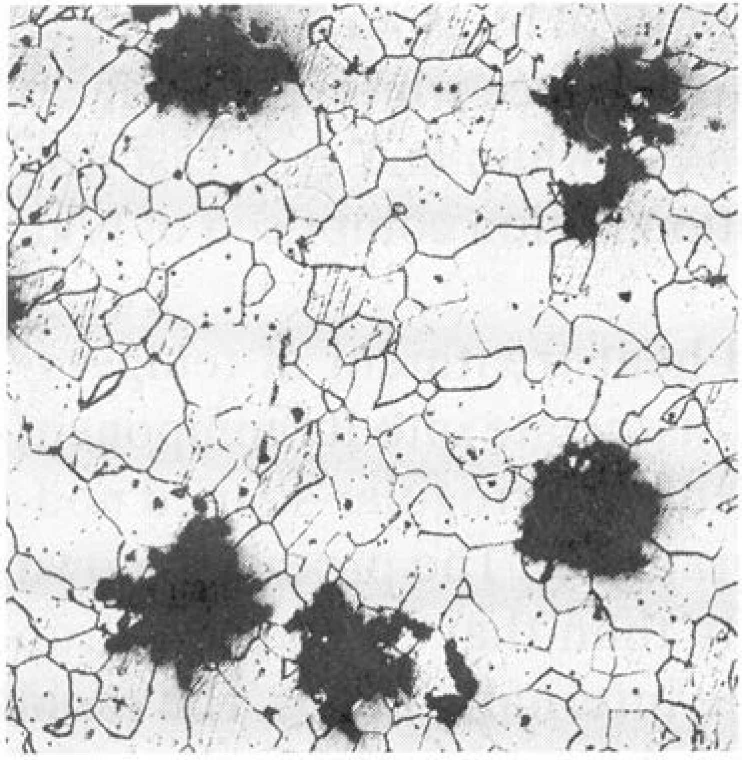
4.6 White Cast Iron

- 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.



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.

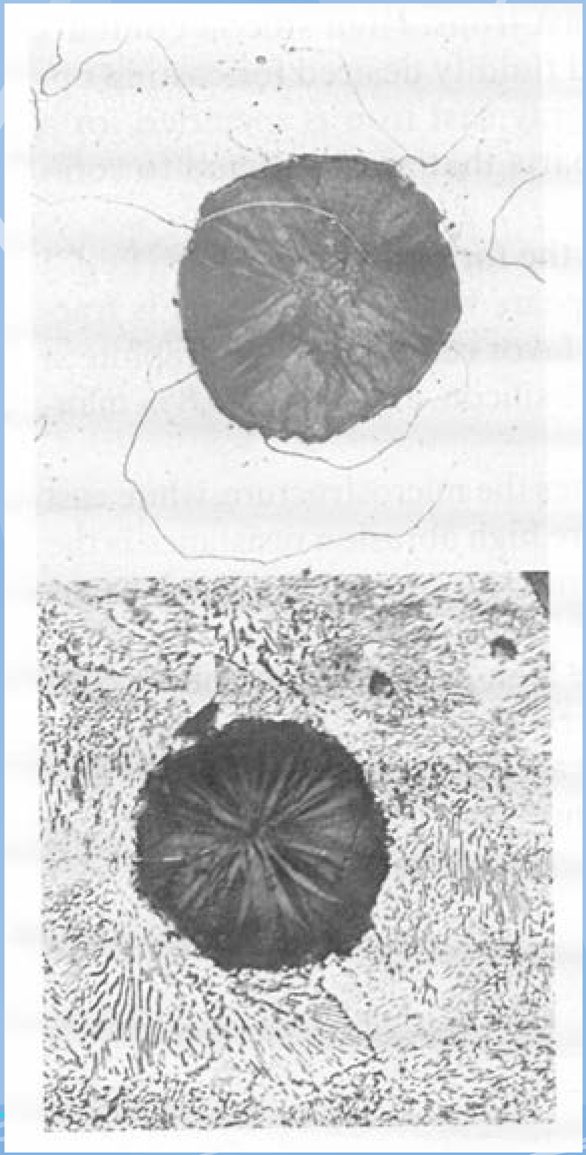
Ductile Cast Iron

- 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.

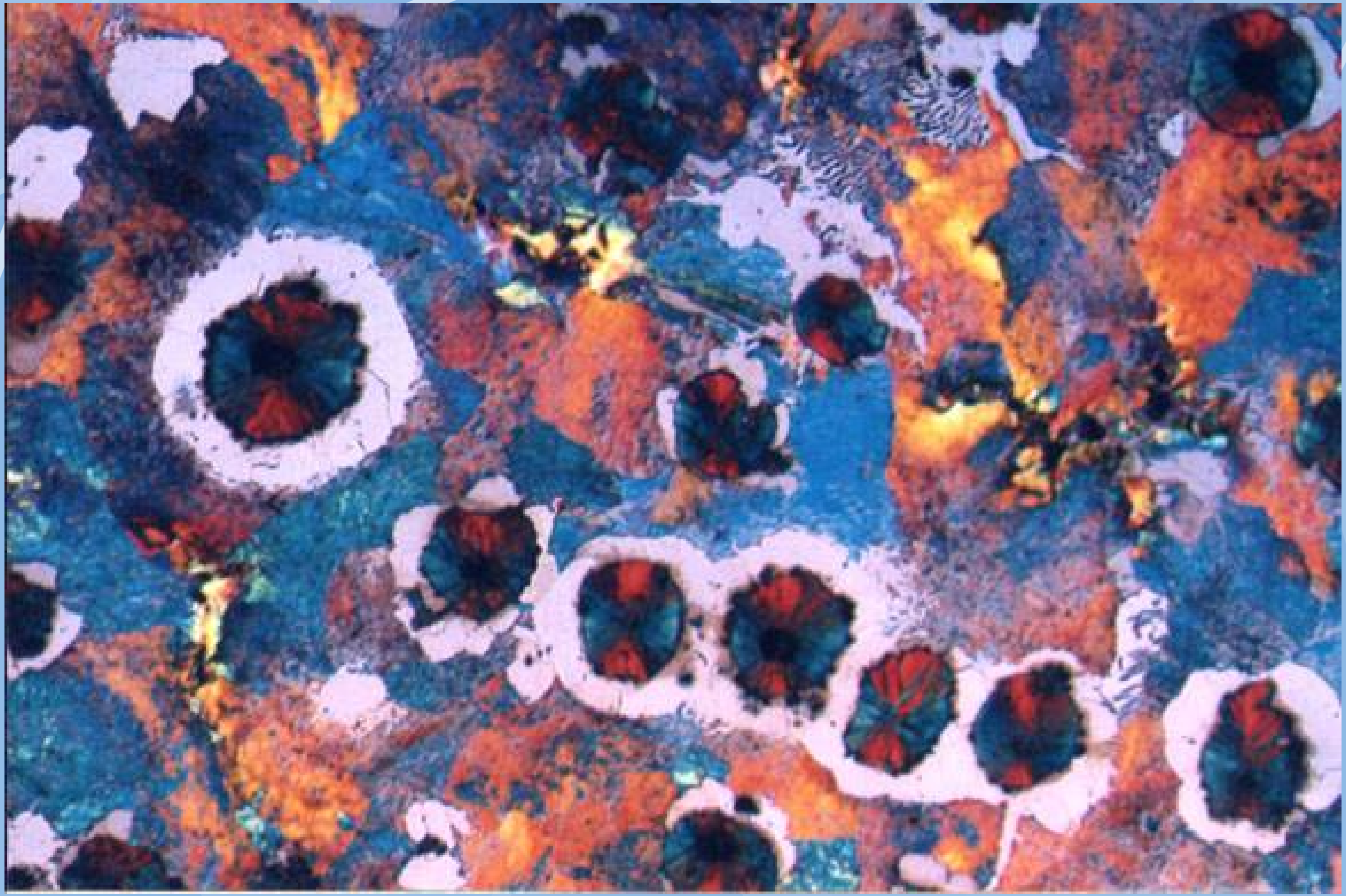
4.6 Malleable Cast Iron

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.ironcarbondiagram.com/product.aspx?id=5