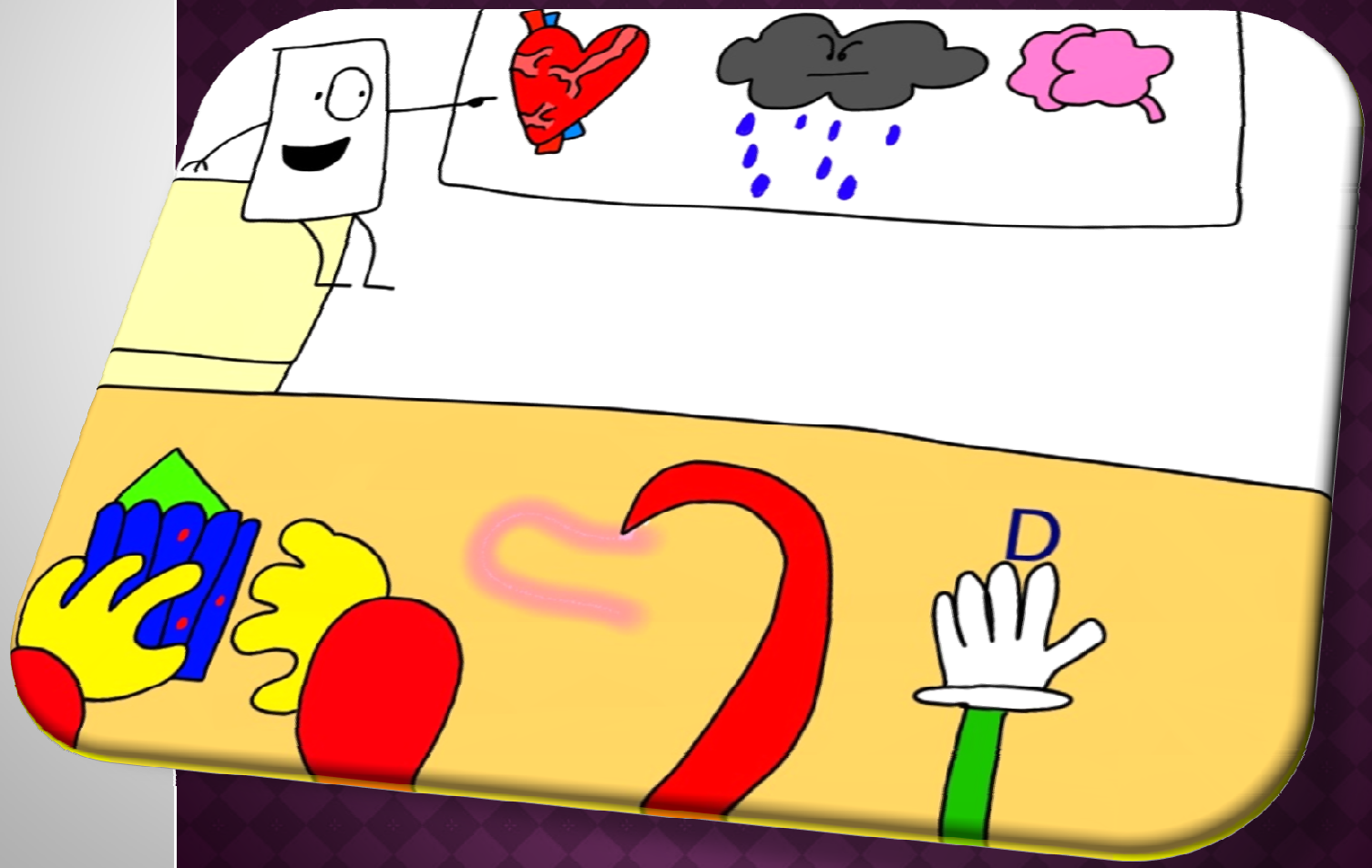
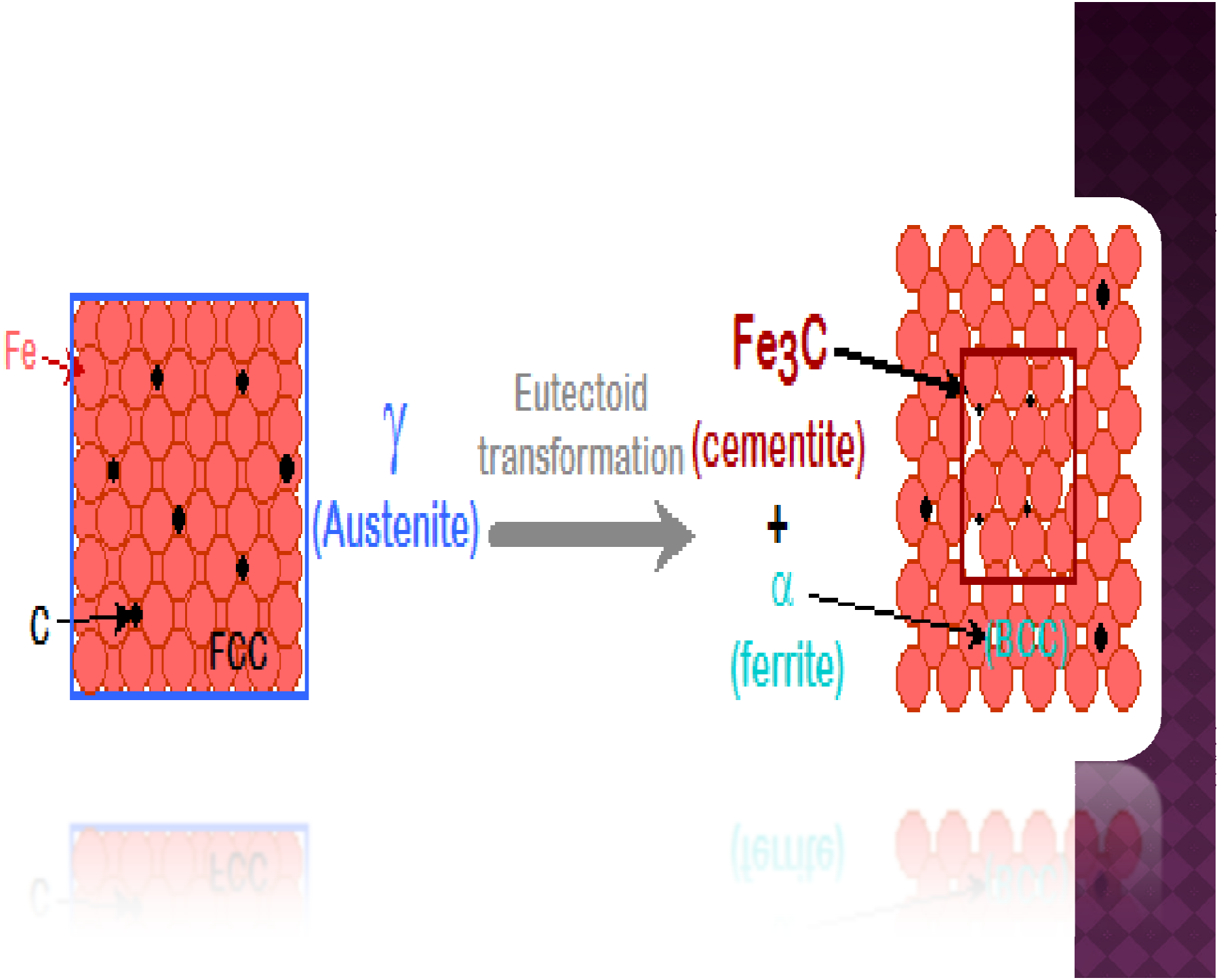
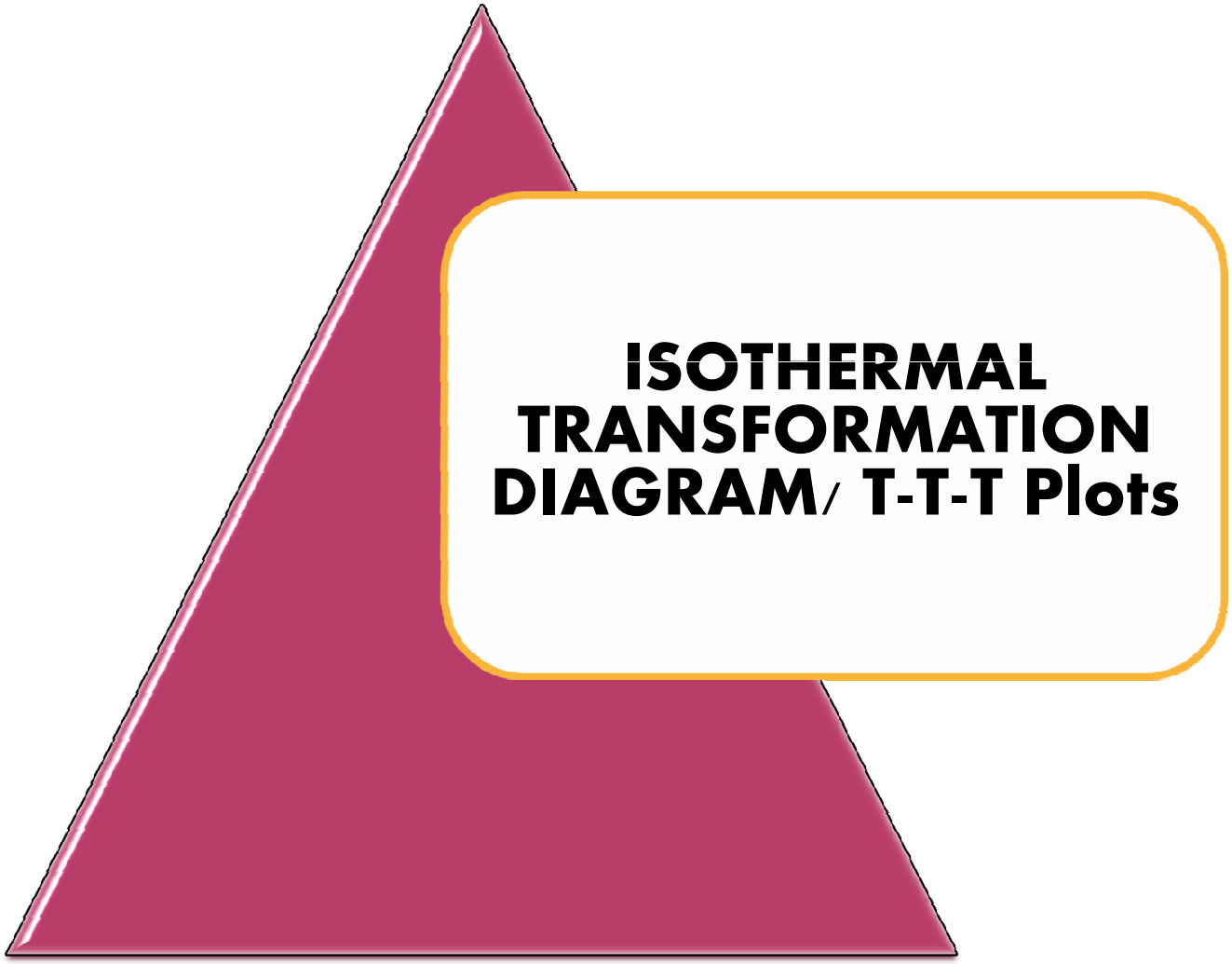
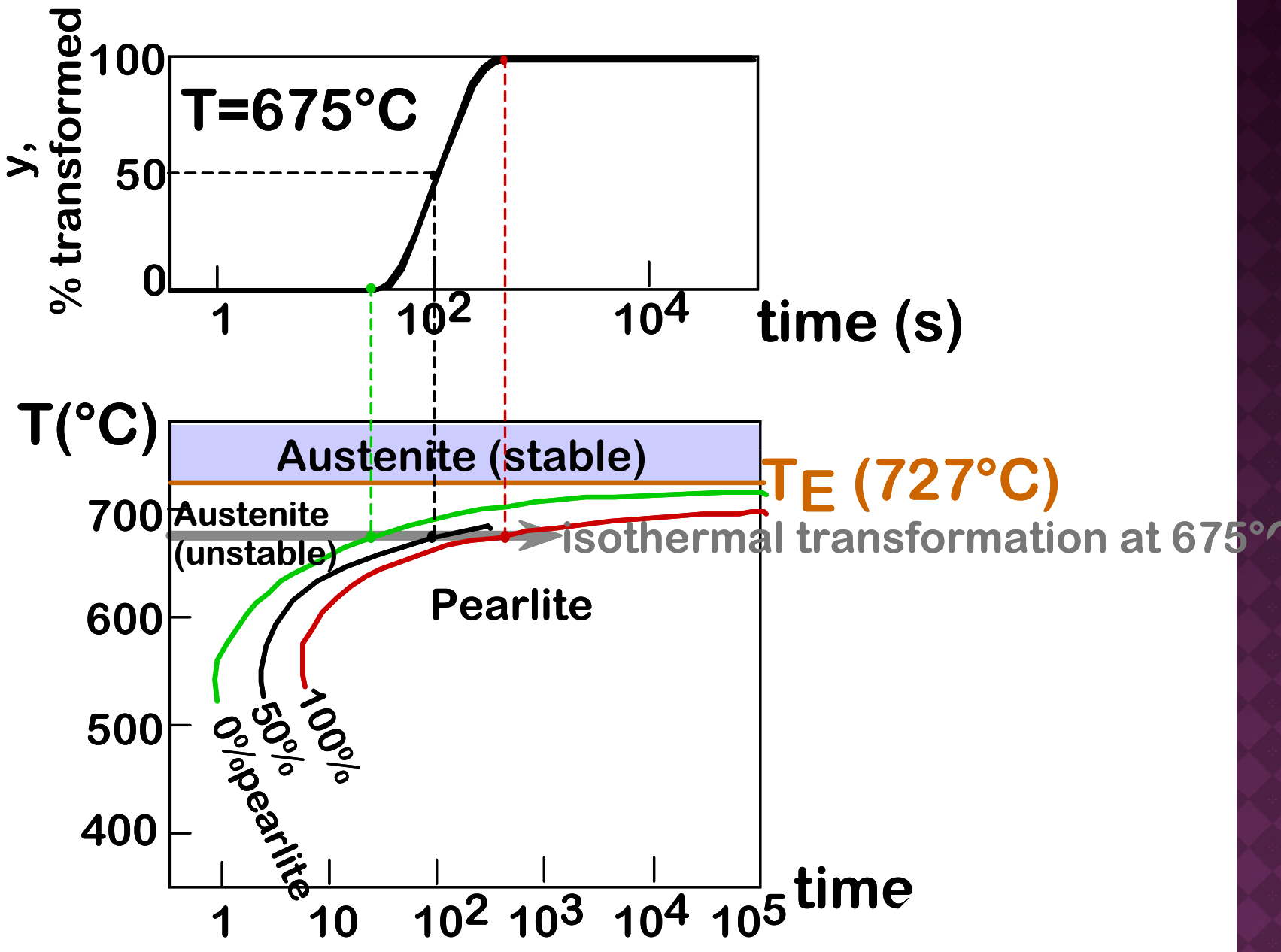
PHASE TRANSFORMATION



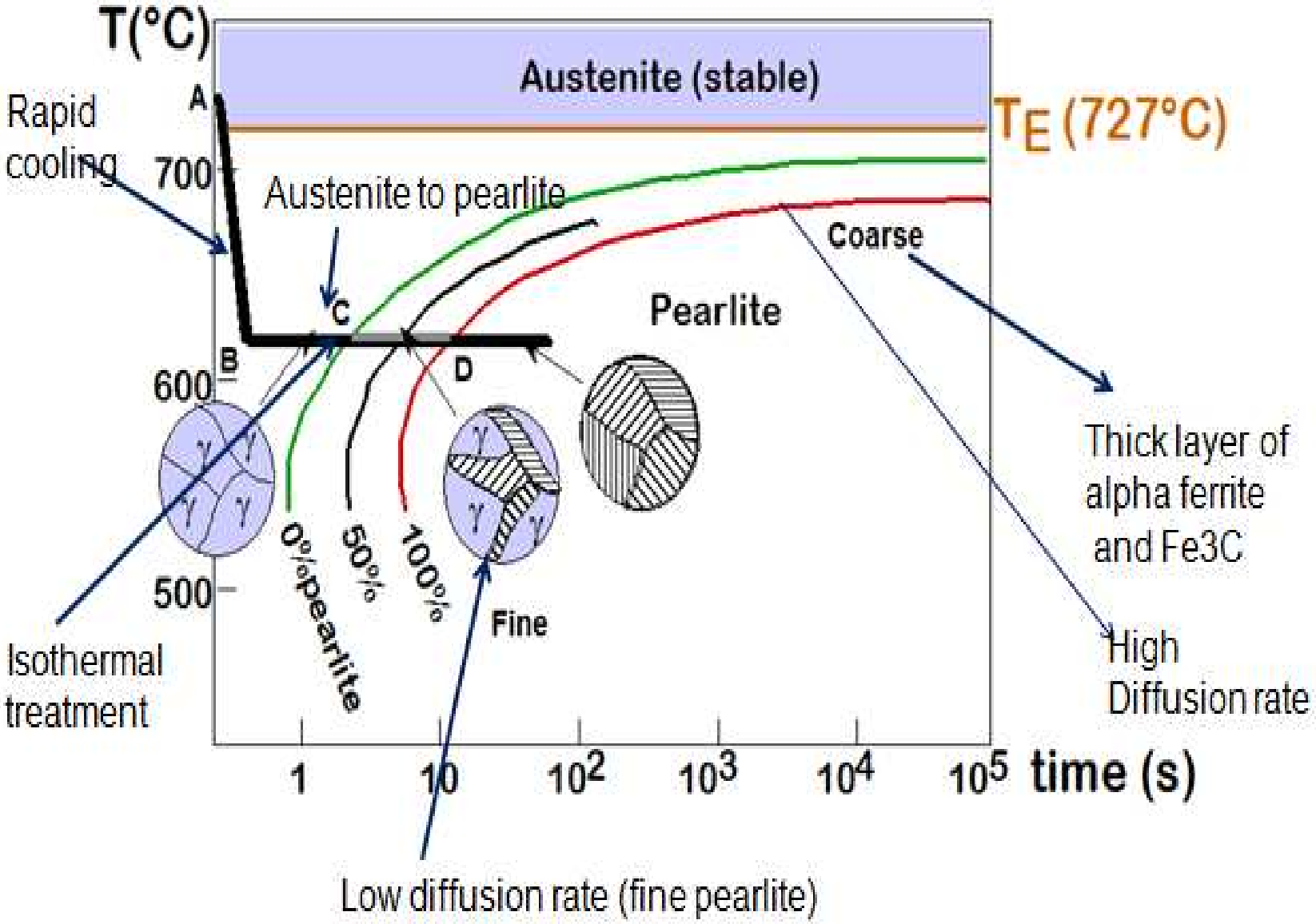

Fe
C
FCC
γ
(Austenite)
Eutectoid
transformation
Fe3C
(cementite)
+
α
(ferrite)
(BCC)



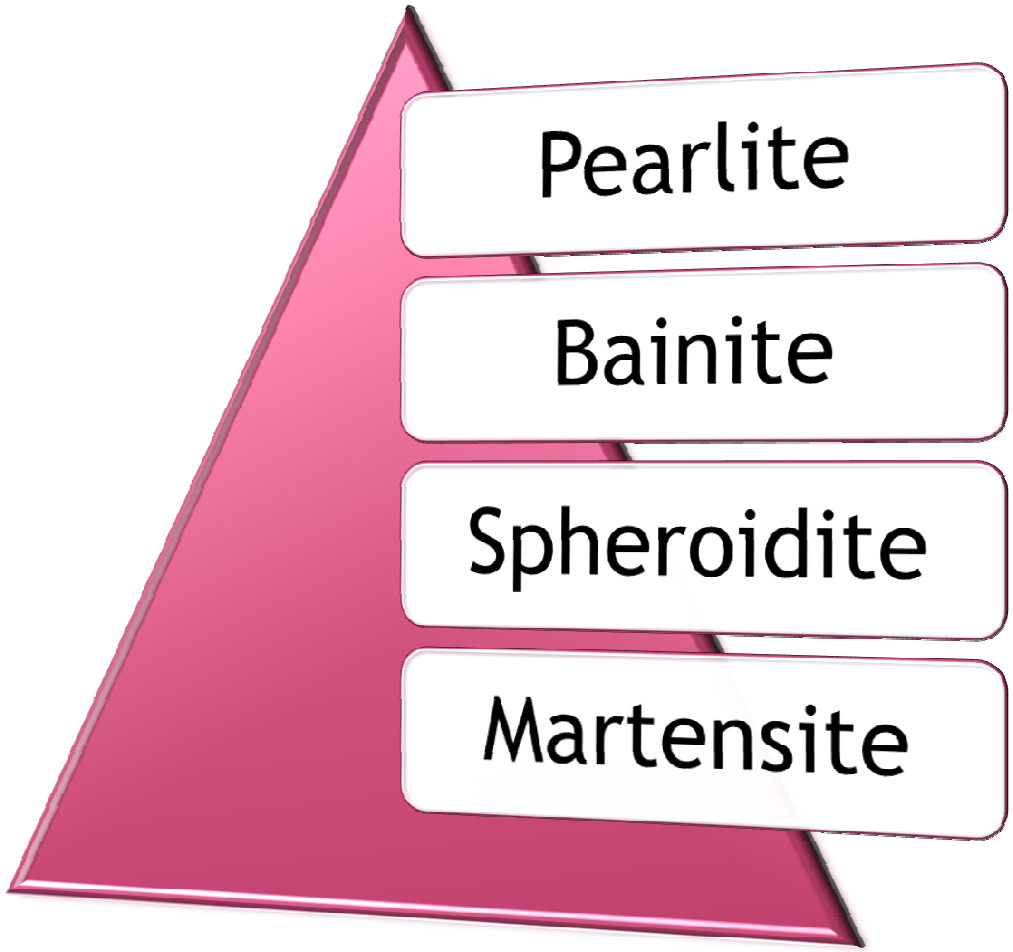
ISOTHERMAL TRANSFORMATION DIAGRAM/ T-T-T Plots


y,
% transformed
100
50
0
T=675°C
1
10^2
10^4
time (s)
T(°C)
Austenite (stable)
T_E (727°C)
700
Austenite
(unstable)
isothermal transformation at 675°C
600
Pearlite
500
400
0%pearlite
50%
100%
1
10
10^2
10^3
10^4
10^5
time

COOLING HISTORY

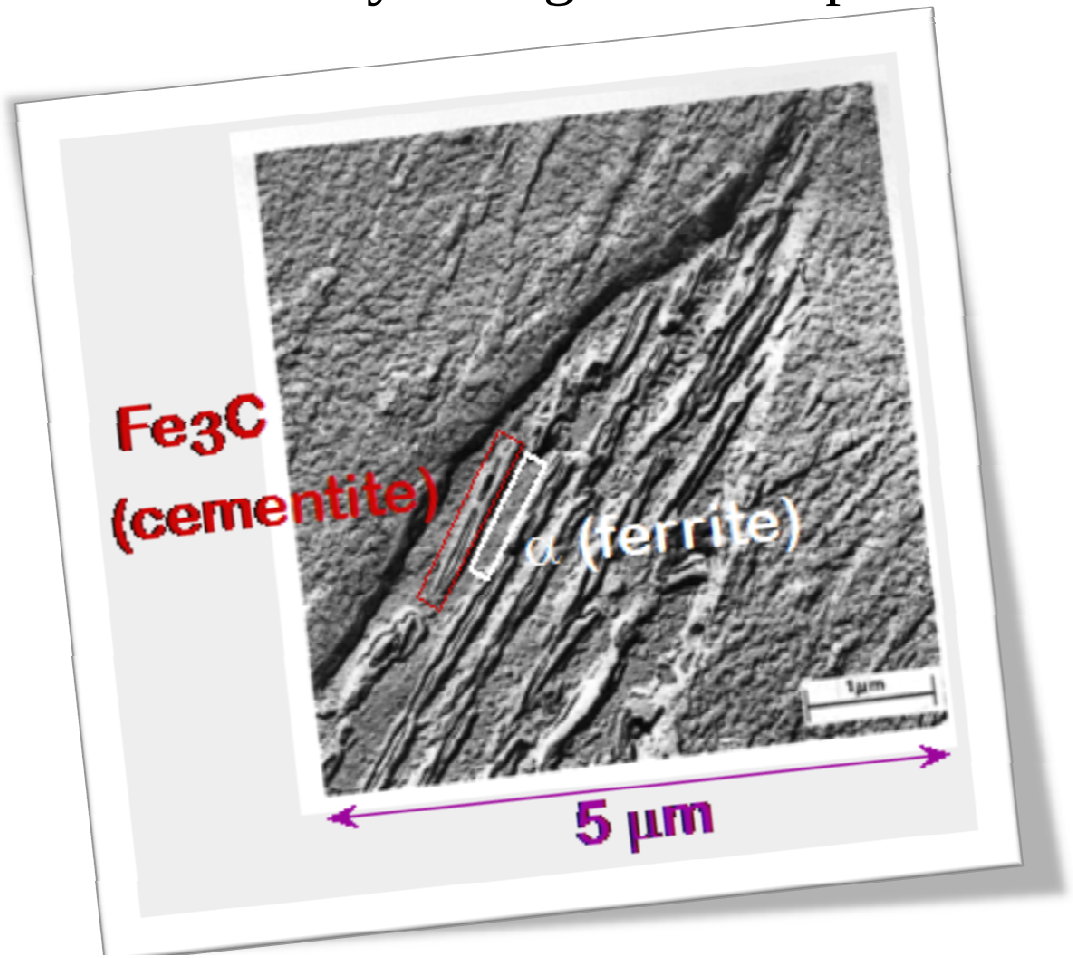


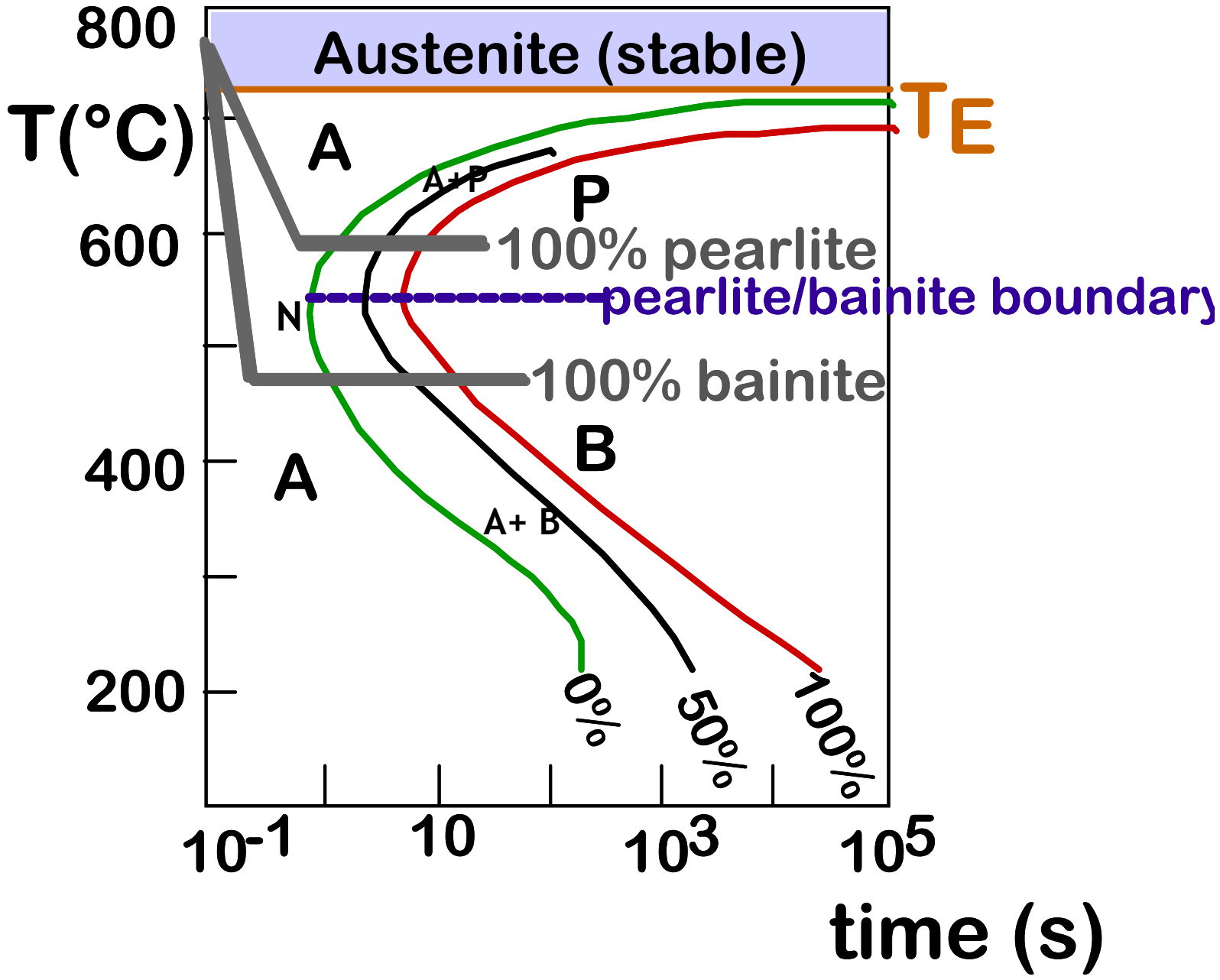
MICROSTRUCTURES



BAINITE

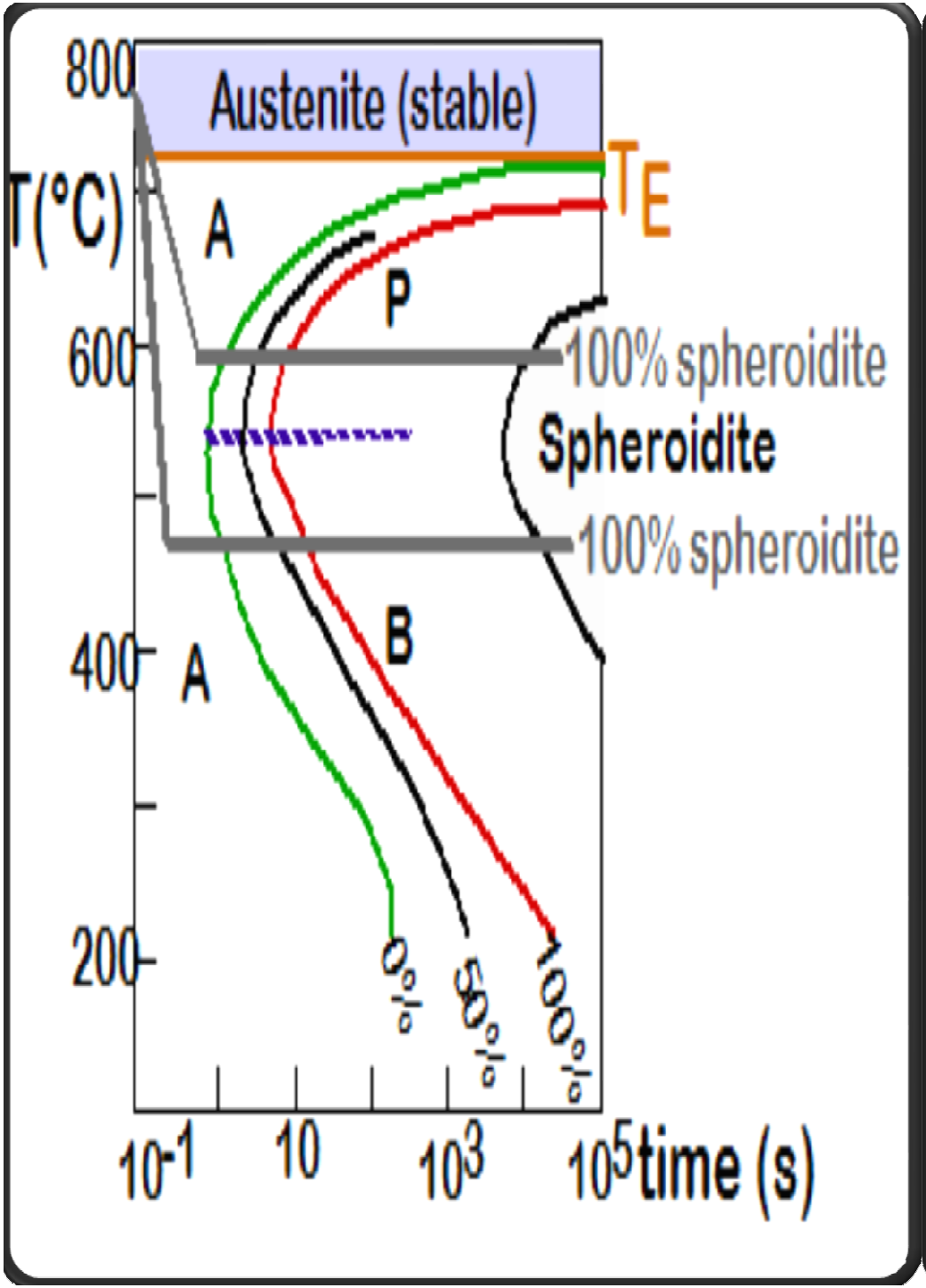
- Consists of **<u>Ferrite and cementite phases</u>**, Bainite forms needles or plates, depending on temperature and they can only be seen under very strong microscope.

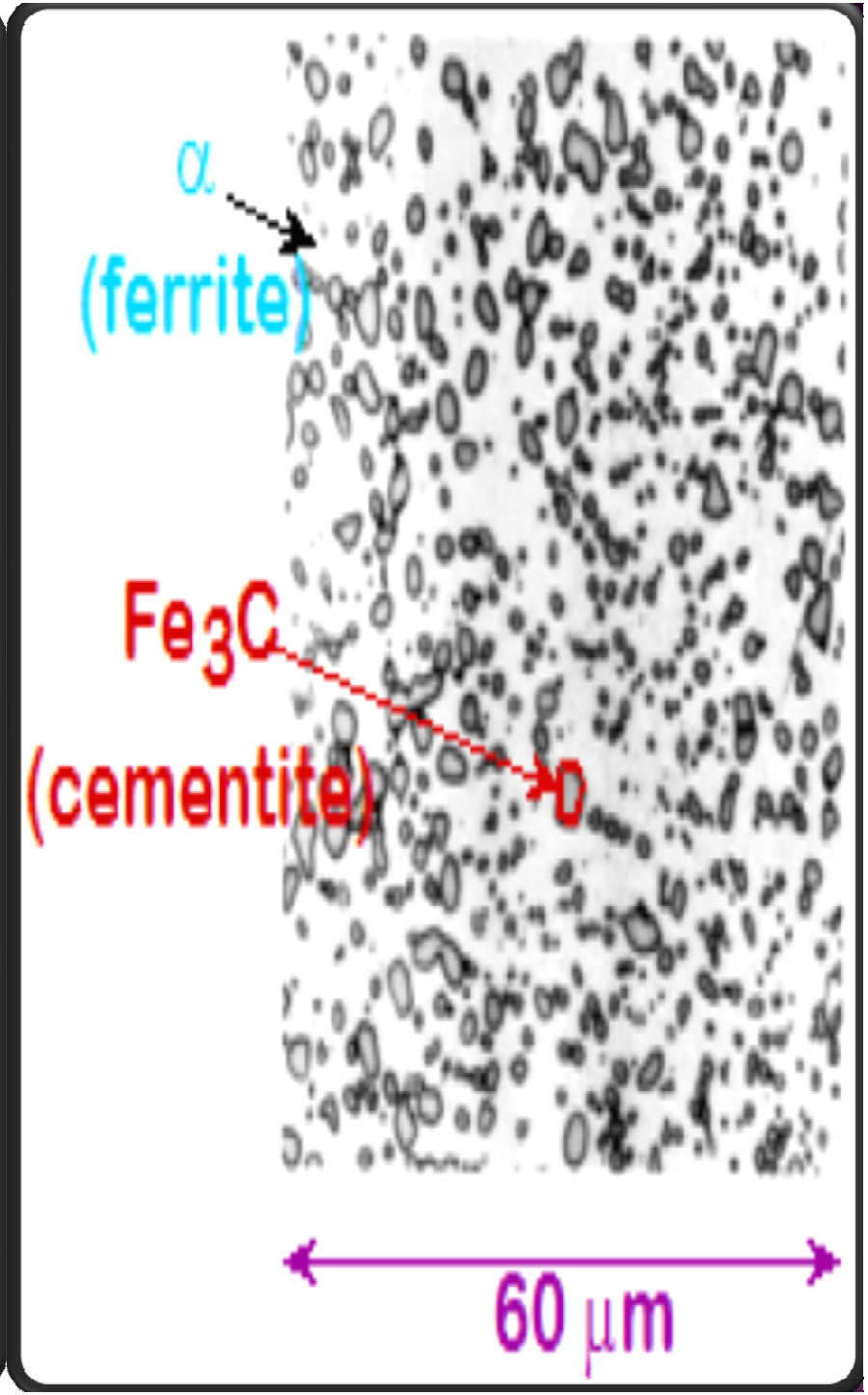



800
600
400
200
T(°C)
Austenite (stable)
TE
A
A+P
P
100% pearlite
N
pearlite/bainite boundary
100% bainite
B
A
A+ B
0%
50%
100%
10-1
10
103
105
time (s)

SPHEROIDITE

- If steel either pearlitic or bainitic microstructures is heated to and left at temp below eutectoid for long time i.e. At **700C for 18 to 24 hours,**

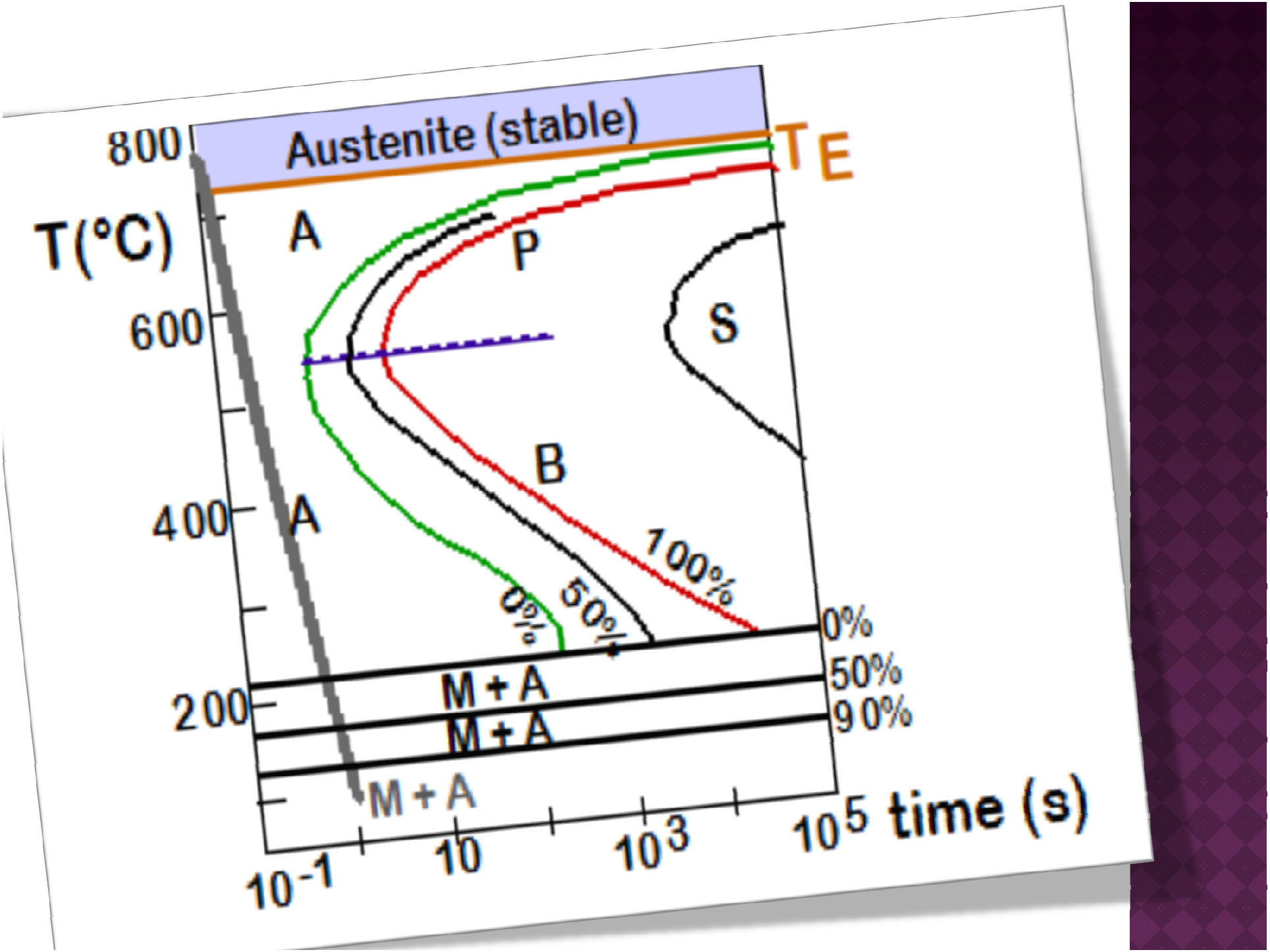

800
600
400
200
T(°C)
Austenite (stable)
TE
A
P
100% spheroidite
Spheroidite
100% spheroidite
B
A
0%
50%
100%
10-1
10
103
105
time (s)


α
(ferrite)
Fe3C
(cementite)
60 μm

MARTENSITE

- When austenitized iron carbon alloys are **rapidly cooled in relatively low temperature**

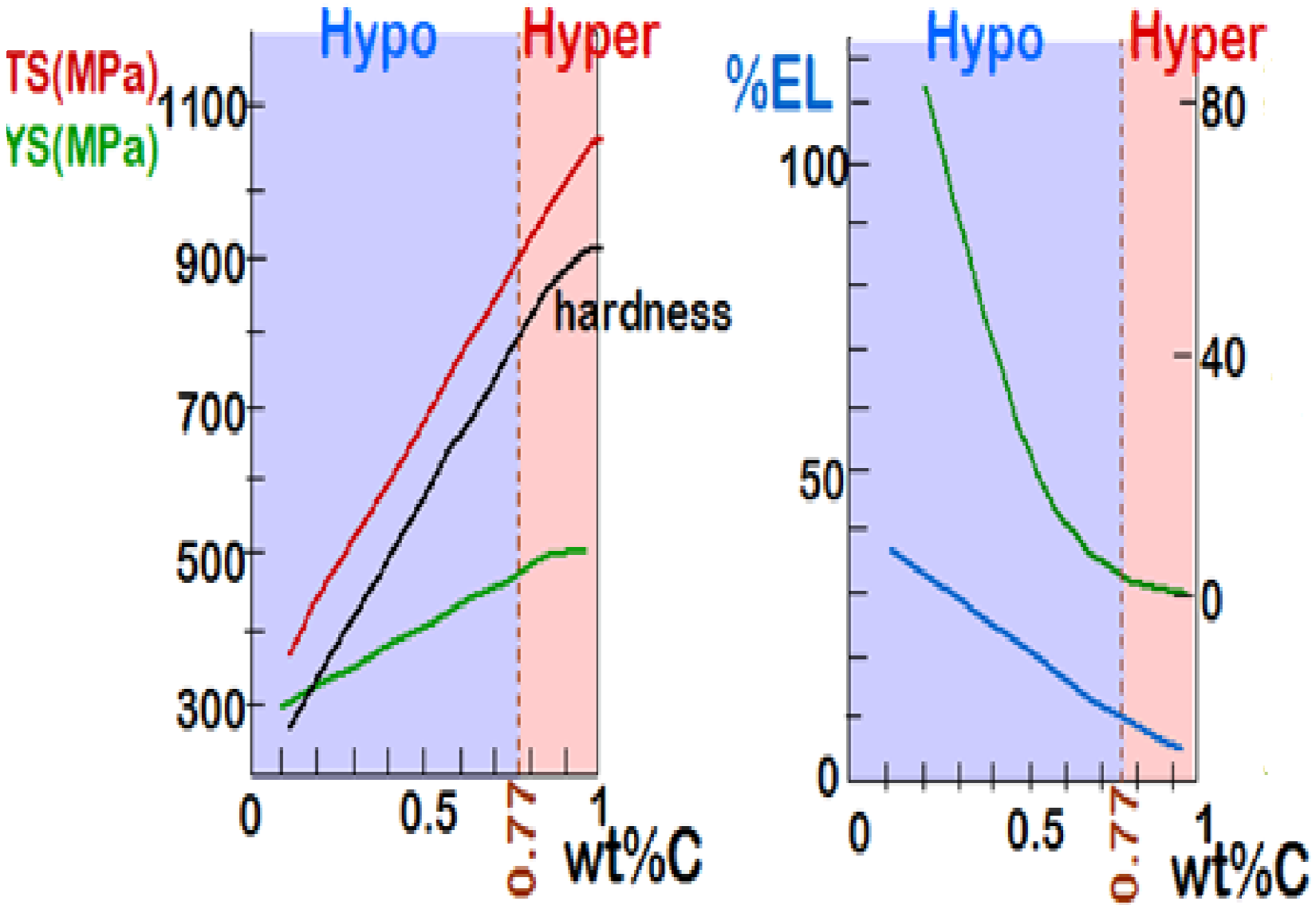
MARTENSITE

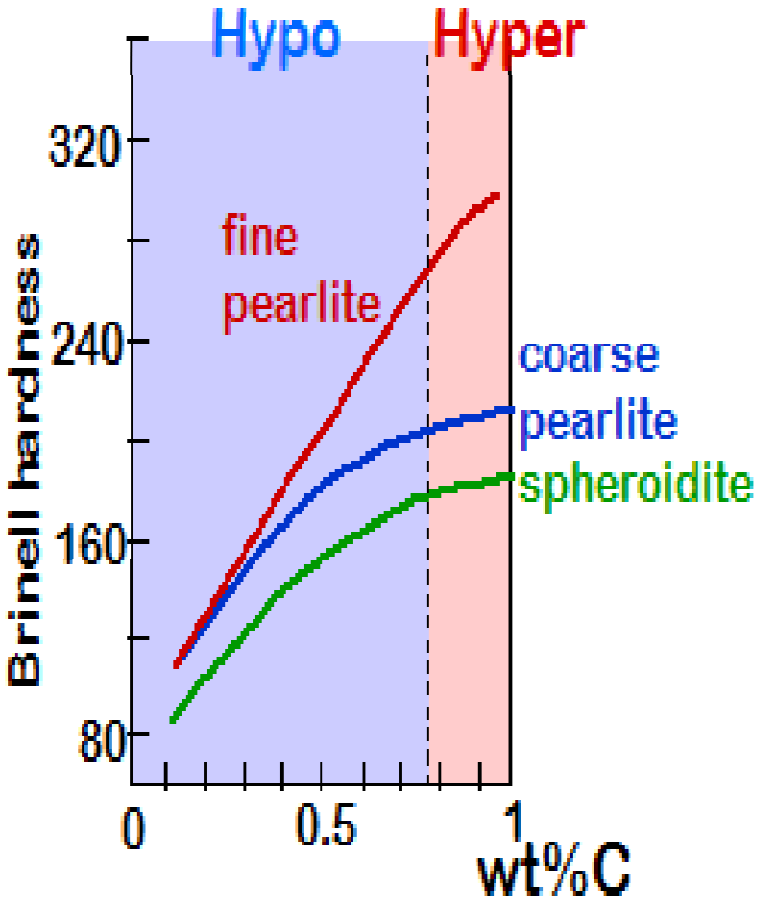

Austenite (stable)
TE
800
T(°C)
600
400
200
A
P
S
B
A
100%
50%
0%
0%
50%
90%
M + A
M + A
M + A
10^{-1}
10
10^{3}
10^{5} time (s)

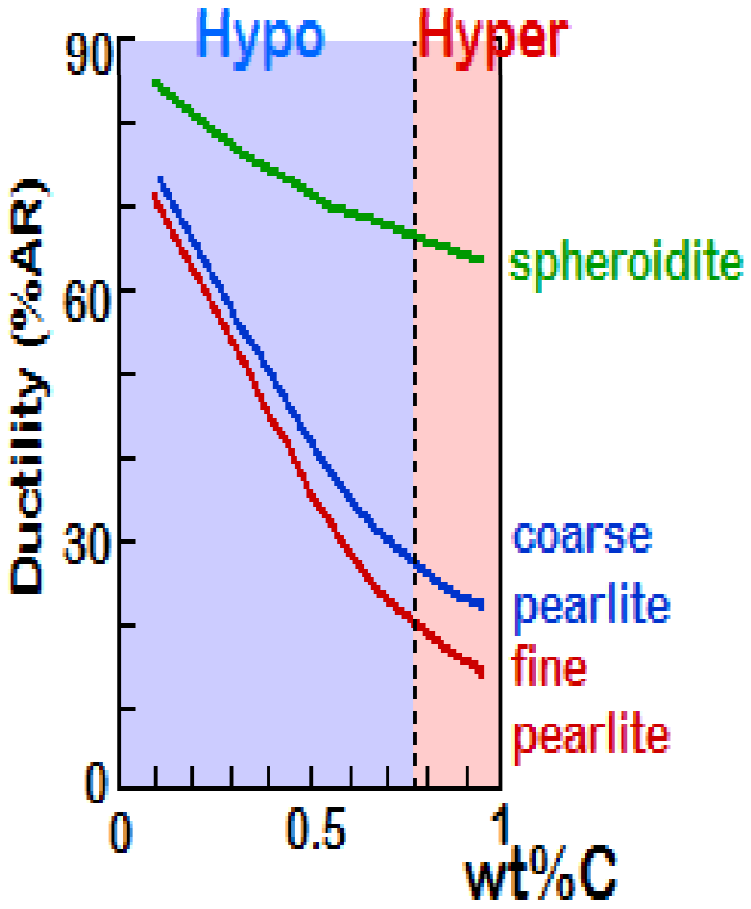
MECHANICAL BEHAVIOUR OF IRON CARBON ALLOYS

- **Pearlite:**

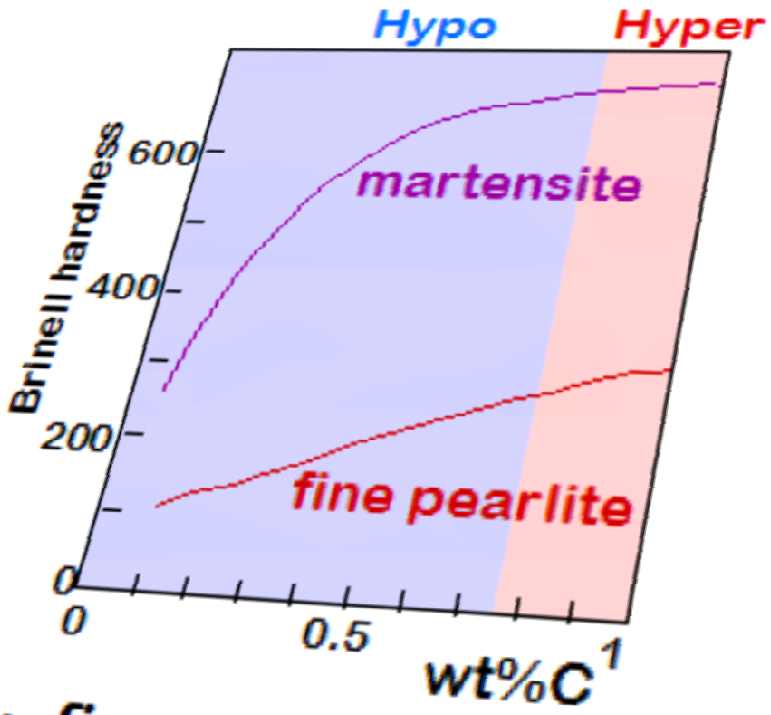
  Cementite is much harder but more brittle than ferrite.


Hypo
Hyper
TS(MPa)
YS(MPa)
1100
900
700
500
300
hardness
0
0.5
0.77
1
wt%C
%EL
100
50
0
80
40
0
Hypo
Hyper
0
0.5
0.77
1
wt%C



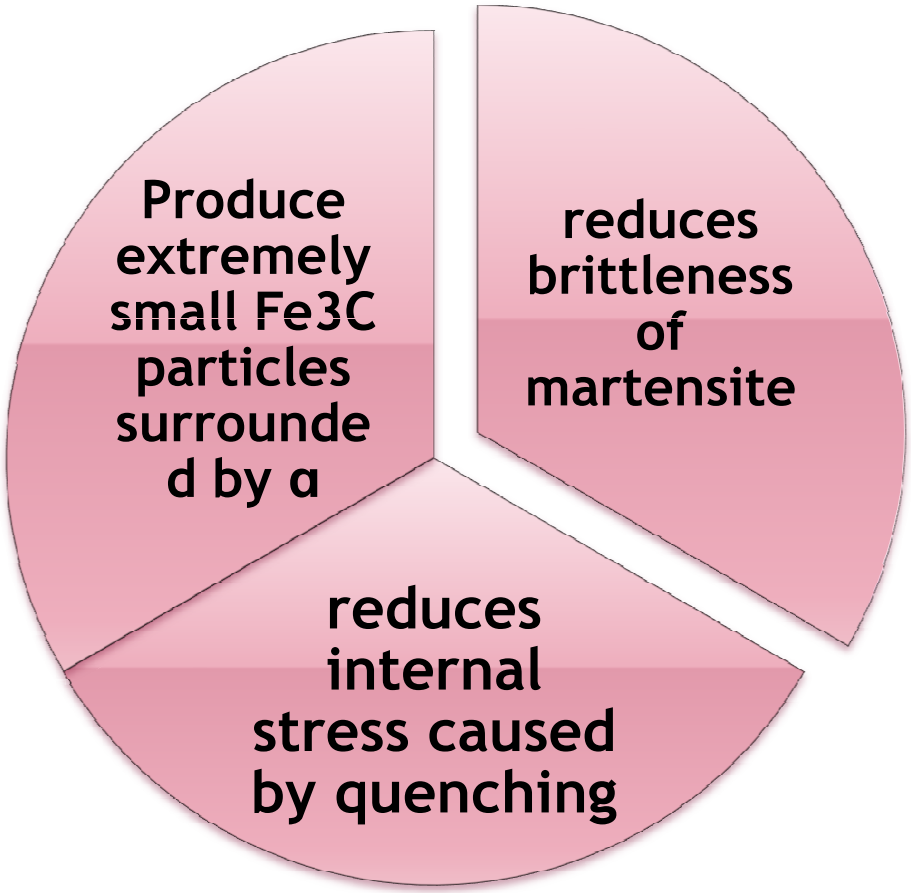


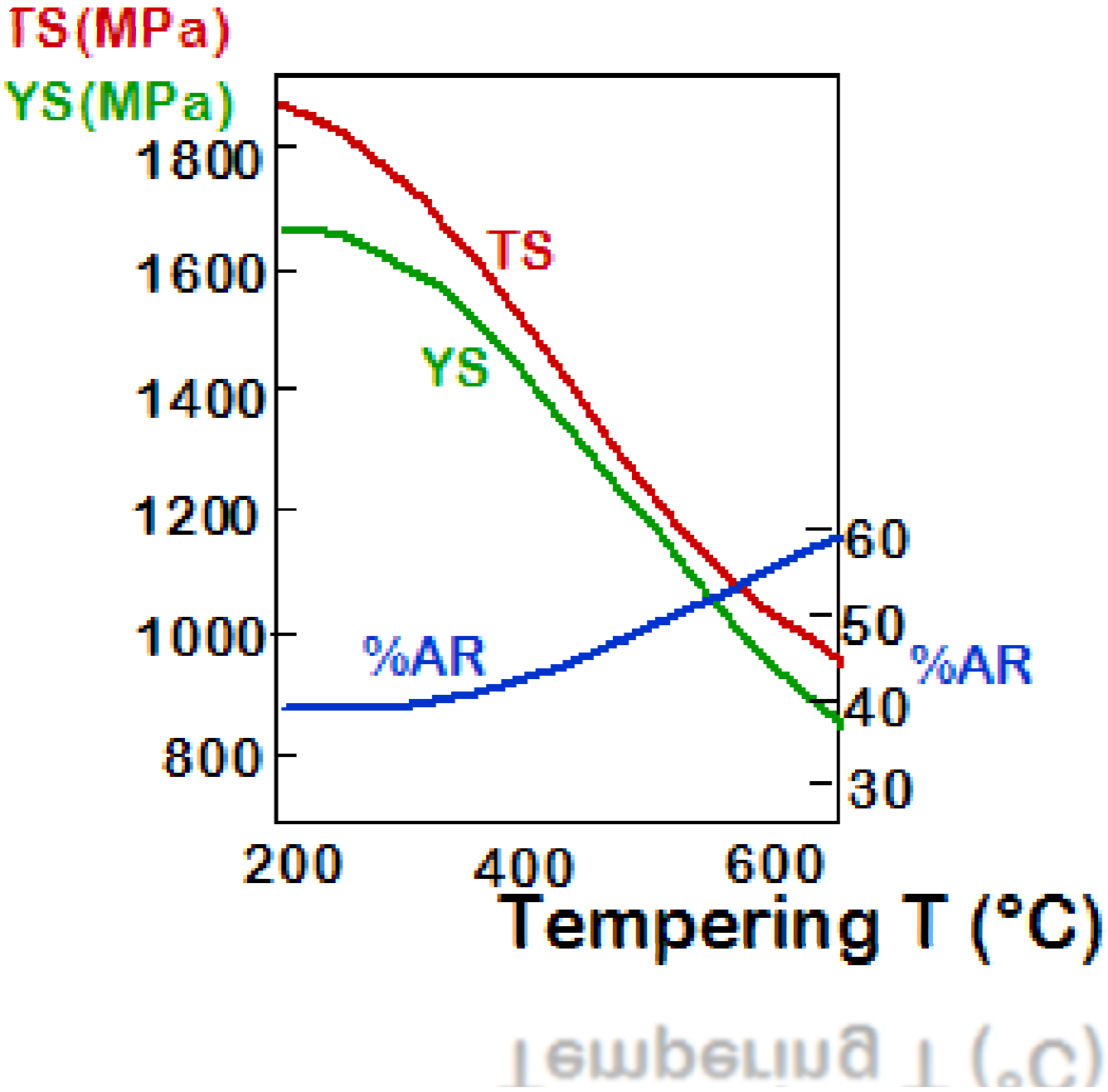
- Hardness: fine > coarse > spheroidite
- %AR: fine < coarse < spheroidite



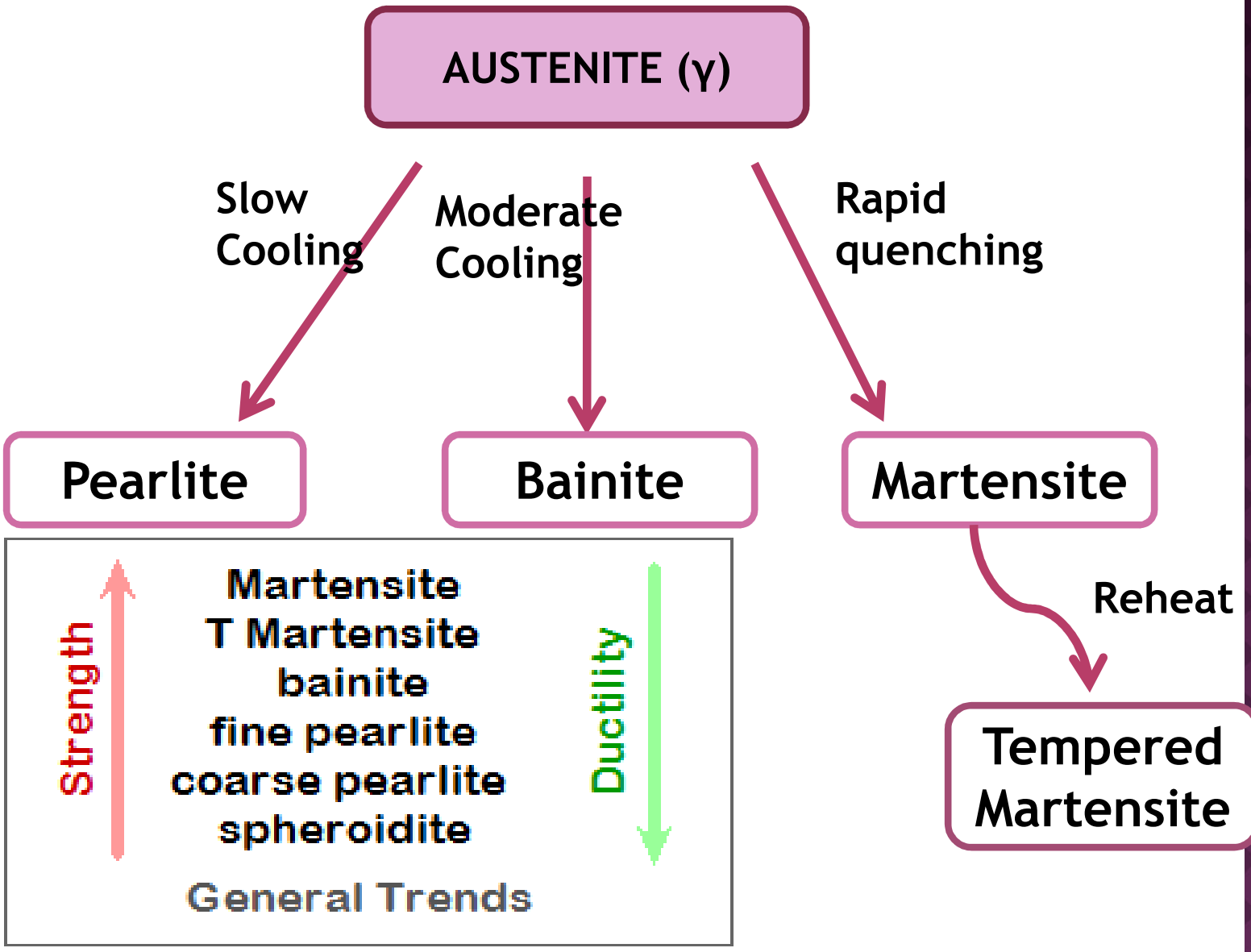
- Hardness: fine pearlite << martensite.

TEMPERING MARTENSITE




TS(MPa)
YS(MPa)
1800
1600
1400
1200
1000
800
TS
YS
%AR
60
50
40
30
%AR
200
400
600
Tempering T (°C)

SUMMARY


AUSTENITE (γ)
Slow Cooling
Moderate Cooling
Rapid quenching
Pearlite
Bainite
Martensite
Reheat
Tempered Martensite
Strength
Martensite
T Martensite
bainite
fine pearlite
coarse pearlite
spheroidite
Ductility
General Trends

THANK YOU