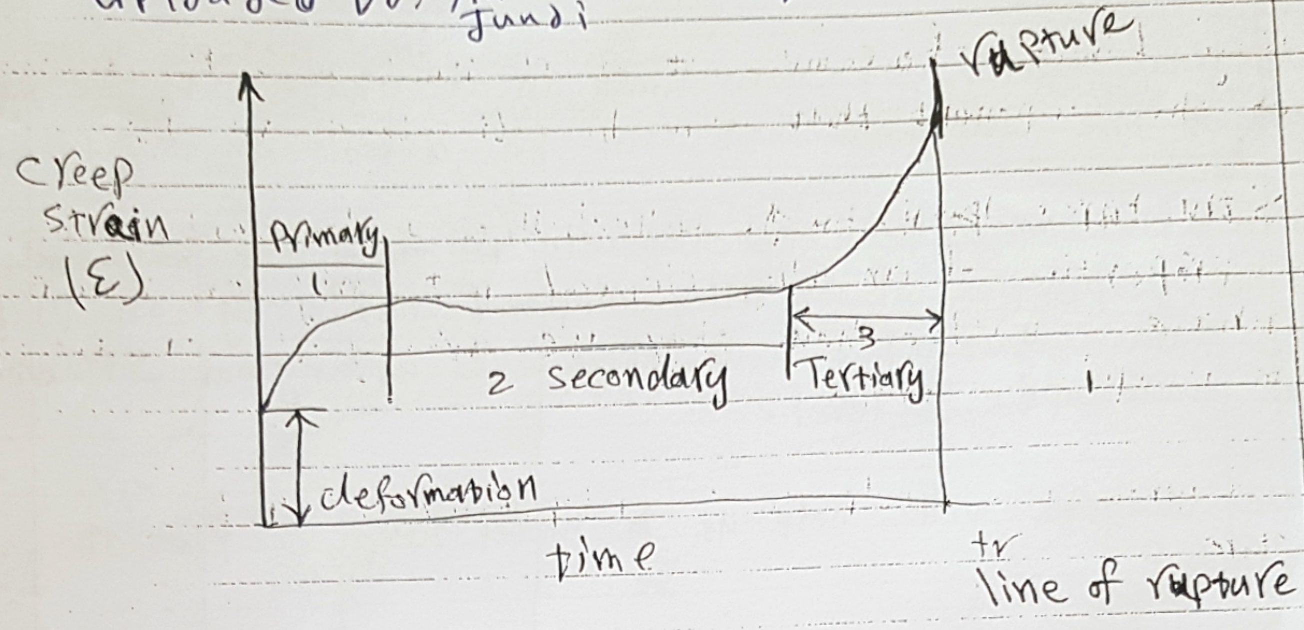
مطلوب Hardness

تلخيص عيسى الزريف

Uploaded by:- Ahmad Jundi



① Instantaneoues deformation: mainly elastic
② Primary / transeat creep: slope strain (ε) vs time decrease with time
③ secondary / steady state creep: Rate of straining is constant
④ Tertiary: Rapidly acceleration strain rate up to failure

Ch 9 & 10 ✓S

Component: chemically recognible species (Fe & C, Steel, H_2O)

Phase: a portion of a system that has uniform physical and chemical characteristics. And they are separated from each other by definit phase boundaries.

Single phase: system is called homogeneus
system with two or more phase are mixtures hetrogeneous

Solubility Limit:
Solvent: host or major component in solution
host

Solute: minor component

Solubility Limit of a component in a phase:

Solubility Limit of a component in a phase: is the maximum amount of the component that can be dissolved in it.

* Microstructures تعتمد أيضاً على نسبة الذرات المكونة و طريقة ترتيبها
* The properties of an alloy depend not only on proportion of the phase, but also how they are arranged structurally at the microscopic level.

* Phase diagram will help us to understand & predict microstructure

* Equilibrium and Metastable States:
* A system is at equilibrium if at constant temperature, pressure, and composition the system is stable (not changing with time.

* Equilibrium is the state that achieved given sufficient time. But the time to achieve equilibrium may be very long. the state along the path to the equilibrium may appear to be stable. This is called a metastable.

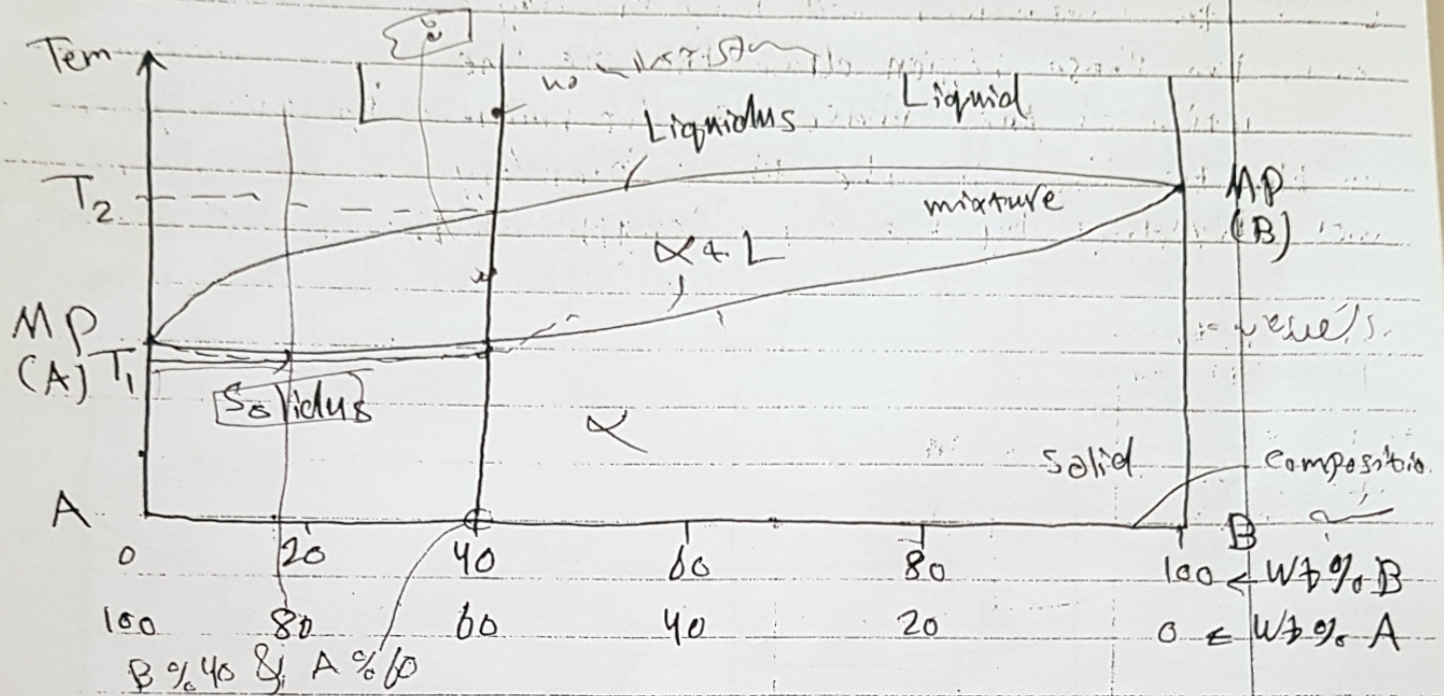
* Phase Diagrams:
* A phase diagram: graphical representation of combinations of Temp, pressure, composition or other variables.

* Phase diagrams show what phases exist at equilibrium and what phase transformations we can expect when we change one of the parameters of the system (T, P, Com)

لو اشتغل على أي تدريج M_A أو M_B نفسه

*Binary Isomorphous System:

Isomorphous systems complete solid solubility of the two compone.



MP: Melting Point

Wt%: weight percent

If: $T > T_2 \rightarrow L$ — Liquids have no microstructure — 100% liquid

$T_1 < T < T_2 \rightarrow \alpha + L$ — has

$T < T_1 \longrightarrow \alpha$ — no microstructure — 100% Solid

* Interpretation of phase diagram:

for a given temp and composition we can use phase diagram to determine:

1. phases that are present.
2. composition of the phase.
3. Relative fractions of the phase.

كيف تم التحرير

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* Lever Rule:

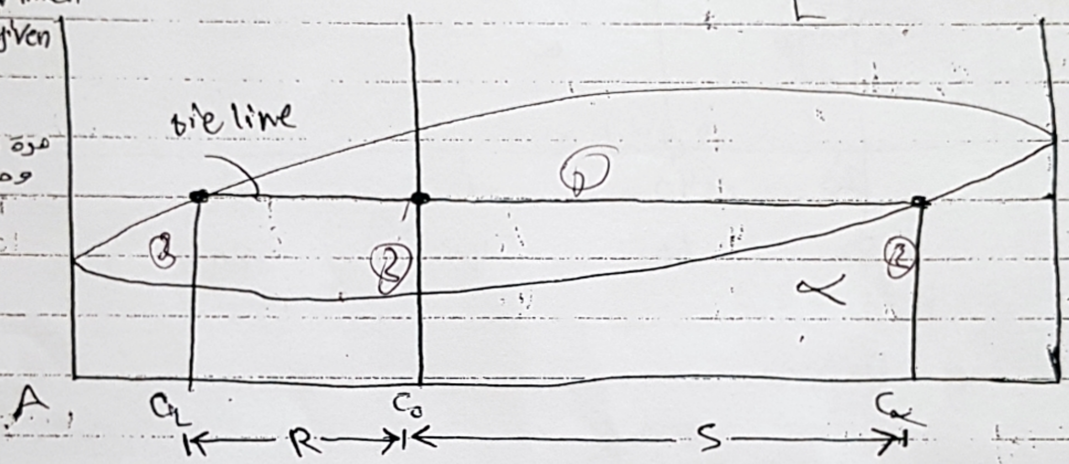
finding of phases in a two phase Region.

1. Locate Composition and temp in diagram.
2. in two phase region draw the tie line or isotherym.
3. fraction of the phase is determined by taking the lengt of the tie line to the phase boundary for the other phase and dividing by the total length of the tie line.

composition; How much A & B given

temp: given

tie line: مرة بنضرب بـ L ومرة بنضرب بـ α



$$W_L = \frac{S}{R+S} = \frac{C_\alpha - C_0}{C_\alpha - C_L}$$

$$W_\alpha = \frac{R}{R+S} = \frac{C_0 - C_L}{C_\alpha - C_L}$$

$\rightarrow W_L + W_\alpha = 1$

$W_\alpha C_\alpha + W_L C_L = C_0$

على Scale طلع الـ C

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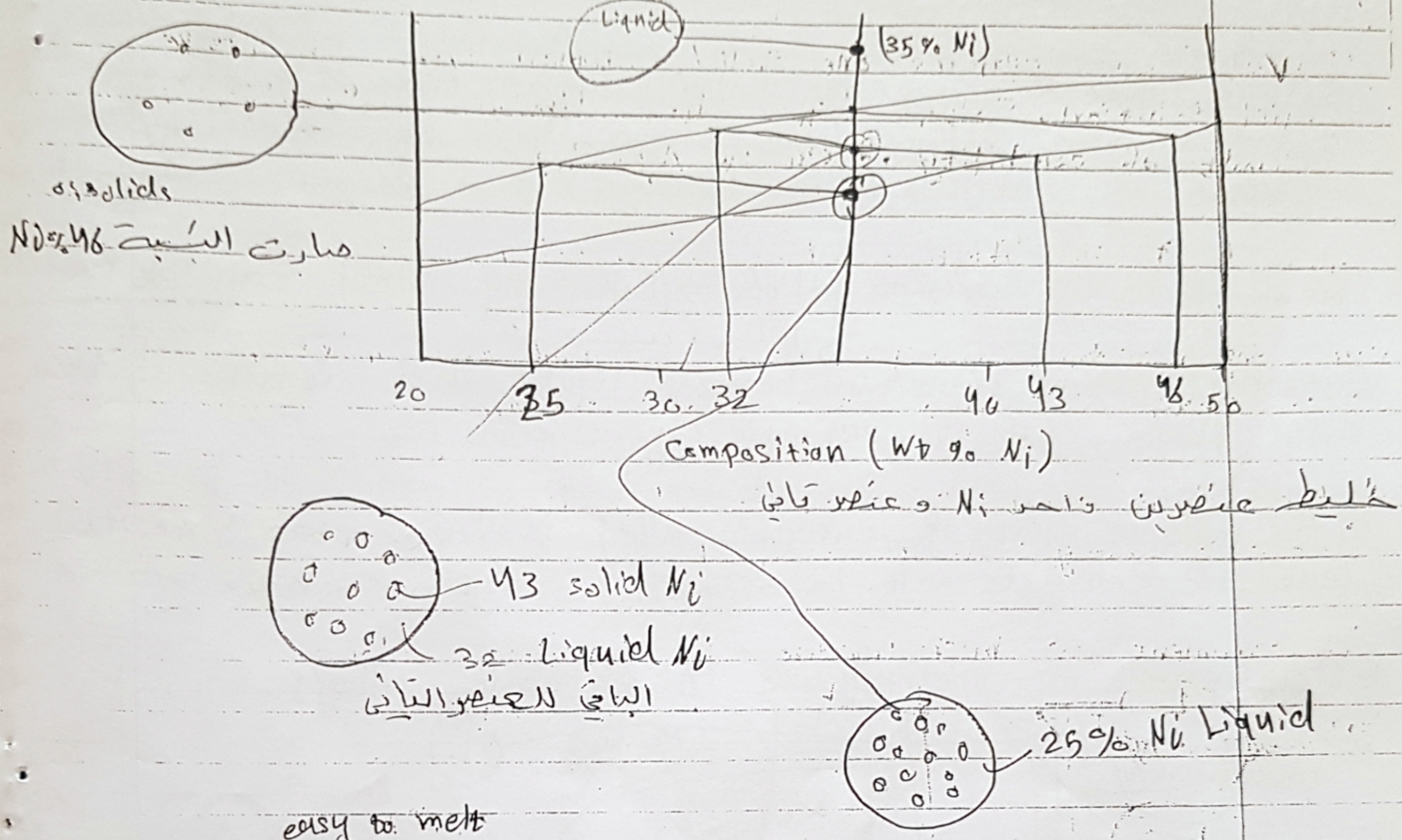
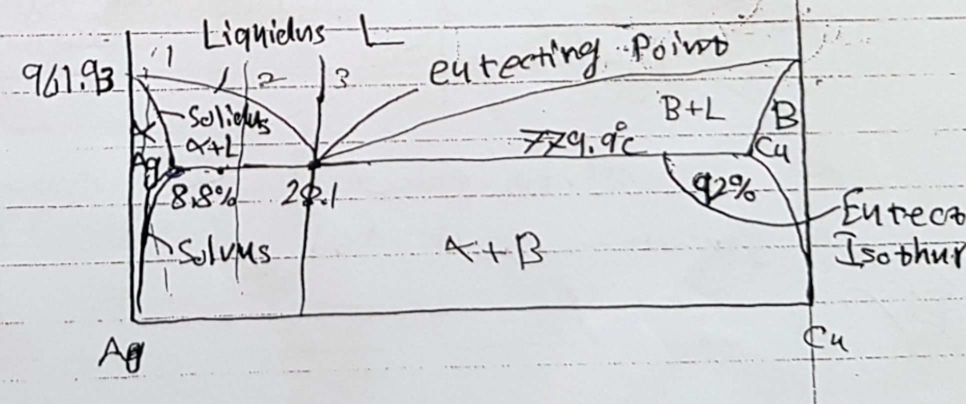
* Development of Microstructure in Isomorphous Equilibriums



easy to melt

* Binary Eutecting Systems Alloys with limited Solubility:



①	②	③
L	L	L
↓	↓	↓
α+L	α+L	α+B
↓	↓	
α	α+B	
↓		
α+B		

α : Solid of Ag

hypo hyper

eutectic Point ال نسبة ال left right

Two phase Region : α+L , β+L , α+β

Solvus Line: Separates one solid solution from a mixture of solid solution. Solvus Line shows limit of solubility

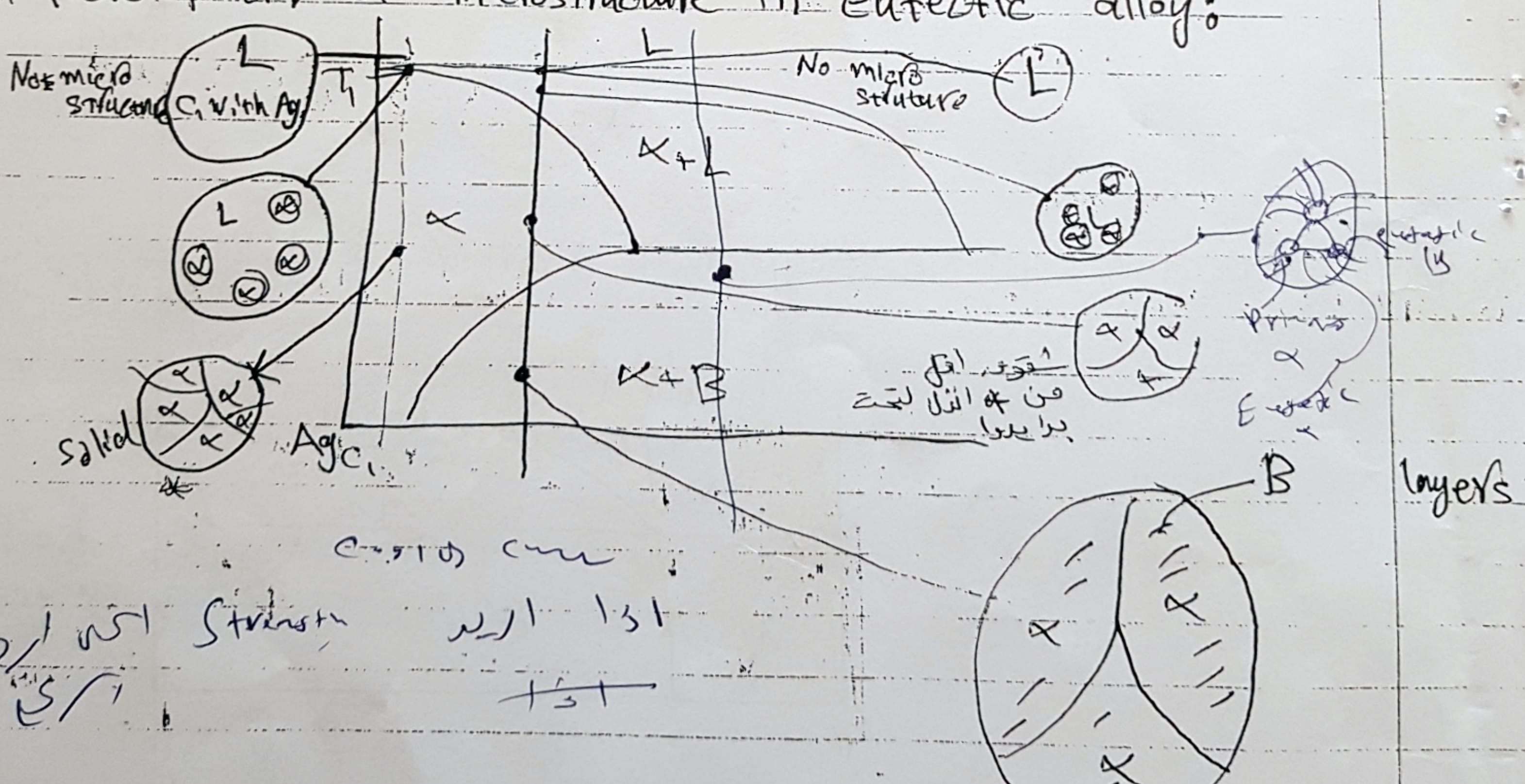
limit of solubility of Cu in Ag = 8.8

from L to two different solids → (Eutecting Point) Eutectic reaction

*Eutecting reaction: transition between liquid and mixture of two solid phase α+β at eutectic concentration C_L

* the melting point of eutectic alloy is lower ~~than~~ that of the combined
(eutectic = easy to melt in Greek)

* Development of microstructure in eutectic alloy:

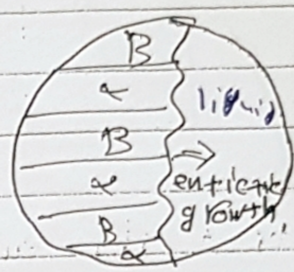


ال strength اكبر

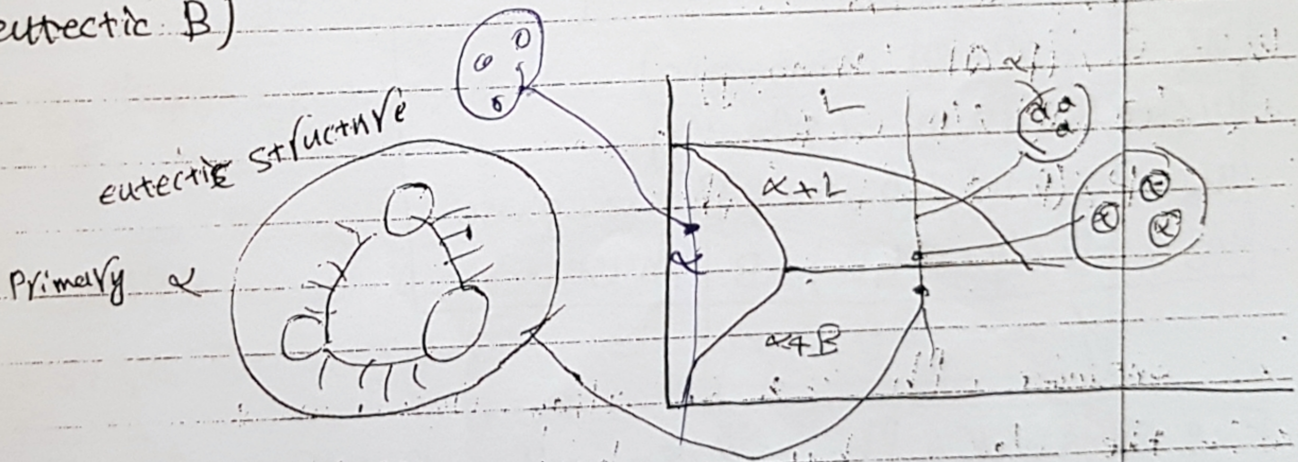
ا كبر

Development of microstructures in eutectic alloy

Composition of α and B phases are very different eutectic reaction involves redistribution of Pb and Sn atom (slide 22) by atomic dillution. This simultaneous formation of α and B phases Result in a layered (lamellar) (رقائقي) microstrstructurs this is called eutectic structure

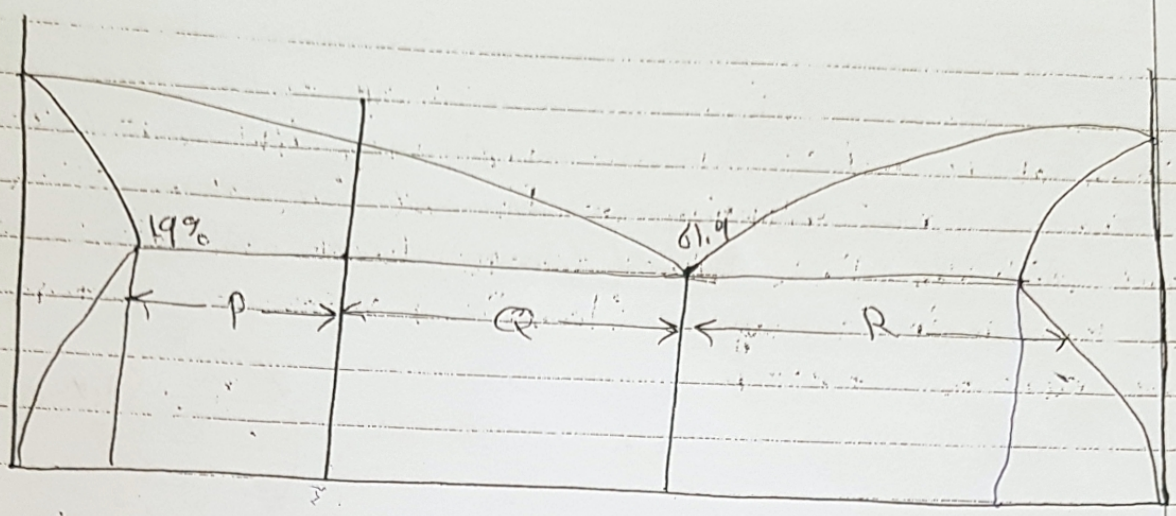


Primary α phase is ~~formed~~ formed in α+L region and eutectic structure that includes layers of α and B phase (eutectic α and eutectic B)



microconstituents: element of microstructure having a distinctive structure

Eutectic microconstituent forms from Liquid having eutectic structure (61.9% wt Sn) (slide 27)



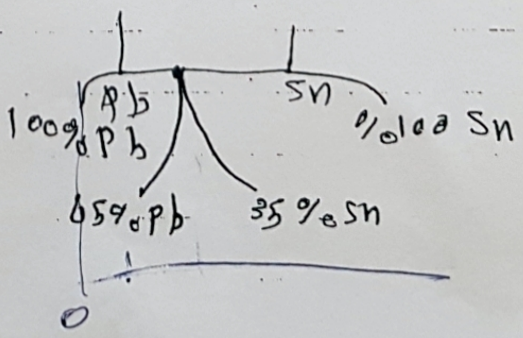
we can treat the eutectic as a ~~sump~~ seprate phase and appl Lever rule to find relative fractions of primary α (19 % sn) and eutectic structure (61.9 wt% Sn)

$W_e = P/(P+Q)$ (eutectic)
$W_{\alpha'} = Q/(P+Q)$ (primary)
$W_\alpha = (Q+R)/(P+Q+R)$ α – phase
$W_B = P/(P+Q+R)$ B – phase

Ex: Consider a Pb - 35% Sn alloy. Determine:

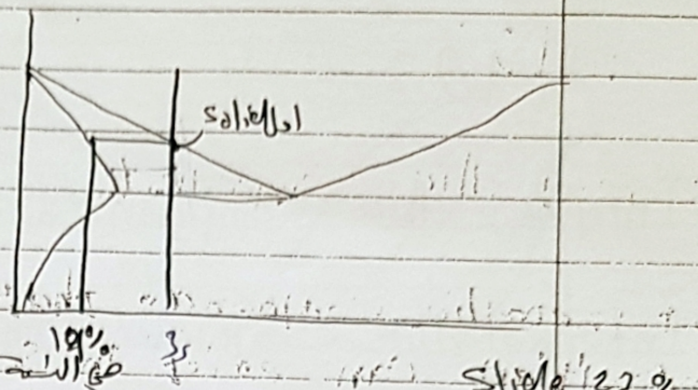
(a) if the alloy is hypo or hypr eutectic
(b) the composition of the first solid to form during Solidification
(c) the amount and Composition at each phase at 184° c
(d) the amount and composition at each phase at 182° c
(e) = = = = of each microconsituent at 182
(f) = = = = = = phase at 25°c

35 for Sn



(a) hypo eutectic لانه قبل ال point

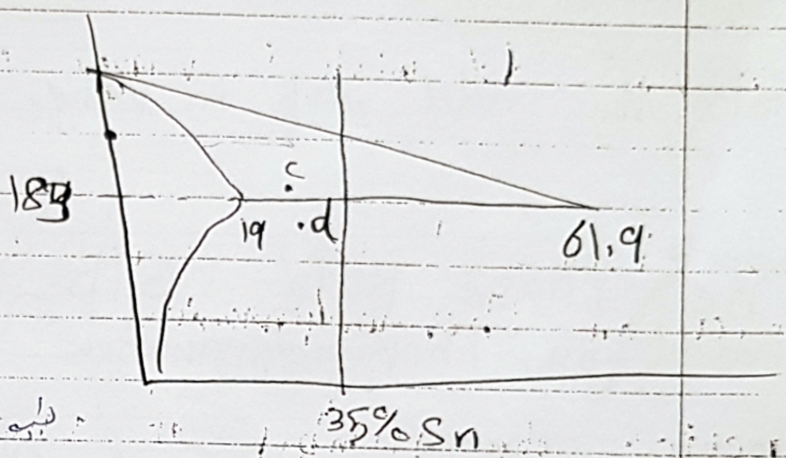
(b) 14% Sn



Slide 22%.

(c) $\% \alpha = \frac{61.9-35}{61.9-19} \times 100\% = 63\%$

$\% L = 37\%$



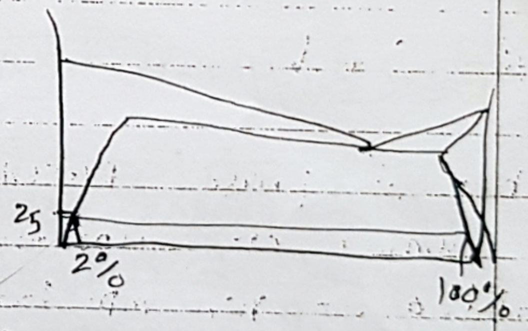
(d) $\alpha = 19\%$ Sn , $B = \cancel{97.5\%}$ Sn

97.5%

$\% \alpha = \frac{97.5-35}{97.5-19} \times 100\% = 80\% , \Rightarrow \% B = 20$

(e) Primary $\alpha = 19\%$ Sn $\Rightarrow \alpha = 63\%$

eutectic $= 61.9\%$ Sn $= 37\%$



(f) $\alpha = 2\%$ Sn , $B = 100\%$ Sn

$\% \alpha = \frac{100-35}{100-2} \times 100\% = 66\%$ $B = 34\%$

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Ch 10:

Intermetallic Compounds:

Intermetallic compounds that have precise chemical composition can exist in some systems.

stoi & Non ; add with in range to Non

The Phase Rule (Gibs phase Rule):

* Based on Thermodynamics   تشتق، تتنبأ للأطوار

* Predicts the number of phase that will coexist with a system at equilibrium.

$$P + f = C + N$$

P: Number of phases present.
C: The number of components.   عنصر أو مركب x Alloys
N: Number of noncompositional Variable.
N: 1 or 2 for Temp & Pressure.
N: 1 if P = constant OR T = constant.
f: Number of degrees of freedom.
Number of external controllable variables (T, P, composition) which can be changed independently.

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Ex:

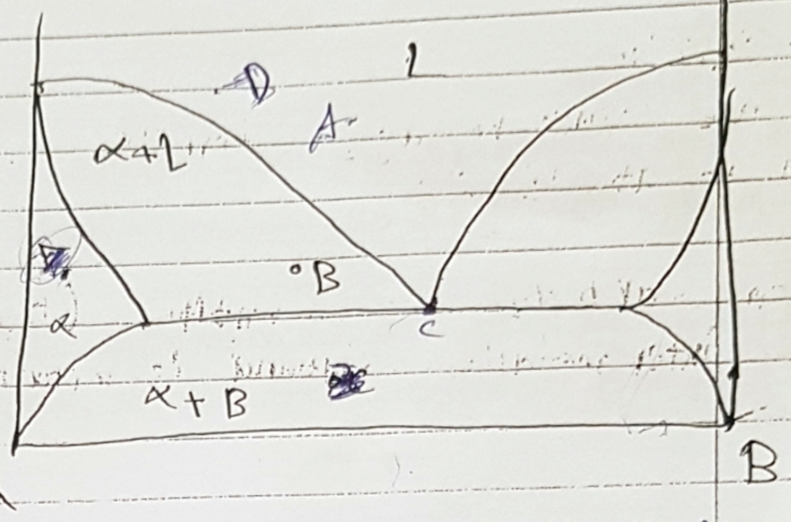
A: $P = 1$
$C = 2$
$N = 1$

Composition هي اللي C
α يعني

$P + f = C + N$
$1 + f = 3$
$\boxed{f = 2}$

B: $f = 1$

C: # of compo



A: $C = 2$
$P = 1$
$N = 1$
$f = 2$

to completely describe the characteristics of the alloy, you must describe 2 parameters

* You can change 2 variable without changing the # of phases at equilibrium

~~Ch 7: Iron-Iron Carbide (Fe-Fe3C)~~

Iron-Iron Carbide (Fe-Fe_3C)

In their simplest form steels are alloys of Iron (Fe) & Carbon (C)

① α-ferrite - Solid Solution of C in BCC (Fe).
* Stable form of Iron at Room Temp
* max Solubility of C is 0.025 wt%
* Transforms to FCC γ-austenite at 912°C.

② γ-austenite - Solid Solution of C in FCC (Fe)
* max Solubility of C is 2 wt %
* transform to BCC δ-ferrite at 1395°C
Is not stable below the eutectoid Temp (723) unless cooled rapidly.

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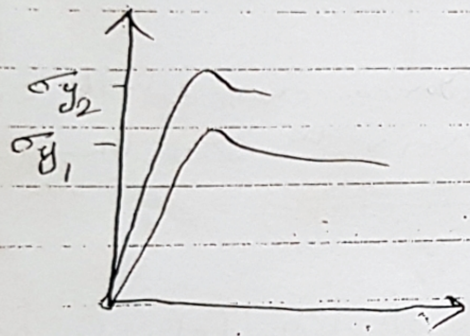
③ δ- ferrite

* Same structure as α - ferrite.
Melts at 1538°C

* Iron carbide or cementite (Fe_3C)
This intermetallic compound is metastable

CH 7

ممكن زيادة σ_y من خلال
سحب القطعة هو Strain Hardening



Slide 34; residual: بعد ما نخلص rolling بضل في stress حتى لما أبعد بالحرارة بتخلص منها

release stress: ال stress هو $\frac{F}{A}$ برفع درجة الحرارة فبتتمدد وبتزيد A وبتقل ال stress لحد ما ينتهي

Cold Work: هو تعامل مع القطعة بدون استخدام الحرارة (زي مثلاً الخراطة)

Annealing: heat treatment بعمله بعد coldwork عشان نتخلص من stress معين مثلاً
بسخن لحد 60% من ال melting point بعدين بتركها

Forging: بكسر بضربها فبتشكل زي ما بدي
بلزم أسخن annealing لما يصير Forging

Anisotropic (slid 4-6) السطح يبرد أسرع من الداخل

ch3 | اطلب الحل فقط

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Control of Annealing:

(A) Recrystalization Temp.

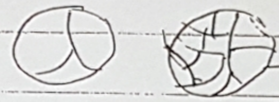
the amount of

ا لزيد

(1) Recrys. Temp. decreases when ↑ Cold work increase. C.W. يقل

thickness فيبدي حرارة أقل

(2) A small original cold work grain size reduces the recrystalization Temp. by providing more sites



في transition sites أكثر فالحرارة بتنقل اسرع بالتالي بدي حرارة أقل

(3) Increasing the annealing time reduces the recreys. temp. بطبخة الرز, وطي الغاز وزيد الوقت

(4) Higher melting point alloys have higher recryst. temp.

(B) Recrystalised Grain Size

Annealing tempreture or annealing time reduces the grain size

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