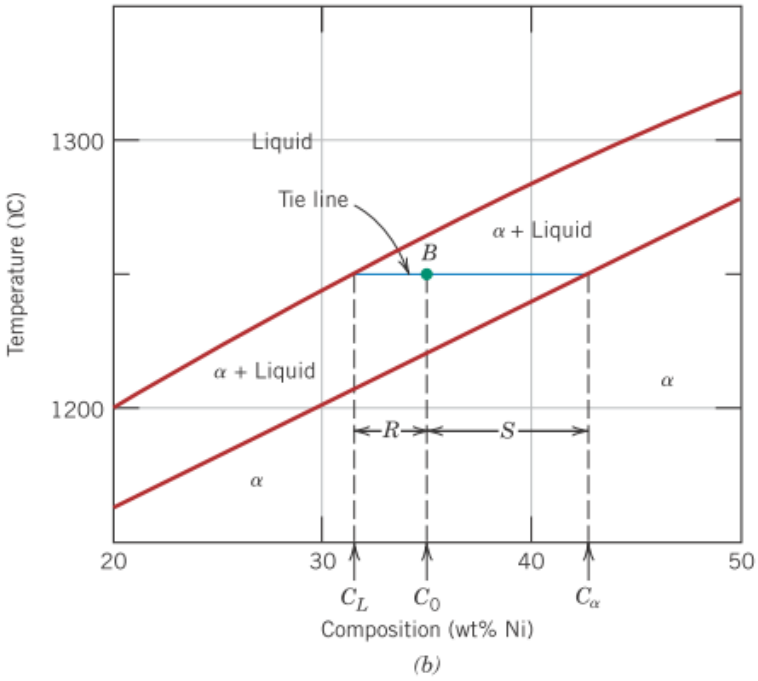
# CH9.相圖

觀念

PHASE→系統的均質部分，有著同樣的物理性質和化學性質

Isomorphous→固.液完全互溶




*tie line→ isotherm

我可以由相圖得到的資訊

1.表現出來的相

2.相的組成→直接讀出來→$C_L$、$C_\alpha$

3.各相所占分率→Phase Amount→lever rule

*對一已知溫度和組成，且達平衡，即可透過 lever rule 得各相分率

Lever rule 推導(對兩相而言)

1.液相和固相分率加起來一定是一→$W_\alpha + W_L = 1$

2.用一成份的質量守恆→ $W_\alpha C_\alpha + W_L C_L = C_0$

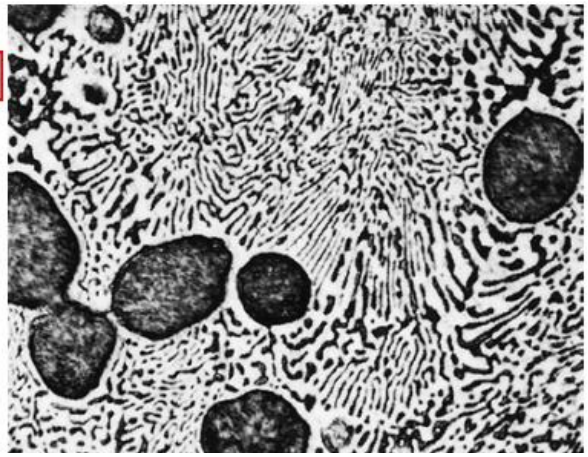
相圖一些小細節

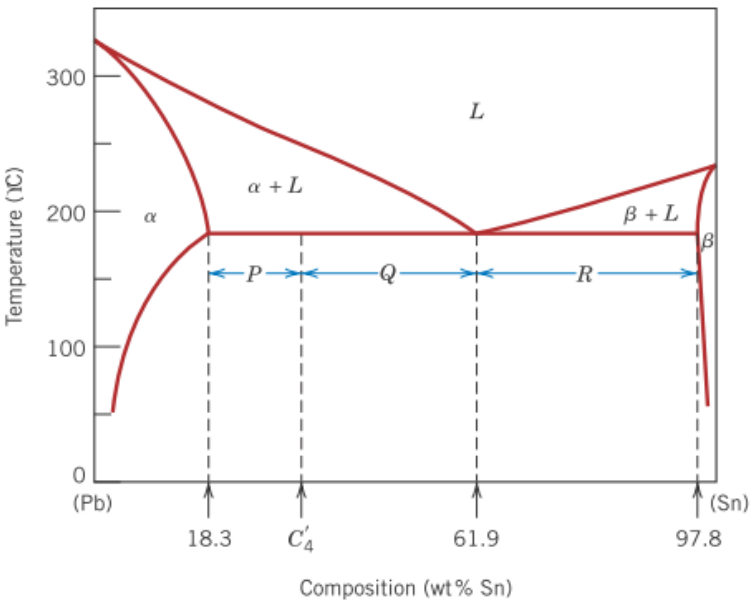
Solidus line→固-液

Solvus line→固-固

共晶組成的應用→焊錫 60–40 solder, containing 60 wt% Sn and 40 wt% Pb.

共晶組成!




初α：$\frac{Q}{P+Q}$

共晶：$\frac{P}{P+Q}$

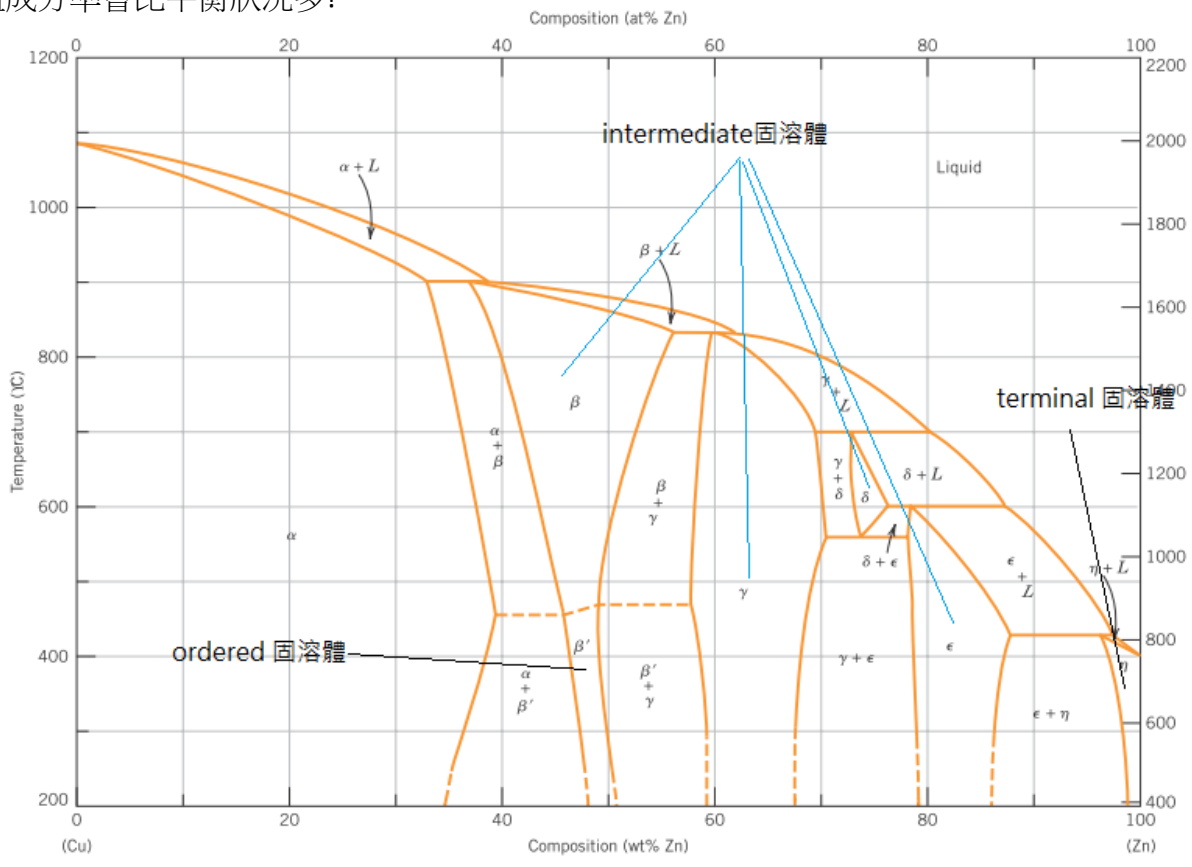
α：$\frac{Q+R}{P+Q+R}$

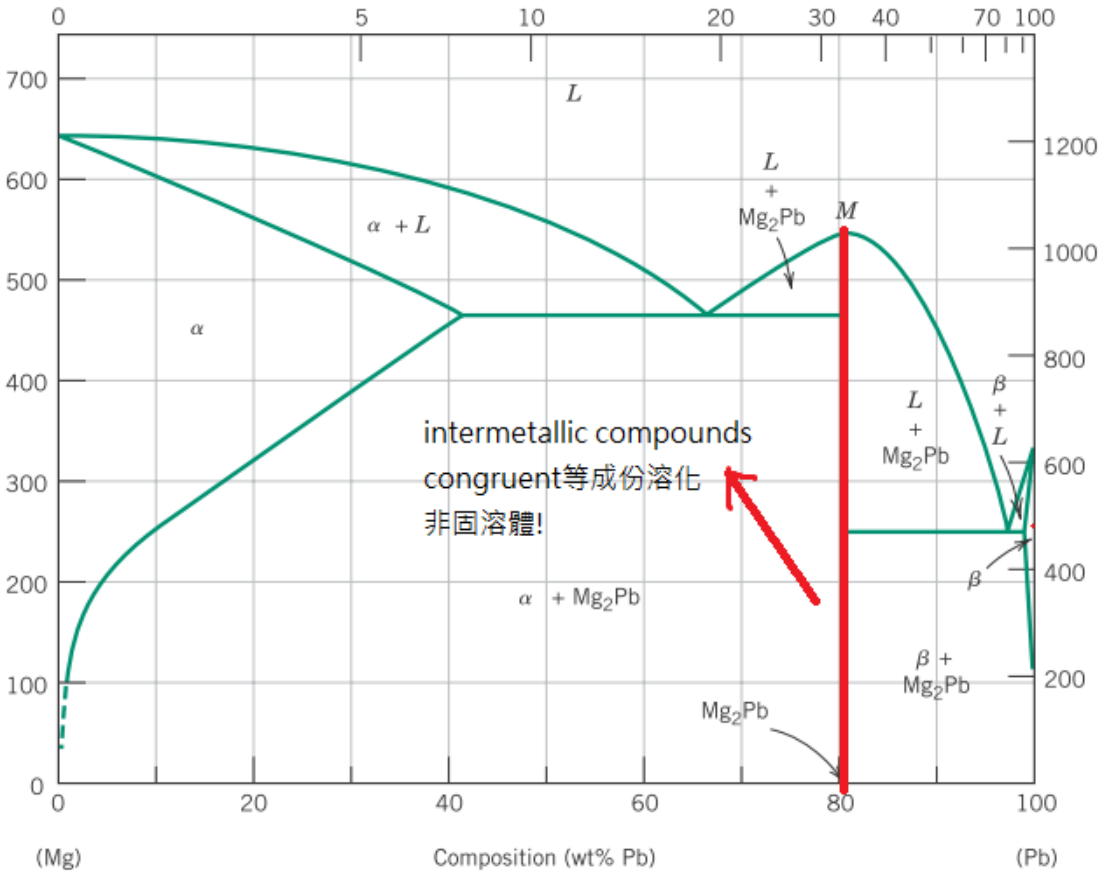
β：$\frac{P}{P+Q+R}$

共晶部分，全部來自於 L 相

若非平衡冷卻，

1. primary microconstituent will be cored→非均質
2. 共晶組成分率會比平衡狀況多!

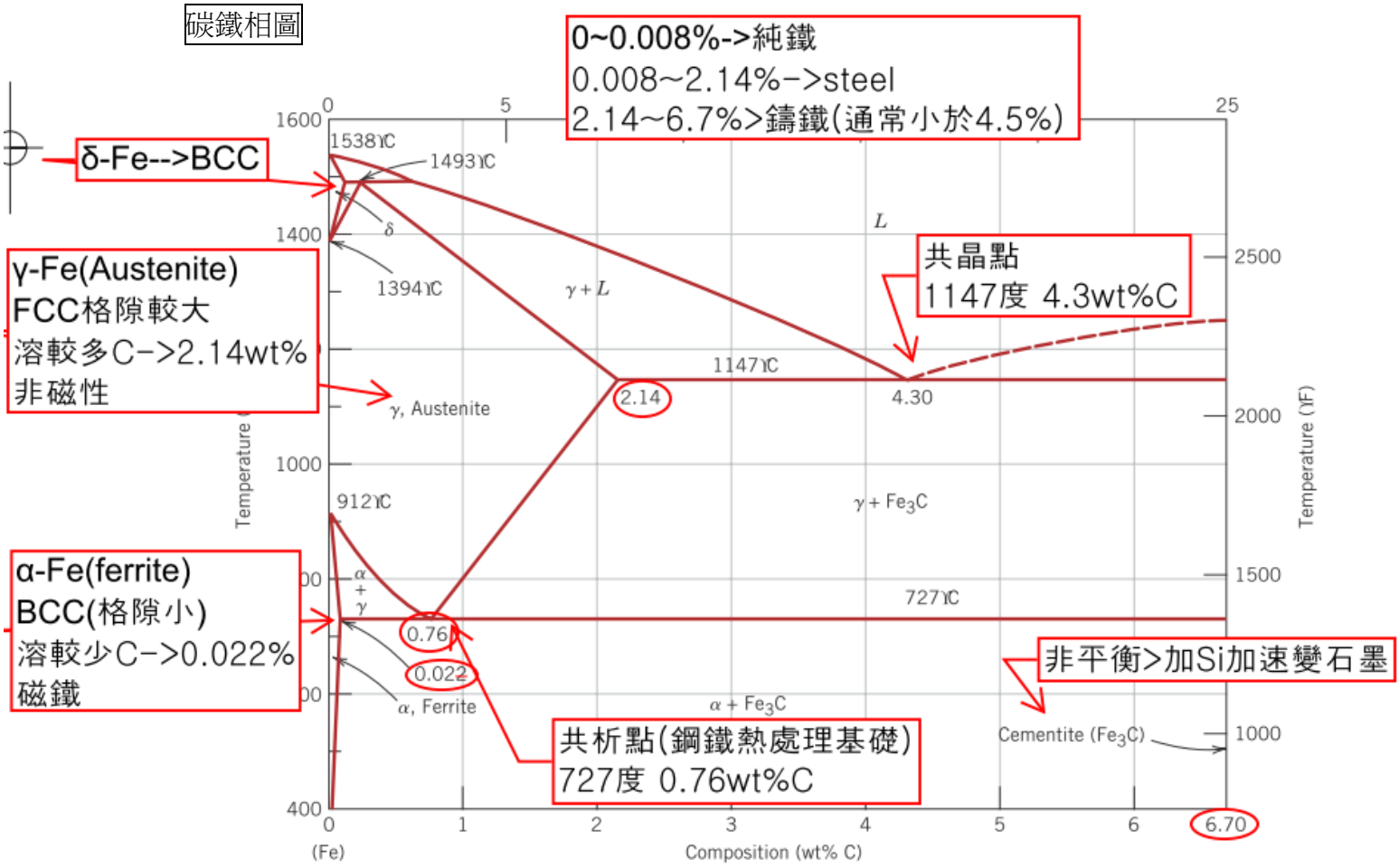


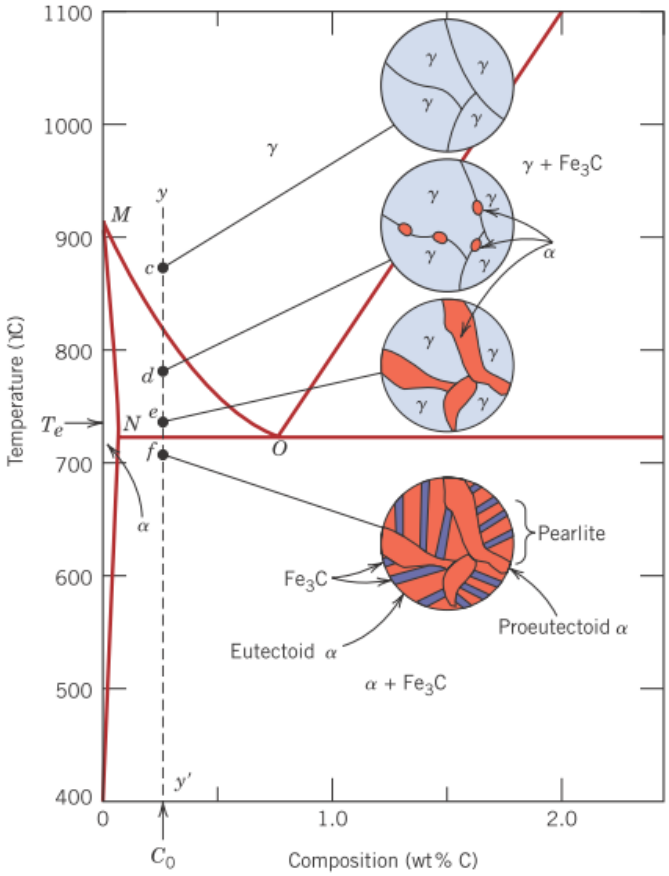


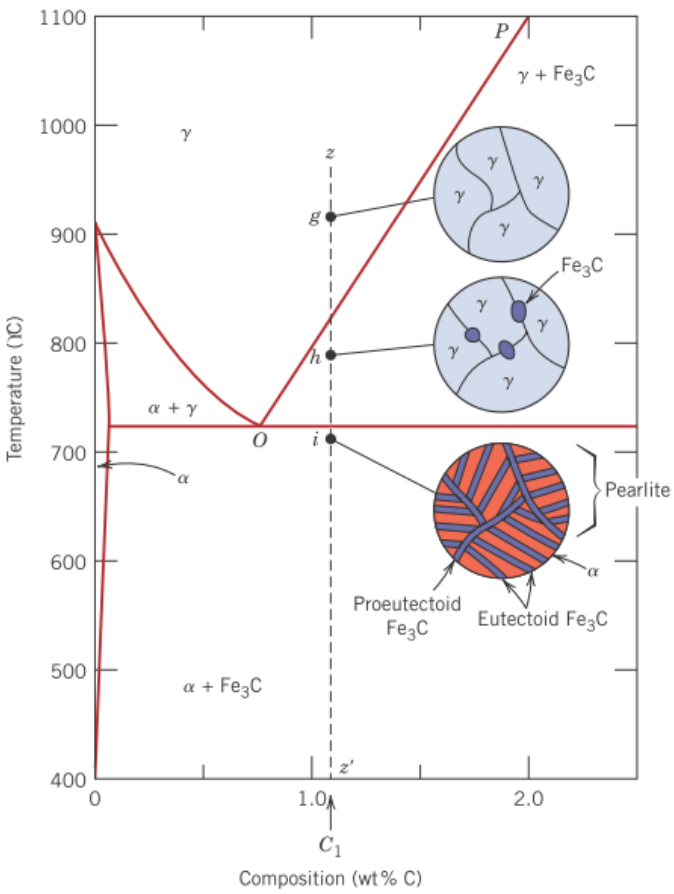

Congruent 相變化→組成成份不變→同素異形相變化、純物質溶化

Incongruent→組成有變→如共晶、共析、包晶...

碳鐵相圖






非平衡冷卻→較實際

1.相變化的發生不在相圖所預測的相界

2.不存在在相圖中卻存在於室溫的非平衡相(Martensite)

*決定合金顯微結構的參數

1.元素 2.濃度 3.熱處理

*平衡狀態的熱力學條件

自由能 G min

*顯微結構發展的趨動力?

平衡冷卻時，沒有濃度梯度!!所以梯度非驅動力

其驅動力為→**使自由能下降**!

9.16 (a) Coring is the phenomenon whereby concentration gradients exist across grains in polycrystalline alloys, with higher concentrations of the component having the lower melting temperature at the grain boundaries. It occurs, during solidification, as a consequence of cooling rates that are too rapid to allow for the maintenance of the equilibrium composition of the solid phase.

(b) One undesirable consequence of a cored structure is that, upon heating, the grain boundary regions will melt first and at a temperature below the equilibrium phase boundary from the phase diagram; this melting results in a loss in mechanical integrity of the alloy.

Smith

**要怎麼利用實驗方法得到 isomorphois 相圖?**

藉由不同冷卻曲線合金成份的冷卻曲線，來得到相圖，取越多冷卻曲線，像圖越精準。

plateau
region of thermal arrest

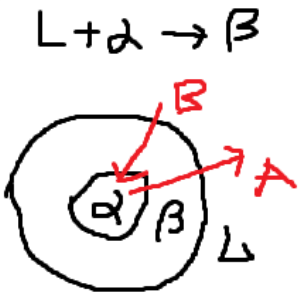
**core structure**:冷卻速率過高，來不及擴散，濃度梯度維持在合金結構裡。

**homogenization process**:藉由熱處理，加速擴散，消除 core structure，產生均質結構。

**liquation**:當溫度高於最低熔點，晶界處會產生局部熔化→liquated structure

**peritectic alloy 的 surrounding(encasement)**

包晶反應時快速冷卻產生的非平衡現象，beta phase(surrounding)成為 alpha phase(coring)擴散的阻礙，所以包晶速率會越來越慢。




**單晶(monotectic)反應在 Cu-Pb 系統的工業重要性**

可以在黃銅 brasses(Cu-Zn)裡面產生非常純的 Pb phase，會降低合金的延性，使 chips 易自斷裂可改進加工性質。

然後鉛可以當潤滑劑、使切削容易。添加鉛的合金可做為軸乘材料。

**Intermediate phase→range**

**Intermediate compound→固定成分**

**Congruently melting→固定成分**

**Incongruently melting→peritectic decomposition，溶化分解成液相和另一固相**