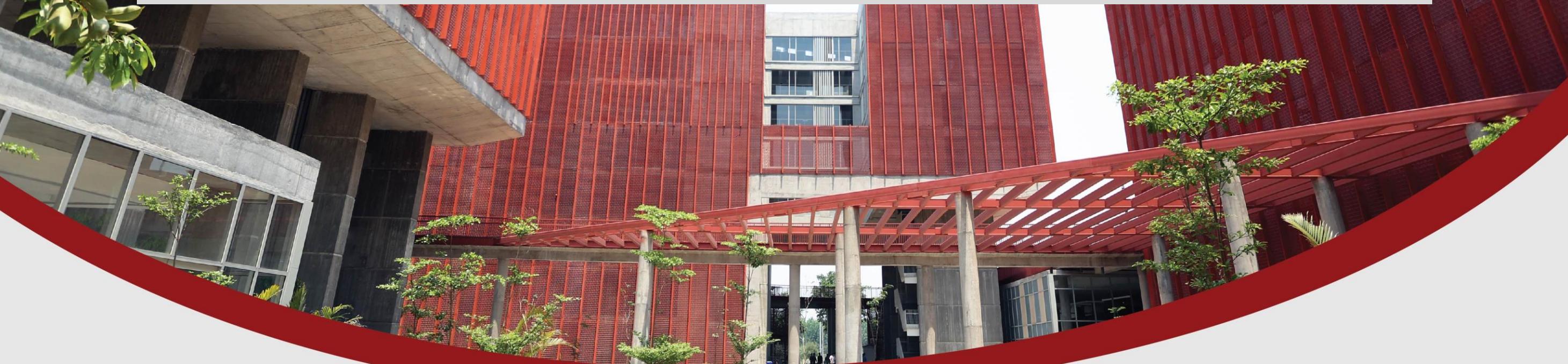


Binary Eutectic Phase Diagram



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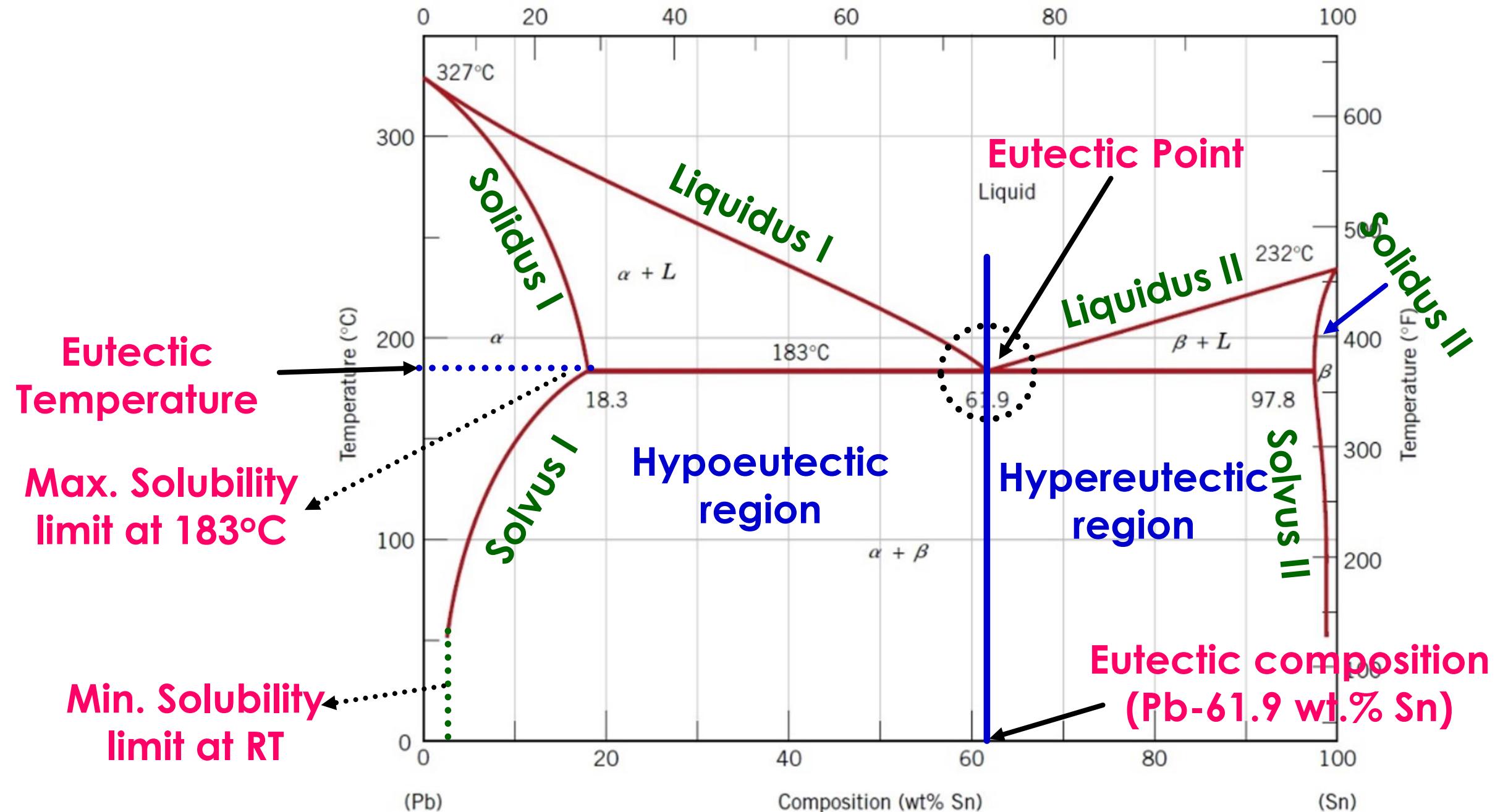
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Three Phase Reactions

Eutectic	<p>Cooling →</p> $L \rightarrow \alpha + \beta$ <p>← heating</p>	<p>A phase diagram illustrating the Eutectic reaction. It shows three phases: liquid (L), solid alpha (α), and solid beta (β). The liquid phase L is at the top vertex. Solid alpha (α) is at the bottom-left vertex, and solid beta (β) is at the bottom-right vertex. A horizontal line connects the liquid phase L to the two solid phases α and β. The regions between the phases are labeled α + β.</p>
Peritectic	<p>Cooling →</p> $\alpha + L \rightarrow \beta$ <p>← heating</p>	<p>A phase diagram illustrating the Peritectic reaction. It shows three phases: solid alpha (α), liquid (L), and solid beta (β). Solid alpha (α) is at the top-left vertex, liquid (L) is at the top vertex, and solid beta (β) is at the bottom-right vertex. A horizontal line connects the solid alpha phase α to the liquid phase L. The regions between the phases are labeled α + L and β.</p>
Eutectoid	<p>Cooling →</p> $\gamma \rightarrow \alpha + \beta$ <p>← heating</p>	<p>A phase diagram illustrating the Eutectoid reaction. It shows three phases: solid alpha (α), solid gamma (γ), and solid beta (β). Solid alpha (α) is at the top-left vertex, solid gamma (γ) is at the top vertex, and solid beta (β) is at the bottom-right vertex. A horizontal line connects the solid alpha phase α to the solid gamma phase γ. The regions between the phases are labeled γ and α + β.</p>
Peritectoid	<p>Cooling →</p> $\alpha + \beta \rightarrow \gamma$ <p>← heating</p>	<p>A phase diagram illustrating the Peritectoid reaction. It shows three phases: solid alpha (α), solid beta (β), and solid gamma (γ). Solid alpha (α) is at the top-left vertex, solid beta (β) is at the bottom-right vertex, and solid gamma (γ) is at the bottom vertex. A horizontal line connects the solid alpha phase α to the solid beta phase β. The regions between the phases are labeled α + β and γ.</p>

Binary Eutectic Systems (easily melted)

When solid solubility is limited and the melting points of the components are not vastly different. Pb-Sn Equilibrium Phase Diagram



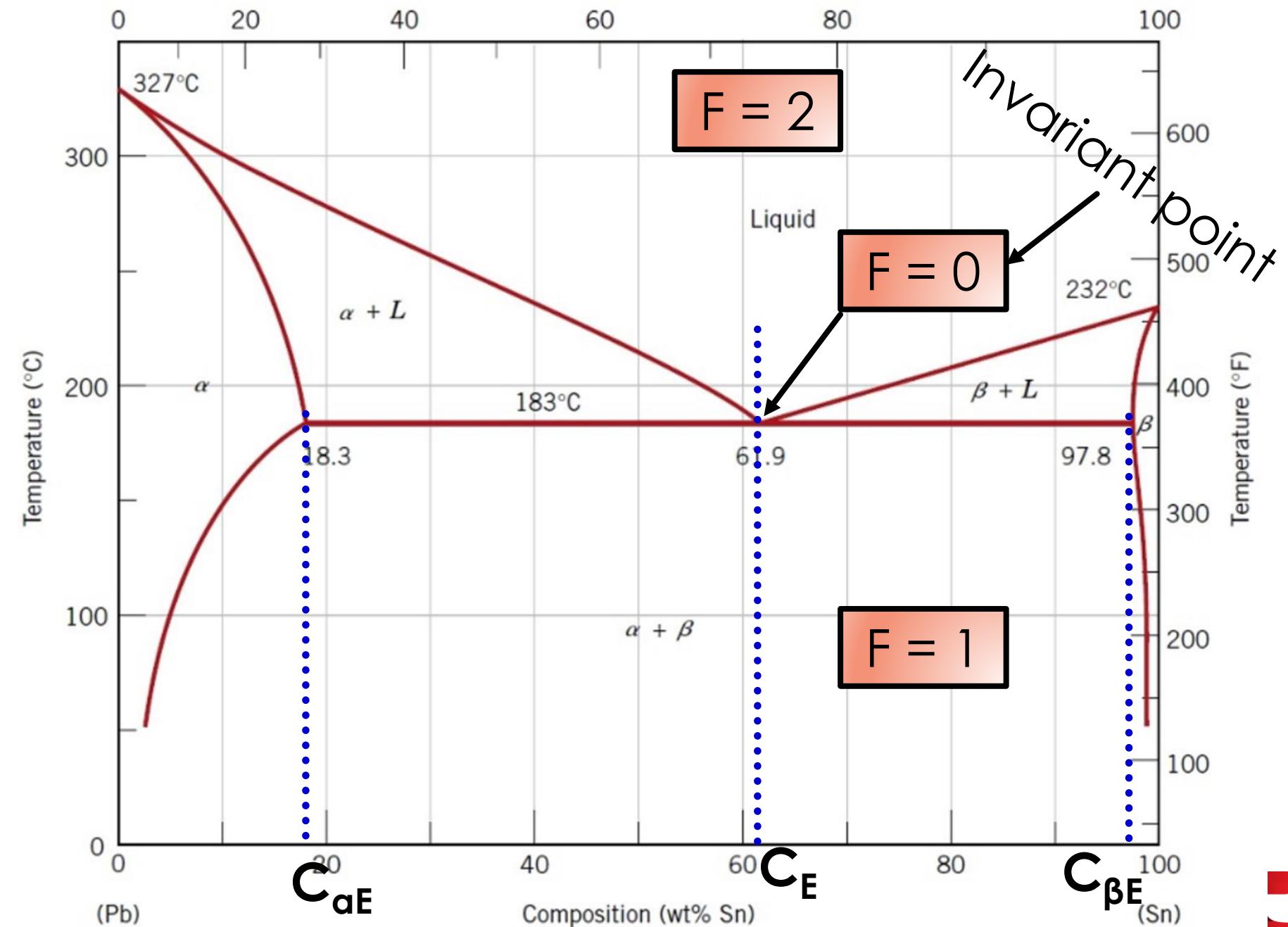
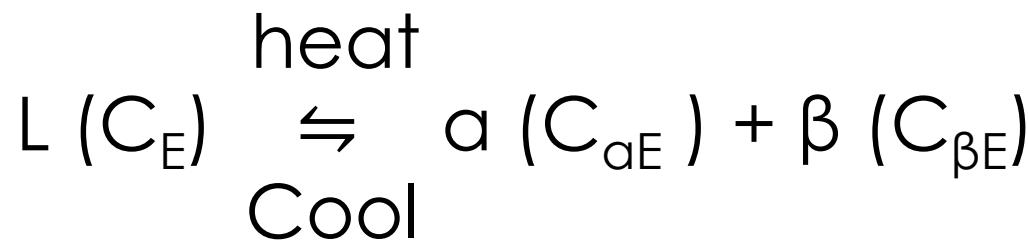
Binary Eutectic Phase Diagram

Gibbs Phase Rule

$$F = C - P + 1$$

Pressure: 1 atm.

Eutectic Reaction:



EX 1: Pb-Sn Eutectic System

- For a 40 wt% Sn-60 wt% Pb alloy at 150°C, determine:

-- the phases present

Answer: $\alpha + \beta$

-- the phase compositions

Answer: $C_\alpha = 11$ wt% Sn

$C_\beta = 99$ wt% Sn

-- the relative amount of each phase

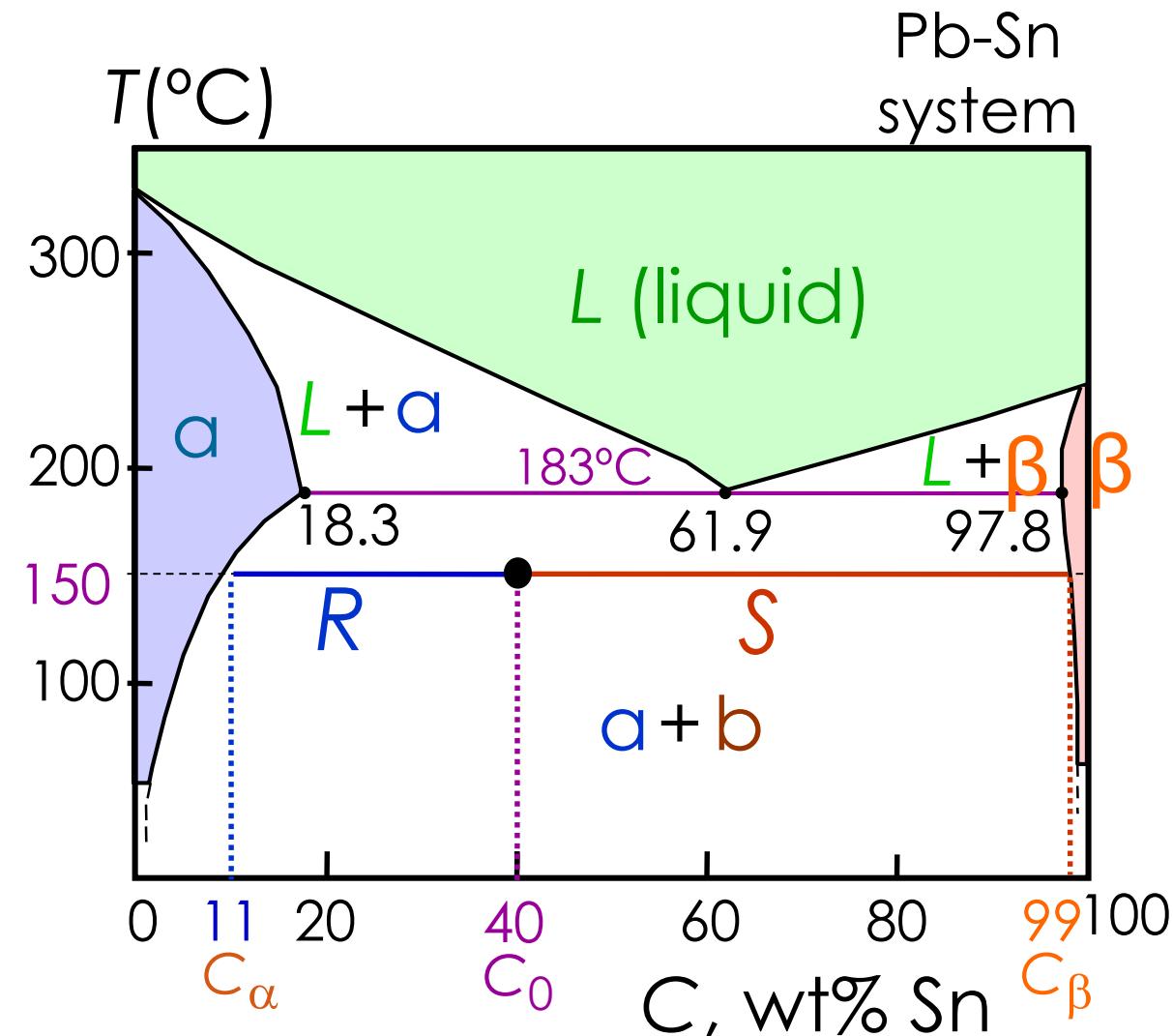
Answer:

$$w_\alpha = \frac{S}{R+S} = \frac{C_\beta - C_0}{C_\beta - C_\alpha}$$

$$= \frac{99 - 40}{99 - 11} = \frac{59}{88} = 0.67$$

$$w_\beta = \frac{R}{R+S} = \frac{C_0 - C_\alpha}{C_\beta - C_\alpha}$$

$$= \frac{40 - 11}{99 - 11} = \frac{29}{88} = 0.33$$



EX 2: Pb-Sn Eutectic System

- For a 40 wt% Sn-60 wt% Pb alloy at 220°C, determine:
 - the phases present:

Answer: $\alpha + L$

- the phase compositions

Answer: $C_{\alpha} = 17 \text{ wt\% Sn}$

$C_L = 46 \text{ wt\% Sn}$

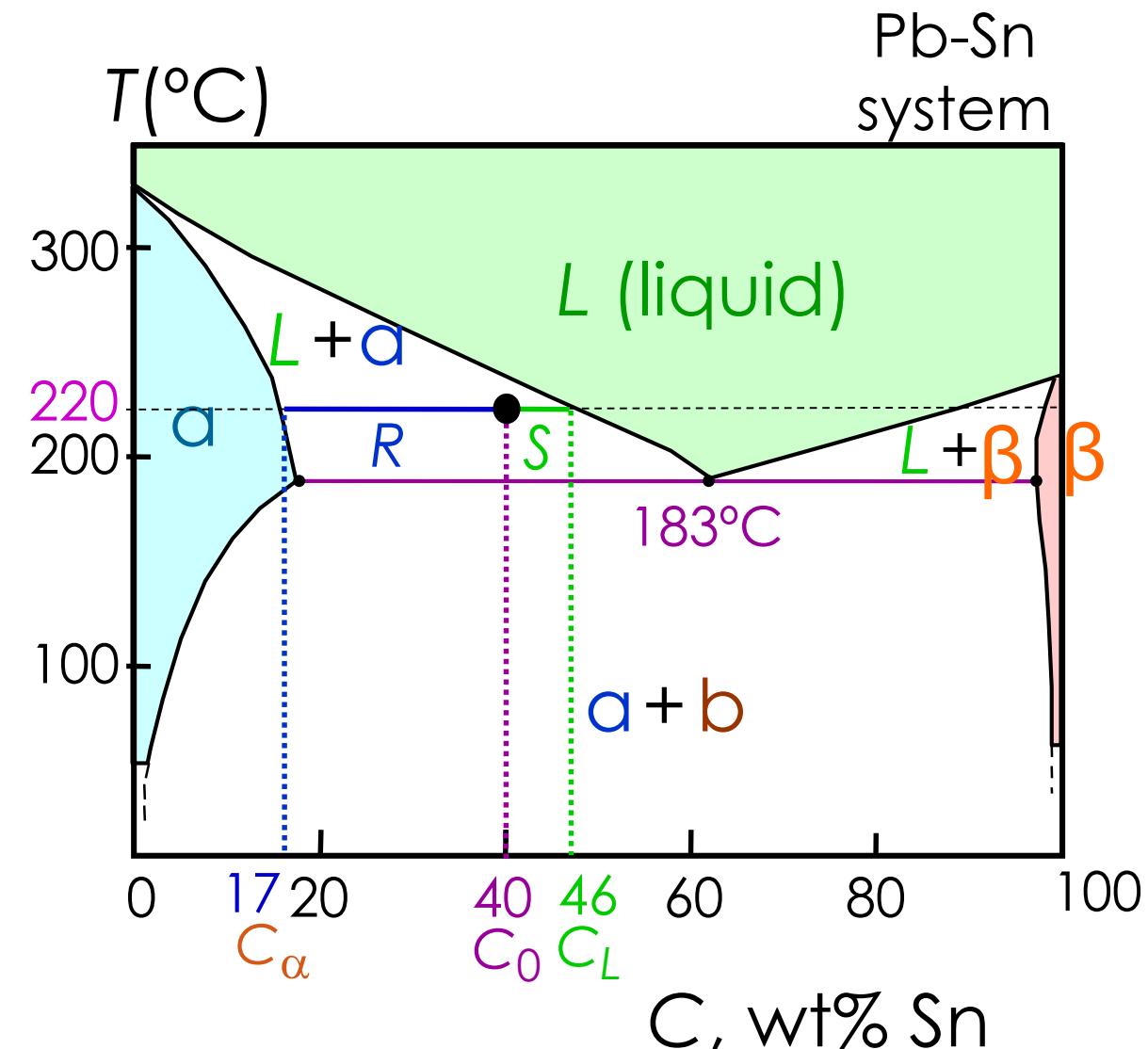
- the relative amount of each phase

Answer:

$$w_{\alpha} = \frac{C_L - C_0}{C_L - C_{\alpha}} = \frac{46 - 40}{46 - 17}$$

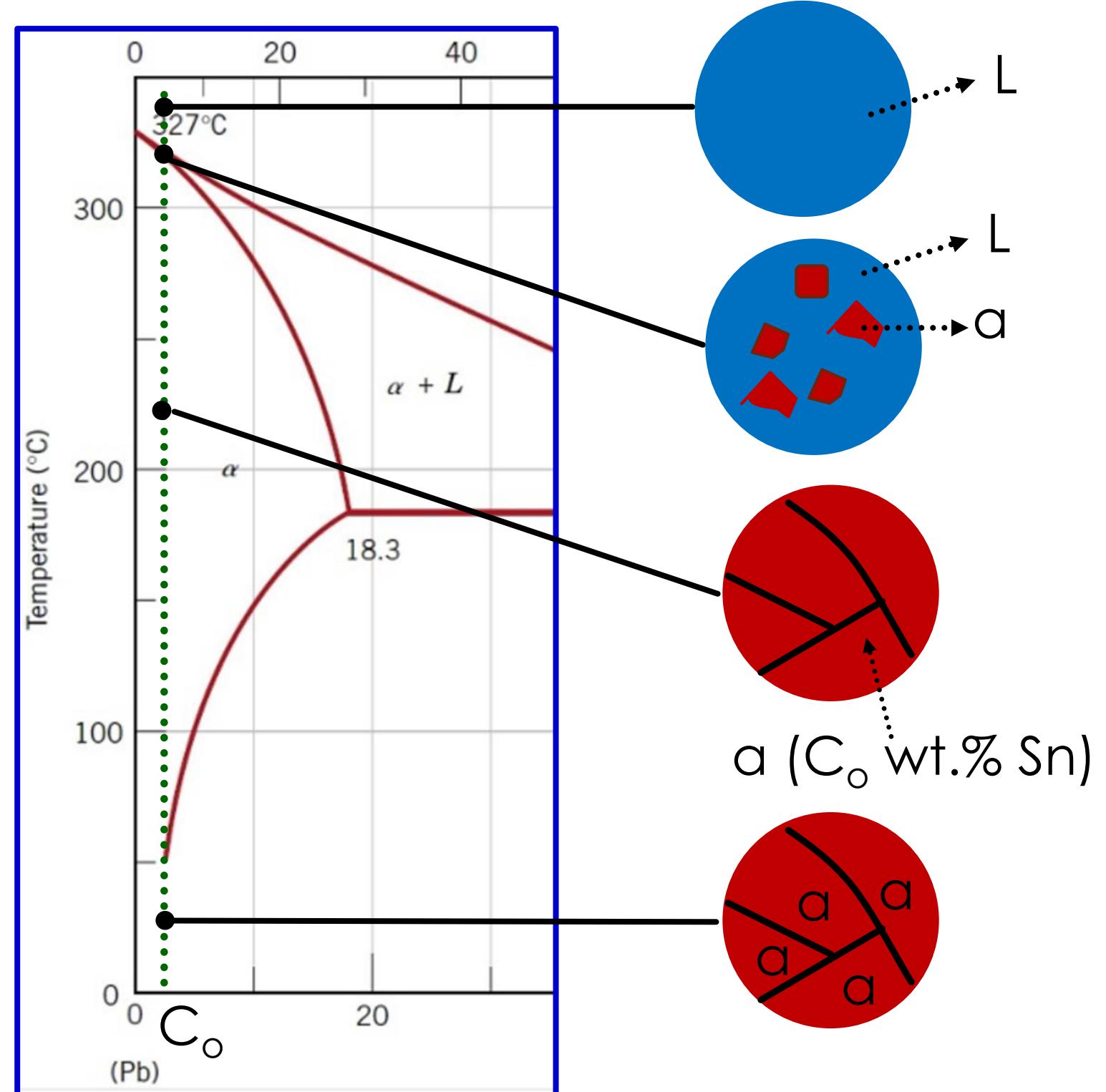
$$= \frac{6}{29} = 0.21$$

$$w_L = \frac{C_0 - C_{\alpha}}{C_L - C_{\alpha}} = \frac{23}{29} = 0.79$$



Microstructure development

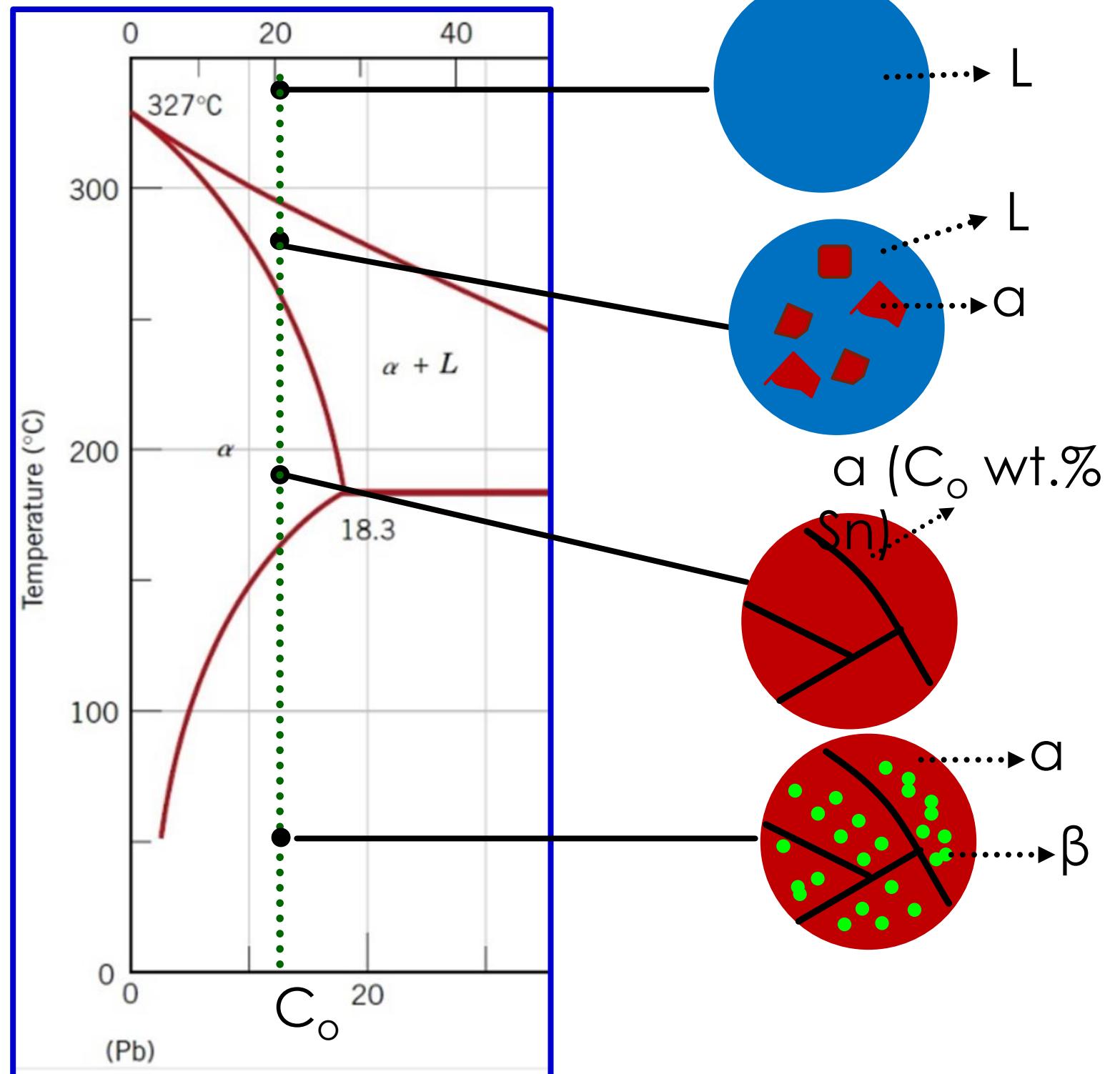
- For alloys where $C_o < 2 \text{ wt\% Sn}$
- Result at room temperature is a polycrystalline with grains of a phase having composition C_o .



Microstructure development

□ $2 \text{ wt\% Sn} < C_o < 18.3 \text{ wt\% Sn}$

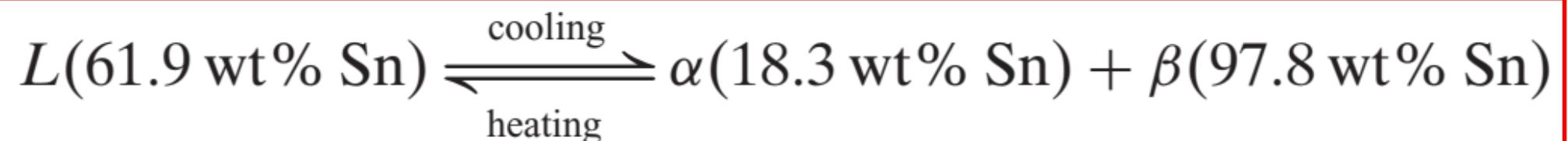
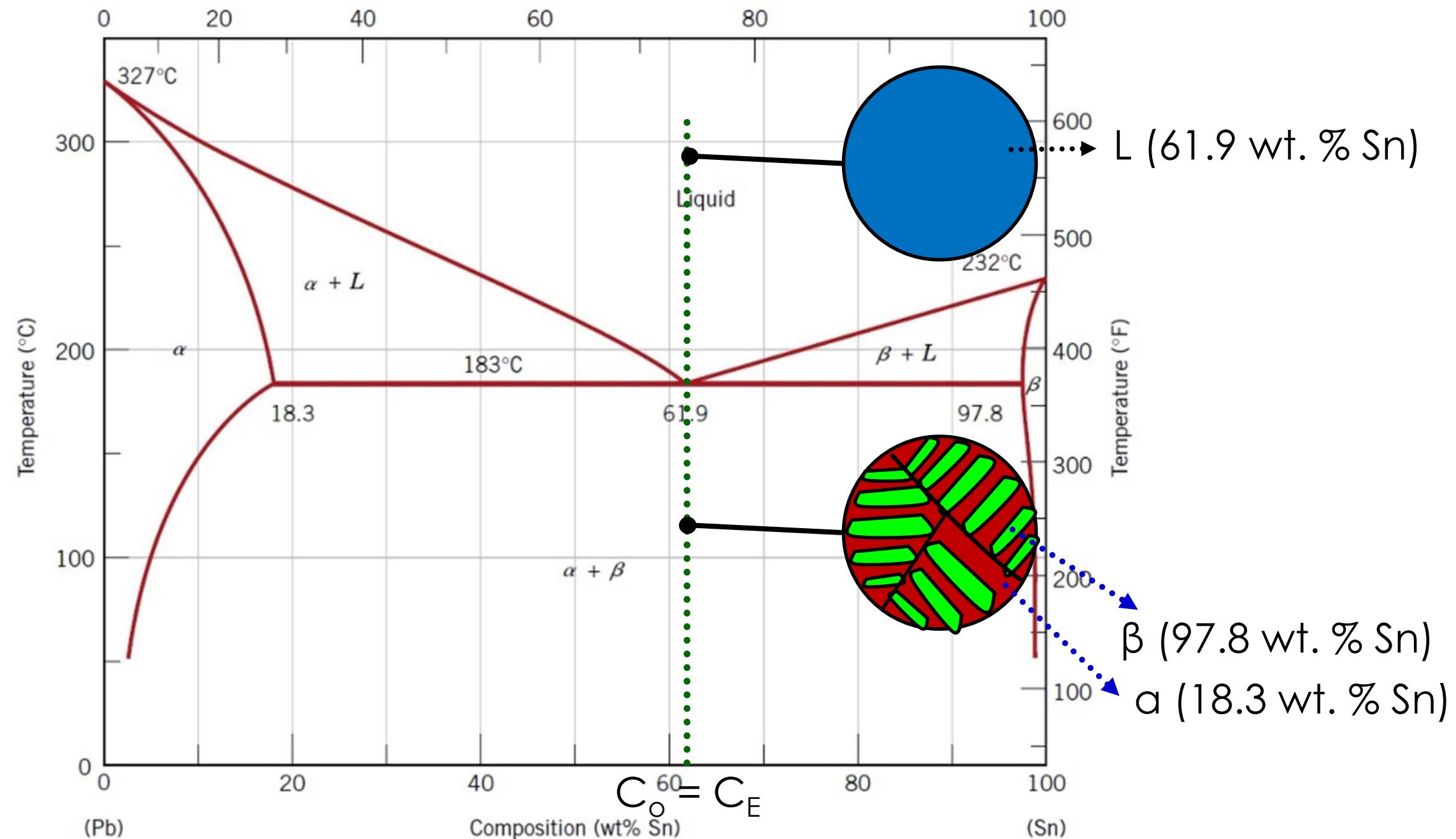
□ Results in polycrystalline microstructure with **a** grains and small β -phase particles at lower temperatures.



Microstructure development

$C_o = C_E$

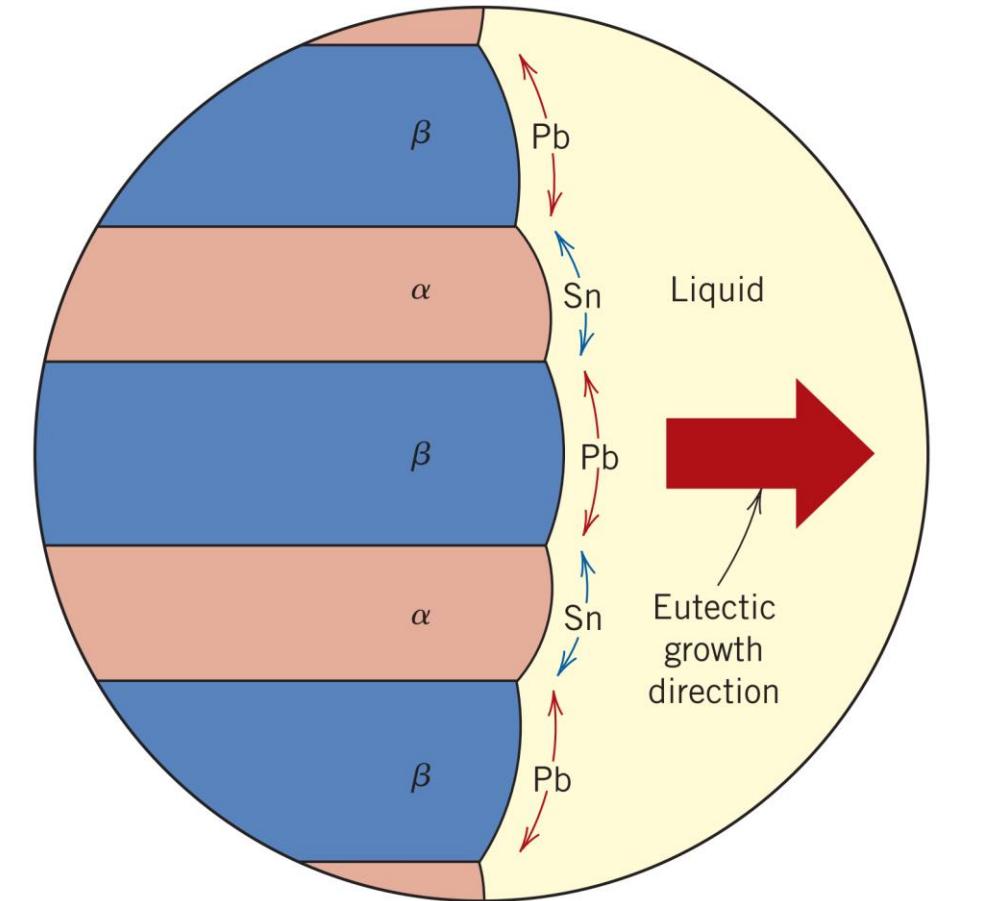
Results in a eutectic microstructure with alternating layers of α and β crystals.



Lamellar Eutectic Microstructure

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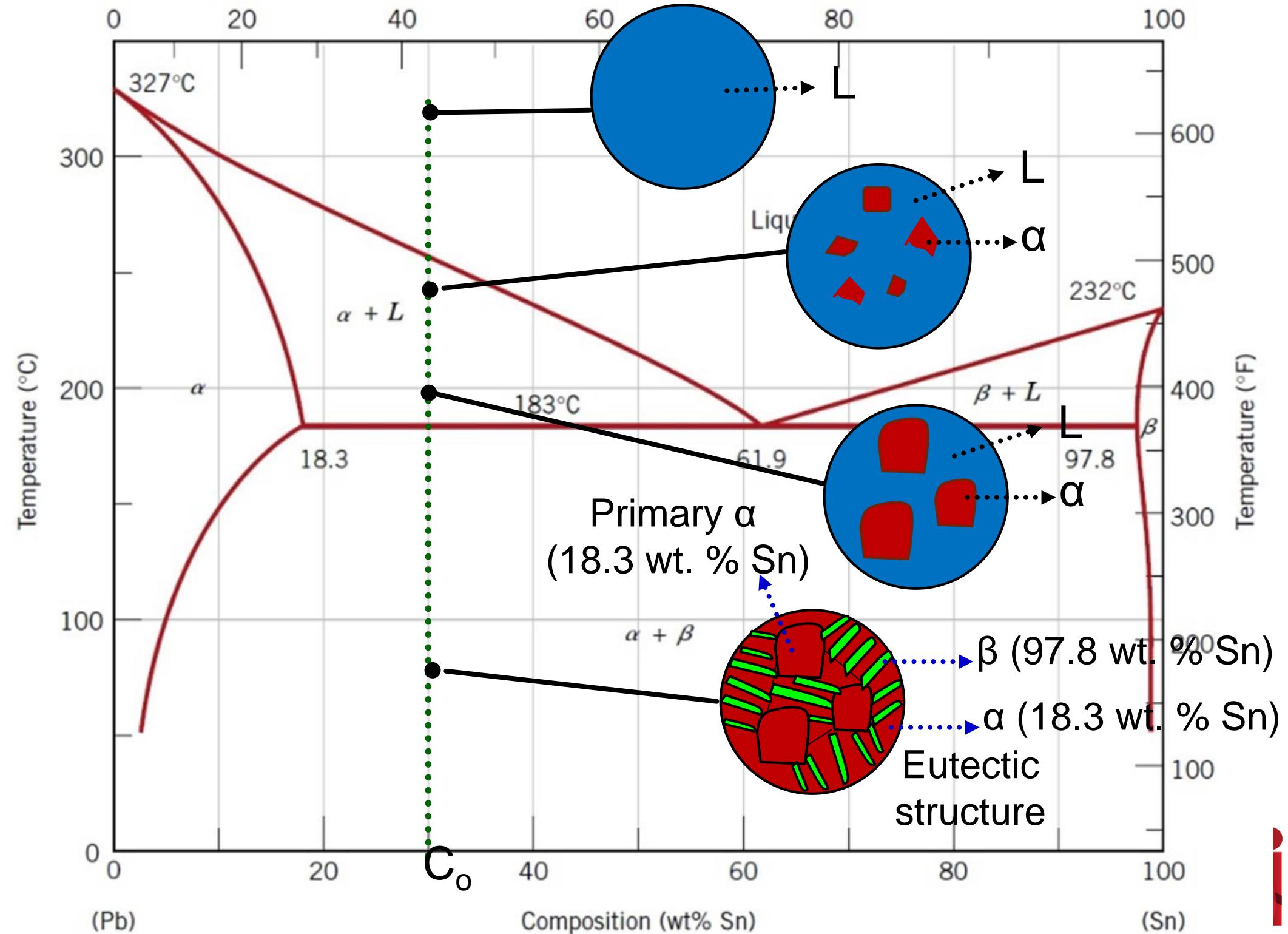
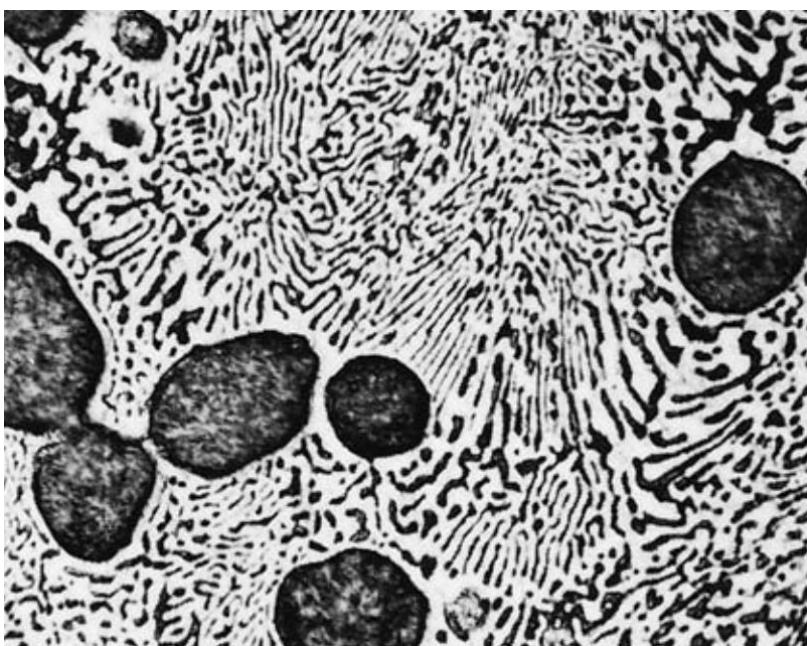
- A **2-phase microstructure** resulting from the solidification of a liquid having the **eutectic composition** where the phases exist as a lamellae that alternate with one another.
- Formation of eutectic layered microstructure in the Pb-Sn system during solidification at the eutectic composition. Compositions of α and β phases are very different. Solidification involves redistribution of Pb and Sn atoms by **atomic diffusion**.



Microstructure development

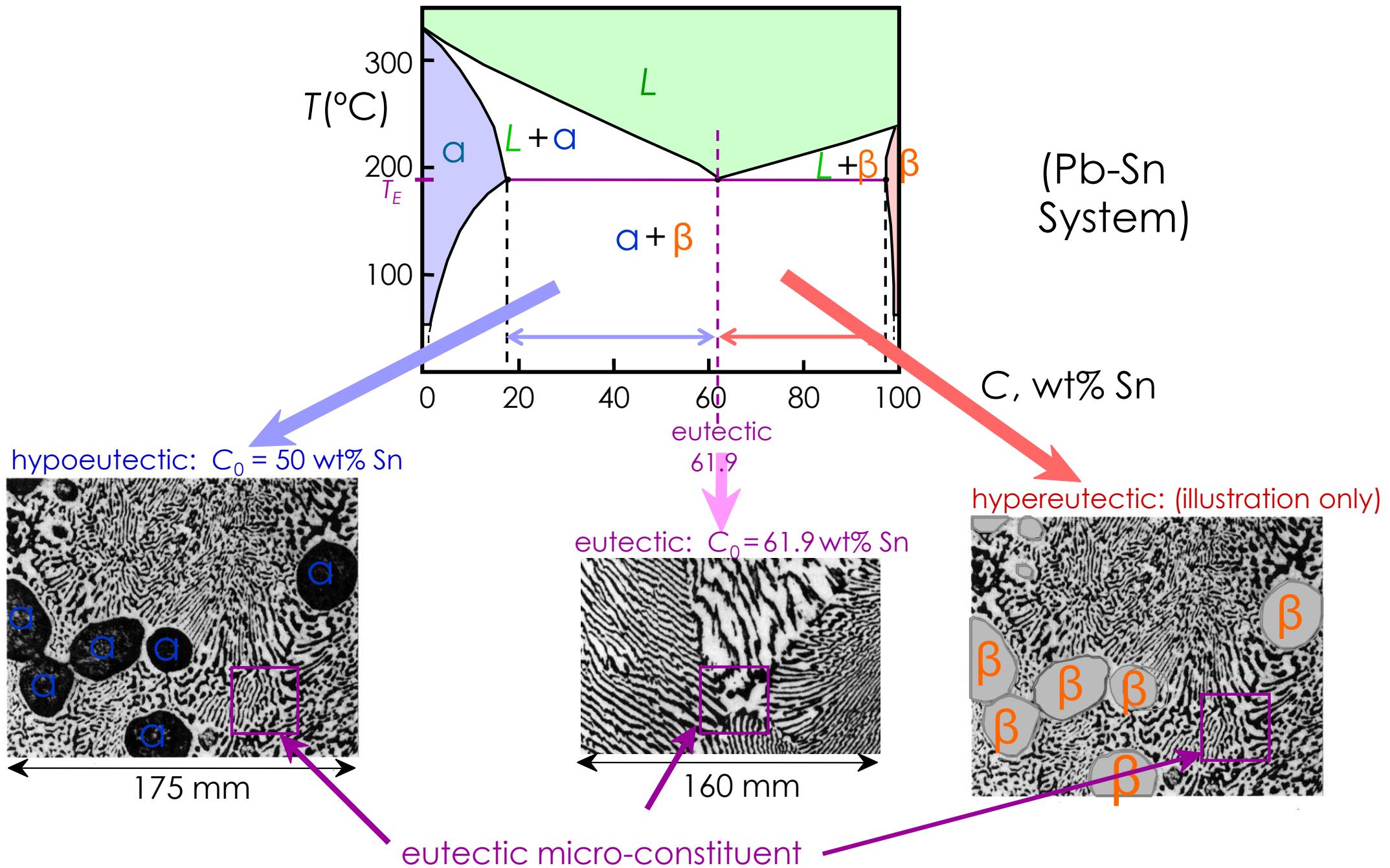
$C_o = 30 \text{ wt. \% Sn}$

Microstructure consists of primary α phase and an eutectic structure between α and β phases



Hypo eutectic & Hyper eutectic

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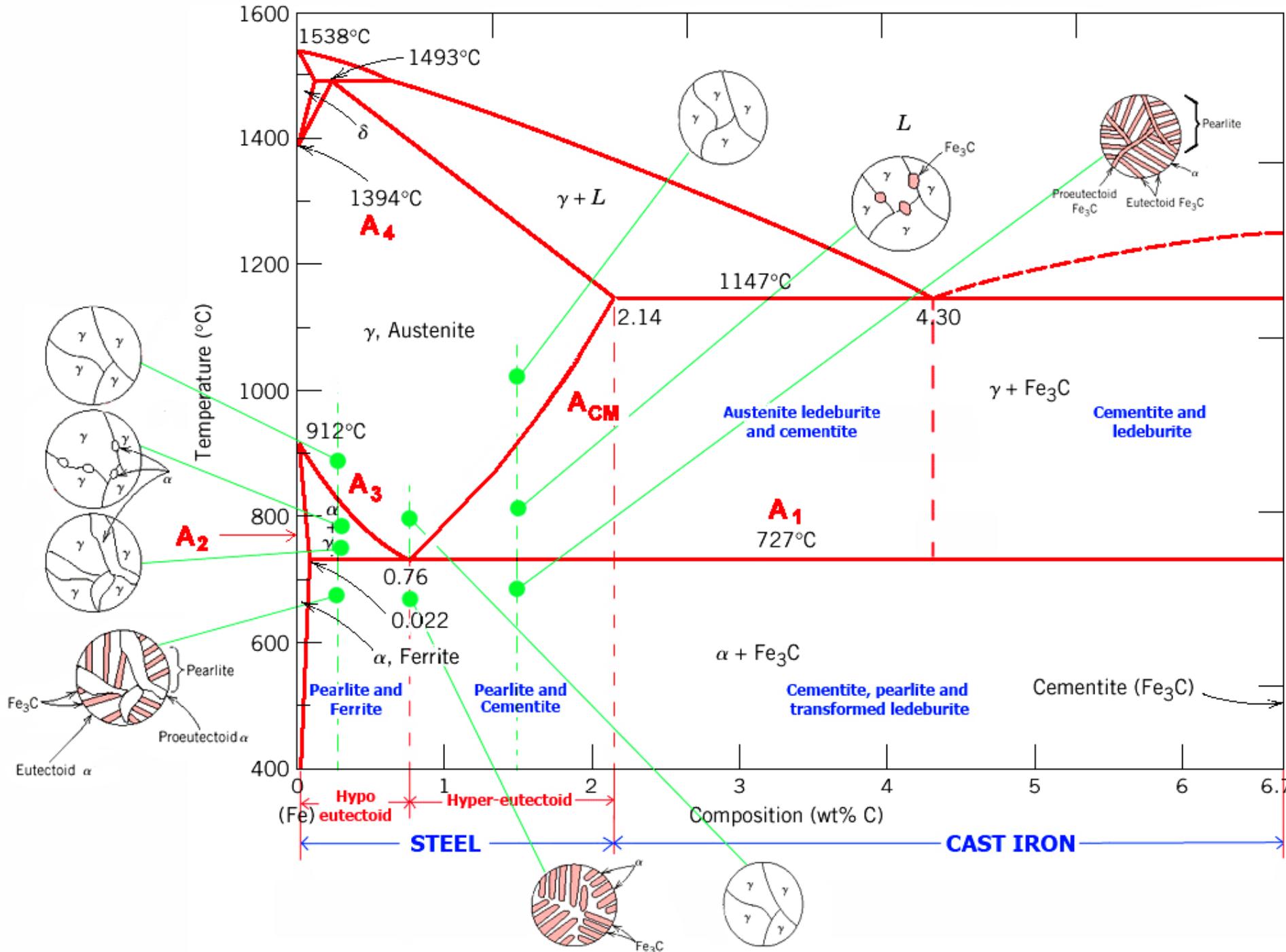


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Iron-Carbon Phase Diagram

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Identify the different reactions in this phase diagram



Summary

1. Binary eutectic phase diagram have a composition where it behaves like a metal called as eutectic composition.
2. Lamellar structure forms at the eutectic composition and below eutectic temperature.
3. Below and above the eutectic composition, the microstructure has primary or proeutectic alpha or beta phase also.