



Phase Diagrams: *Review*

Outline

- Isomorphous phase diagram
- Eutectic phase diagram
- Fe-Fe₃C phase diagram
- Examples



Isomorphous Phase Diagram

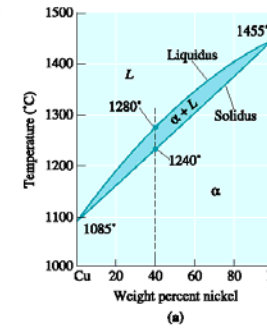
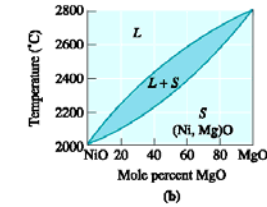
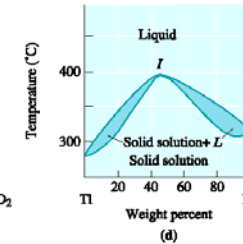
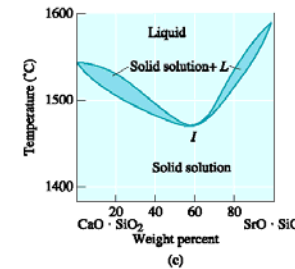


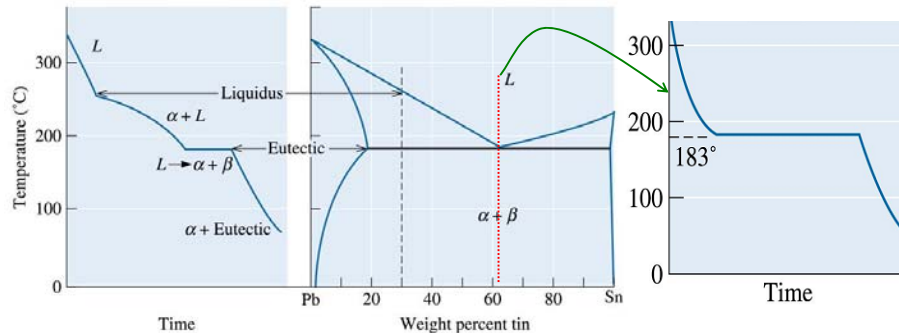
Figure 9.10: adapted from "The Science and Engineering of Materials" by D.R. Askeland and P.P. Phule.



Isomorphous binary phase diagram can be found in a number of metallic and ceramic systems



Eutectic Phase Diagram



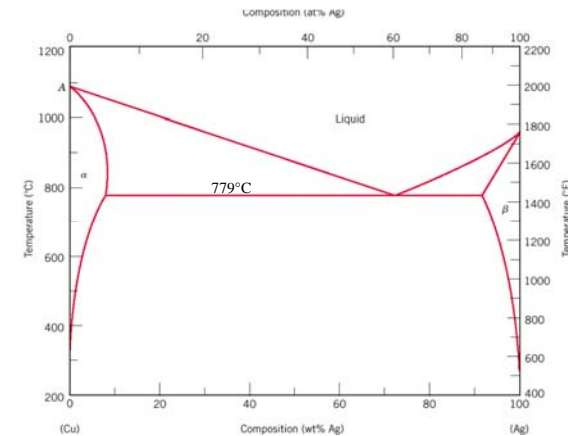
Adapted from Figure 10.13 and 10.18 - "The Science and Engineering of Materials" by D.R. Askeland and P.P. Phule.

- The cooling curve for an eutectic alloy is a simple thermal arrest.
- Please note that eutectics melt or freeze at single temperature whereas another composition like 30 wt% Sn experience primary solidification before the eutectic transformation



Example 1

For Cu-Ag phase diagram shown below:
(a) **Label** the unidentified regions on the diagram.

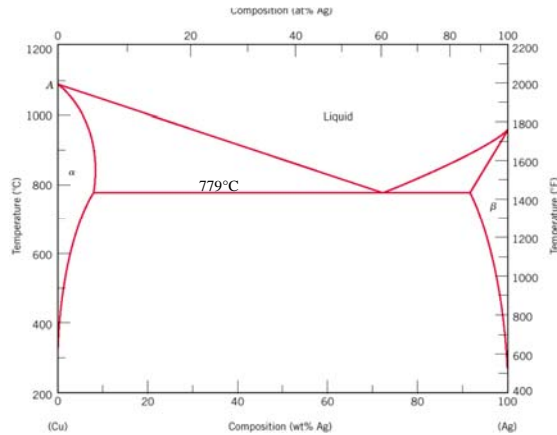


What are the melting temperatures of Cu and Ag?



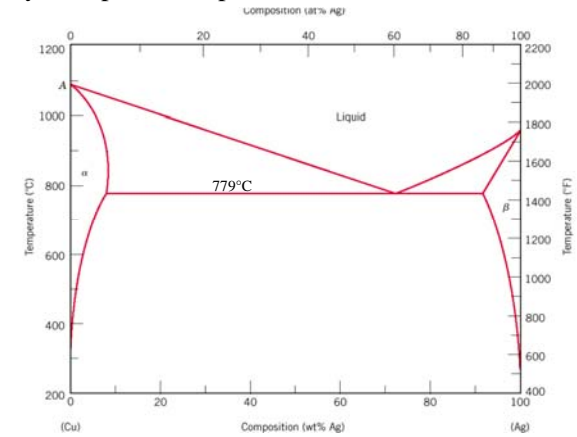
Example 2

Consider the equilibrium cooling of a 95wt% Cu - 5 wt% Ag alloy from the liquid region to room temperature. **Sketch** the microstructure at: 1100°C, 1050°C, 800°C, and 400°C. Please **label** your sketches.



Example 3

Consider a 10 wt% Cu - 90 wt% Ag alloy that has been slowly cooled from liquid to 600°C. **Identify** the phases present; determine their **compositions** and the **relative amounts** of each phase. Also, list the **micro-constituents** that you expect to be present.



Reactions in Binary Phase Diagrams

Eutectic	$L \rightarrow \alpha + \beta$	
Peritectic	$\alpha + L \rightarrow \beta$	
Monotectic	$L_1 \rightarrow L_2 + \alpha$	
Eutectoid	$\gamma \rightarrow \alpha + \beta$	
Peritectoid	$\alpha + \beta \rightarrow \gamma$	

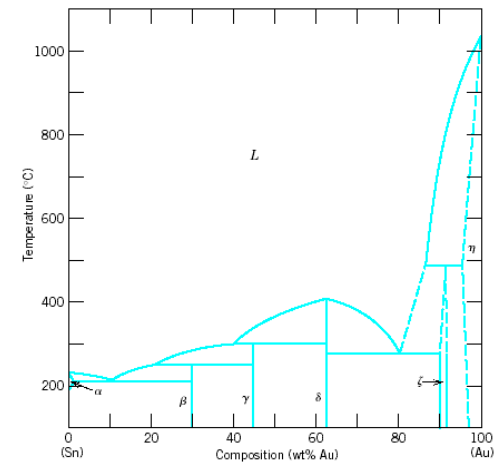
The five most important invariant reactions in binary phase diagrams



Example 4

For the tin-gold phase diagram:

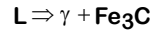
- Label the different phase regions
- Specify the invariant points and write the reaction associated with it



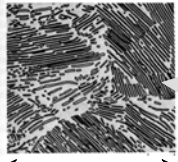
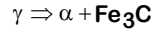


IRON-CARBON (Fe-C) PHASE DIAGRAM

-Eutectic (A):

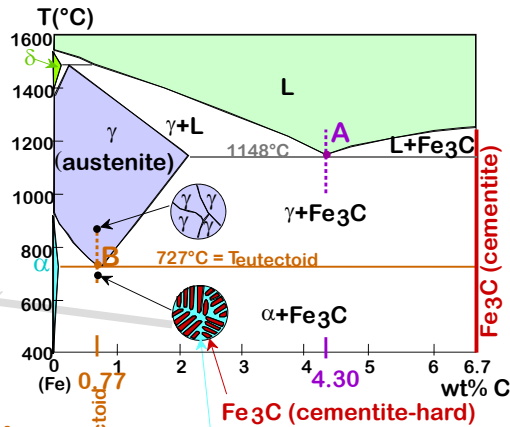


-Eutectoid (B):



Result: Pearlite = alternating layers of α and Fe_3C phases.

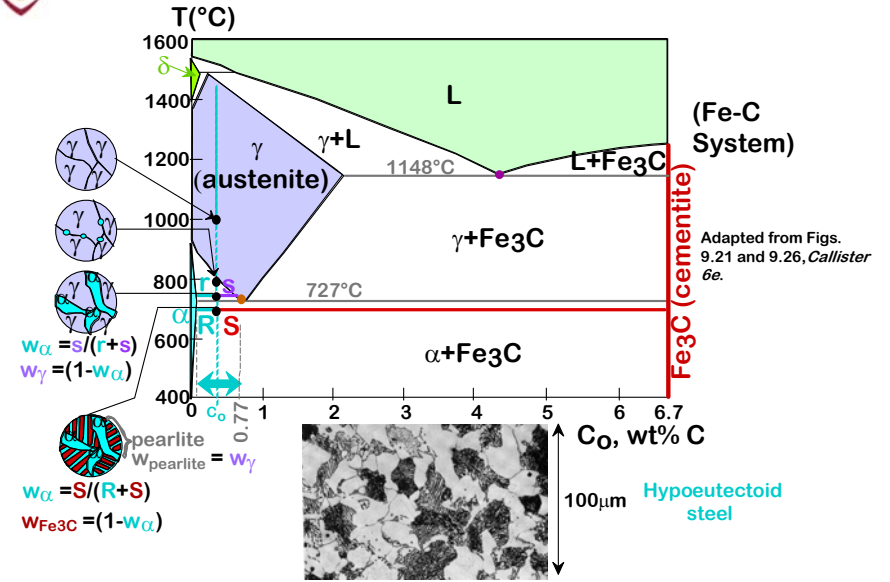
Adapted from Fig. 9.24, Callister 6e.



Adapted from Fig. 9.21, Callister 6e.



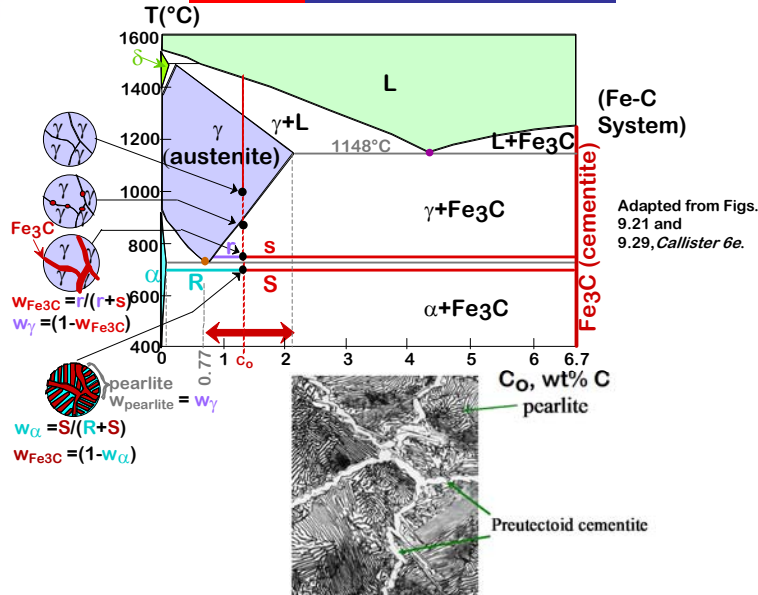
HYPOEUTECTOID STEEL



Adapted from Figs. 9.21 and 9.26, Callister 6e.



HYPEREUTECTOID STEEL

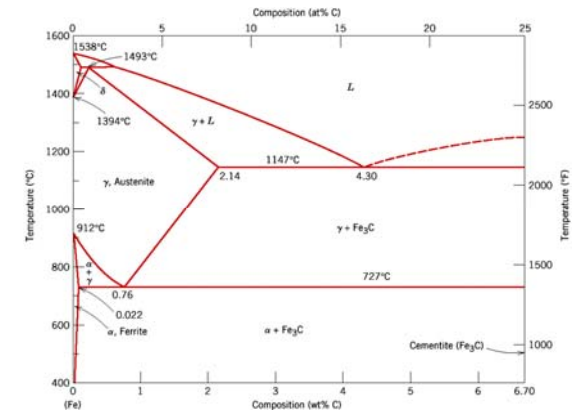


Adapted from Figs. 9.21 and 9.29, Callister 6e.



Example 5

Consider a 2.5 kg sample of austenite containing 0.65wt% C, cooled to below 727°C. (a) what is the proeutectoid phase? (b) how many kilograms each of total ferrite and cementite form? (c) How many kilos each of pearlite and proeutectoid phase form?





The End