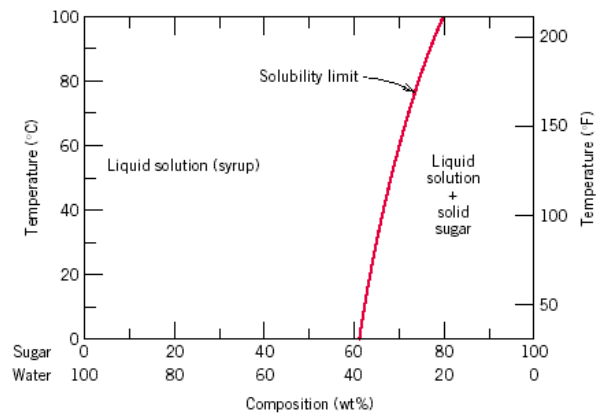
Chapter 9 Phase diagrams

- Introduction
- Solubility limit
- Phases
- Phase equilibria
- Binary isomorphous systems

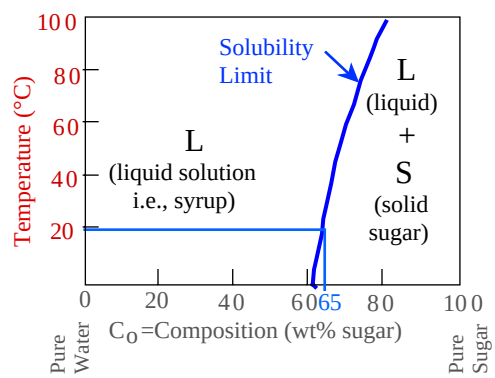
Definitions and basic concepts

- Component: pure metals and/or compounds of which an alloy is composed
- System: a specific body of material under consideration
- A phase: a homogeneous portion of a system that has uniform physical and chemical characteristics
- Equilibrium: a system is at equilibrium if its free energy is at a minimum under some specified combination of temperature, pressure, and composition.
- Phase equilibrium: minimum energy for a system with multiple phases
- Phase diagram: Information about phases as function of T, composition, and pressure

Solubility limit

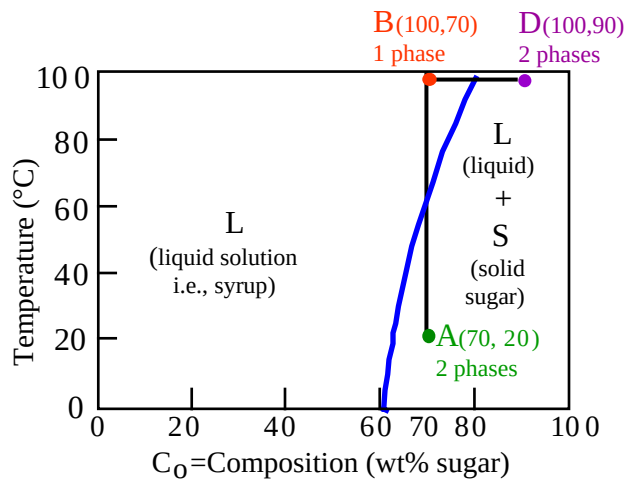


Examples: phase diagram- water-sugar system



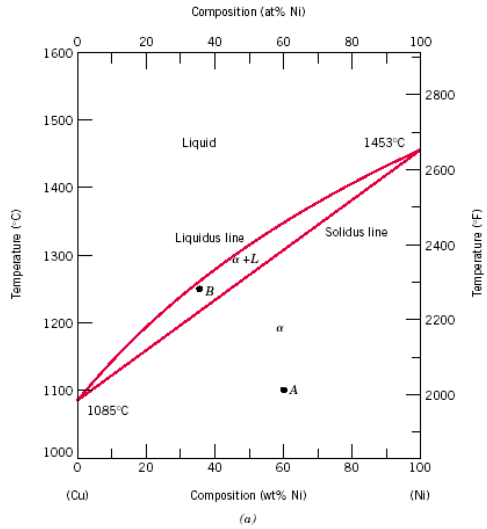
Examples

- water-sugar system



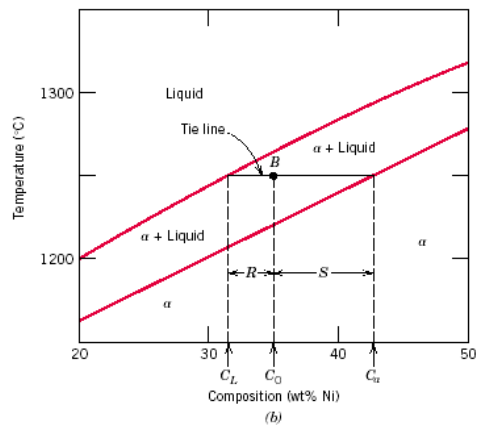
Binary isomorphous systems

- Complete liquid and solid solubility of the two components
- Cu-Ni solid solution
- liquidus line
- solidus line
- melting temperatures
- phase composition
- phase relative amount: tie line and lever rule



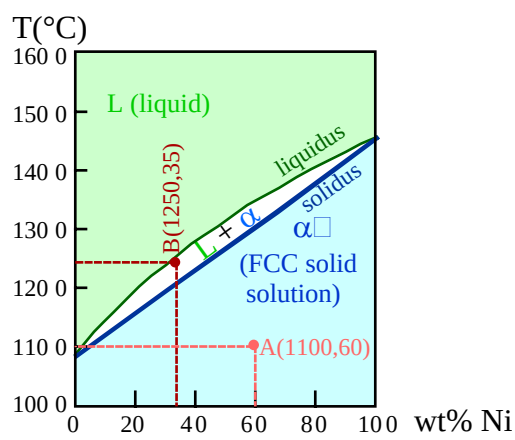
Binary isomorphous systems (*continue*)

- Determine phase composition: lever rule
  - Liquid amount
  - Solid amount



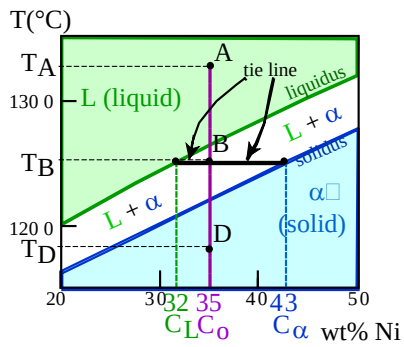
Determination of the number and types of phases present

- Rule 1: If we know T and C_o, then we know:
  --the # and types of phases present.



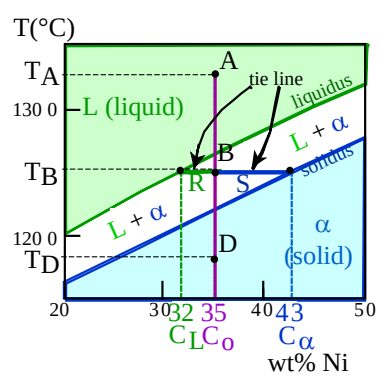
The composition of each phase

- Rule 2: If we know T and C_o, then we know:
  --the composition of each phase.

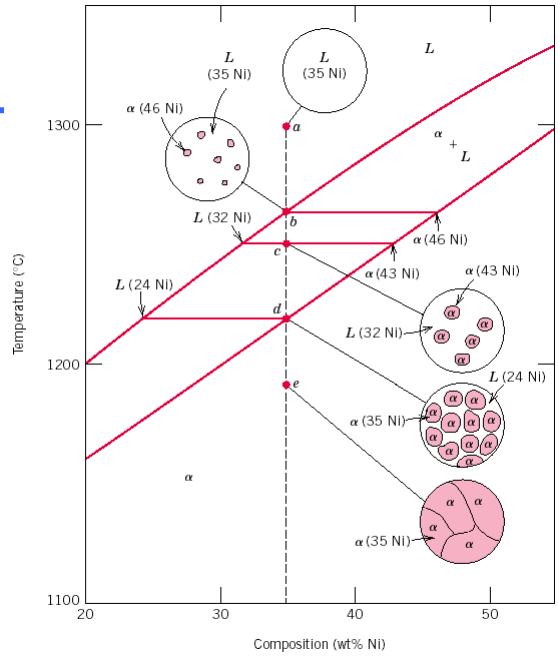


The amount of each phase

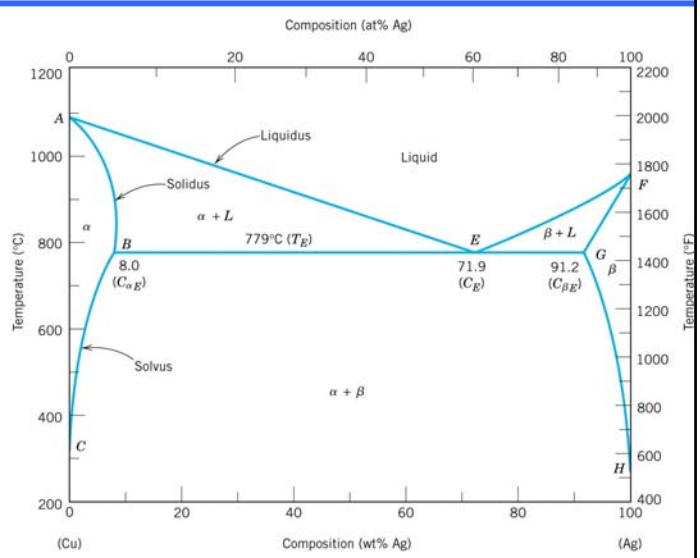
- Rule 3: If we know T and C_o, then we know:
  --the amount of each phase (given in wt%).
- Examples:



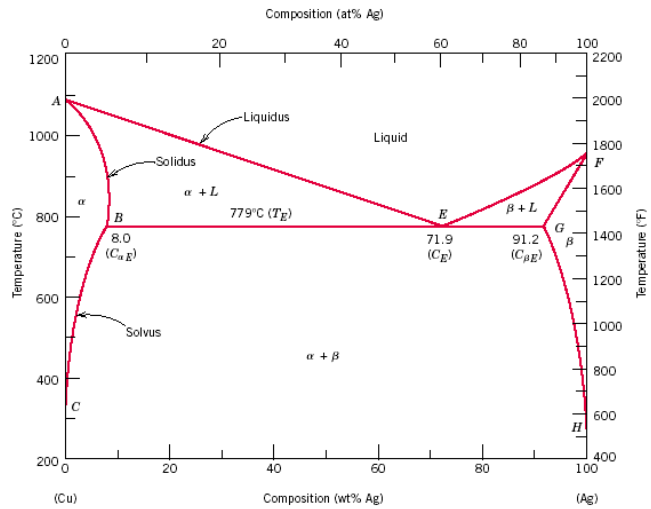
- Development of microstructure



Cu-Ag binary eutectic systems

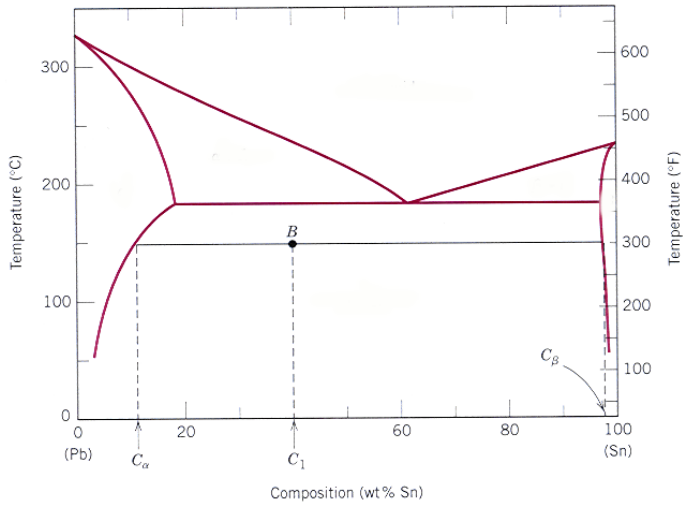


Cu-Ag Binary eutectic systems



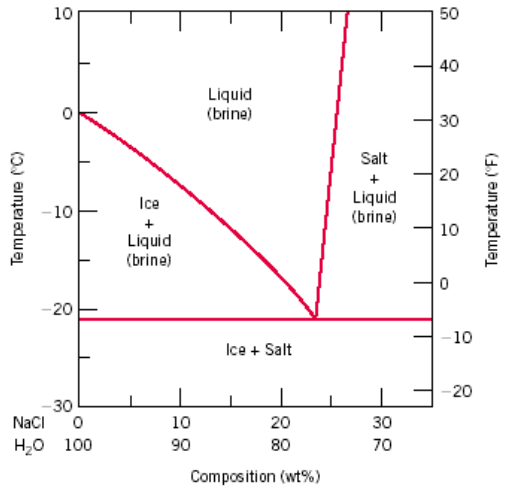
Pb-Sn Binary eutectic systems

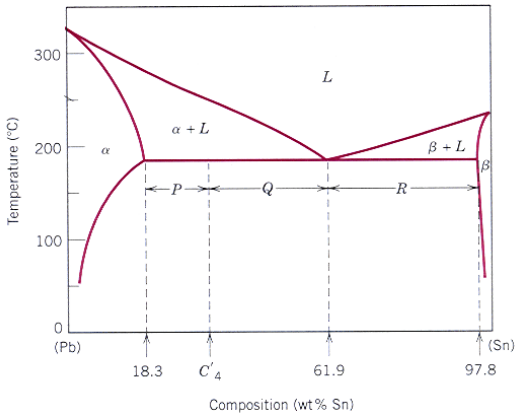
- Low melting temp, solder
- Example:
- Known 40% Sn+60%Pt, T=150^{0}C
- Find phases, phase composition, and relative amount



Binary eutectic systems (Example)

- Explain how spreading salt on ice that is at a temperature below 0^0C can cause the ice to melt.



Binary eutectic systems (example)

- Relative amount
- Liquid
- Primary α
- α