Lecture 16, Feb 17, 2022

Determining Phase Composition

- Given T and C_0 we can determine the composition of the phases present
- When there are multiple phases present, draw a horizontal tie line (isotherm), and the compositions are the compositions at the liquidus and solidus
- The tie line can be thought of as a lever: $M_\alpha S = M_L R$
- Compare the relative lengths of the isoterms

Cored and Equilibrium Structures

- In a equilibrium phase diagram we give infinite time to allow the material to reach equilibrium
- In practice there is often not enough time for equilibrium to form when cooling is fast
- With enough time diffusion smoothes out the grains; if cooling is too fast (quenching) the structure will be *cored*: the innermost layers have higher concentration and then lower concentrations in the outer layers

Mechanical Properties

- Combining metals in solid solution strengthens the materials
  - e.g. in nickel-copper alloy this increases tensile strength but decreases ductility

Binary Eutectic Systems

- "Low melting point" materials with limited solubility with each other
- 2 solid phases, each with limited solubility
  - The lines bounding the left and right regions are the solubility limits
- At the eutectic concentration:
  - Above the melting point we get a homogeneous liquid
  - Just below the eutectic line we get both phases
- For an alloy of composition $C_0 = C_E$, a lamella structure is formed
  - α and β phases alternate in micropatterns
  - Rapid diffusion over very small distances as the α and β phases form
- Going from above the eutectic temperature to below the eutectic temperature locks in the grains formed initially and the rest of the liquid forms lamellae
- Hypoeutectic: lower than the eutectic concentration; hypereutectic: above the eutectic concentration