

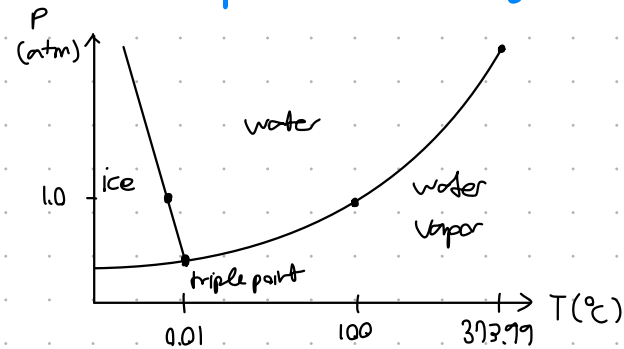
Component: indiv. chemical elements within a material
Phase: distinct arrangements w/ unique prop. formed by comp.
Homogeneous solution: homogeneous mixtures where one component (solute) is uniformly distributed in another (solvent).
Heterogeneous: distinct phases visible.
Substitutional solutions: solute atoms replace solvent atoms
Interstitial solutions: smaller solute atoms occupy empty spaces within solvent lattice (enhances ductility & σ).

Phase Diagrams: graphical rep. of thermodynamic conditions where diff. phases of a material exist & are stable.
 → mat. selection, process optimization, property prediction

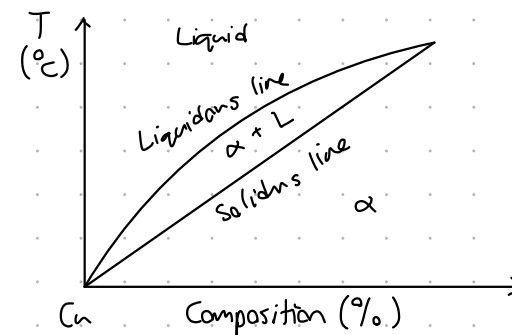
Phase Equilibrium: when diff. phases coexist in a stable state (e.g. water/ice/water vapor @ 0.01°C triple point).

Solubility Limit: max concn. of a comp. that can dissolve in another comp. @ a Temp.

One-Component Phase Diagram



Binary System



Solidus Line: marks temp. below which all materials are solid
Liquidus Line: marks temp. above which all materials are liquid
Boundary Lines: separate regions where diff. phases coexist.
Tie Lines: connect comp.s of coexisting phases.

Lever Rule: calculating comp. of the diff. phases;
 optimizes material blends, control properties, & ensure mat. uniformity.
 quantifies the relative amounts of diff. phases present in a mat.

↳ **Weight Fractions:** amount of each phase;
 mat. characterization, performance prediction, & cost analysis.

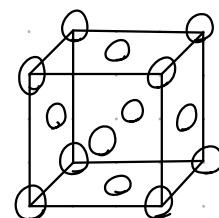
Eutectic Mixture: eutectic pt → liquid → unique mix. of 2 solid phases at specific temp & comp. ⇒ high strength & wear resist.

Lead-Tin (Pb-Sn) Eutectic System:

61.9% Sn, eutectic temp ~ 183°C ⇒ solder
 Comp. > 61.9% Sn at 183°C: precipitation of Tin-rich solid in liquid mix, comp < 61.9%, then app.

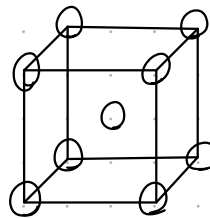
Iron-Carbon Phase Diagram:

Austenite (FCC)



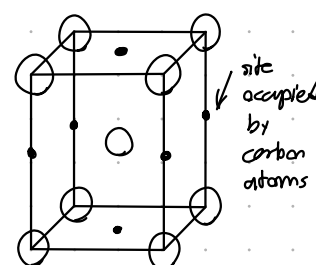
Face-Centered Cube

Ferrite (BCC)



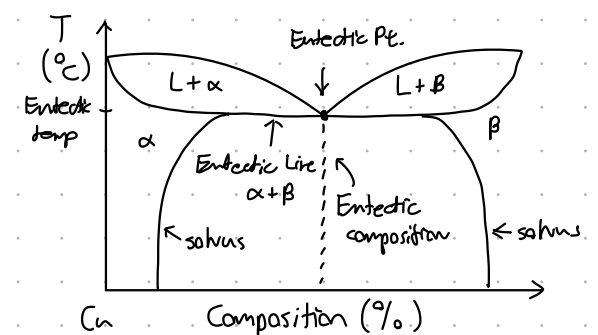
Body-Centered Cube

Martensite (BCT)



Body Centered Tetragonal

Binary Systems w/ a Eutectic Point



Eutectic point: liquid phase → two solid phases
 @ a fixed Temp & composition
Graph: shows temp & comp. for liquid, solid alpha, solid beta, & the eutectic mixture.

Ternary Systems: three components