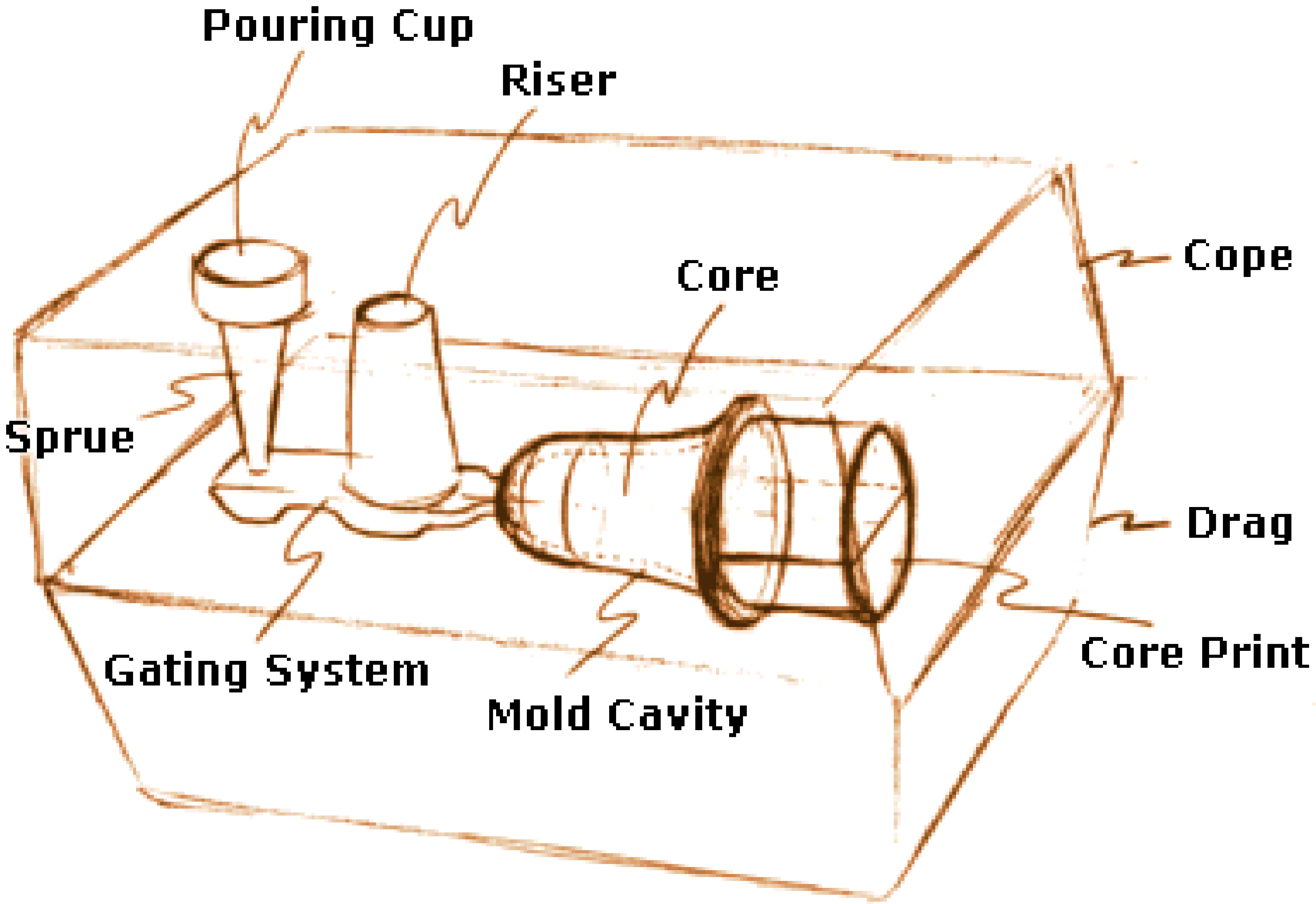
ME 330: Engineering Materials

Lab - 4

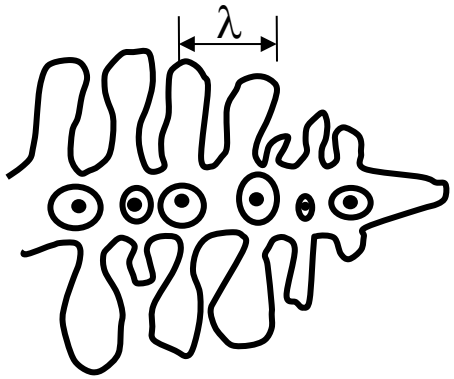
Solidification and Phase Diagrams

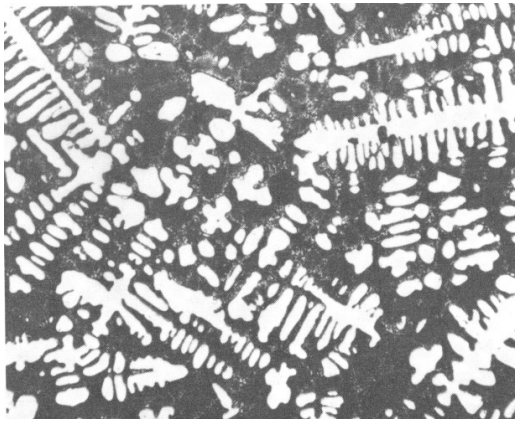
Sand Casting

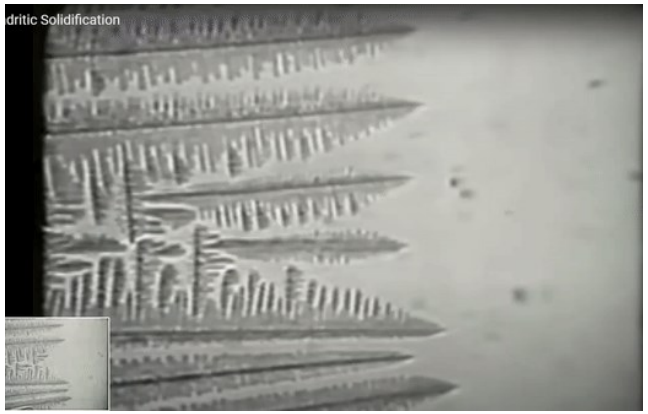


Dendritic Growth

- Dendrite formation occurs at nucleation sites
  - Branched, tree-like structures
  - Three dimensional (fractal like structures, with high surface area)
  - In most cubic systems [100] is the only growing directions
- Dendrite arm spacing (λ) has important effects on material properties







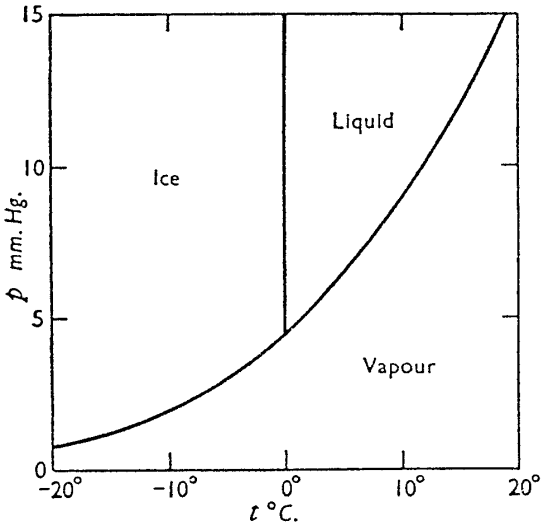
Controlling microstructure

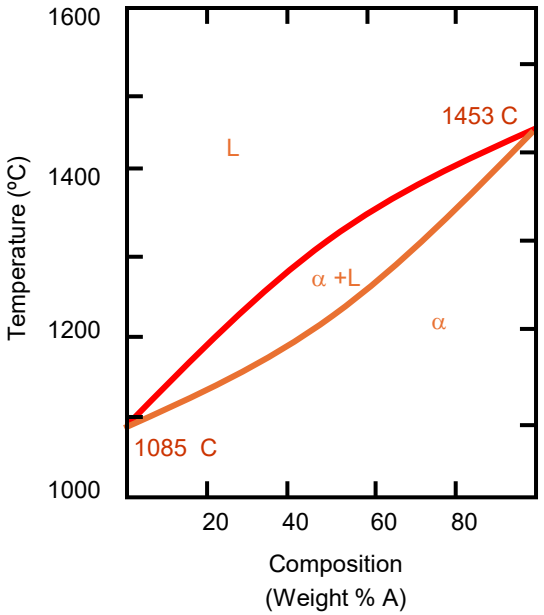
More central grains form with:

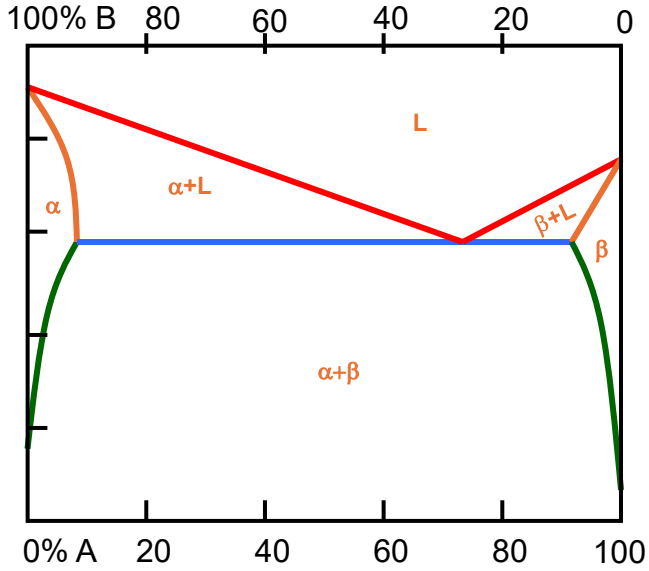
- Heterogeneous Nucleation
  - Mold walls also act as nucleation sites
  - Add alloy to increase melting (mushy) range
    (pure, high-freezing-temp nuclei survive easier in alloy, low-freezing-temp liquid, so more equiaxed crystals)
  - “Grain refiners” promote nucleation
    - Add solid second phase which act as nucleation sites
- Mold vibration
  - Break off dendrites
  - Broken dendrites act as nucleation sites
- Heat mold
  - Less chill zone at wall
- Lower Superheat of molten metal
  - (easier for central nuclei to form and survive)

Phase diagram

- Graphical representation of (equilibrium) phases present as a function of the state of the system (e.g., environment, composition)

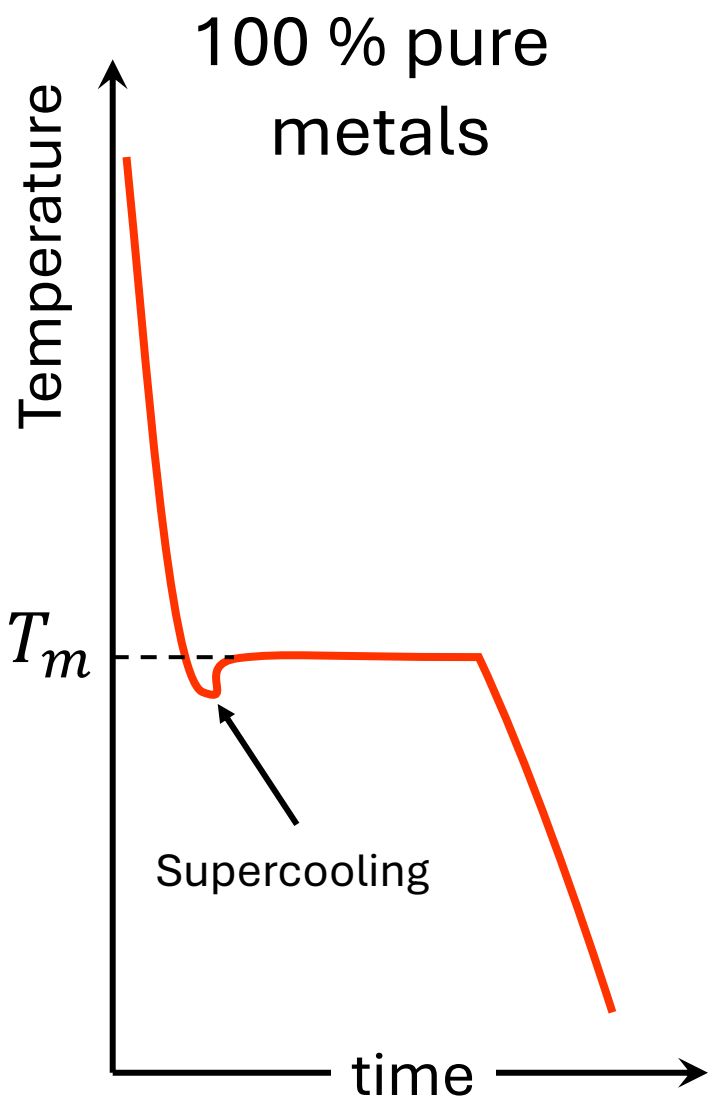


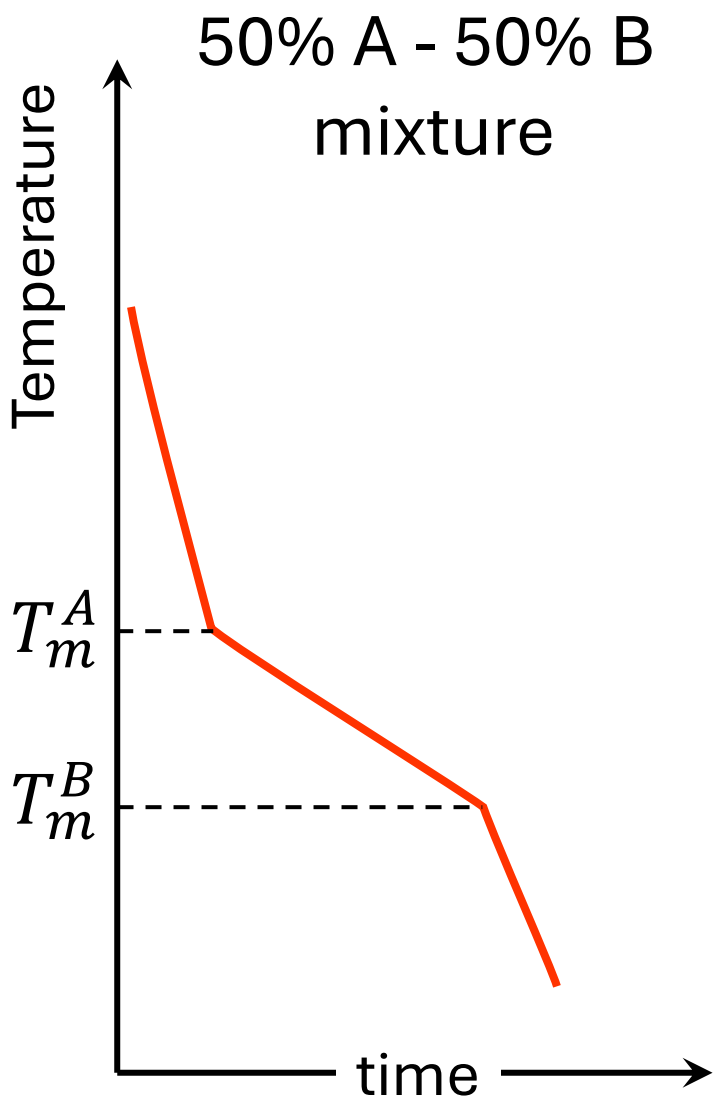




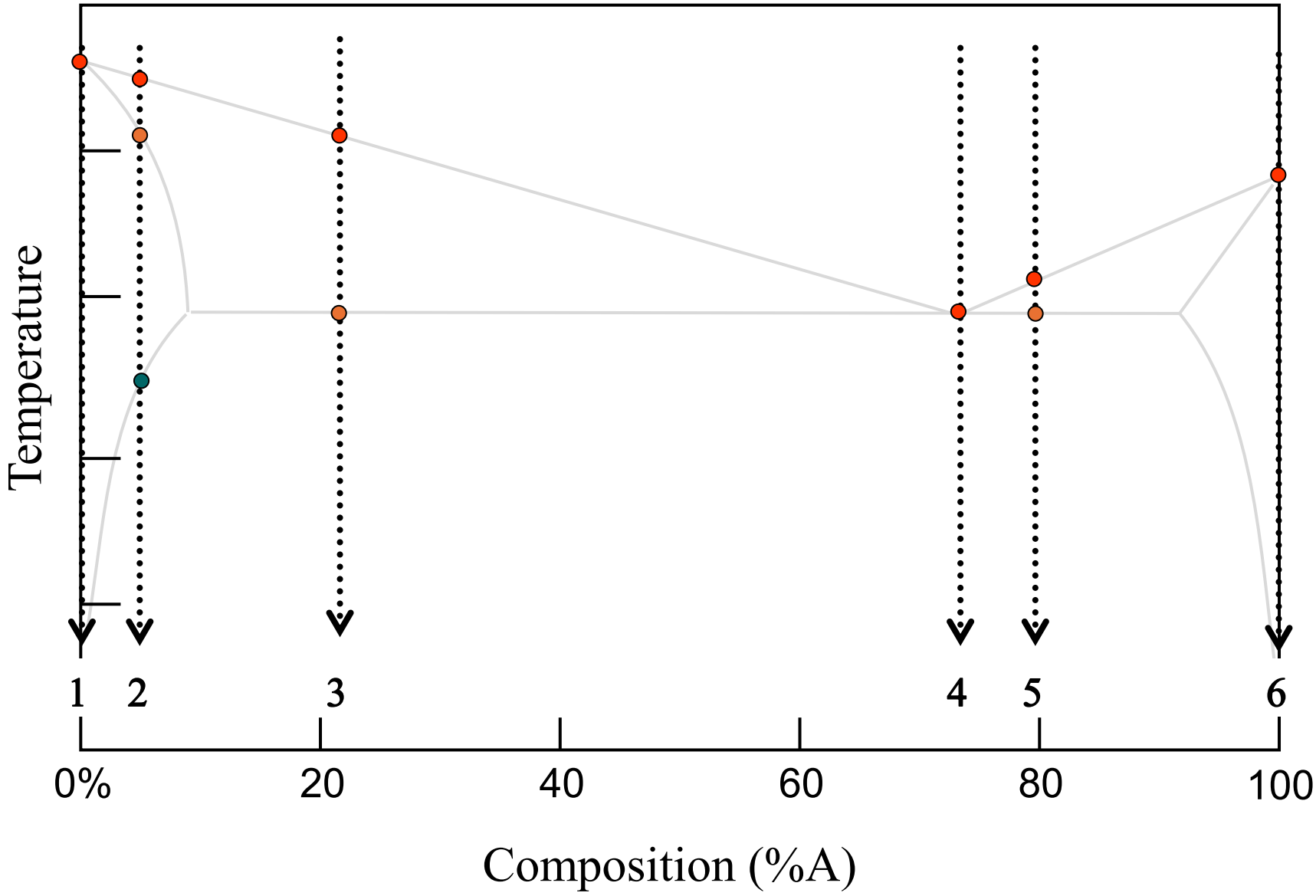
Answer the question in one (01) sentence, what is phase?

Cooling curve





Building a Eutectic Phase Diagram



Casting video links

Casting:

https://www.youtube.com/watch?v=mx1qteRUYwI

Die Casting:

https://www.youtube.com/watch?v=h2A7oUMeLmM