

MSE200

Lecture 11 (CH. 8.1-8.4)

Phase Diagrams I

Instructor: Yuntian Zhu

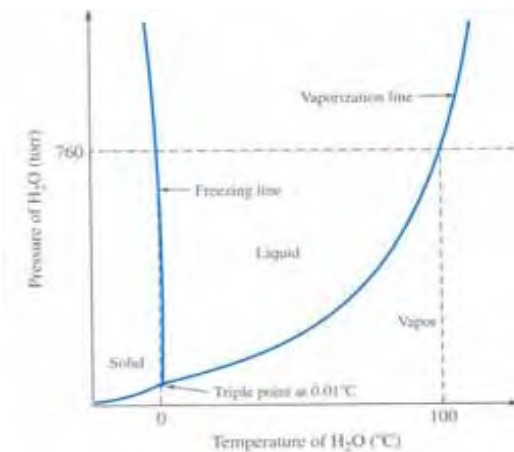
•Objectives/outcomes: You will learn the following:

- Definition of phase
- Phase diagram
- Phase rule
- Simple phase diagrams
- Time-temperature cooling curves
- Phase diagram determination

Introduction

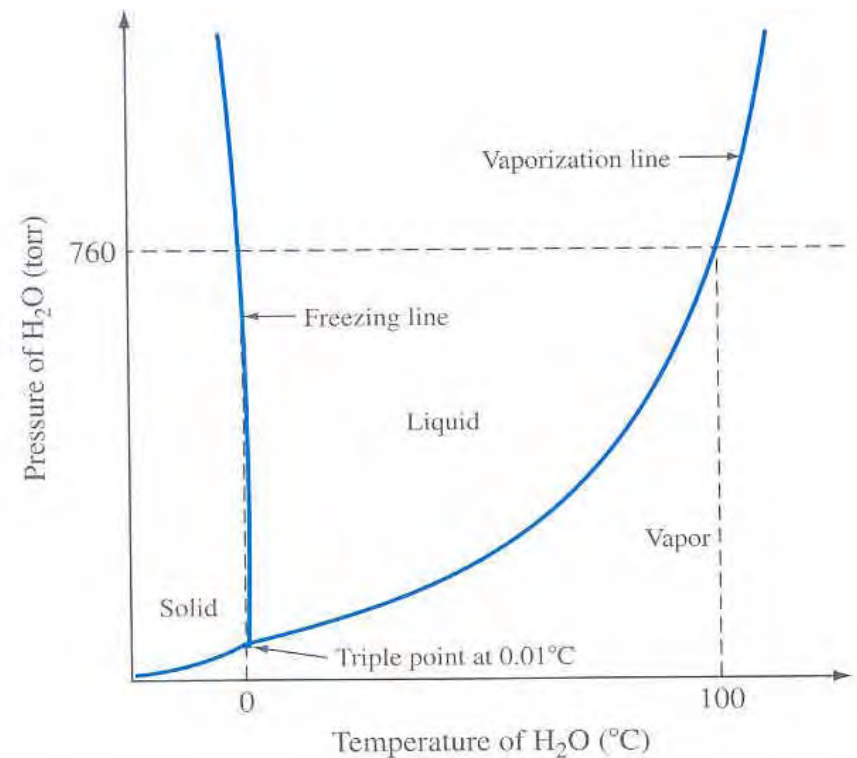
- **Phase:**
 - A material with distinct structure
 - Solid ice, liquid water, water vapor: 3 different state
 - Glass, quartz
 - Fe: bcc, fcc
 - Why is it important?

- Phase diagrams:
 - A phase map



Phase Diagram of Pure Substances

- Pure substance exists as solid, liquid and vapor.
- Phase regions for a pure material (T-P)
 - *Single phase*
 - *Two phases*
 - *Three phases*
- Phase regions for a pure material (constant pressure)
 - *Single phase*



Gibbs Phase Rule

- $P+F = C+2$

P = number of phases that coexist in a system

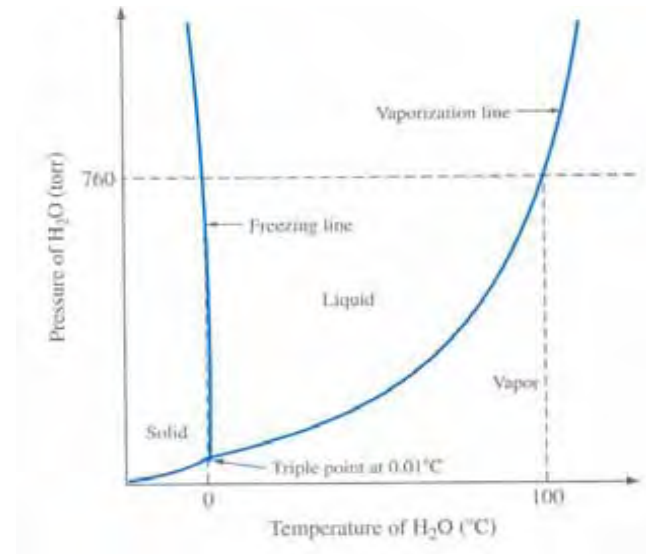
C = Number of compositional components

F = Degrees of freedom

- $P+F = C+1$

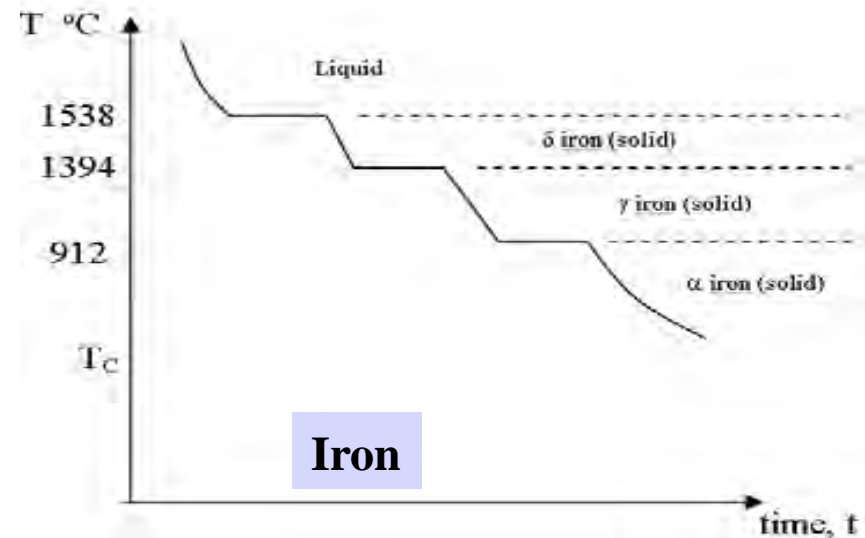
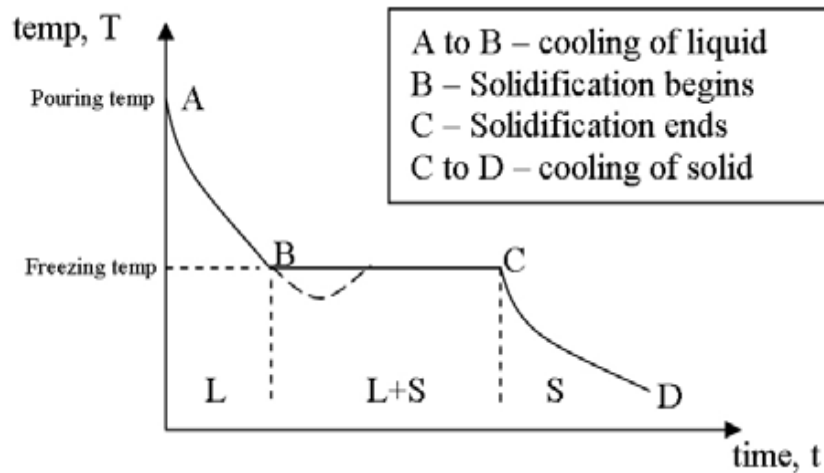
- **Freedom in water phase regions:**

- **Phases in equilibrium**



Cooling Curves of Pure Substance

- Temperature and time data of cooling

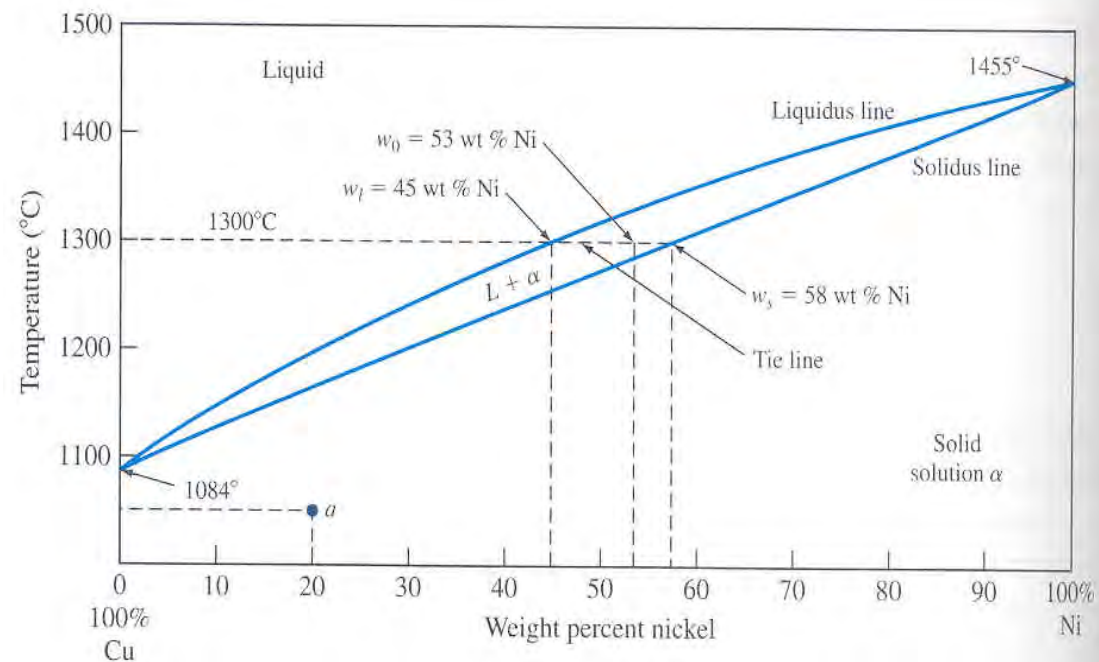


Iron

Pure Metal

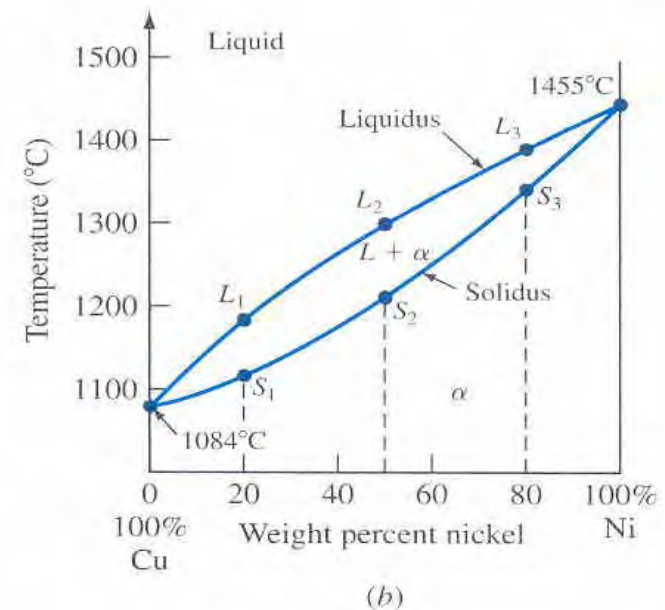
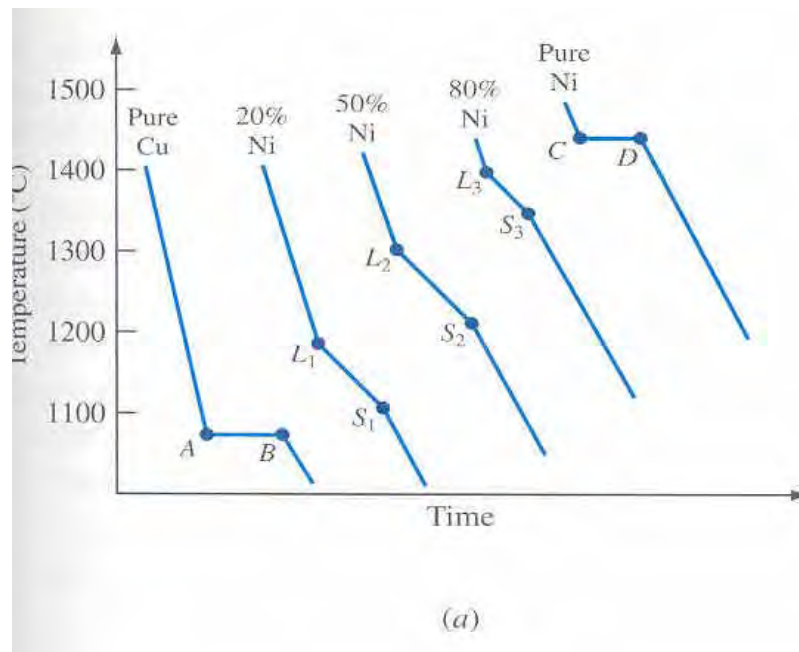
Binary Isomorphous Alloy Systems

Isomorphous system: Two elements completely soluble in each other in liquid and solid state.



Phase Diagram from Cooling Curves

- Series of **cooling curves** at different metal composition are first constructed.
- Determination of phase diagram



Homework

- Example problems:
- Chapter 8: 2, 3, 4, 5, 6,
- Reading assignment: 8.5-8.8