

ENGR/MSE 170 final review

- ☐ Exam date: Section A: 6/8/2004 Tues, 8:30-10:20am; B: 6/10/2004 Thurs 8:30am-10:20pm
- ☐ Place: Mueller 153
- ☐ The final exam will be comprehensive
- ☐ Closed book, notes and neighbors
- ☐ 2 sheets of double-side letter-sized paper are allowed
- ☐ Material on the exam will be taken from text book, lecture, homework and lab
- ☐ Bring a calculator and straight edge/triangle

Bonding and atomic forces

- ☐ The Periodic table
- ☐ What types of bonding are there?
- ☐ How does bonding affect materials properties?

Bonding and atomic forces (continue)

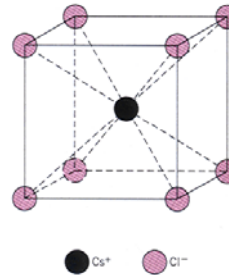
- ☐ Atomic forces & potential vs interatomic distance

Crystal structure

- ☐ Determine #atoms/unit cell, CN#, APF and density
- ☐ Draw and index crystallographic direction and planes
- ☐ Close-packed plane stacking sequence

Crystal structure (*continue*)

- Know the types of ceramic structures and identify their unit cells
- Determine coordination number for ceramic structures based on ionic radii and charge



Defects

- Distinguish point, linear (dislocation 1D), interfacial(2D), volume(3D)
- Draw and describe edge and screw dislocations
- Understand equilibrium of vacancies and effect of T

Diffusion

- ☐ Mechanisms, concentration gradients, diffusion coefficient
- ☐ Ficks first law
- ☐ Effects of T on diffusion coefficients
- ☐ Diffusion paths (interstitial vs. vacancy, grain boundary and surface)

Mechanical properties

- ☐ Definition of stress, strain, elastic modulus
- ☐ Analysis of stress-strain curves
- ☐ Yield strength, tensile strength, Poisson's ratio, ductility, resilience and toughness
- ☐ Hardness

Plastic deformation

- Slip plane, direction and system, resolved stress
- Mechanism of plastic deformation
- Strengthening mechanisms
- Recovery, recrystallization and grain growth

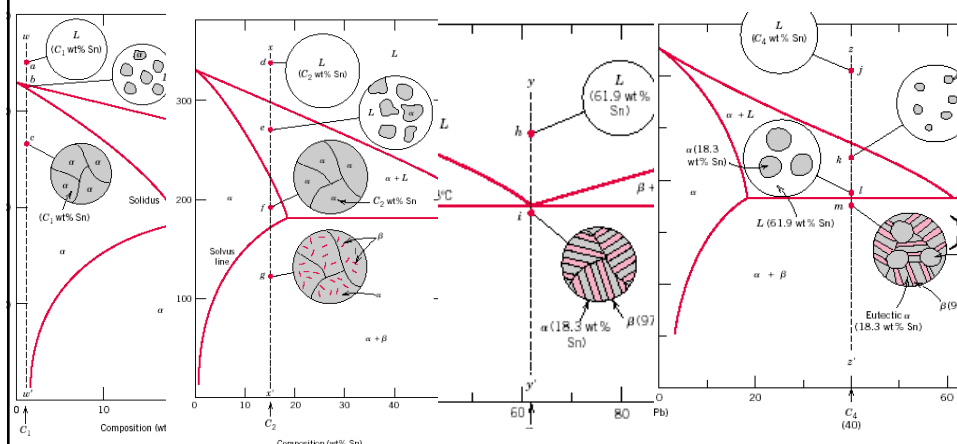
Failure

- Ductile vs brittle fracture
- Stress concentrations and fracture toughness
- Creep and fatigue failure

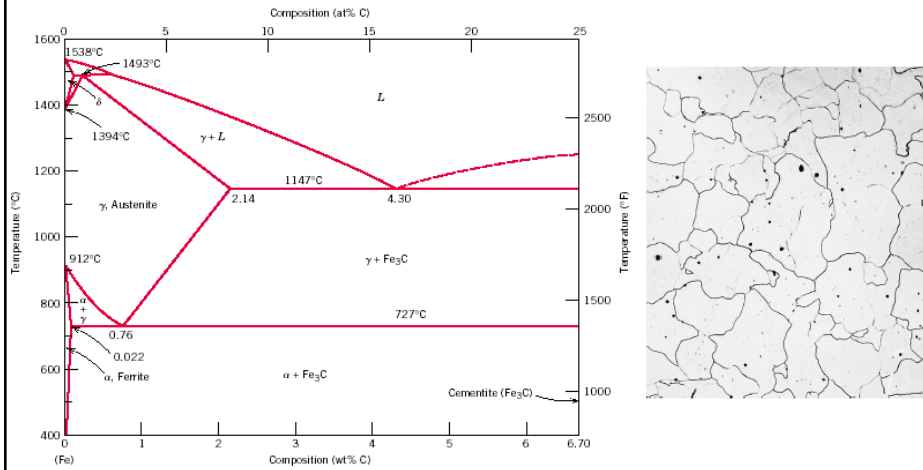
Phase diagram

- Solubility limits, solidus, liquidus
- Binary isomorphous and eutectic phase diagrams
- Eutectic, peritectic, eutectoid reactions
- Lever law, weight fraction of phases
- Composition and microstructure of equilibrium phases

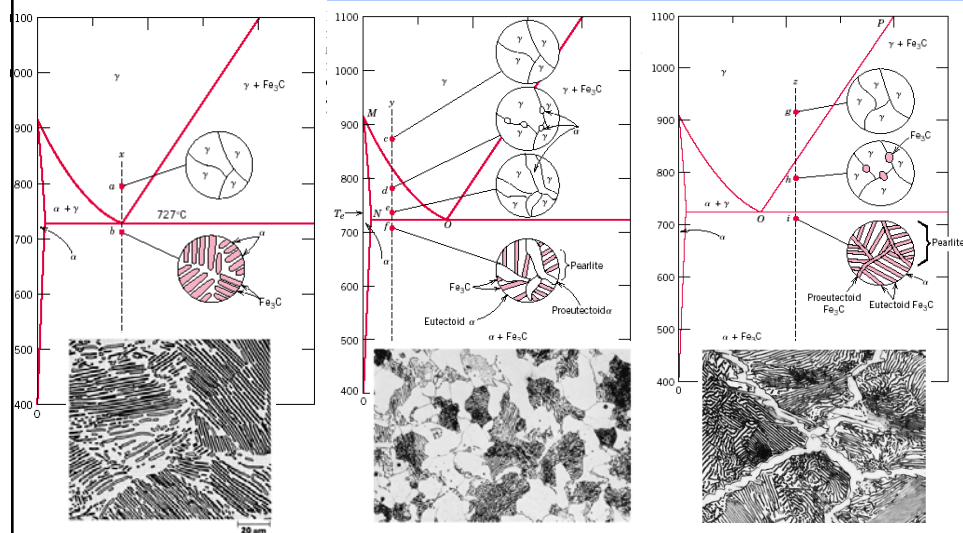
Phase diagram



Phase diagram



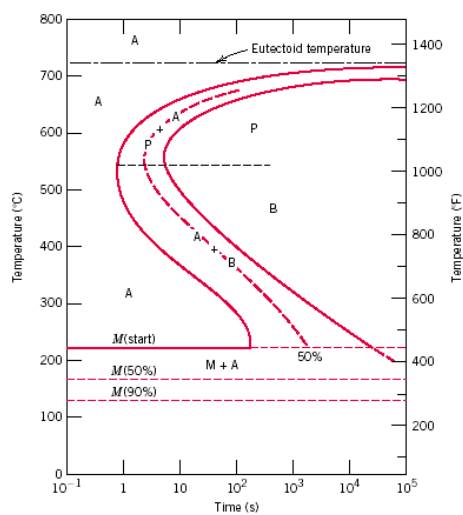
Phase diagram



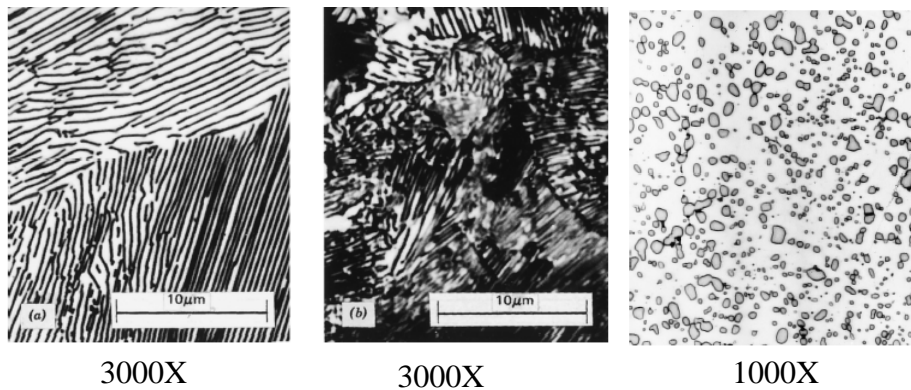
Phase transformation

- Nucleation/growth controlled phase transformation
- Diffusional vs diffusionless
- Rate of transformation
- Isothermal transformation diagrams

Phase transformation



Phase transformation



Electrical properties

- ☐ Intrinsic semiconductors
- ☐ Extrinsic semiconductors
- ☐ Energy band structure
- ☐ Electric conductivity, resistivity and mobility
- ☐ Carrier concentration
- ☐ P-N junctions and diodes

Polymer properties

- ☐ Hydrocarbon molecules
 - Saturated and unsaturated
 - Bonding
 - Melting point
 - Isomerism
 - mer, monomer, polymer
- ☐ copolymer, homopolymer, blockpolymer
- ☐ molecular structures of polymers
- ☐ Mechanical properties of polymers
- ☐ Crystallization, melting, and glass transition phenomena
- ☐ Thermoplastic and thermosetting polymers

Structures and properties of ceramics

- ☐ Imperfection in ceramics
- ☐ Electric properties of ceramics
- ☐ Ceramic phase diagrams
- ☐ Mechanical properties of ceramics

Composites

- Composites, matrix, dispersed phase
- Types of composites and characteristics of each
- Mechanical properties of composites including upper bound and lower bound of elastic modulus