ENGR/MSE 170 final review

- Exam date: Section A: 6/5/2007 Tues, 8:30-10:20am; B: 6/7/2007 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)

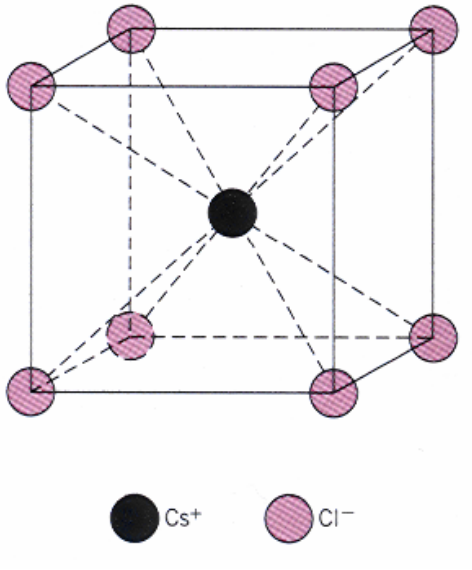
- Atomic forces & potential vs interatomic distance

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 shear stress
- Mechanism of plastic deformation
- Strengthening mechanisms
- Recovery, recrystallization and grain growth

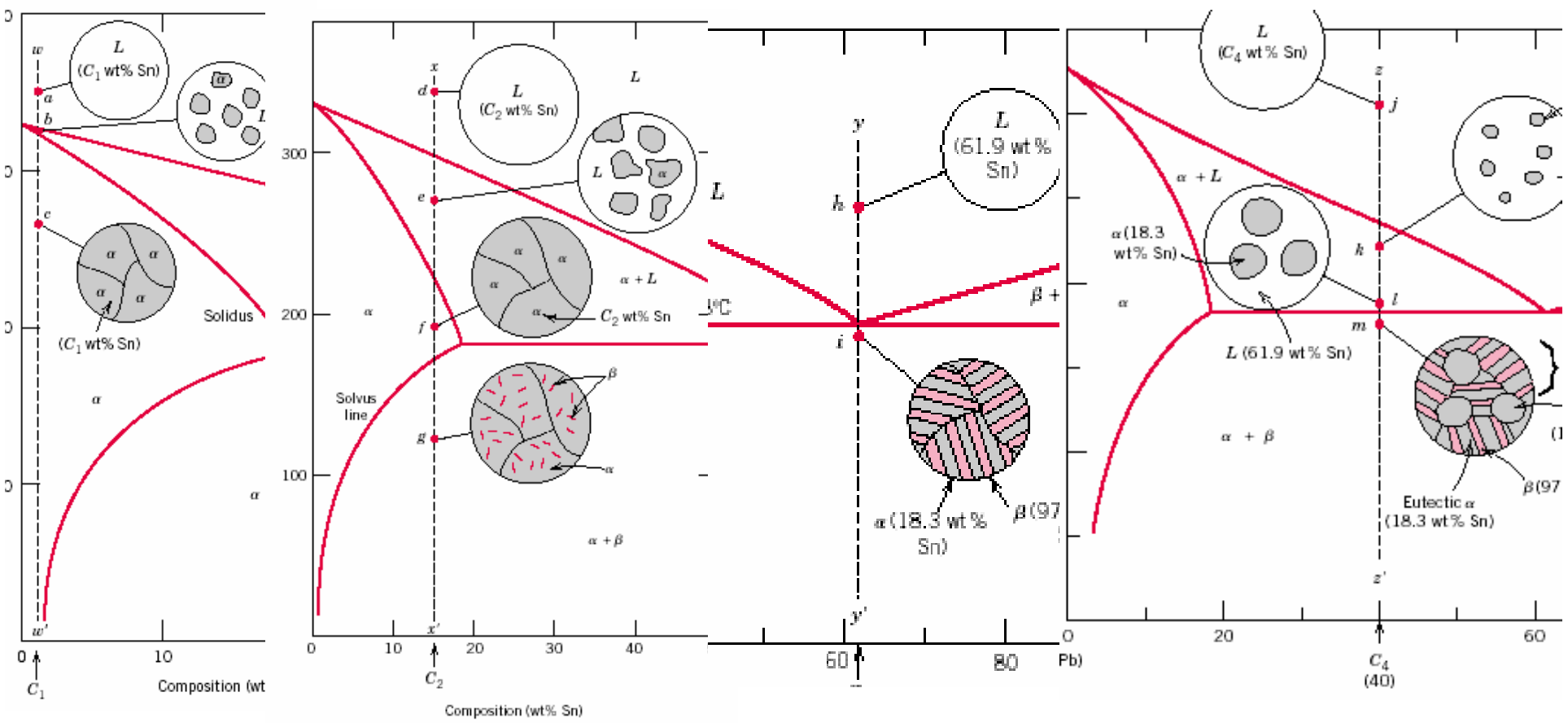
Failure

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

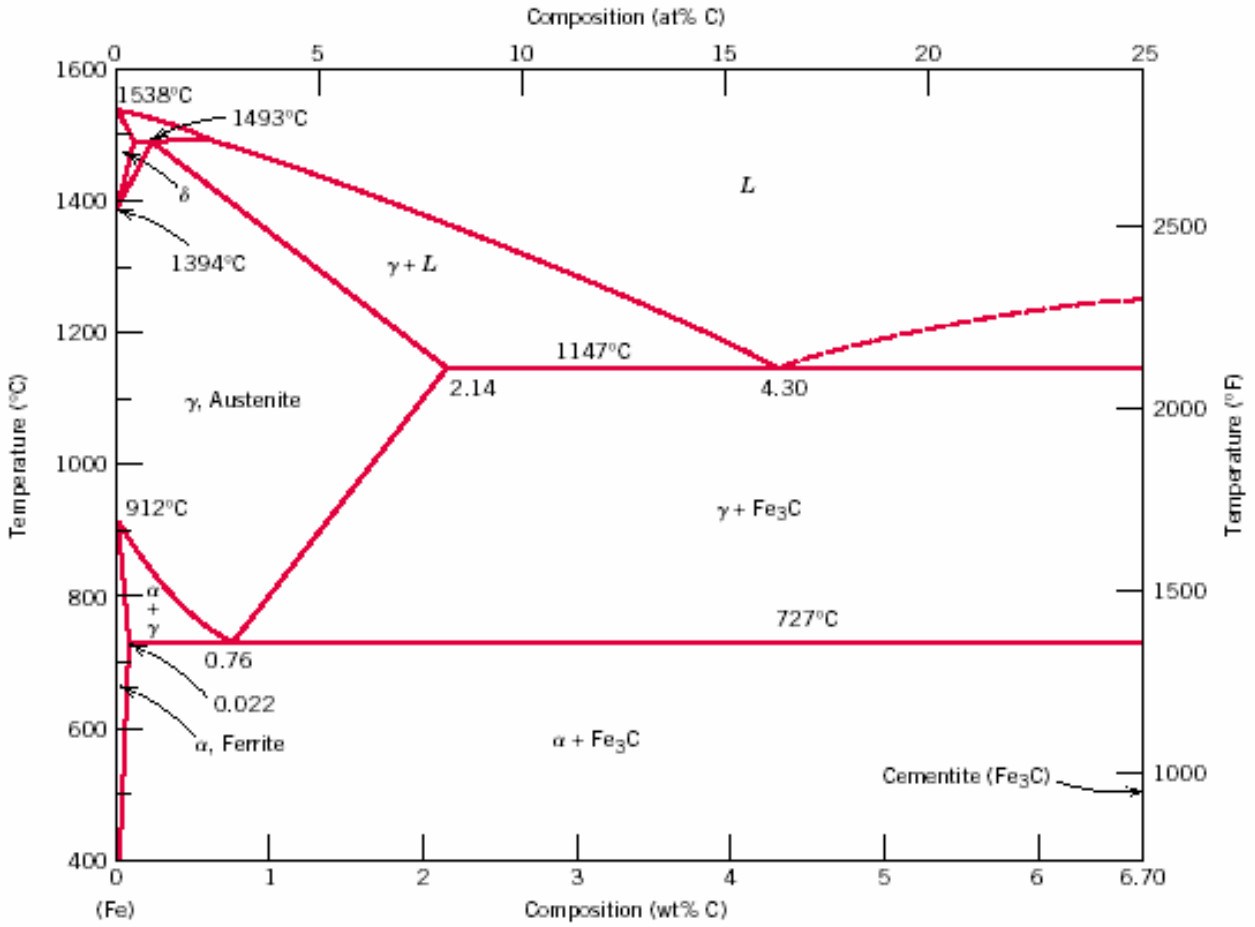
Phase diagram

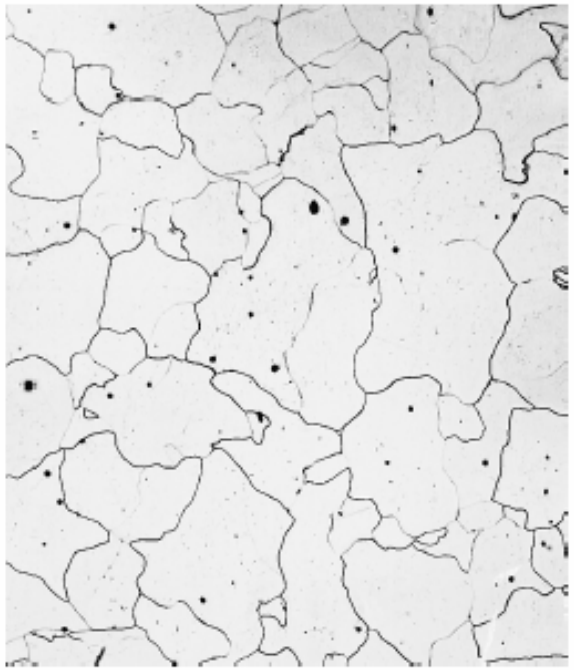
- Solubility limits, solidus, liquidus
- Binary isomorphic and eutectic phase diagrams
- Eutectic, peritectic, eutectoid reactions
- Lever law, weight fraction of phases
- Composition and microstructure of equilibrium phases

Phase diagram

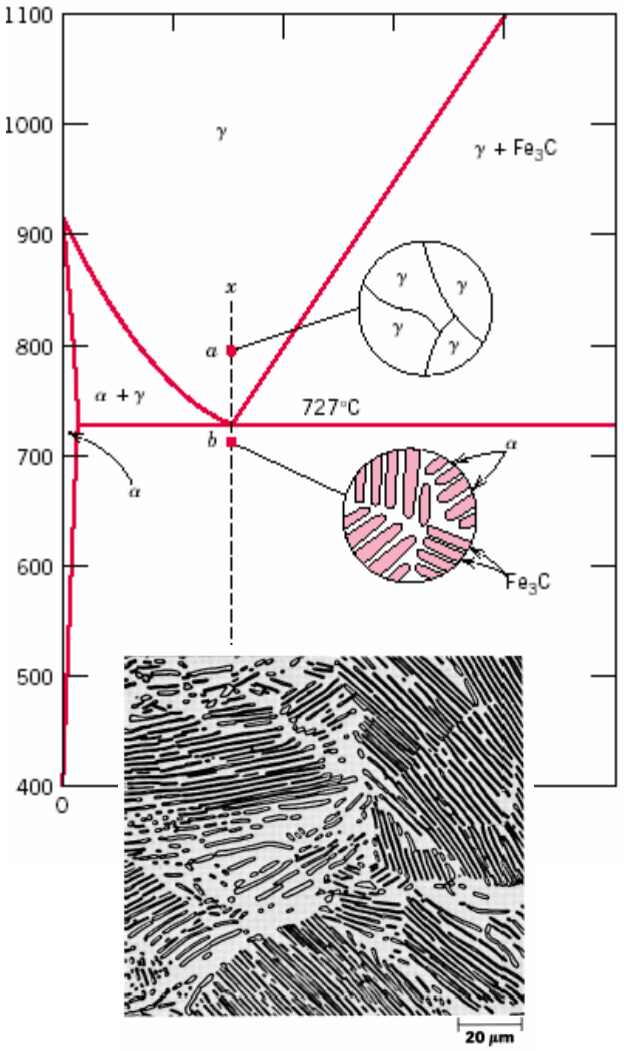


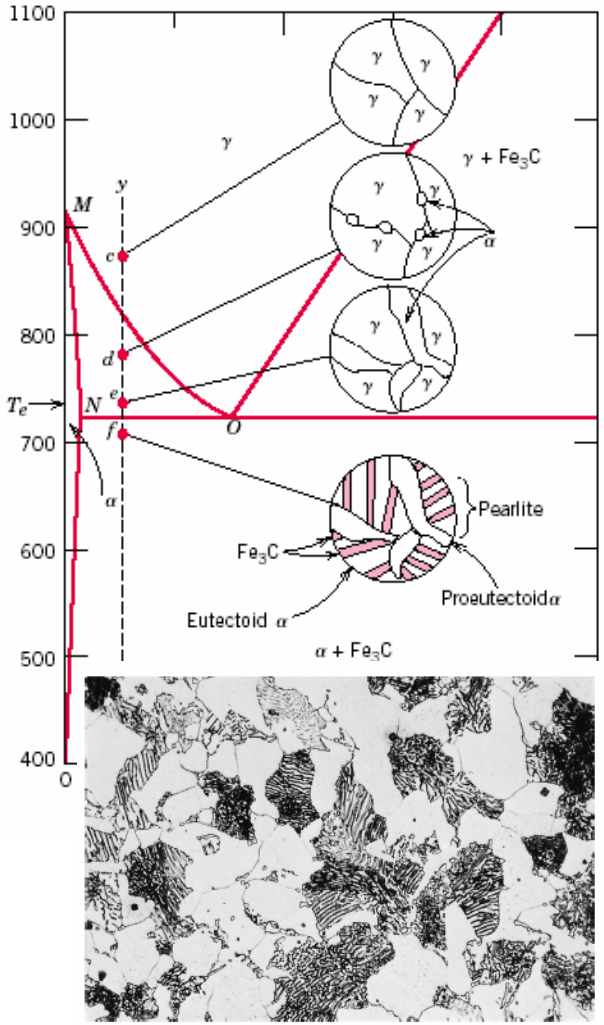
Phase diagram

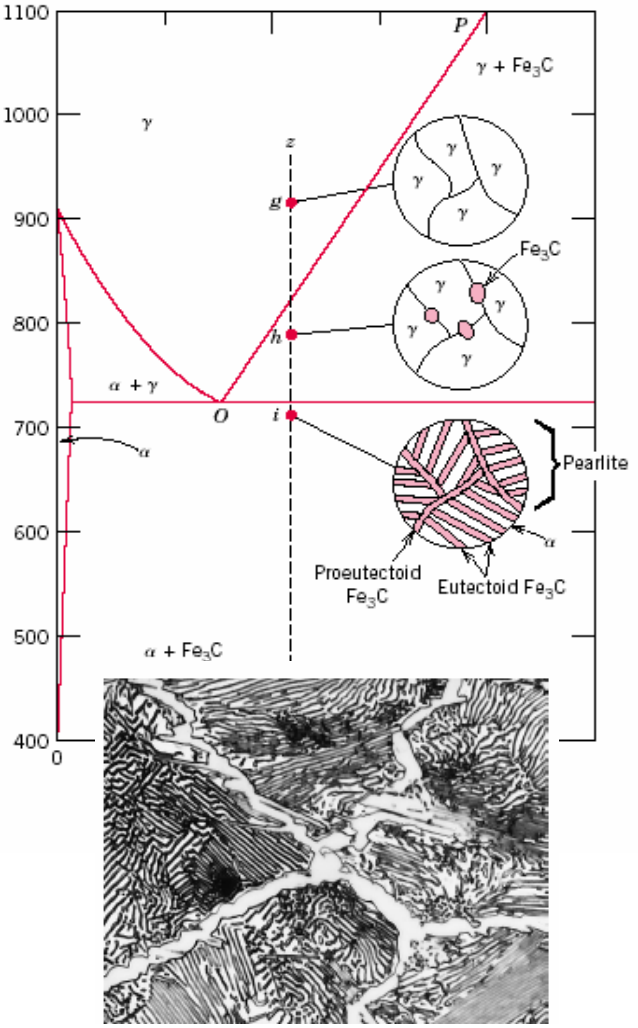




Phase diagram



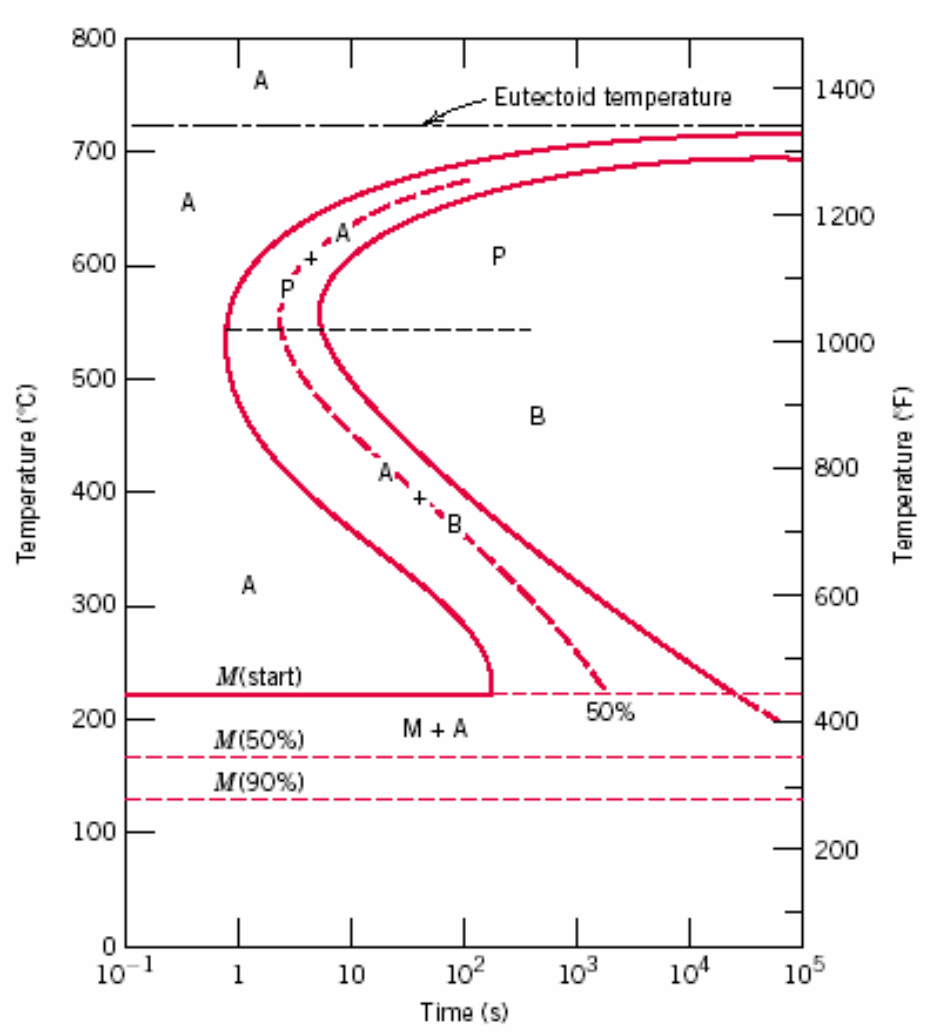




Phase transformation

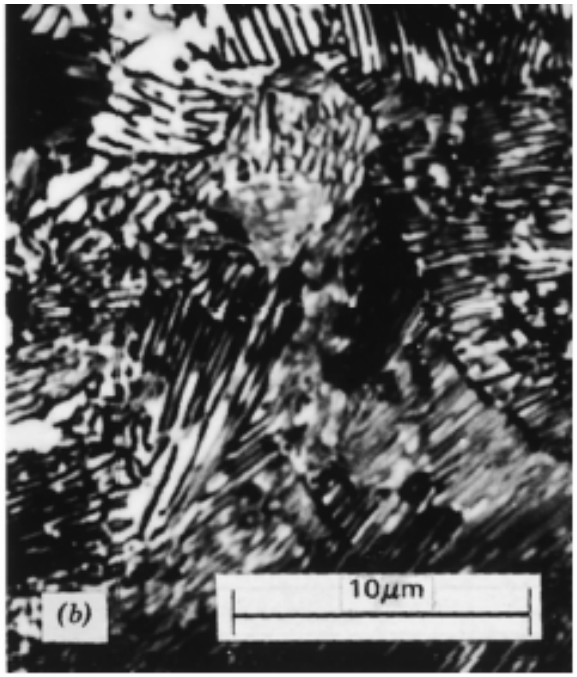
- Nucleation/growth controlled phase transformation
- Diffusional vs diffusionless
- Rate of transformation
- Isothermal transformation diagrams

Phase transformation

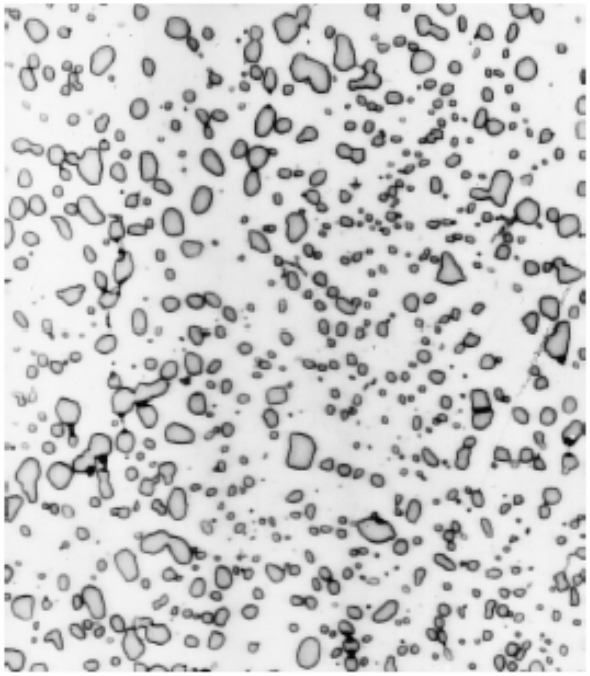


Phase transformation

3000X



3000X



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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