Lecture 31, Apr 14, 2022

Review

- Chapter 2, 3, 6: Mechanical properties (metals)
  - Stress strain curves
  - Young's Modulus
  - Elastic vs. inelastic behaviour
  - 3-point bends
  - Tensile, yield strength, 0.2% offset for metals
- Chapter 7: Strengthening mechanisms
  - Defects: 0D (substitutional, interstitial, vacancies), 1D (edge, screw dislocations), 2D (grain boundaries), 3D (secondary phases)
  - Strengthening mechanisms for metals:
    1. Work hardening (introducing 1D defects, deforming the metal)
    2. Solid solution hardening (introducing of 0D defects, e.g. steel)
    3. Precipitation hardening (introducing second phase 3D defects)
    4. Grain refinement (introducing 2D grain boundaries, e.g. making amorphous metals)
- Chapter 8: Polymers
  - Calculating molecular weights
  - 5 mer units:
    1. Polyethylene
    2. Polypropylene
    3. Polyvinyl chloride
    4. Polytetrafluoroethlene (PTFE)
    5. Polymethylmethacrylate (PMMA)
  - Structure:
    * Mer unit
    * Crystallinity
    * Molecular weight
    * Dispersivity (i.e. width of the weight distribution)
    * Branching (e.g. HDPE vs LDPE)
    * Cross-linking and elastomers
    * Tacticity
  - Physical properties:
    * Mechanical properties
    * Density
    * Melting point
    * Glass transition temperature
    * Viscoelasticity
    * Optical transparency
- Chapter 9: Electronic properties
  - EM spectrum: $\nu = \frac{c}{\lambda}, E = h\nu$
    * Visible light: 400nm to 700nm
  - Types of bonding:
    * Ionic bonding (e.g. NaCl)
      - Hard sphere model
      - Coulomb model
      - Madelung constant
    * Covalent bonding
    * Metallic
    * Van der Waals
    * Mixed ionic/covalent, e.g. GaAs is mostly covalent but has an ionic part
  - Electronic structure

- Metals vs nonmetals: partially vs completely filled bands
- Semiconductors, conductance calculations, band gap
  * Resistivity $R = \rho \frac{L}{A}$
  * Conductance $\sigma = ne\mu_e + pe\mu_h$
  * Group 3 vs group 5 elements
  * N vs P type doping
- Optical absorption
- Crystal structure: BCC, FCC for metals, NaCl and CsCl structures for ionic compounds, diamond cubic (silicon, germanium) or zincblende for semiconductors