12.8 – Polymeric Solids

Plastics – Materials that can be formed into various shapes

Thermoplastic – Can be reshaped

Thermosetting – Irreversible chemical process for shaping

Elastomer – Material that exhibits rubbery behavior

Addition Polymerization – Monomers are coupled together through their multiple bonds

- Polyalkenes – Made from an alkene
- Polydienes – Made from a diene

Condensation Polymerization – Two molecules are joined to form a larger molecule by elimination of a small molecule such as water

- Polyesters – Formed from an acid and an alcohol
- Polyamides – Formed from an acid and amine

Copolymer – Polymers formed from two different monomers

Cross-Linking – Forming bonds between chains

Vulcanization – Cross-Linking of natural rubber

Polymers are molecular solids with softness and low melting point. Some decompose upon heating before reaching melting point.

A reaction with an alcohol and carboxylic acid to form an ester has the OH group taken off from the carboxylic acid and the H from the alcohol to form water

11.7 – Liquid Crystals

Intermediate state between solid and liquid with viscous quality

Ordered molecules in one or two dimensions forming stacks or sheets with some freedom to move

Liquid crystals are long, polar, and slightly asymmetric

12.4 – Metallic Bonding

Compounds of d- and p- metals with less electronegative nonmetals can be semiconductors

Oxides of transition metals can also be semiconductors because bonding is inbetween ionic and covalent
With the interacting number of interacting atoms, the energy gaps between some MOs disappears and continuous bands of energy results

Happens in ionic, metallic, and covalent-network solids but not in molecular

Results in having energy bands

**Conduction Band** – Unoccupied antibonding molecular orbitals

**Valence band** – Occupied bonding molecular orbitals

**Metals:**

Valence electrons are in a partially filled band

There is little energy needed for an electron to go from the lower occupied part of the band to a higher unoccupied part

Allow electrons to move through metal easily

Conductivity decreases with increasing temperature

**Semiconductors:**

Silicon and germanium are most common

Tend to have an average of 4 valence electrons per atom for inorganic semiconductors

Have a gap between the valence band and conduction bands

At room temperature, some electrons from VB hop to CB and thus in both of them there is freedom of motion

Conductivity increases with temperature

Band gap is about 0.5 eV – 3 eV
Insulators:

Energy gap is greater than 3.5 eV

Not conductive at room temperature

Doping:

Introducing small amounts of impurities that have more n-type or fewer p-type valence electrons to increase conductivity of semiconductor

Light emitted from LEDs is a semiconductor band gap

Nanoparticles of different size can emit different wavelengths (quantum dots) with energy gap between bands depending on size