Basic Electron Theory

This presentation will
• Review the basic structure of the atom.
• Define conductor, insulator, and semiconductor.

Structure of an Atom

Example – Carbon Atom

Nucleus
• 6 Protons
• 6 Neutrons

Electrons

Orbits

The distribution of electrons in the orbital rings around an atom’s nucleus determines the element’s electrical properties.

Conductor / Insulator / Semiconductor

• The stability of the electrons in the outer ring determines whether a material made from this element is a conductor, insulator, or semiconductor.
• Elements whose electrons are unstable and can easily move from one atom to another make good conductors.
• Elements whose electrons are stable and can not easily move from one atom to another make good insulators.
• Any elements that are not considered conductors or insulators are categorized as semiconductors.
Conductors

- When an element’s outer electron ring is incomplete or not full, its electrons can move more freely from one atom to another atom.
- Elements whose electrons can move more freely make good conductors.
- In general, most metals make good conductors because they only have one or two electrons in their outer band.
- Silver and gold are the best conductors. Copper is the second best conductor. Most wiring uses copper wire because it is a good conductor and is less expensive than the other metals.

Insulator

- When an element’s outer ring is complete, or full, its electrons can not easily move from one atom to another atom.
- Elements whose electrons can not move freely make good insulators.
- Examples of good insulators are glass, plastic, rubber, paper, or air. Most wiring uses plastic as an insulator.
- Plastics are polymers or long chains of atoms bonded to one another. Viewing the atomic structure of plastics is far beyond the scope of this class (If you are interested in such topics, you may want to take AP Chemistry.).
- Neon and argon, both gases, are good insulators and are often used in light bulbs.
Semiconductor

- When an element’s outer ring is neither complete nor incomplete, the element is considered to be a semiconductor.
- Examples of good semiconductor materials are:
  - Carbon (used to make resistors)
  - Silicon (used to make transistors)

Semiconductors: Example C & Si

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<thead>
<tr>
<th>Carbon (C)</th>
<th>Silicon (Si)</th>
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<td>The outer-most orbits of carbon and silicon can each contain a maximum of eight (8) electrons. Because they both contain four (4), these electrons are neither stable nor unstable. This electron structure is what makes carbon and silicon good semiconductors.</td>
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