Atoms and Charge

Peter Mathys
ECEN 1400

Atoms

• The atom is considered to be the basic building block of matter.
• Atoms consist of a nucleus, made up from protons and neutrons, and electrons.
• Protons have positive electrical charge, electrons have negative electrical charge, and neutrons have no electrical charge.
• The number of protons determines the chemical properties of different types of atoms (elements).

Example: Lithium (Li) Atom

Bohr model, neglects quantum mechanics and the wave-like behavior of electrons

Atoms

• An atom is neutral if it has the same number of protons and electrons.
• An atom with more protons than electrons is said to be positively charged.
• An atom with more electrons than protons is said to be negatively charged.
• Charged atoms are called ions.
• Electrons not bound to an atom are called free electrons.

Atoms and Charge

• The balance between protons and electrons can be modified by chemical, mechanical, optical, or electrical processes.
• In a battery, for instance, a chemical process is used to move electrons from the negative to the positive terminal.
• Rubbing wax with wool mechanically removes electrons from the wool and transfers them to the wax.

Periodic Table

Elements are arranged according to their atomic number (number of protons in nucleus).
Electron Orbits/Shells

- Electrons orbit only at **discrete distances** from the nucleus. Electrons in more distant orbits have more energy.
- The orbits are grouped into energy bands called **shells**. For a given atom the number of shells is fixed.
- The electrons in the outermost shell are called **valence electrons**. They determine the chemical reaction and bonding properties of an atom.

Material Conductivity

- **Conductors**, like copper or silver, are materials in which electrons or ions can move easily, characterized by 1 to 3 valence electrons.
- In **semiconductors**, like silicon or germanium, electrons or ions move less easily than in conductors. They have 4 valence electrons.
- Materials where electrons and ions cannot move freely are **insulators**. They have more than 4 valence electrons in their atomic structure.

Example: Copper (Cu)

- Copper (Cu)
  - Atomic number: 29
  - Protons: 29
  - Neutrons: 35
  - Electrons: 29
  - Valence electrons: 1

Example: Silicon (Si)

- Silicon (Si)
  - Atomic number: 14
  - Protons: 14
  - Neutrons: 14
  - Electrons: 14
  - Valence electrons: 4