

# Chemical Bonding: Ionic, Covalent, and Metallic Bonds

Understanding how atoms bond to form compounds

## Introduction to Chemical Bonding

Chemical bonding refers to the force that holds atoms together to form molecules and compounds. The type of bond formed determines the physical and chemical properties of the substance.

## Ionic Bonding

An ionic bond is formed when electrons are transferred from one atom to another, resulting in positively and negatively charged ions that are attracted to each other.

- **Formation:** Between metals and non-metals.
- **Examples:** Sodium chloride (NaCl), Magnesium oxide (MgO).
- **Properties:**
  - High melting and boiling points.
  - Soluble in water.
  - Conducts electricity in molten or dissolved state.

## Covalent Bonding

A covalent bond is formed when atoms share electrons to achieve a stable electron configuration.

- **Formation:** Between non-metal atoms.
- **Examples:** Water (H<sub>2</sub>O), Carbon dioxide (CO<sub>2</sub>).
- **Properties:**

- Lower melting and boiling points compared to ionic compounds.
- Poor conductivity of electricity.
- Insoluble in water but soluble in organic solvents.

## Metallic Bonding

Metallic bonding occurs when metal atoms share their outer electrons freely, forming a 'sea of electrons' that binds the atoms together.

- **Formation:** Among metal atoms.
- **Examples:** Copper (Cu), Aluminum (Al).
- **Properties:**
  - High electrical and thermal conductivity.
  - Malleability and ductility.
  - Shiny and reflective surfaces.

## Comparison of Bond Types

Property	Ionic Bond	Covalent Bond	Metallic Bond
Formation	Transfer of electrons	Sharing of electrons	Sea of electrons
Conductivity	High (when molten or dissolved)	Poor	High
Melting Point	High	Low	Variable

## Conclusion

Chemical bonds are fundamental to the structure and properties of matter. Understanding ionic, covalent, and metallic bonding helps in explaining the behavior of substances in different conditions.

