Ionic Solids

Crystalline

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Categories of solids based on the particles that form the solid pack

1. Crystalline solids
2. Amorphous solids
3. Polycrystalline solids
Crystalline solids

• Three-dimensional analogs of a brick wall.

• They have a regular structure, in which the particles pack in a repeating pattern from one edge of the solid to the other.
Amorphous solids

- (literally, "solids without form") have a random structure.
Polycrystalline solids

- Aggregate of a large number of small crystals or grains in which the structure is regular, but the crystals or grains are arranged in a random fashion.
Categories of solids based on bonds that hold the solid together

1. Molecular
2. Covalent
3. Ionic
4. Metallic
Molecular solids

- **Intramolecular bonds** between the atoms that form the molecules >>>

- **Intermolecular bonds** between these molecules <<<

- **Soft substances** with low melting points.
Molecular solids

• Example: dry ice, or solid carbon dioxide

• The van der Waals forces holding the CO$_2$ molecules together are weak enough that dry ice sublimes it passes directly from the solid to the gas phase at -78$^\circ$C.
Covalent solids

• Can be viewed as a single giant molecule made up of an almost endless number of covalent bonds.

• Example: diamond
Diamond

– Each carbon atom in diamond is covalently bound to four other carbon atoms oriented toward the corners of a tetrahedron.

– Because all of the bonds in this structure are equally strong, covalent solids are often very hard and they are notoriously difficult to melt.
Ionic solids

• Held together by the **strong force** of attraction between ions of opposite charge.

• The **strength** of an ionic bond **depends on** the **radii** of the ions that form the solid.
Ionic solids

• As these ions become larger, the bond becomes weaker.

• But the ionic bond is still strong enough to ensure that salts have relatively high melting points and boiling points.

• Example: NaCl
Metallic solids

- Metal atoms **don't have enough** electrons to fill their valence shells by sharing electrons with their immediate neighbors.

- **Electrons** in the valence shell are therefore **shared by many atoms**, instead of just two.

- In effect, the valence electrons are **delocalized** over many metal atoms.
Metallic solids

• Because these electrons aren't tightly bound to individual atoms, they are free to migrate through the metal.

• As a result, metals are good conductors of electricity.

• Electrons that enter the metal at one edge can displace other electrons to give rise to a net flow of electrons through the metal.
Metallic solids

- Bonds in the solid can be:
  - Very strong
    - m.p of W = 3422°C
  - Very weak
    - m.p of Hg = -38°C