Solid state

Solids are made up of small parts that are closely packed together with little space between them, and these parts push against each other with a lot of force.

the tiny parts in a solid only move in place and don't move around freely.

Types of Solids

There are two main types of solids:

(i) Amorphous Solids

These are solids where the tiny particles don't have a regular, repeating pattern throughout the entire structure.

Some parts may have small, ordered sections called crystallites.

However, they don't have a clear melting point and break in a messy way.

A liquid's structure is similar to that of a solid.
When heated, they become softer and can be shaped into different forms. At certain temperatures, they can change into a crystalline form. Because of this, they are also called pseudo solids or super cooled liquids. For example, glass can become cloudy when heated because of this behavior. Since the particles aren't arranged in a regular pattern over long distances, they show the same properties in all directions. This is called isotropy. Their physical properties like electrical resistance or how light passes through them do not depend on the direction. Plastics, rubber, and glass are examples of amorphous solids Although natural quartz has a crystal

structure, quartz glass is amorphous. Amorphous silicon is one of the best materials for converting sunlight into electricity.

(ii) Crystalline Solids

Solids where the tiny pieces, like atoms, ions, or molecules, are arranged in a neat, repeating pattern over long distances are called crystalline solids.

These have very clear melting points and can be cut cleanly along certain directions.

They are anisotropic, which means some of their properties, like electrical resistance or how light bends through them, vary depending on the direction.
This happens because the particles are arranged differently in different directions. Examples of crystalline solids include all metal elements, some non-metal elements like sulfur and phosphorus, and ionic compounds such as sodium chloride, zinc sulfide, and naphthalene.

Crystalline solids can be grouped into four main types based on the forces that hold the particles together.

These are:

i) Molecular Solids

ii) Ionic Solids

iii) Metallic Solids

iv) Covalent or Network Solids

(i) Molecular Solids

These are further divided into three categories:

a) Non-polar Molecular Solids

Properties:

i) Particles: non-polar molecules

ii) Bonding force: dispersion forces or London forces

iii) Binding energy (kJ/mol): 0.05–40

iv) Melting point: very low (about 84 K)

v) Physical nature: soft

vi) Electrical conductivity: insulator

Examples: H_2, N_2, O_2, He, Ar, Kr

b) Polar Molecular Solids

Properties:

i) Particles: polar molecules

ii) Bonding force: dipole-dipole interaction

iii) Binding energy (kJ/mol): 5–25

iv) Melting point: low (about 158 K)

v) Physical nature: soft

vi) Electrical conductivity: insulator

Examples: HCl, HBr, SO_2, SO_3 etc.

c) H-bonded Molecular Solids

Properties:

i) Particles: polar molecules containing O, N, F and H

ii) Bonding force: hydrogen bonding and dipole-dipole interaction

iii) Binding energy (kJ/mol): 10–40

iv) Melting point: low (about 273 K)

v) Physical nature: hard

vi) Electrical conductivity: insulator

Examples: H_2O (ice)

(ii) Ionic Solids

Properties:

i) Particles: ions

ii) Bonding force: electrostatic force of attraction

iii) Binding energy (kJ/mol): 400–4000

iv) Melting point: high (1500 K)

v) Physical nature: hard but brittle

vi) Electrical conductivity: insulator in solid state; conductor in molten and aqueous state

Examples: NaCl, KCl, $CuSO_4$, CaF_2, CsCl etc.

(iii) Metallic Solids

Properties:

i) Particles: positively charged ions (kernels) in a sea of mobile electrons

ii) Bonding force: metallic bonding

iii) Binding energy (kJ/mol): 70–1000

iv) Melting point: 800–1000

v) Physical nature: Except for Na, K, and Li, it is hard but malleable and ductile.

vi) Electrical conductivity: conductor

Examples: Fe, Cu, Zn, Ni, Co, Al, Au, Pt etc.

(iv) Covalent or Network Solids

Properties:

i) Particles: atoms

ii) Bonding force: covalent bonds

iii) Binding energy (kJ/mol): 150–500

iv) Melting point: high (4000)

v) Physical nature: hard

vi) Electrical conductivity: insulator except graphite

Examples: SiO_2, diamond, graphite, SiC (carborundum)