

M.Sc. (III-Sem)

Condensed Matter Physics

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Unit - 1.

①
⇒ Crystalline solids :- These solids in which atoms and molecules are arranged internally in a definite or regular manner and possess a definite geometrical shape throughout the crystal structure.

Examples:- Mica, Quartz, Sugar, Copper sulphate etc.

Characteristics of crystalline solids :-

1. These type of solids have "long range order".
2. These solids have flat surfaces.
3. These solids are "Anisotropic".

It means that in crystalline solids physical properties, like electrical and thermal conductivity, compressibility, shape etc are different along different directions.

4. Bonds between atom/molecules have equal strength.
5. They have sharp melting point.

Reason:- It is because when the melting point is attained on heating these solids all the bonds breaks altogether causing a sudden change in the state of the solid i.e. from solid to liquid.

6. On crystallisation, these solid have minimum energies and hence are more stable.

⇒ Amorphous solids:- These solids in which the atoms and molecules are arranged internally in an indefinite or irregular manner and so that, they do not pass a definite external geometrical shape throughout the crystal structure.

Examples:- Glass, rubber, elemental form of sulphur etc.

Characteristics of Amorphous solids:-

1. These solids have "short range order".
2. These solids do not have flat surfaces.
3. These solids are "Isotropic" i.e. opposite of "Anisotropic".
4. The bonds b/w atoms and molecules are of unequal strength.
5. They do not have sharp melting point.

⇒ Semicrystalline solids:- These are also called "polycrystalline solids" and may be defined as,

A solid which has many crystallites grown together to form an interlocking mass which are separated by well defined boundaries and orient randomly.

Characteristics of Semi-Crystalline solids :-

1. They are isotropic in nature.
2. They can be grown as a single crystal under suitable specific conditions.
3. The surface is random.

Example:- Rocks, sand, metals, salts-etc.

Note:- (1.) The branch of science under the shadow of which the crystals and their structure is studied is called crystallography or crystal physics.

(2.) In crystalline solids following result holds.

$$f + c = e + 2$$

where,

f = Faces of crystalline solids.

c = The number of angles.

e = Edges of crystalline solids.

(3.) Crystalline solids have reticulate structure, which means the constituent particles of solids are arranged in a periodic manner in 3D {space}.

(4.) Amorphous solids do not have a reticulate structure.

→ Crystals:- It may be defined as a solid composed of atoms or other microscopic particles arranged in an orderly repetitive manner.

Crystals are also the purest available solids but it does not mean that they do not have any impurity.

Types of crystals:- There are following types of crystals ~~of crystals~~

1. Single-Crystals:- The crystal in which the pattern of constituent particles continues throughout the piece of crystal. These crystals can vary from a fraction of cm to few cm.

2. Mono-crystals:- These actually are very small sized single crystals which are not visible through the naked eyes. They usually have dimensions $\approx 5 \times 10^8$ cm.

3. Poly-Crystals:- A poly crystal is basically a collection of some monocrystals together such that the faces of the mono-crystals are joined together.

Examples:- Ceramic, TiO_2 , BaO, ~~and~~

(4.) Liquid crystal :- These are fluid substances (more like ~~for~~ ^{for} liquids) having "long range order" and by nature are mainly organic compounds which on heating do not directly convert into liquids. These are widely used in making LCDs.

Example:- Alkyl carboxyl and cholesterol ester.

⇒ Crystallisation :- It is a process by which the crystals are basically obtained.

Example:- Crystals of rock salt (NaCl) are obtained from evaporating sea water.
