THE SOLID STATE

TOPIC-1

Classification of solids with structures

VERY SHORT ANSWER QUESTIONS

1. What are solids?

Ans: Solids are characterized by their high density and low compressibility as compared to those of the gas phase. The properties of solids indicate that the molecule (or ions) in them are relatively close together

2. What are different types of solid?

Ans: There two types of solids. They are crystalline solids and amorphous solids.

3. What are different types of crystalline solids?

Ans: There are fou different types of crystalline solids. They are a) Ionic solids, b) covalent solids c) molecular solids and d) metallic solids.

4. What are crystallites?

Ans: Due to short range order,, amorphous solids may have small parts in crystalline and the rest non-crystalline form. Crystalline parts of an otherwise amophous substance are called crystallites.

SHORT ANSWER QUESTIONS

1. **What are the properties of solids?**

Ans:

- Solids have a definite shape, mass and volume.
- Solids are almost incompressible, rigid and have mechanical strength.
- Solids have high density but very slow diffusion rate.
- Solids can have only vibrational motions the constituents have fixed positions.
- In solids constituents have strong force of attraction as intermolecular distances are short.

2. What are the properties of crystalline solids?

Ans:

- In these solids, the constituents are arranged in a definite or orderly manner which repeats itself over long distances.
- They have a definite geometry with flat and sharp edges.
- Such solids have sharp edges and undergo clean cleavage.
- They are considered as true solids.
- They show anisotropy i.e. different physical properties in different directions.
- They are normally incompressible.

3. **What are the properties of amophous solids?**

Ans:

- In these solids the constituents are not arranged in a regular or orderly manner over a long range.
- Such solids do not have sharp melting points and clean cleavage that is, have no irregular cut.
- These are considered as pseudo solids.
- These show isotropy, i.e. same physical properties in all directions.
- They do not show clean cleavage.

4. What are the properties of ionic solids?

Ans:

- The constituent particles are ions.
- They are bound by strong electrostatic forces of attraction.
- They are hard but brittle.
- They have high melting points
- Their bond energy lies between 400 – 4000 kJ/mole.
- They are good conductors in molten and dissolved state.

5. What are the properties of covalent solids or network solids?

Ans:

- These solids contain atoms.
- These possess covalent bonds
- These are very hard.
- Melting points of these solids is very high, i.e. > 3900 C,.
- The bond energy is 150 – 500 kJ/mole.
- These are generally insulators.

6. What are the properties of molecular solids?

Ans:

- These solids generally contain molecules.
- These are bound by weak Vander Waal's forces of attraction.
- These are soft solids.
- They posses low melting points , 300C
- Bond energy is < 40 kJ/mole.
- These are generally insulators.

7. What are the properties of molecular solids?

Ans:

- These solids contain atoms.
- These are bound by metallic bond.
- These are very hard, malleable and ductile.
- Possess high melting points.
- Bond energy is 80 – 1000 kJ/mole.
- These are all conductors.

LONG ANSWER QUESTIONS

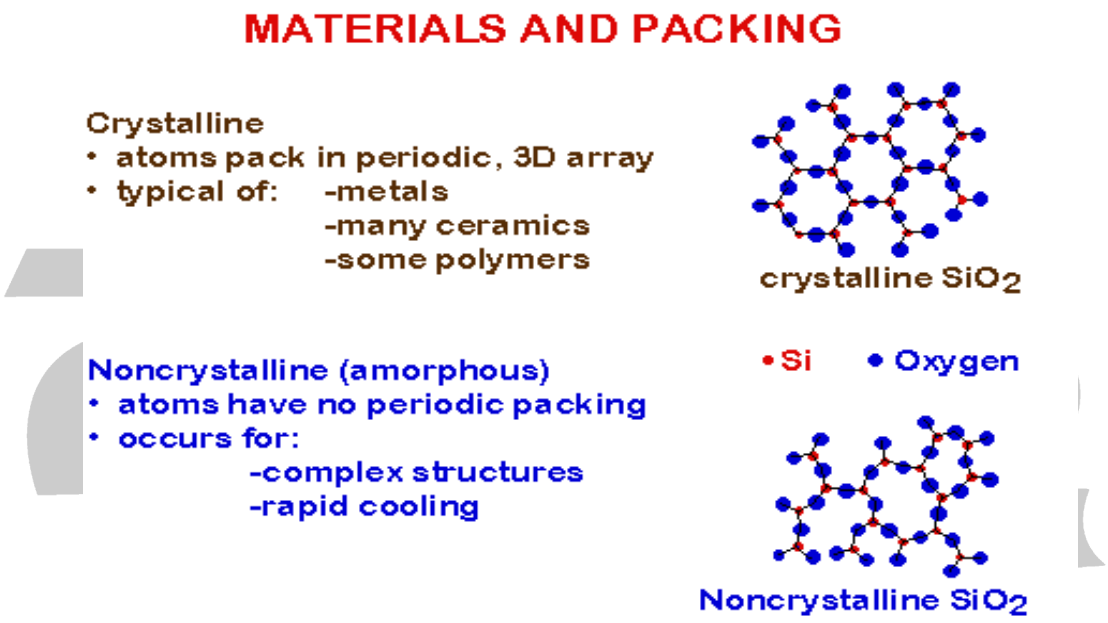
1. Explain the classification of solids.

Ans:

Solids are characterized by their high density and low compressibility as compared to those of the gas phase. The properties of solids indicate that the molecule (or ions) in them are relatively close together.

Solids can be broadly classified into two categories, namely, crystalline and amorphous solids. The main characteristics of these are described in the following.

1. <u>Crystalline Solids</u>: The outstanding characteristics of a crystal are its sharp melting point, its flat faces and sharp edges. These properties are due to a high degree of internal order which extends throughout the crystal (a definite pattern constantly repeating in space). This is know as long-range order.



2. <u>Amorphous Solids</u>: Amorphous solids do not have the long-range order but have a short-range order. These characteristics may not be found around a similar atom placed at a distance from the other atom.

Examples of amorphous solids are glass, used silica, rubber and polymers.

Amorphous solids do not have the characteristics as possessed by crystalline solids. In many ways, they are more closely related to liquids than to the crystalline solids and are, therefore, regarded as super cooled liquids with high viscosity. A given material may be converted into the amorphous or glassy form by rapidly cooling the melt or freezing the vapour.

CLASSIFICATION OF CRYSTALS BASED ON BOND TYPE

The properties of most of the crystals are found to conform to one of the four general types of chemical bonds, in terms of which it is possible to classify them into four categories as described in the following.

a) Molecular Crystals (or Vander Waals Crystals):

Molecular crystals are those in which the crystalline state is composed of an aggregate of discrete molecules held together by Van der Waals forces.

Because of these weaker forces, molecular crystals are soft and posses comparatively low melting points.

Examples are CO_2, CCl_4, Ar and most of the organic compounds.

b) **Ionic Crystals**: Ionic crystals involve electrostatic forces amongst their structural units.

Because of stronger forces, ionic crystals are strong and likely to be brittle. The melting points are high, which decease with increasing size of the ions. In ionic crystals, some of the atoms may be held together by covalent bonds to form ions having definite positions and orientations in crystal lattice.

c) Covalent Crystals: Covalent crystals involve forces of chemical nature (covalent bonds) extended in three dimensions. These forces are strong, and consequently the crystals are strong and hard, with high melting points. Examples are diamond, silicon, etc.

d) Metallic crystals: Electrons are held loosely in these type of crystals. They are god conductors or electricity. Metallic crystals are strong and can be bent..