Anisotropic

It's been found that many of the materials' properties depend on the crystal structure. However, crystals are not symmetric in all directions, or not the crystal planes same with respect to atomic density/packing. Different directions in the crystal have different packing. This directionality of properties is termed as Anisotropy.

Q. Why are crystalline solids called anisotropic in nature?

Crystalline solids are called anisotropic because their physical properties change when measured in different directions. This directional difference happens because atoms and ions are arranged in distinct, repeating patterns along different axes inside the crystal. The reason for showing anisotropic behavior shown by crystalline solids lies in their long range order. Due to a rigid arrangement of constituent particles in crystalline solids, particles tend to occupy fixed positions and are not subject to any movement or disorder. Therefore one observes a unique arrangement along different directions in the same crystal. These different arrangements are responsible for showing variable results while calculating many physical properties.

For instance, atoms along the edge of FCC crystals are more separated than along its face diagonal. This causes properties to be different in different directions.

Q. Write the cell parameters for the most unsymmetrical unit cell.

The most unsymmetrical unit cell is the Triclinic Crystal System.

$\alpha \neq \beta \neq \gamma \neq 90^o$ and $a \neq b \neq c$

Q. What are the different types of crystalline solid? Give the characteristic feature of each of them.

There are four types of crystalline solids:

Ionic solids- Made up of positive and negative ions and held together by electrostatic attractions. Ionic solids are crystalline, rather than amorphous. They are soluble in polar liquids such as water, in which the dipole moment of the water molecule can supply the electrostatic force necessary to break the ionic bonds. There are no free or valence electrons, so they are poor electrical conductors and not strongly magnetic. They are transparent to visible light (because light rays have too little energy to excite electrons from the filled shells), but absorb strongly in the infrared (corresponding to the vibrational frequencies of the atoms in their lattice sites). They're characterized by very high melting points and brittleness in the solid state. An example of an ionic solid is table salt, NaCl.

Covalent-(also called atomic) solids- The constituent particles in covalent network solids are atoms. The atoms in these crystals are linked by a continuous system of covalent bonds. The result is a rigid three dimensional network that forms a giant molecule. The entire crystal is a single molecule. As a result of rigid and strongly bonded structure, covalent network crystals are very hard. In fact they are the hardest and most incompressible of all the materials. These crystals have high melting and boiling points. The electrons are localized in covalent bonds and hence are not mobile. As a result, covalent solids are poor conductors of heat and electricity. Examples diamond, Quartz (SiO_2)

Molecular solids- The constituent particles of molecular solids are molecules (or unbonded single atoms) of the same substance. The bonds within the molecules are covalent. The molecules are held together by various intermolecular forces of attraction: Weak dipole-dipole interactions (solid HCl, H_2O, SO_2), Very weak dispersion or London forces in nonpolar molecules (solid CH_4, H_2), and Intermolecular hydrogen bonds (in solids such as H_2O (ice), NH_3, HF). Because of weak intermolecular attractive forces, molecular solids are usually soft substances with low melting points. These solids are poor electrical conductors and are good insulators.

Metallic solids- In a solid metal, the valence electrons are delocalised over the entire crystal leaving behind positively charged metal ions. Therefore, metallic crystals are often described as an array of positive ions immersed in a sea of mobile electrons. The attractive interactions between cations and mobile electrons constitute the metallic bonds. Therefore, metals have good electrical and thermal conductivity. Eg. metals such as Na, K, Ca, Li, Fe, Au, Ag, Co, etc

Q. Explain why metallic solid is a good conductor of electricity but ionic solid is not at room temperature.

Answer yourself