Perspective

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Characterisation of Crystalline Solid

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Perspective

A crystalline solid is a type of solid whose basic three-dimensional structure is made up of a highly regular pattern of atoms or molecules that create a crystal lattice. The vast majority of solids are crystalline solids, and the various configurations of atoms and molecules within them can alter their properties and appearance. In all three dimensions, atoms or molecules in a crystal form a periodic, or repeating, pattern. This results in a highly structured interior structure of a crystal. The constituent atoms or molecules of the crystal are bound together by bonds. The type of link that holds them together, whether ionic, covalent, molecular, or metallic, is determined by the crystal's composition.

The perfectly ordered crystal lattice with every molecule in its expected lattice position is a rare, if ever, attained ideal. The other extreme is the amorphous state, in which a solid includes the maximum possible density of imperfections (defects of varied dimensionalities), resulting in the loss of all long-range order and the retention of only short-range order imposed by its nearest neighbours. Real crystals exist somewhere in the middle of these two extremes. The position of a crystal on a scale limited by these two extremes is referred to as crystallinity. Even in their pristine state, all actual crystals have some lattice faults or defects that increase both the energy (enthalpy at constant air pressure) and the disorder (expressed as the entropy) of the crystal lattice. A crystal with a high crystallinity and a low density of defects is said to be highly crystalline. A particle with a relatively high density of defects, on the other hand, is said to be partially amorphous and to have a low crystallinity. In ideal words, a completely amorphous particle has no crystallinity. Amorphous particles may have certain ordered domains that can act as crystallisation nuclei.

When a liquid cools to its freezing point, it solidifies in a process known as precipitation. Crystallization occurs when a substance precipitates into a regular crystalline form. Crystallization starts with a process known as nucleation, in which atoms or molecules cluster together. Crystal growth begins when the clusters become stable and large enough. Nucleation can be sped up by employing seed crystals (pre-made clumps) or a rough surface that favours the creation of clusters. Crystalline solids are classified into four types: ionic, covalent network, metallic, and molecular. They are distinguished from one another by the atoms or molecules they are composed of and the manner in which those atoms or molecules are bound to one another.

1) Ionic crystals have high melting temperatures and are typically brittle. They do not conduct electricity as solids, but they can conduct electricity as liquids. As long as they are charged, they can be comprised of atoms or molecules. Sodium chloride (NaCl), also known as table salt, is a popular example of an ionic solid.

2) Covalent network crystals, also known as network crystals, are kept together by covalent bonds between the atoms that make up the network. (It's worth noting that covalent network crystals are atomic solids, which means they can't be constructed of molecules.) They are extremely hard solids with high melting temperatures and poor electrical conductivity. Diamond and quartz are two common examples of covalent network solids.

3) Metallic crystals, which are formed of metal atoms bound together by metallic bonds, are also atomic solids. Metals' malleability and ductility are due to metallic bonding, which allow metal atoms to roll and slide past each other without breaking the substance. The metallic bonds also allow valence electrons to freely travel throughout the metal, creating a "electron sea," making them excellent conductors of electricity. Their hardness and melting points differ greatly.

4) Unlike metallic and network crystals, which are made up of bonded atoms, molecular crystals are formed up of bonded molecules. When compared to atomic bonds, molecular bonds are relatively weak and can be caused by a number of intermolecular forces, including dispersion forces and dipole-dipole forces.

Despite being constituted of individual atoms, the solids

generated by noble gases are called molecular crystals; the noble gas atoms are connected by similar forces as the ones weakly linking molecules together in a molecular crystal, giving them extremely similar features. A polycrystal is a material made up of various types of crystal structures that are arranged in a non-periodic pattern. Water ice, as well as most metals, ceramics, and rocks, are polycrystals. A grain is a bigger unit that consists of a single pattern, and a grain may contain several unit cells.