Chemistry, Carbon and its Compounds.

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Carbon and Its compounds

1) Allotropes of Carbon

The different forms of same element having similar chemical properties but differ in their physical properties are called allotropes and properties itself is called **allotropy.**

Carbon exists in different allotropic forms.

A. Crystalline forms- Diamond and Graphite

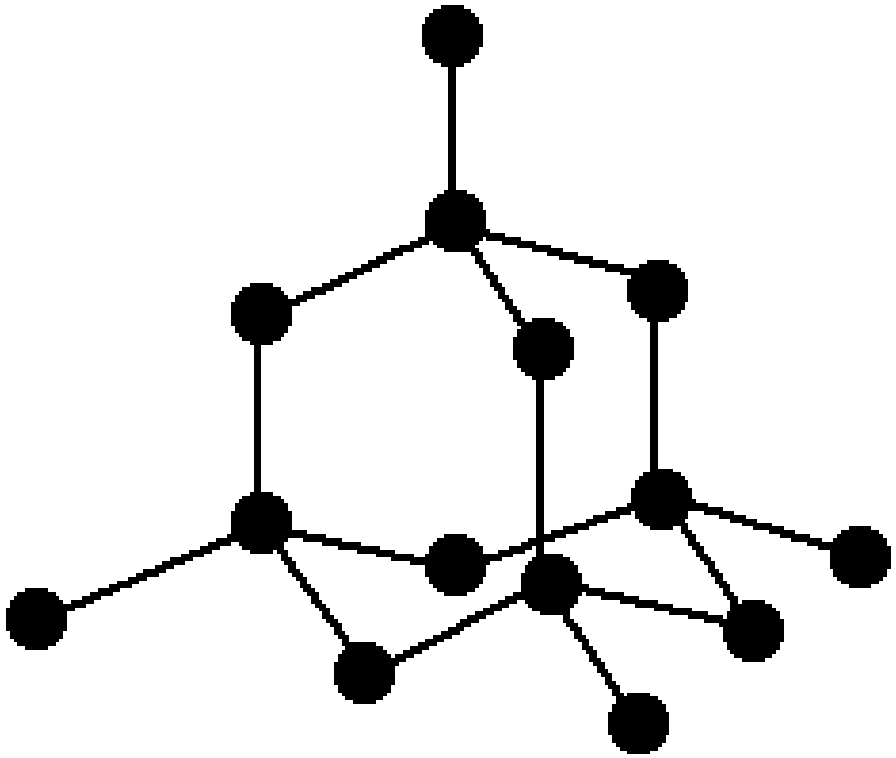
B. Amorphous forms- Coal, wood charcoal, animal charcoal, lampblack, coke etc.

Diamond

Diamond is the hardest substance known. It is the purest and densest form of carbon. Its extreme hardness is due to its structure. In diamond, each carbon atom is strongly bonded to four other neighboring carbon atoms by four tetrahedrally oriented SP^3 covalent bonds.

Thus all the carbon atoms in a diamond crystals are bound by such covalent bonds to form a number of inter-interlinked tetrahedra (each tetrahedron having a carbon atom at the centre, and four at its corners). This results in the formation of a huge three dimensional hard and compact crystal. Each C-C bond is only 1.54 A˚ in length.

Structure of Diamond



Properties of diamond

i) As already mentioned, the extreme hardness and the high melting (3750˚C) of the diamond is due to the fact that in a diamond crystal, the carbon atoms are rigidly held by strong SP^3 covalent bonds.

ii) Since all the four valence electrons of each carbon atom are fully utilized in the formation of four SP^3 covalent bonds, there are no mobile electrons in a diamond crystal. Hence, diamond is a poor conductor of electricity.

iii) Diamond has high sp. gravity (3.5). It's refractive index is 2.45, higher than that of any other substance.

iv) It is transparent to X-rays.

Uses of Diamond

i) Diamond are used in jewellery as precious stones.

ii) Industrially diamonds are valued more for their hardness than for their brilliance. Black diamonds are used for cutting glass, metals, rock drilling, and for making dies required for drawing hot metals into wires

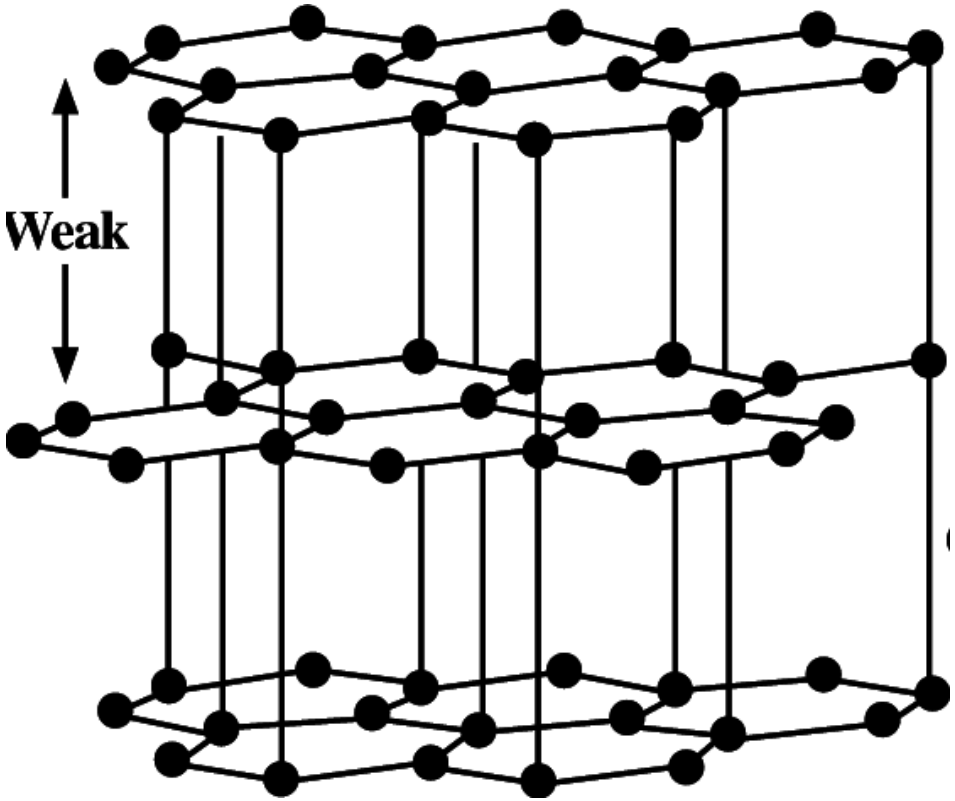
Graphite

Graphite is another crystalline allotrope of carbon. It is also called **plumbago or black lead**. It is the most stable allotrope of carbon. Diamonds slowly changes to graphite (probably after millions of years)

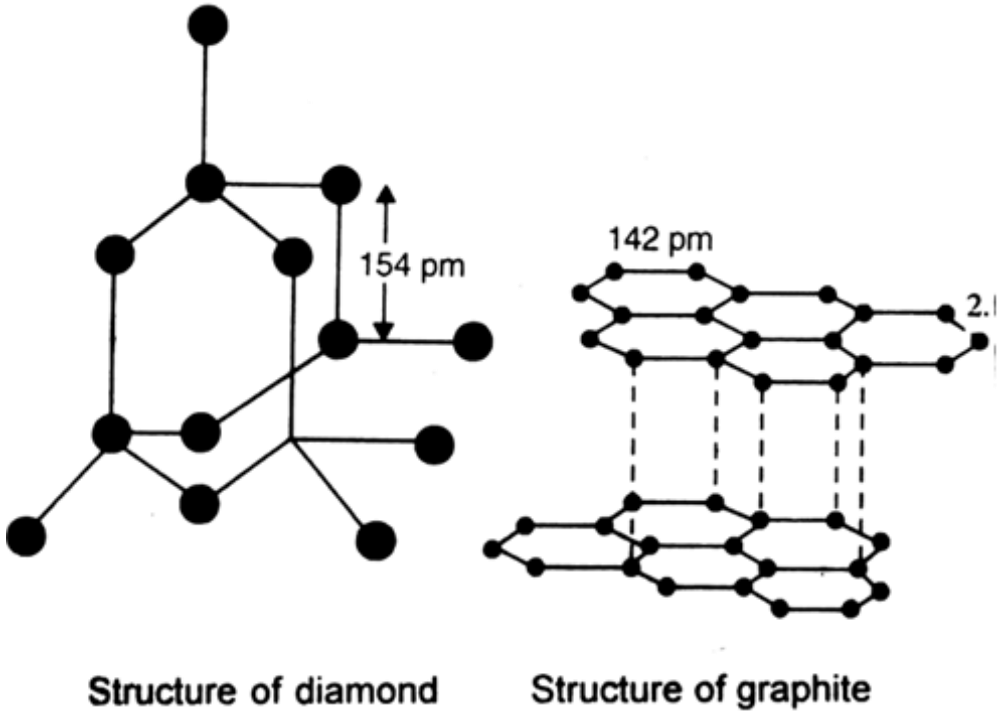
Diamond ---→ Graphite + 1.890KJ/mol.

In graphite each carbon atom is bonded to three other neighbouring carbon atoms by trigonal SP^3 covalent bonds forming a number of hexagonal rings arranged in coplanar sheets. Each C-C bond is 1.42A˚in length. These planar layers of graphite are held to each other only by weak Vander Waal's forces.

Structure of graphite



Structure of Diamond and Graphite..



Properties of graphite

i) Since the successive planar layers of graphite are held together only by weak vander waal's forces, the layers can slip one over the other. That is why, graphite is soft and slippery.

ii) Since, only three of carbon's four valence electrons are used in SP^2 trigonal bonding, the fouth electron is free and mobile. That is why, graphite is a good conductor of electricity.

iii) It sp. gravity is about 2.2. So, it is lighter than diamond.

Uses of graphite

i) Graphite mixed with dry clay is used in the manufacture of pencils

ii) It, being soft and slippery, is used as a lubricant, as an additive for motor oil.

iii) It is used to manufacture graphite crucibles which can withstand high temperature.

iv) It is also used as electrodes in electric furnaces.

v) Graphite is used as moderators to slow down fast moving neutrons in nuclear reactors.

Oxides of Carbon (CO_2 and CO)

Carbon monoxide- Sources

It is present in all auto mobile exhaust, chimney gases, fumes of tobacco and volcanic gases etc.

Toxic Effects of Carbon monoxide

Carbon monoxide is a colourless toxic gas. It is an insidious (slow) poison, and combines strongly with the iron in the haemoglobin of red blood corpuscles (RBC) to form a complex carboxy haemoglobin.

As a result, blood cannot absorb oxygen and transport it to the different parts of the body. So, when coal or wood is burnt in closed rooms, CO is produced, which may cause death for the inmates workers. Air containing carbon monoxide (CO), 1 in 100 parts may be fatal (death) for us.

Carbon dioxide

Carbon dioxide -- **Sources**

It is present in the atmosphere, Carbon when burnt in air or O_2, forms both CO and CO_2. The main source of CO_2 are automobile exhaust, burning firewood, plant, soil etc.

Green House Effect (VVI)

Any effect similar to that in a glass green house i-e short infra-red rays do not, pass through the glass. Short infra-red rays pass through a layer of CO_2 but the long infra-red rays do not. If a layer of CO_2 builds up in the atmosphere, short infra red rays from the sun will pass through and be absorbed by the ground (earth, building, sea etc). These will emit long infra red rays which will not pass through CO_2. This results in a permanent building up of heat energy causing a temperature rise, which is also called **' Global Warming'.**

Green house effect contd…

Importance of green house effect

CO_2 is a natural fertilizer The plants will grow larger and faster with increasing CO_2 in atmosphere which is beneficial to farmer.

Effect of Excess of CO_2 in atmosphere

i) The temperature of the earth rises, as a result of excess of CO_2 ocean get warm up and sea level would rises and flooding attack the nearby area.

ii) In temperate region, the winter will be shorter and warmer, summer will be longer and hotter.

iii) Increase in rain fall.

iv) The tropics may became more wet and sub tropic which are already dry, expected to drier.

Controll for the green house effect

i) Reducing the consumption of fossil fuels such as coal and petroleum.

ii) Disposing of green house gases formed elsewhere than in the atmosphere.