Carbon is the fourth most abundant element in the known universe but not nearly as common on the earth, despite the fact that living organisms contain significant amounts of the element. Common carbon compounds in the environment include the gases carbon dioxide (\((\text{CO}_2)\)) and methane (\((\text{CH}_4)\)).

**Inorganic Chemistry of Carbon**

Inorganic carbon is carbon extracted from ores and minerals, as opposed to organic carbon found in nature through plants and living things. Some examples of inorganic carbon are carbon oxides such as carbon monoxide and carbon dioxide; polyatomic ions, cyanide, cyanate, thiocyanate, carbonate and carbide in carbon. Carbon is an element that is unique to itself. Carbon forms strong single, double and triple bonds, therefore it would take more energy to break these bonds than if carbon were to bond to another element.

For carbon monoxide the reaction is as follows:

\[
2\text{C}_{(s)} + \text{O}_2 \rightarrow 2\text{CO}_{(g)} \quad \Delta H = -110.52 \text{ kJ/mol} \ \text{CO} \\
\text{C}_{(s)} + \text{O}_2 \rightarrow \text{CO}_2(g) \quad \Delta H = -393.51 \text{ kJ/mol} \ \text{CO}_2
\]

CO and \(\text{CO}_2\) are both gases. CO has no odor or taste and can be fatal to living organisms if exposed at even very small amounts (about a thousandth of a gram). This is because CO will bind to the hemoglobin that carries oxygen in the blood. \(\text{CO}_2\) will not become fatal unless living organisms are exposed to larger amounts of it, about 15%. \(\text{CO}_2\) influences the atmosphere and effects the temperature through the greenhouse gas effect. As heat is trapped in the atmosphere by \(\text{CO}_2\) gases, the Earth's temperature increases. The main source for \(\text{CO}_2\) in our atmosphere, amongst many is volcanoes.

**Allotropes**

Carbon exists in several forms called allotropes. Diamond is one form with a very strong crystal lattice, known as a precious gem from the most ancient records. Graphite is another allotrope in which the carbon atoms are arranged in planes which are loosely attracted to one another (hence its use as a lubricant). The recently discovered fullerenes are yet another form of carbon.

- Inorganic carbon may come in the form of diamond as transparent, isotropic crystal. It is the hardest natural occurring material on this earth. Diamond has four valence electrons, and when each electron bonds with another carbon it creates a \(\text{sp}^3\)-hybridized atom. The boiling point of diamond is 4827°C.
- Unlike diamond, graphite is opaque, soft, dull and hexagonal. Graphite can be used as a conductor (electrodes) or even as pencils. Graphite consists of planes of \(\text{sp}^2\) hybridized carbon atoms in which each carbon is attached to three other carbons.
- Fullerenes are carbon cages with the formula (\(\text{C}_{2n}\)) where (\(n > 13\)). The most abundant fullerene is the spherical \(\text{C}_{60}\). Fullerene may contain atoms or molecules inside the cage (endoedral fullerenes) or covalently attached outside (exoedral or adduct fullerenes). The discovery of fullerenes is accredited to Richard Smalley and his team in 1985 at Rice University by photoablating the surface of graphite with a laser.
Applications

Carbon has a very high melting and boiling point and rapidly combines with oxygen at elevated temperatures. In small amounts it is an excellent hardener for iron, yielding the various steel alloys upon which so much of modern construction depends. An important (but rare) radioactive isotope of carbon, C-14, is used to date ancient objects of organic origin. It has a half-life of 5730 years but there is only 1 atom of C-14 for every 1012 atoms of C-12 (the usual isotope of carbon).

References

1. General Chemistry Principles & Modern Applications Ninth Edition by Petrucci pg. 84-90
3. Inorganic Chemistry Third Edition by Housecroft, Catherine