

CLASSIFICATION OF CARBON MATERIALS

- ☐ **General information about carbon**
- ☐ **Classification of carbon**

General information about carbon

Symbol: C

Atomic Number: 6

Atomic Mass (average): 12.011

Electron Configuration: $1s^2 2s^2 2p^2$

Classification: Non-metal

Group Number: 14

Period Number: 2

Number of Protons/Electrons: 6

Atomic Radius: 0.077 nm

Isotopes: C-11 (half-life 20.3 min.), C-12 (stable), C-13 (stable), C-14 (half-life 5730 years), C-15 (half-life 2.5 sec.)

Name Origin: from Latin *carbo* (charcoal).

Carbon (C) is the sixth most abundant element in the Universe and the nineteenth most abundant element in the Earth's crust.

Carbon occurs in the earth either in its elemental forms (minor quantities): charcoal, graphite, diamond or mostly as carbon compounds: organic (petroleum, natural gas) and inorganic (limestone, marble, oyster shells, corals, dolomite, magnesite).

Carbon is a basic constituent of organic compounds (ex.proteins) of the living organisms. DNA molecules forming the genetic code contain carbon.

Classification of carbon

☐ **Graphite**

Graphite is a crystalline, low density and soft allotrope of carbon. The crystalline structure of graphite consists of hexagonal rings forming thin parallel plates. The plates are bonded to each other by weak Van der Waals forces. The layered structure of graphite determines its self-lubricating properties.

Graphite material having fine Grain structure is sometimes named amorphous graphite, however it is not really amorphous but micro-crystalline.

☐ **Diamond**

Diamond is a crystalline, transparent and extremely hard allotrope of carbon. The crystalline structure of diamond is FCC (face centered cubic), in which each carbon atom is bound to four

other carbon atoms forming a triangular prism. Diamond occurs and exists only in mono-crystal form.

Diamond is characterized by high hardness (the hardest of the natural minerals) and high refractive index 2.42 (measure of how a ray of light bends when passes from vacuum to the medium). Due to these characteristics diamond is widely used in jewelry. Industrial applications of diamond are associated with its hardness: cutting tools, grinding and polishing.

☐ **Carbon black**

Carbon black is a powdered form of carbon produced by pyrolysis (thermal decomposition in a limited amount or in the absence of Oxygen) of hydrocarbons, wood or other carbon containing materials.

Carbon black is sometimes called amorphous carbon however it is not correct as its structure is crystalline. The powder particles are finely divided graphite micro-crystals having dimensions in the range 8 nm - 400 nm (3.2×10^{-6} - 1.6×10^{-5} inch).

Besides carbon, carbon blacks may contain Oxygen, Hydrogen, Nitrogen and sulfur.

Carbon black (lamp black, acetylene black, furnace black, gas black, thermal black, channel black) is used for manufacturing tires and other rubber products, as a pigment in inks, paints and toners, as active carbon and for fabrication electrodes and cell batteries cores.

☐ **White carbon**

White carbon is a crystalline soft, transparent and birefringent (having more than one refractive index) allotrope of carbon made first in 1969 from graphite crystals by heating them to a high temperature (4130°F/2277°C) at low pressure.

Little information is known about this carbon allotrope.

☐ **Nanocarbons** are allotropes of carbon consisting of large molecules, in which carbon atoms are arranged in form of spheres, tubes, hollow cones or foams.

☐ **Fullerenes (buckyballs)** - nanocarbons, spherical molecule of which is composed from both: hexagonal rings characteristic for graphite structure and pentagonal rings. The presence of pentagonal rings in hexagonal structure converts planar graphite sheet into spheric shape (like soccer ball). Fullerenes were discovered in 1985 and were named after Buckminster Fuller designed geodesic domes. Fullerenes possess ferromagnetic, tribological and superconductive properties.

☐ **Nanotubes (buckytubes)** - nanocarbons, every molecule of which is built of an individual graphite-like layer (graphene) rolled-up in the form of a tube. Nanotubes possess extremely high strength and toughness (highest of the known substances).

☐ **Nanocones**- nanocarbons, every molecule of which is built of an individual graphite-like layer (graphene) rolled-up in the form of a cone.

☐ **Nanofoams** - low density nanocarbons consisting of carbon clusters, in which carbon atoms (about 4000) are arranged in form of curved graphene layers. Nanofoams possess ferromagnetic properties.

- ▣ **Nanodiamonds** - nanocarbon spherical molecules having diamond-like atoms arrangement combined with geodesic dome structure (similar to fullerenes).

Source : http://www.substech.com/dokuwiki/doku.php?id=classification_of_carbon_materials