# Organic Chemistry



*All here shown objects are based on carbon compounds*

## Allotropes of Carbon

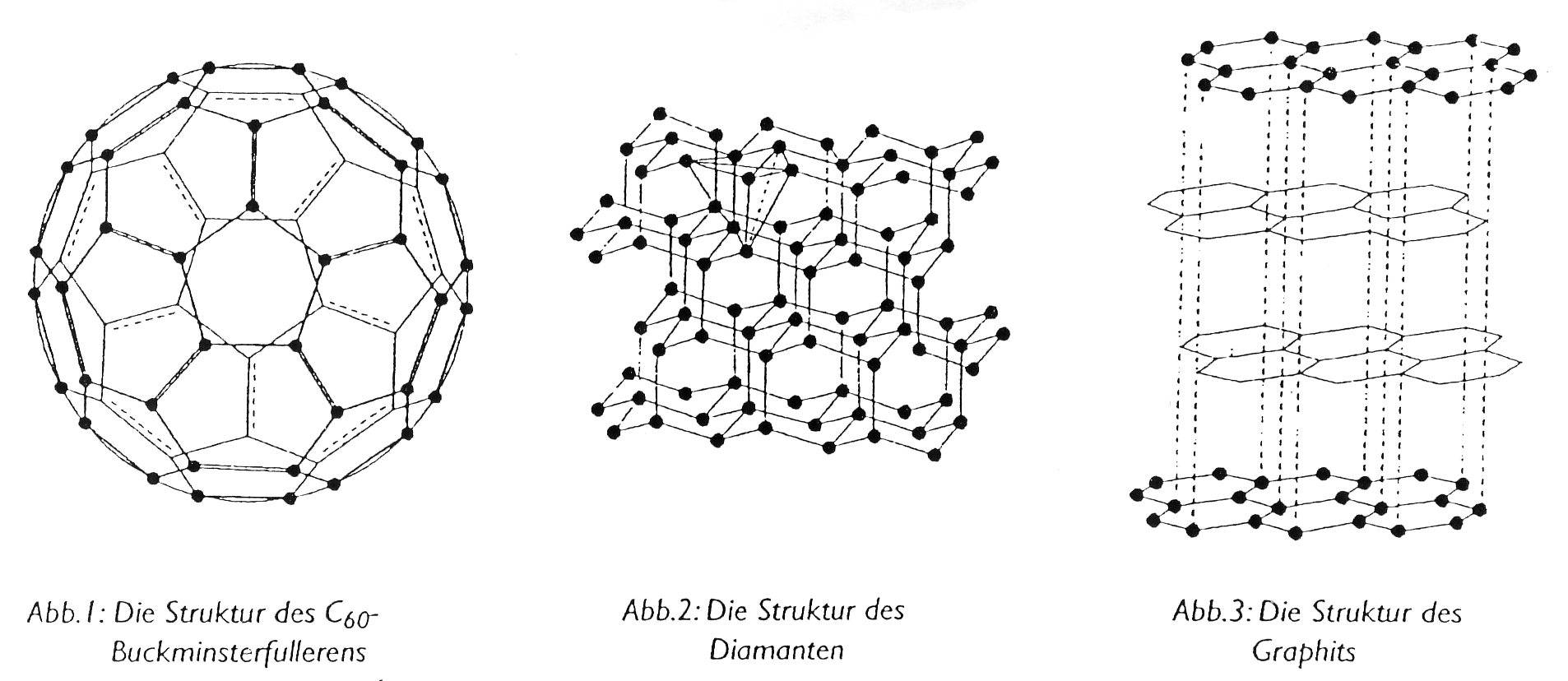
Pure carbon is available in a number of different forms (allotrope). The most common form of pure carbon is **graphite**. This is also the thermodynamically most stable form. **Diamond** is a second form of carbon but is much less common. 1985, another allotrope of carbon was characterized: the fullerenes. Whereas diamond and graphite are infinite lattices, **fullerenes** such as buckminsterfullerene (C60) are discrete molecular species. Amorphous forms of carbon such as soot are materials consisting of very small particles of graphite.

In graphite each carbon is directly bound to three other carbon atoms at a distance of 141.5 pm. Delocalization in the bonding is evident since the C-C distances are equal and shorter than normal carbon-carbon single bonds (typically 154 pm). The distance between the layers of carbon atoms is 335.4 pm.

Diamond is a slightly more compact structure, hence its density is greater than that of graphite. The appearance of diamond is well known and it is also one of the hardest materials known. Like graphite, it is relatively unreactive but does burn in air at 600-800°C. Each carbon atom is bound to four neighbours at a distance of 154.45 pm in a tetrahedral fashion and so each diamond crystal is a single giant lattice structure. In principle (and in practice!) graphite may be converted into diamond by the application of heat and pressure.

The tube fullerenes are called **nanotubes** which are very strong and are conductors of electricity. Their unusual electrical properties mean that nanotubes are used as semiconductors in electronic circuits. Their strength makes them useful in reinforcing structures where exceptional lightness and strength are needed for example, the frame of a tennis racket. They're also used as a platform for industrial catalysts.

## Comparison of some properties



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***C60-Fullerene Diamond Graphite***

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Graphite** | **Diamond** | **C60-Fullerene** |
| appearance |  |  | shiny black crystals |
| hardness |  |  | soft |
| el. conductivity |  |  | insulator |
| density (g/cm3) | 1.8 – 2.1 | 3.51 | 1.65 |
| melting temperature | approx. 3700 °C | conversion to  graphite at approx. 1500 °C | sublimes at  approx. 1000 °C |

## 

## Characteristics of Carbon Compounds

Compounds of carbon are defined as chemical substances containing carbon. More compounds of carbon exist than any other chemical element except for hydrogen. Organic carbon compounds are more abundant than inorganic carbon compounds.

A global team of scientists is continually adding substance information from the world's disclosed chemistry to the **“Chemical Abstracts Service (CAS)”**, the gold standard for chemical substance information. (http://www.cas.org):



**Date 26/08/2012 08:49:21 EST**

**Count 68,298,541**

**63,981,270 sequences**

**CAS RN 1392396-84-7 is the most recent CAS Registry Number**

An important carbon property is catenation as the ability to form long carbon chains and rings. This is only possible, because the C-C bond as well as the C-H bond are stable at room temperature.

## Functional groups

A functional group is a particular atom, or a group of atoms, in a molecule that is responsible for how the molecule reacts. The members of a **homologous series** will contain the same functional group. For example, haloalkanes contain halogen atoms and alkenes contain a C=C double bond *(from AQA1)*.

**Some important functional groups:**

|  |  |  |
| --- | --- | --- |
| **Functional group** | **Name** | **Homologous series** |
|  | **hydroxyl** group | alcohol |
|  | **carbonyl** group | ketone (within a C-chain)  aldehyde (terminal) |
|  | **carboxyl** group | carboxylic acids |
|  | **amino** group | amine |
|  | „ether” group | ether |
|  | „ester” group | ester |

“” means, the functional group is attached to a carbon atom. Exceptions are the Carboxyl- und die Carbonyl group where it can also be a hydrogen atom.

