Synthesis and Chemistry of Fullerenes



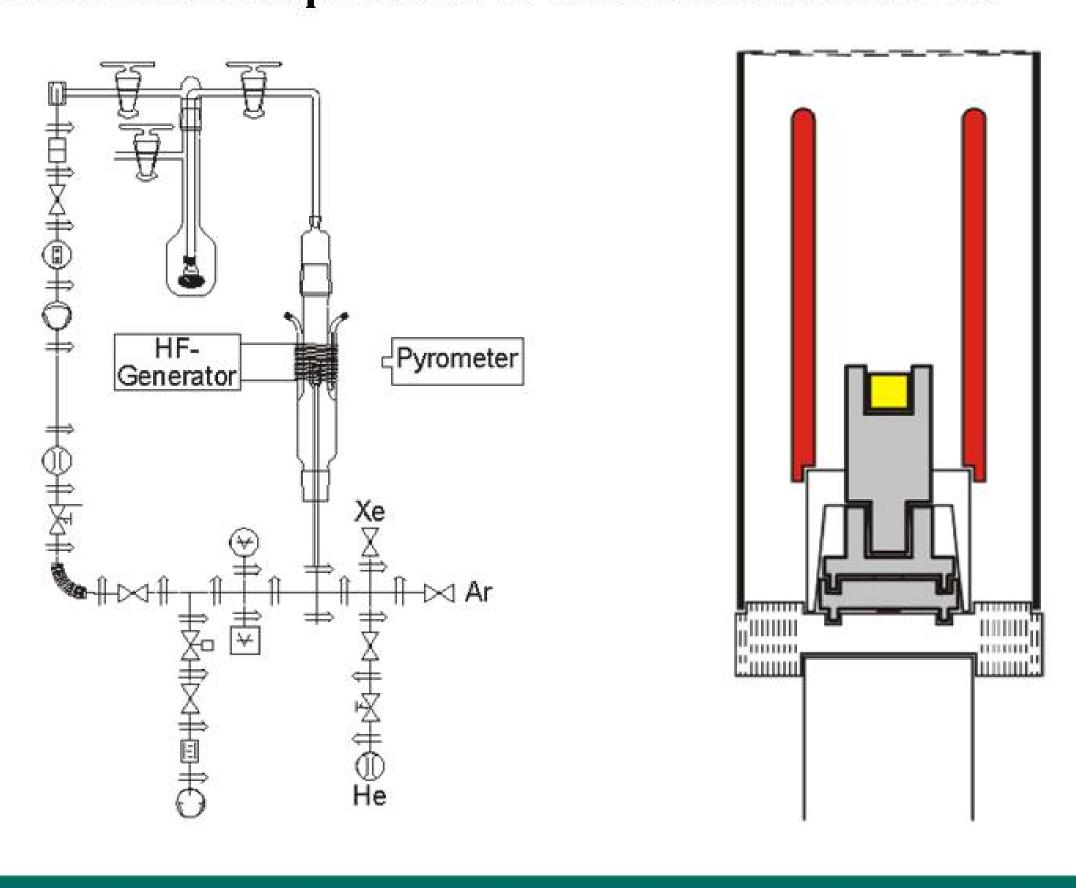
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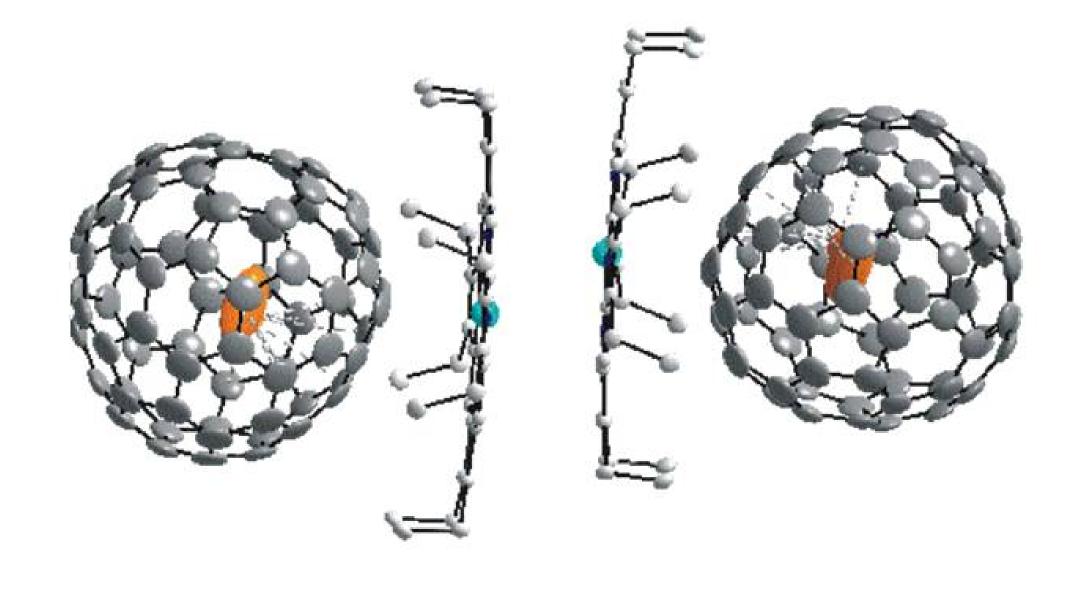
Introduction

Fullerenes are promising candidates for the generation of novel materials due to their electron acceptor capabilities and the interesting electronic, optic and magnetic properties. These molecules are known to form supramolecular adducts with small molecules like porphyrins, calixarenes, tetrachalcogenefulvalenes and various aromatic donors. Crystal structure determination of such co-crystals is often seriously hampered by orientational and librational disorder phenomena that are also common to pristine fullerenes.

Production and separation of endohedral fullerenes

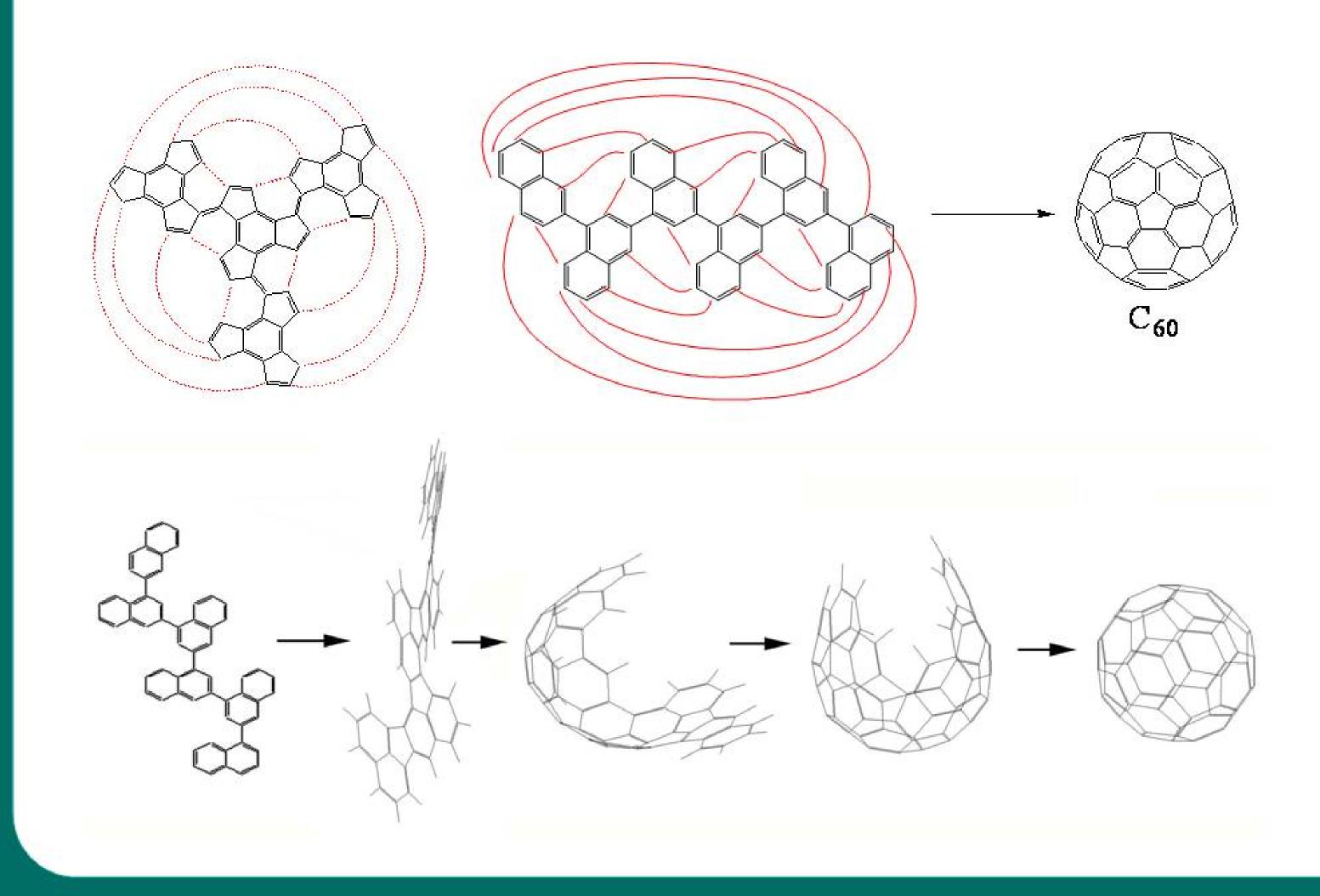


The radio frequency furnace allows the production of higher amounts of small fullerene cages and endohedral ones. The special construction of the oven allows to evaporate carbon and the respective metal separately. Such an independent heating of the carbon and metal sources permits to use a broad range of metals for generating/producing endohedral fullerenes.



 $Ba@C_{74}$ and $Sr@C_{74}$ The first endohedral crystall structures with an atomic resolution of the fullerene cage.

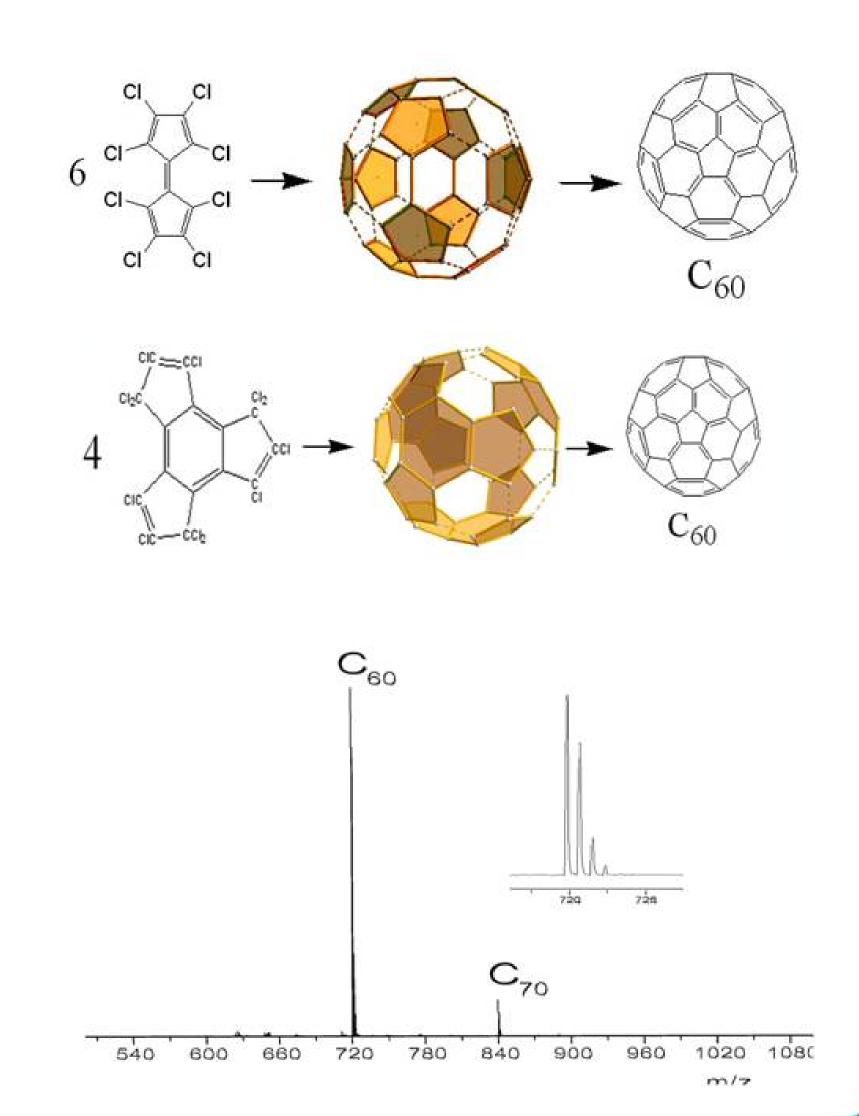
Direct synthesis of fullerenes



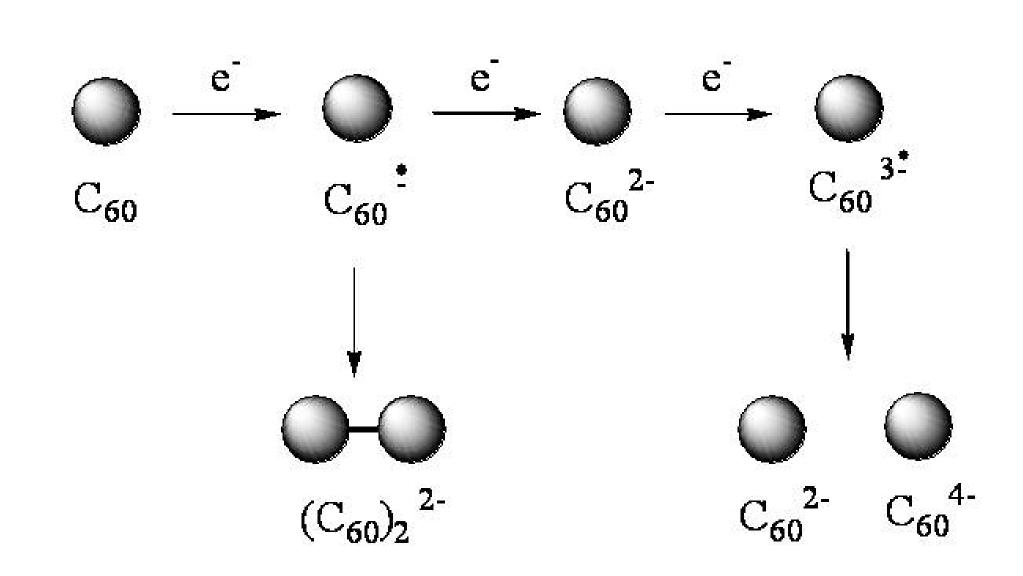
Direct synthesis of fullerenes is of particular interest as a perspective method of access to new fullerenes, including endohedral ones, which can not be obtained in the uncontrolled process of graphite evaporation.

Fullerene cages can be formed from precursors which contain all carbon atoms in appropriated positions. Intramolecular condensation of such precursors leads to formation of fullerenes.

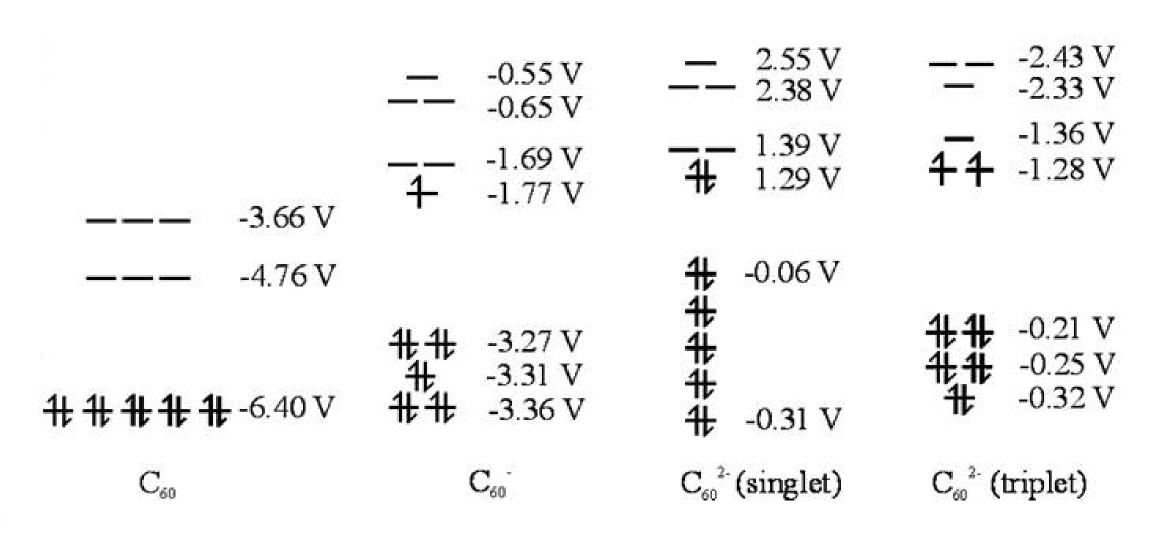
An alternative approach for fullerene synthesis - the so-called 'patch-assembly' synthesis - is based on composing a fullerene core from suitable syntons. Step by step condensation of such molecules leads to formation of fullerene cage.



Fullerides



Energy levels of pristine C_{60} and C_{60}^{n-}



Fullerenes have a very high electron affinity and C_{60} can accept up to 12 electrons reversibly.

Fullerides (negatively charged fullerenes) are interesting materials exhibiting many exceptional solid state properties such as superconductivity (K₃C₆₀) or ferromagnetism (TDAE-C₆₀). Due to their tendency to crystallize as disordered structures, detailed structure analyses were performed in a very limited number of cases.

The monoanionic alkali metal fullerides AC₆₀ display monomers, dimers or polymers depending on the thermal history of a given sample.

In our experiments we employ the seal-and-break technique which enables us to handle extremely air sensitive fullerene anions and anion-radicals.

Polymerization

