# (C60) and The Pore Structure (Nanoparticles) in CNTs and CNT Nanotubes

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- **Abstract:**

- Note: Buckyballs are hollow, spherical carbon structures, the most famous of which is C60, or fullerene. C60 has a structure similar to a soccer ball. The carbon atoms in it are connected by covalent bonds in pentagons and hexagons.

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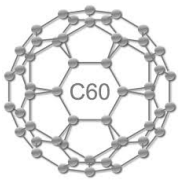
- **Keywords:** Nanostructure , nanomaterials , Buckyballs , Fullerene C60 , Nanoelectronic

## Introduction •

C60s or fullerenes are actually made up of 30 parts, 10 of which are hexagonal and 12 of which are pentagonal. Buckyballs have many applications due to their chemical properties and hollow, cage-like shape. Buckyballs are extremely stable and can withstand very high pressures and temperatures. The carbon atoms of buckyballs can react with atoms and molecules without changing or damaging their stability and spherical structure.

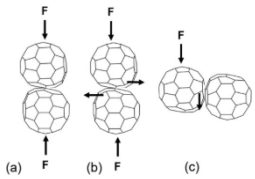



**The structure of Nanoparticle in CNTs (CNT) nanotubes**

Carbon nanotubes are one of the most important and widely used carbon structures. They have unique properties and characteristics. In addition to being very strong, carbon nanotubes also have good flexibility and twistability. One of their applications is composites. The most important property of nanotubes is their electrical conductivity, which varies depending on the order of the atoms. They are cylindrical molecules with open or closed ends. The structure of nanotubes is like a rolled sheet of graphite. To better understand the structure of a nanotube, consider a layer of graphite. The atoms are arranged in a row with (m,n) indicating the coordinates of a point in the sheet. So that the coordinate n corresponds to the column of atoms and the coordinate m corresponds to the row of atoms. As we know, to prepare a tube from a sheet, it is enough to place one point of the sheet on another point. A nanotube is like a graphite sheet that has been shaped into a tube. Depending on how the two ends of the graphite sheet are connected to each other, we will have different types of nanotubes.

**Zigzag type Nanotube**

To make a zigzag type of nanotube, we arrange the atoms in a (horizontal) column by column (numbered) 1, 0, etc., according to the figure, and align the end atom (1, 5) with the starting atom (1, 1) by bending the plate. To ensure the correctness of the manufacturing method, we must be careful that at the end of the work, we see a broken zigzag line around the nanotube in the horizontal direction.



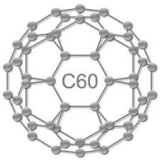

**Nanotube chair type**

If the initial atom and the atom that is in a 05 degree position with respect to it are placed on top of each other, a chair-type nanotube is obtained. In this case, we can draw a straight line between these two atoms, the equation of which is "n=m". That is, the column and row numbers

of each of them are equal to each other. In this case, with one rotation around the nanotube, we will see a number of chairs in a row.

**Asymmetric type of Nanotubes**

In this case, we act similarly to the chair method, except that the coordinates of the end atom will be n≠m. If we rotate the nanotube horizontally once, we see a set of chairs that are inclined to the horizon. To make a model of each type of nanotube, simply bend the paper according to the shape and match the end point to the starting point.




Each of the three types of nanotubes has its own properties due to their specific atomic arrangement. Nanotubes have strong bonds between their atoms, which is why they are very resistant to tensile forces . For example, the force required to break a carbon nanotube is many times the force required to break a piece of steel with a thickness equivalent to a nanotube. In addition to providing high strength, the interatomic bonds in nanotubes allow them to be easily malleable and even twisted, while steel only has resistance to tensile forces and does not have the flexibility required for twisting.

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