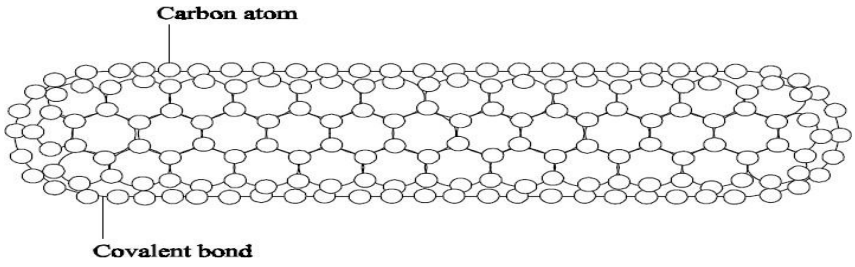
Carbon nanotubes (CNTs)- Properties and uses

Empathy questions

7. **How might the commercialization of carbon nanotubes impact traditional industries and their workers?**
8. **What role do carbon nanotubes play in advancing sustainable economic development, and who stands to benefit the most?**

Carbon nanotubes (CNTs)

- Carbon nanotubes are allotropes of carbon with a nanostructure having a length- to-diameter ratio greater than 1,000,000. When graphite sheets are rolled into a cylinder, their edges joined and form carbon nanotubes i.e., carbon nanotubes are extended tubes of rolled graphite sheets.
- Nanotubes naturally align themselves into "ropes" and held together by vanderwaals forces.
- But each carbon atoms in the carbon nanotubes are linked by the covalent bond.



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Single walled carbon nano tubes (SWCNT) Structure

(or) Types of carbon nanotubes

- Depending upon the way in which graphite sheets are rolled, two types of CNTs are formed.

(i) Single - walled nanotubes (SWCNTs)

- SWCNTs consist of one tube of graphite. It is one-atom thick having a diameter of 2 nm

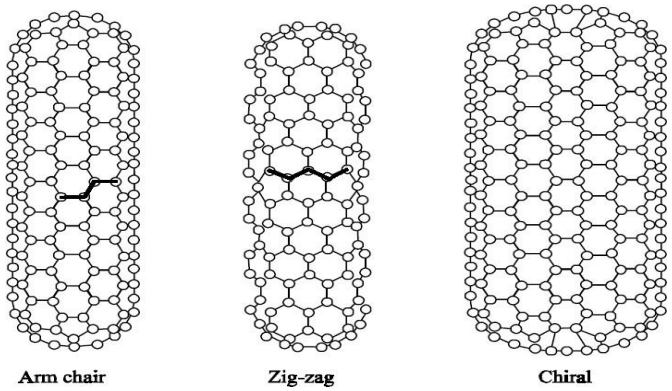
and a length of 100 nm.

- SWCNTs are very important, because they exhibit important electrical properties.
- It is an excellent conductor.
- Three kinds of nanotubes are resulted, based on the orientation of the hexagonlattice.

(a) Arm-chair structures: The lines of hexagons are parallel to the axis of thenanotube.

(b) Zig-zag structures: The lines of carbon bonds are down the centre.

(c) Chiral nanotubes: It exhibits twist or spiral around the nanotubes.



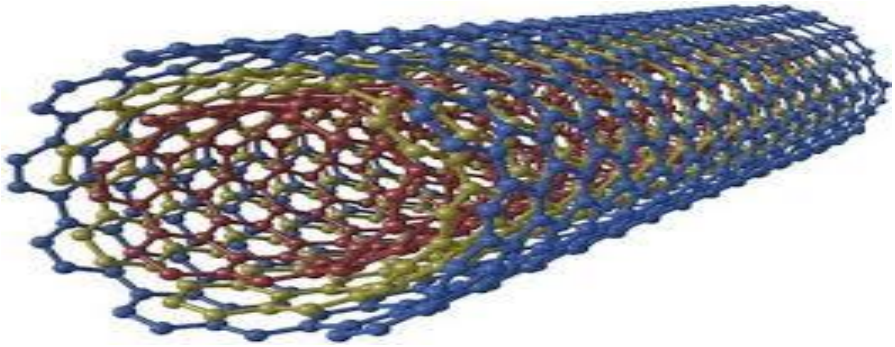
Structure of Single walled carbon nanotubes

- It has been confirmed that arm-chair carbon nanotubes are metallic while zig-zag and chiral nanotubes are semiconducting.

(ii) Multi - walled nanotubes (MWNTs)

- MWCNTs (nested nanotubes) consist of multiple layers of graphite rolled in on themselves to form a tube shape.
- It exhibits both metallic and semiconducting properties. It is used for storing fuelssuch as hydrogen and methane.

Multi walled Carbon Nanotubes (MWCNT)



SYNTHESIS OF CARBON NANOTUBES

- Carbon nanotubes can be synthesised by any one of the following methods.

1. Pyrolysis of hydrocarbons.
2. Laser evaporation.
3. Carbon arc method.
4. Chemical vapour deposition.

Properties of CNT's

- CNTs are very strong and withstand extreme strain in tension and possess elastic flexibility.
- The atoms in a nano-tube are continuously vibrating back and forth.
- It is highly conducting and behaves like metallic or semiconducting materials.
- It has very high thermal conductivity and kinetic properties.
- It has high kinetic properties

Uses of CNT's

- It is used in battery technology and in industries as catalyst.
- It is also used as light weight shielding materials for protecting electronic equipments.
- CNTs are used effectively inside the body for drug delivery.
- It is used in composites, ICs.
- Carbon nanotubes are used as sensors for gases
- They are used in desalination and to filter carbon di oxide from power plant emission