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# CARBON NANOTUBES: A REVIEW PAPER

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## **Abstract**

*In the field of nanotechnology, carbon nanotubes are perhaps the most exceptional creations and carbon nanotubes are huge material for what's to come. It has been found in 1991, on account of the tremendous creation they have pulled in numerous enterprises and organizations towards it. Carbon nanotubes are utilized in nanotechnology, films, capacitors, polymers, metallic surfaces, earthenware production, nanomedicine, and so on the primary rationale of this paper is to feature the amalgamation, properties, and harmful impacts of the carbon nanotube.*

**Keywords:** Nanotechnology, Nanoparticles, Carbon Nanotube, SWCNT, MWCNT.

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## **1. INTRODUCTION**

Carbon-containing sp<sup>2</sup> hybridization having various designs. Graphite is a notable illustration of it yet now other than graphite, carbon can form shut and open confines with honeycomb arrangement [1]. Graphene is known as a 2D single layer of graphite in the rundown of carbon nanomaterials. Graphene is a more grounded material than jewel since it contains sp<sup>2</sup> hybridization which is more grounded than the sp<sup>3</sup> hybridization in diamond [2]. in ongoing many years carbon nanotubes are the most energizing regions of research[3]. Carbon nanotubes are comprised of carbon and it is a cylinder formed material. its breadth is excessively little and is estimated by nanoscale. Graphenes are folded up into chamber that forms carbon nanotubes[2].

### **Structure of Carbon Nanotubes:**

Carbon nanotubes are buckytubes, in carbon nanotubes, carbon atoms are in a round and hollow shape and have special properties that make carbon nanotubes utilized in various territories. They have properties like warm, electrical, and mechanical properties [4]. Carbon nanotubes have a

fullerene-like construction and having Graphene sheets that contain sp<sup>2</sup> hybridization of every carbon atom [5].

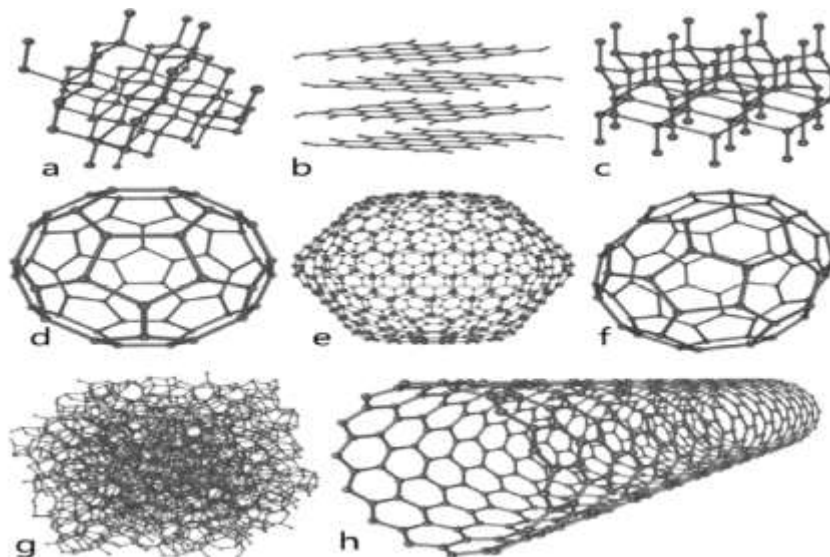


Fig. 1 Eight allotropes of carbon a) a) diamond, b) graphite, c) lonsdaleite, d) C<sub>60</sub> buckminsterfullerene, e) C<sub>540</sub>, Fullerite f) C<sub>70</sub>, g) amorphous carbon, and h) single-walled carbon nanotube [6]

### Orders of Carbon Nanotubes

Carbon nanotubes are of two sorts

#### Single-Walled Carbon Nanotubes:

It comprises of a solitary layer of graphene. It requires an impetus for its combination. SWCNT are of poor immaculateness and doesn't have any intricate construction. It can without much of a stretch be bent [4].

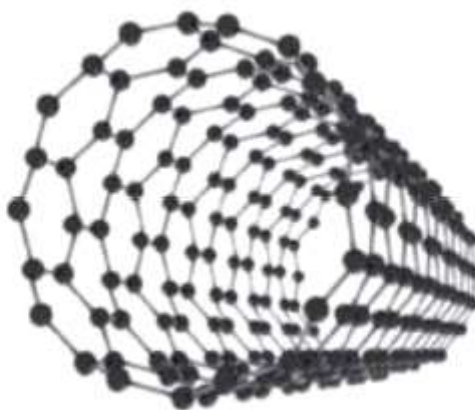


Fig. 2 Single walled carbon nanotubes[7]

### Multi-walled Carbon Nanotubes

It comprises of a multi-layer of graphene. it doesn't need any impetus for its blend. MWCNTs are of high virtue and have an intricate construction. it can't be effectively twisted[7]

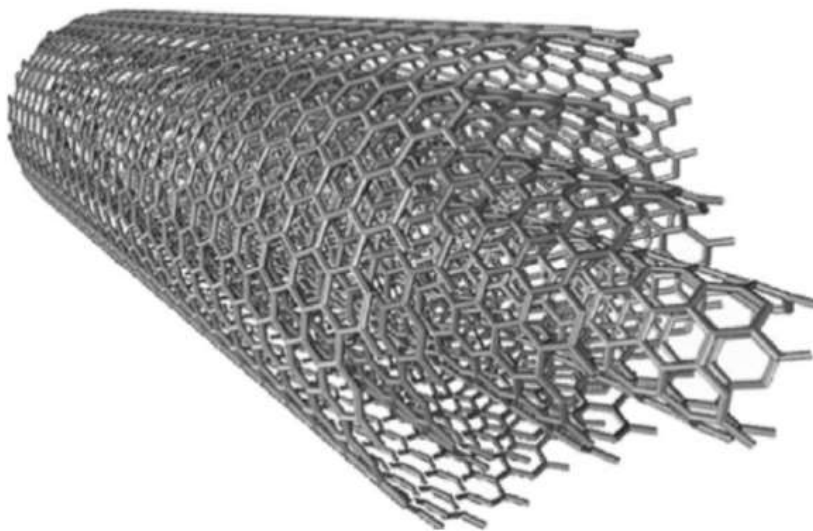


Fig. 3 Multi walled carbon nanotubes[7]

### Technique for Preparation of Carbon Nanotubes

**Plasma-based blend technique (circular segment release strategy)**

For the best nature of nanotubes, plasma-based strategies or curve release strategy can be utilized. It includes two graphite terminals in presence of helium and a current of 50 amperes is gone through two graphite terminals. it causes vaporization of graphite; a few pieces of it consolidate on the response vessel and some of it gathers on the cathode. The part is the store on a cathode carbon nanotube. on the off chance that we need single-walled carbon nanotubes, at that point Co, Ni metals can be presented in anode [8].

### **Laser Method**

in 1996 Laser was utilized for the creation of carbon nanotubes with 70% immaculateness. As of now this technique is utilized for the creation of carbon nanotubes. This cycle comprises of graphite poles and it contains a 50:50 impetus combination of Co and Ni at 1200°C and argon are coursing through it for test readiness [9]. In this strategy metal catalyze the development of single-walled carbon nanotubes and likewise many side items are formed. We can get nanotubes by cooling vaporized species [10].

### **Chemical vapor statement**

In the above techniques, there are two major issues for example ordered amalgamation and huge scope creation [11]. In 1996, the compound vapor testimony technique was utilized for the creation of carbon nanotubes [12]. This strategy is used to create a lot of nanotubes. In this cycle response chamber contain a combination of nitrogen, ethylene, and acetylene. During this temperature of the response chamber were 700-9000C and one climatic pressure [13]. This strategy is utilized on a lower temperature and we get efficient carbon nanotubes [14].

Table 1: A Summary of the synthesis of carbon nanotubes

Method	Arc discharge method	Laser method	Chemical vaporization method
Process	it involves two graphite electrode in presence of helium and a current of 50 ampere is passed through two graphite electrodes	this process consist of graphite rods and it contain 50:50 catalyst mixture of Co and Ni at 1200°C and argon is flowing through it	in this process reaction chamber contain mixture of nitrogen, ethylene and acetylene. during this temperature of reaction chamber was 700-900°C and one atmospheric pressure.
Conditions	Low pressure inert gas(helium)	Argon gas at 1200°C.	700-900°C temp at one atmospheric pressure
Yield	32-91%	Up to 70%	Up to 100%
SWCNT	Short tubes with diameter .6-1.4nm	Long tubes with diameter 1-2nm	Long tubes with diameter .6-4nm
MWCNT	Short tubes with diameter 1-3nm	they are very expensive and not prepared but can be synthesized	Long tubes with diameter 10-240nm
CARBON SOURCE	graphite	graphite	hydrocarbon
Cost	high	high	low

### Utilizations of Carbon Nanotubes

- 1) Carbon nanotubes are utilized in medication conveyance transporters for the therapy of cancer [15]. And they are reported for focusing of amphotericin B to cells [16].
- 2) Carbon nanotubes are utilized for the age of tissue. Lately carbon nanotubes are best for tissue age on the grounds that these are biocompatible, impervious to biodegradation, and upgrading organ age [17].
- 3) Carbon nanotubes are utilized as energy storage devices.
- 4) Carbon nanotubes are utilized in counterfeit inserts. Carbon nanotubes having high rigidity so they are loaded up with calcium and orchestrated like a bone, so can go about as a bone substituent.
- 5) Carbon nanotubes are cell reinforcement in nature so they are utilized to safeguard medicates that are effectively oxidized [18].
- 6) Carbon nanotubes are utilized for Gene treatment by DNA conveyance. Quality treatment is a treatment to fix the quality which can cause hurtful infection by bringing DNA into cells [19][20]

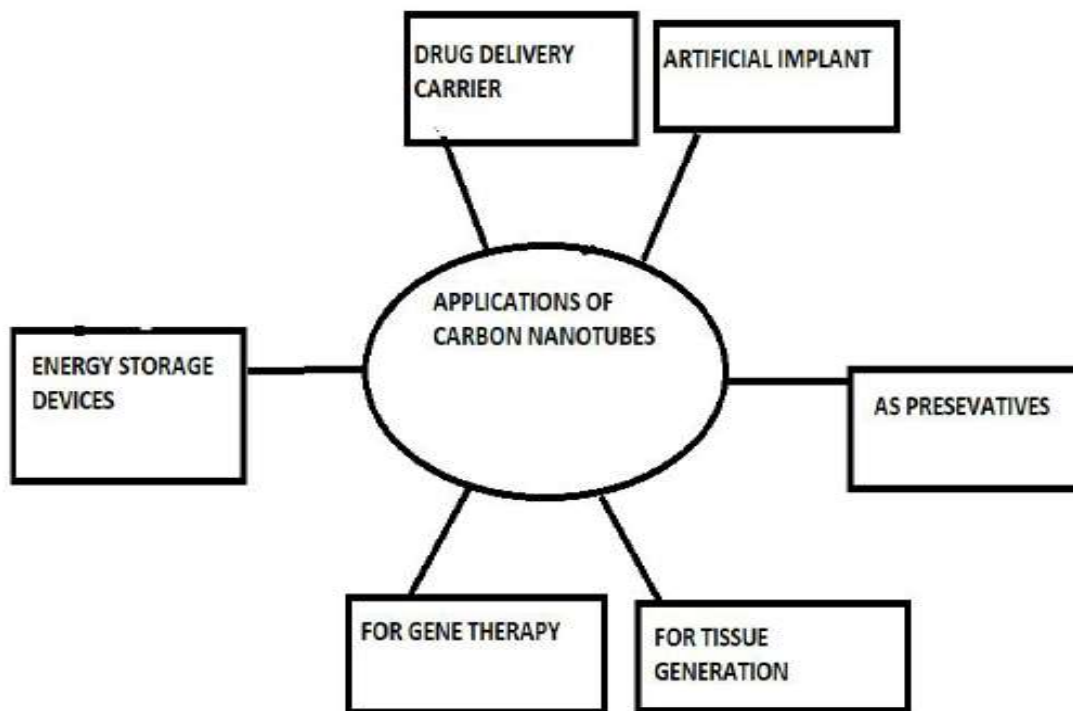


Fig. 4: Application of Carbon Nanotubes

### Inconveniences of Carbon Nanotubes

- 1) It is hard to keep up high caliber and lower debasements [21].
- 2) Cost of nanotechnology is extremely high [22].
- 3) In arc discharge and laser strategy enormous measure of energy is needed to finish the cycle [29].
- 4) It is hard to target enormous measure of graphite in mechanical cycle [23].

## II. DISCUSSION & CONCLUSION

This survey paper depends on the properties, applications, and constraints of carbon nanotubes. The point of this paper isn't just to lay weight on its extraordinary properties yet additionally its unsafe impacts that can happen during the utilization of metals that harmful. In this examination, we notice that substance vapor affidavit is the best strategies for the creation of carbon nanotubes since it gives high immaculateness carbon nanotubes. Analysts taking an unmistakable fascination for carbon nanotubes and liable to give more headway in the coming future.

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