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CARBON NANO TUBES

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1. ABSTRACT
In this paper we review history, types, structure and different synthesis methods for carbon nanotubes (CNT_S).In (CNTs) are allotropes of carbon with a nanostructure that can have a length-to-diameter ratio greater than 1,000,000. These cylindrical carbon molecules have a great property that makes them useful in many applications in nanotechnology. Their unique surface area, strength and resilience have led to much excitement in the field of pharmacy. These nanotubes are majorly classified into single walled and multiple walled nanotubes. Many techniques have been developed to produce nanotubes in sizeable quantities, including arc discharge, laser ablation, chemical vapour deposition, silane solution method and flame synthesis method. The properties and characteristics of CNTs are still being researched. They can pass through membranes, carrying therapeutic drugs, vaccines and nucleic acids deep into the cell to targets previously unreachable.

2. KEYWORDS: nanotubes, nanomedicine, nanotechnology.

3. INTODUCTION

The word nanotube is derived from their size, because the diameter of a nanotube is about of few nanometres (approximately 50,000 times smaller than the width of a human hair) In the last few years, most of the inventions and development had been done on the Nano scale only due to the application of them at the cellular level.[1] Such inventions and development of nanomaterials consist of inorganic or organic matter and in most of the cases they have never been studied in pharmaceuticals.[2] Carbon nanotubes are one of them. They are tubular in shape, made of graphite. CNTs possess various novel properties that make them useful in the field of nanotechnology and pharmaceuticals. They are having nanometres in diameter and several millimetres in length and have a very long range of electronic, thermal, and structural properties.[3] Their unique properties like stiffness, strength and resilience have attracted the pharmacy field towards them.

Many studies have explained that when bonded to CNTs, these molecules are delivered more effectively and safely into cells than by conventional methods. This fantastic discovery has opened a new way of the formulation in the pharmaceutical field when compared to the conventional dosage form.[5] It has first used in the formulation of the anti-cancer drugs and Antibiotics which are useful to treat the cancer at the cellular level.

CLASSIFICATION: There are two types of the nanotubes i.e.[6]
(1) SWNTs- Single walled carbon nanotubes
(2) MWNTs- Multiple walled carbon nanotubes

Difference between the SWCNTs and MWCNTs

Table1: difference between the SWCNTs and MWCNTs.

SWCNTs	MWCNTs
1. Single layer of graphene	1. Multiple layer of graphene
2. Catalyst is required for synthesis	2. Can be produced without catalyst
3. Purity is poor.	3. Purity is high
4. Less accumulation in body.	4. More accumulation in body
5. Characterization and evaluation is easy	5. It has very complex structure
6. It can be easily twisted and are more pliable.	6. It cannot be easily twisted

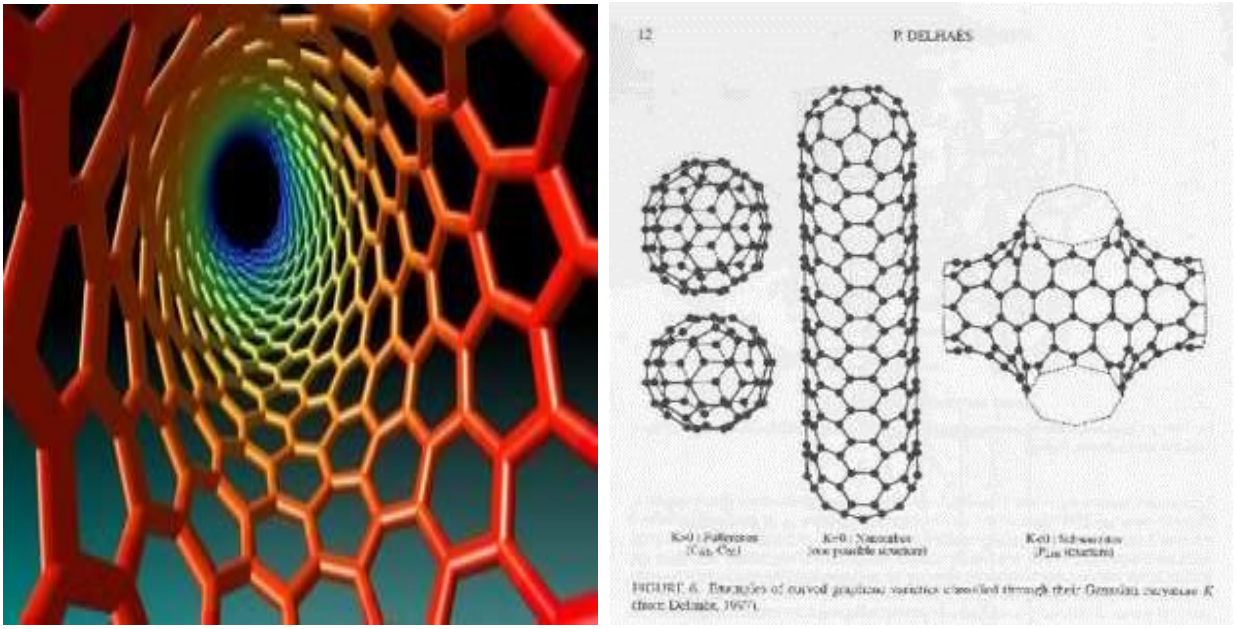

Fig. 1: Shape of carbon nano tubes.

4. HISTORY: In 1952 Radushkevich and Lukyanovich have published 50 nanometer diameter tubes made of carbon in the Soviet Journal of Physical Chemistry.[7] 2. A paper by Oberlin, Endo, and Koyama in 1976 clearly showed hollow carbon fibres with nanometer-scale diameters using a vapour-growth technique in their publication.[8] 3. In 1979, John Abrahamson presented of carbon nanotubes the conference paper described carbon nanotubes as carbon fibber's which were produced on carbon anodes during arc discharge.[9] 4. In 1981 a group of Soviet scientists published the results of chemical and structural characterization of carbon nanoparticles produced by a thermocatalytical disproportionation of carbon monoxide. Using TEM images and XRD patterns, the authors suggested that their "Carbon multi-layer tubular crystals" were formed by rolling grapheme layers into cylinders.

5. FORMULATION

They are majorly three types of methods i.e.
(1) ARC Discharge method
(2) Laser Ablation method &
(3)CVD (chemical vapour deposition)

5.1 ARC discharge method: This method used for preparations of large amounts of the nano tubes. This method is the most common and the easiest way to produce carbon nanotubes. This technique contains a large mixture of components and also requires separation of the nanotubes from the catalytic metals which are present in the crude products. This technique contain of about two carbon rods placed end to end wise, which are having the gap of 1cm and these are kept in the helium gas at low pressure i.e.50 to 700 mbar , then the direct current of 50 to 100A driven by the 20Vcreats the high temperature between the two rods. Then due to evaporation the one of the carbon nanotube is formed and a small residue deposit on the other rod .based on the parameters applied the SWCNTs and MWCNTs can be formulated. the yield in this technique Is about of 30to90%.[10]

5.2 Laser Ablation method

This method was first reported in the year 1995 by the scientist group called Smalley's group at Rice University. A continuous laser is usually used to evaporate graphite in an oven at the temperature of the 1200^{o}c. The oven should be filled with the inert gas like the helium due to maintain the pressure at the 500 Tor. Then the hot vapour forms which expands and cools rapidly. The graphite which is present in the oven cools and condenses to form the large clusters. The catalyst also starts to condense and attach to the carbon atoms which generally forms a closed ring or cage structure.in this technique the SWCNTs are blended due to the Vander walls forces. The yield of carbon nano tubes in this method is about of the 70%.[11]

5.3 Chemical vapour deposition (CVD)

This method is achieved by keeping the carbon source in the gas phase and by the using of plasma or the heated coil that will transfers the energy to a carbon source in the gas phase.

The energy source is used to break the carbon molecule in to the reactive atomic carbon .when the carbon diffuses with the substrate, which is already heated and the catalyst is coated with the (NI &FE) where they will under the binding process.CVD is an process which consist of the two step process i.e. preparation of the catalyst and then synthesis of the nanotubes. The catalyst is generally prepared by sputtering a transition metal onto a substrate and then using either chemical etching or thermal annealing to induce catalyst particle nucleation. Then the thermal annealing forms the growth of the nano tube. The temperature that should be maintained is 32and

ranges to the 650to 900^{o}c.yelid of the product is about of the 20to 100 %.[12]

6. FILLING UP OF NANOTUBE

After the synthesis of the nano tube the second step and vital step is filling of the nano tube by the drug so that it will be ready for the human administration.by above preparation methods we obtain the closed tubes which can be opened by the suitable chemistry.[13] one the technique is the acid treatment in which the tube gets oxidizes and opens at the one end through which we can add a drug in the tube and make ready for the administration of human.[14]

7. DRUG DELIVERY

The drug delivery is generally designed for showing the greater physiology and the also therapeutic response. the hallow place in the tube generally allows the large as well as small molecular drugs.it also allows both the lipophilic and hydrophilic drugs.it can also give as the multidrug delivery too .It also acts as the controlled release drug system.[15]

7.1 THE PURPOSE OF USING NANOTUBES IN THE HUMAN BODY

These nano tubes are used in the human body due to their stability and also they can penetrate in the cellular level too.in the case of tumor targeting these nanotubes can go and reach the cellular level and release the drug so that we can generally get the good therapeutic response than the conventional dosage forms.[16] these are the vehicles which carry the drug to the tumor cells so the adverse drugs reactions of the cancer drugs can be overcome by destroying the tumor cells only.

7.2 CNTS IN DRUG DELIVERY AND CANCER THERAPY

Present trend in the drug targeting are the Dendrimers, liposomes. but there is an possibility for taking the nanotubes for drug delivery due to the high loading capacity and good penetration qualities .due their tube structure the drug can be either kept closed or not closed because un caped can cause good accessibility. These are having good bioavailability and reduced toxicity. The only disadvantage is the solubility of which can be overcome by the advances in the nanotubes.[17-18]

8. MATABOLISM OF NANOTUBES

In the recent years nano tubes after synthesis and have been drug loaded in the laboratories then they were given or tested on the animals by given them through the inhalation and also by the injectables .in the case of inhalation the nano tubes caused the inflammation and also led to the cancer also i.e.pulmanary cancer.[19-21] Some of the scientist has given a report that continues exposure to the carbon nanotubes can led to lung cancer. Later a group of American scientist has given an report that they have found an enzyme called Myeloperoxidase (MPO) that can break the nanotube which is seen in the white blood cells. This (MPO) is seen in the some of the white blood cells i.e. neutrophils which acts against the harmful bacteria.[22-24] These (MPO) converts the carbon nano tubes in the carbon dioxide and also the water also scientist found that the after metabolism or break down of the nanotubes there is presence of the inflammation in the mice. They are also several studies have been going on the breakdown of the carbon nanotubes.[24-25]

9. Applications

- Targeted drug delivery
- Magnetic fields drive drug loaded nanoparticles to reduce blood vessel blockages in an animal study.
- They can be used as lubricants or glidants in tablet manufacturing due to Nano size and sliding nature of graphite layers bound with van der Waals forces.
- These nanotubes can be given alternative to the oral route for some drugs which are having of the gastric irrigation e.g. erythopotien.
- In the cases of the cancer antibiotics can be given by nanotubes because of their penetration at cellular level.
- Used as the preservative because of having the antioxidant property.
- Used in the artificial implants.
- Diagnosis tool.
- Also used as catalyst.[25]

Limitations: there are some of the limitations that are

- Lower solubility
- Very difficult to synthesis the nanotubes.
- Difficult to maintain the quality and far from impurities.[26]

10. CONCLUSION

In the prospects of the cancer and gene therapy scientist are doing lot of innovations which shows the better action. Nanotubes are the one of them showing better response by having the properties like the stability and also the acts as the better vehicle for drugs to take them to their site of action i.e. is at the cellular level by the penetration. These SWCNTs and MWCNTs have already proven to serve the better and effective to the alternative to the older dosage forms i.e. the conventional dosage forms.it can reaches in the cells also which is not done by the recent dosage forms i.e. conventional dosage forms Overall, recent studies regarding CNTs have shown a very promising glimpse of what lies ahead in the future of medicine.

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