CARBON NANO TUBES

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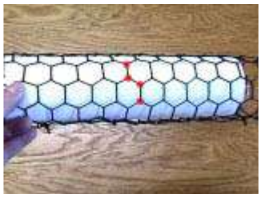
ABSTRACT

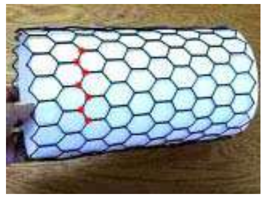
Carbon nanotubes (CNTs)have allotropes of carbon with a nanostructure that may have a length-to-diameter relationgreater than 1,000,000. These cylindrical carbon molecules have such properties that make them undoubtedlyuseful in various applications . Their distinctive area, stiffness, strength and resilience and strength contain maximum potential for the field of pharmacy. Nanotubes area unit classified as single-walled nanotubeand multiple walled nanotubes. Techniques are developed to provide nanotubes in sizeable quantities, including arc discharge, optical device ablation, chemical vapor deposition , saline resolution methodology and flame synthesismethod. The properties and characteristics of CNTs area unit still being researched heavily and scientists have barelybegun to faucet the potential of those structures. they will withstand membranes, carrying therapeutic medicine, vaccines and nucleic acids deep into the cell to targets antecedently out of reach. Overall, recent studies relating toCNTs have shown a really promising glimpse of what lies ahead within the way forward for medicines.

I INTRODUCTION

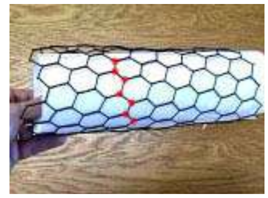
The previous couple of years have witnessedthe discovery, development and, in somecases, large-scale producing andproduction of novel materials that liewithin the nanometre scale. Such novelnanomaterials comprises inorganic ororganic matter and in most cases havenever been studied within the context ofpharmaceuticals. Carbon nanotubes(CNTs) area unit one among them. CNTs areallotropes of carbon. they'recannular inshape, fabricSated from carbon. CNTs possessvarious novel properties that build themuseful within the field of engineering science andpharmaceuticals. they're nanometers indiameter and several other millimeters longand have a really broad vary of electronic,thermal, and structural properties. Theseproperties vary with reasonably nanotubesdefined by its diameter, length, chirality ortwist and wall nature. Their distinctive surfacearea, stiffness,
strength and resilience haveled to abundant excitement within the field ofpharmacy [1]. There are three unique geometries of carbon nanotubes. The three differentgeometries are also referred to as flavors. The three flavors are armchair, zig-zag, and chiral [e.g. zig-zag (n, 0); armchair (n, n); and chiral (n, m)]. These flavors can be classified by how the carbon sheet is wrapped into a tube (see pictures below).[38,39,40]



Arm Chair Arrangement



ZigZag Arrangement



Chiral Arrangement

II STRUCTURE AND MORPHOLOGY

The bonding in Carbon Nanotubes is sp2 ,with every atom joined to three distinctive strength .Under high pressure, nanotubes will merge along, trading some sp3 bonds , giving the possibility of manufacturing robust ,unlimited length wires through hard- hitting nanotube linking [1,9].Structure of Nanotubes is as shown in Figure 1.

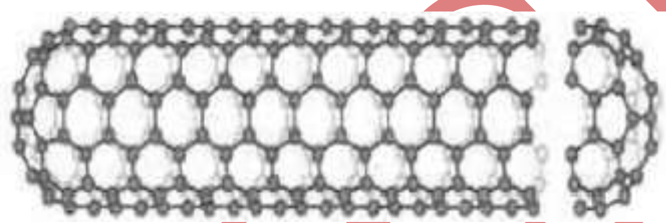


FIG 1. Structure of carbon nanotube

2.1 Classification of Carbon Nanotubes

Carbon nanotubes are classified in following two types, [1, 9]

- SWNTs- Single walled carbon nanotubes
- MWNTs- Multiple walled carbon nanotubes

Comparision between SWNT and MWNT is as presented in TABLE 1.

S.NO	**SWNT**	**MWNT**
1	Single layer of graphene.	Multiple layer of grapheme
2	Catalyst is required for synthesis.	Can be produced without catalyst.
3	Bulk synthesis is difficult as it requires proper control over growth and atmospheric condition.	Bulk synthesis is easy.
4	Purity is poor.	Purity is high
5	A chance of defect is more during functionalization.	A chance of defect is less but once occurred it's difficult to improve.

6	Less accumulation in body.	More accumulation in body.
7	Characterization and evaluation is easy.	It has very complex structure.
8	It can be easily twisted and are more pliable.	It can not be easily twisted.

Table 1- Comparison between SWNT and MWNT

III METHODS OF PRODUCTIN OF CNT'S

3.1 ARC Discharge Method [10-13]

Arc discharge technique has been rumored for manufacturing carbon nanotubes.During this technique,as shown in fig 2 , two nanotubes square measure made through arc vaporization of 2 carbon rods placed end to finish with a distance of 1mm in Associate in Nursing environment of argon like element, argon at pressure between fifty to 700 mbar.Carbon rods square measure gaseous by a right way, a current of fifty to a hundred amps driven by 20v which will produce warm temperature discharge between 2 electrodes.due to this, anode can get gaseous and rodshaped tubes are going to be deposited on cathode.Bulk Protection of CNT'S depends on uniformity of plasma arc and temperature of deposition.

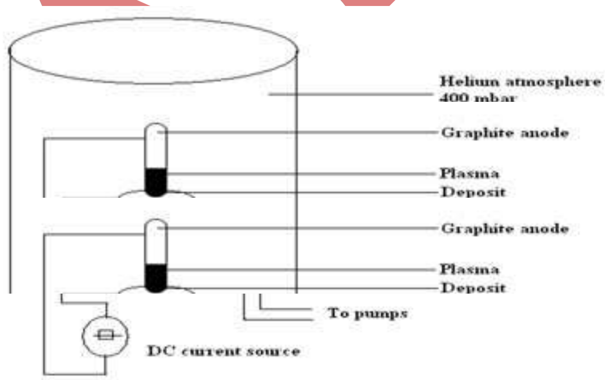


Fig 2 : Arc Discharge Technique

3.2 Production of SWNT'S

In the production of swnt's anode is swayback with a metal catalyst like Fe,Co,Ni,Y, or Mo. It produces SWNT'S with a diameter of 1.2 to 1.4nm.Efficiency of SWNT production by arc discharge method is improved with

i) Inert Gas:

Argon with a lower diffusion coefficient and thermal conduction has given carbon nanotube with smaller diameter (1.2nm) and 0.2 nm diameter decreasewith 10% increase in argon:element magnitude relation , when Nickel and Y is employed as a catalyst[4.2,1].

ii)Optical Plasma Control :

As the distance between anode and cathode will increse , anode vaporization increases, owing to that sturdy visible vortices around cathode is occured.With a nickel and atomic number 39 catalyst yttrium (c/Ni/Y is 94.8:4:2:1) the optimum nanotubes were produced at a pressure of 660 mbar forpure He and 100 mbar for pure chemical element.the nanotubes diameter ranges from 1.27 to 1.37 nm.

iii) Catalyst:

By dynamical metal catalyst , nanotubes with a diameter of 0.6 to 1.2 nm are created.catalysts used are Co & Mo

iv) Open Air Synthesis With Welding Arc Torch :

This Techniquue is specifically used for SWNT'S with graphite rod containing metal catalyst .Ni and Y (3.6:0.8%)are fastened at aspect wall of water cooled, steel based electrode, torch arc geared toward the siting of target and soot is deposited on substrate behind the target.The arch is operated at 100 amp current and shielding Ar gas flowed through torch to reinforce arc jet information.This technique is incredibly convenient and inexpensive.

3.3 Production of MWNT'S

MWNTs are made with the utilization of pure c arc with an inner diameter 1-3 nm and outer diameter 10nm (approx).since catalyst isn't utilized in this method ,there is no necessity for a significant acidic purification.So, MWNTs will be shaped with a less range of defects.Different methods accustomed synthesize are :

i)Synthesis in Liquid Nitrogen[11]

MWNTs are shaped by generating arc discharge in liquid nitrogen.In this low pressure and overpriced gas are not required.

ii)Magnetic Field Synthesis [12] :

MWNTs shaped by this methodology are defect free and are highly pure.in this arc discharge is controlled by the magnetic field across the arc plasma.

iii)Plasma Rotating Arc Discharge[13] :

The force caused by the rotation generates turbulence and acclerates the carbon vapour perpendicular to the anode and therefore the rotation distributes the micro discharges and results in stable plasma.Also, plasma will increase resulting in increase in plasma temperature.

3.4 Optical Laser Ablation Method [13]

The instrumentation used for this method is shown in figure 3.A continuous optical laser is measured which can vapourize graphite at 1200degree celsius.this method is pricy thus its principally used for SWNTs.optical laser vaporization results in higher yield of SWNTs with narrower size distribution than those produced in arc discharge method.

3.5 Chemical Vapours Deposition Method [14-15]:

It is applied in two step process **:**

i)Catalyst is deposited on substrate and then nucleation of catalyst is done by chemical etching or thermal annealing.Metal Catalysts used are ni,co.

ii) Carbon source is then placed in gas in reaction chamber.then carbon molecule is reborned to atomic level by victimization energy supply like plasma.This carbon canget subtle towards the substrate ,that is coated with the catalyst and nanotubes grow over this metal catalyst.temperature required for synthesis of fullerene is 650-900**.**

3.6 Flame Synthesis Method:

SWNTs are designed in controlled flame atmosphere from organic compound fuelsand small aerosol metal catalyst [15-16].

SWNTs are observed within the post-flame region of apremixed acetylene/oxygen/argon flame operated at fifty pressure unit(6.7 kPa) with iron pentacarbonylvapour used as a supply of metal catalyst.

3.7 Silane Solution Method:

Carbon nanotubes were created using a silane solution methodology ,in which substrate like carbon paper or untainted steel mesh was immersed in a very silane solutionof a metal catalyst.ratio of Co:Ni is 1:1.substrate was heated by applying associate degree electrical current to that.Thus ,a reaction occurs between the catalyst and thus the gas yields CNTs supported on the semiconducting substrate [18].

IV CHARACTERISATION AND PROPERTIES OF CNTS [20]

RAMAN spectrometry appropriate forth fast and reliable screening of the presence of SWCNT **:**

i)Transmission microscopy allowing for the assessment of careful structures.

ii) Scanning microscopy providing overviews of sample structures while less sensitive to sample preparation and homogenity than TEM.

iii) CNTs have terribly attention - grabbing physicochemical properties.[1]

V APPLICATIONS OF CNTs

Various applications of CNTs are as follows:

1) Carrier for Drug delievery.

2) Functionalised carbon nanotubes are reported for targeting of amphotericin B to cells.[31].

3)Anti-tumour drug with nanotubes had enchanced retention within the brain because of controlled lipophilicity of nanotubes.

4) Antibiotic drug given with nanotubes is rumored for increse intracellular penetration.[33]

5) CNT mixture (hydro-gel)has been used as potential carrier system for biomedicals.

VI LIMITATIONS OF CNTs[22]

1)Lack of solubility in most solvents compatible with the biological environment.

2)There is a problem in maintaining top quality and tokenish impurities.

VII CONCLUSION

With the prospect of sequence medical aid, cancer treatments, and innovative researches for dangerous diseases.The properties of CNTs unit of measurement still being researched.single and multiple walled carbon nanotubes have already verified to operate safer alternatives to previous drug delievery ways. They will stand up to membranes, carrying therapeutic medication, vaccines, and nucleic acids deep into the cell to targets previously inaccessible. They together operate ideal non-toxic vehicle that ,in some cases ,increase the solubility of the drug connected ,leading to bigger safety.Overall ,recent studies regarding CNTs have shown a promising glimpse of what lies ahead in way forward for medication.

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