ISSN: 2617-2070 (Print) ; 2617-2070 (Online)
Journal of Advanced Sciences and Engineering Technologies
Available online at: http://www.isnra.com/ojs/index.php/JASET/

Journal of Advanced Sciences and Eng. Technologies
JASET

Carbon Nano tube and it`s medical applications*

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Keywords

Nanotube
Carbon nanotubes
Preparation methods of carbon nanotubes
Medical applications of carbon nanotubes

ARTICLE INFO

Article history:

Received	01 November 2018
Accepted	15 November 2018
Available online	01 December 2018

DOI: https://doi.org/10.32441/jaset.v1i3.190

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ABSTRACT

The carbon nanotube (CNT) represents one of the most unrivaled contrivances in the domain of new technology represented by contemporary revolution of nanotechnology. CNTs is closed to be the more important branch of nanotechnology which have been matured painstakingly meanwhile the last 20years by many investigators and different types of application papers, researches and studies around the expert because of their senior potency in various area. These tubes are rolled in the hybridization found in the grapheme type of carbon nanotubes. The paramount portions of CNTs are their nimble weightiness, small size with a high aspect ratio, pretty stretchy strength, and kindly forthright traits, which make them profitable as tautologies for various materials such polymers, metallic flatness's and earthenware. CNTs also have potential enforcements in the range of nanotechnology, medical Nano manufacture, transistors, actuators, sensors industrialization, and membranes preparation and capacitors industry. There are assorted techniques, which can be utilized for the compilation of CNTs. These implicate the arc discharge mode, chemical fumigate precipitation (CVD),the laser ablation way and the sol-gel method. CNTs can be monowalled, duplicate-walled and multi-walled. CNTs have individual mechanistic, electrified and optic qualities, commonalty of which has been extensively elaborated. The sitting article-review is converging on the composition, functionalization, differences and enforcements of CNTs. The toxic influence of CNTs is also offered in a concise form. It is clear, by the beginning of the last century, that carbon Nano-tubes (CNTs) were important in the fields of health, such as medicine and pharmacy, which had entered into system of drug delivery. The ability of these compounds attracted the interest of researchers in the fields of biomedicine and its biomedical applications such as advanced imaging, regeneration of organism tissues, drug disposal or gene delivery. There is a lot of interesting evidence about the unique advantages of nanotubes that confirm their effectiveness compared to their negative effects.

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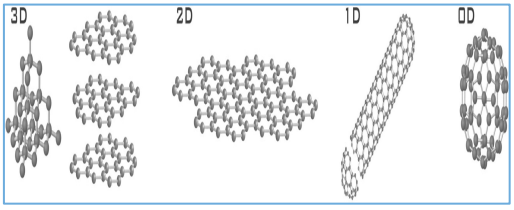
Journal of Advanced Sciences and Engineering Technologies Journal of Advanced Sciences and Engineering Technologies

Introduction

Carbon on our environment has two types' styles, the first one is Graphite and the second is diamond. The two forms differ from each other by its physical properties like the lineup of carbon atoms at crystalline structure, Hardness, melting point, color…extra. As well as the different between hydride between the two types while Diamond hybridization is Sp3and Graphite is Sp2(1-4) .

Diamond and Graphite configure in the vacuity with three dimensions, Grapheme with two dimensions and one dimension is for nanotube or as well-known carbon nanotube(5,6).



The last one, carbon nanotube is with spherical shape is well-known as fullerene black. fullerene black is not homogenous substance , has non-soluble residue and with particle size of (40-50nm)(7-9). Fullerene was invented in 1985 by Korto and his team (10). The last one, carbon nanotube is with spherical shape is well-known as fullerene black . Fullerene black is not homogenous substance , has non-soluble residue and with particle size of (40-50nm)(7-9). In 1991 another form of Carbon was indicated by Ijima which represented the type of carbon nanotube with quasi one-dimension as well as the reported types of Carbon Diamond, Graphite and Fullerene. This type of carbon nanotube was with Multi-walled carbon (MWCNTs). A Period after this of preparation of carbon nanotube (MWCNTS), another type of carbon nanotube with single-walled carbon (SWCNTs)(11-14). Carbon nanotube was with sp2 hybridization of its carbon atoms, which associate together by covalent bond, and these nanotubes have tightening force steel and Kevlar. Since carbon nanotubes have the sp2 bonds between the carbons - atoms, they have a higher tensile intensity than steel and Kevlar. This bond is more potent than the covalent bond, which was found in the diamond with sp3 hybridization. In theory, SWCNTs has a tensile strength many times biggest than steel. Flexibility and elasticity are the second another astonishing characteristic of carbon-nanotubes when it was be under high strength and stress sitting and while exposure to large pivotal compressive strength which can bow, wrap, kink and at last it sway without destroy the nanotube. At this stage the nanotube will get back to its main composition but the flexibility of nanotubes does have a border and beneath very physically force presses and nanotube structure may distorted tentatively. The strength of nanotube may be decreased if there are faults in the body of the prepared Nanotube. As example, Faults in atomic vacancies or a rearrangement of the carbon associations (15). Nanotubes of single walled is more cramped than the other one of multi-walled tubes , with diameter of (1-2)nm and the single-walled nanotubes are generally more cramped than the multi-walled tubes, with diameters typically in the range 1-2 nm, and resort to be crooked rather than alignment line(1). This article addresses the preparation of Nanotubes, Types of Nanotubes, Carbon Nanotubes preparation and medical applications.

Types of Carbone Nano tubes:

Single -walled carbon nanotubes (SWNTs)

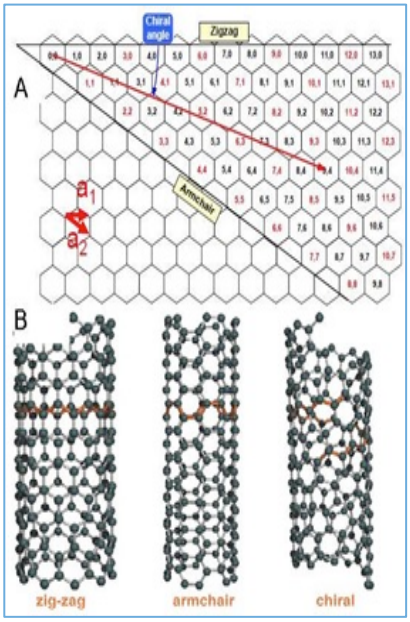
Single wall-nanotubes (SWNTs) were discovered at 1993. This type of carbon nanotube differentiate with it`s one-dimensional and by difficulty of preparation compare to the second type (MWNT). As definition Single-walled carbon nanotube is Single Carbon Sheets of benzene rings which are wrapped in a cylinder with diameter of 1 - 2 nm and its length ranges between 50 nm - 1 cm and the end of this tubes are closed by a fullerene crate. Mostly, the caps closing which are closed the end of nanotubes take half-Bucky ball molecule. SWNT formed as crooked strands more than right lines. Methods

of divided the single walled of nanotube depend on difference of the graphite plane angle which form the bulk of a single-walled nanotube. Two chiral vectors (n.m) act as a couple of indicator of the method of graphene sheet wraps. The relation between n and m realizes three types of Carbon nanotubes. When graphene plates wrapped up and made them equal to the row as winding or zigzag bonds in the hexagonal shape(n is zero, m is zero and the angle between the rolled sheet is zero), they were called Zigzag`` nanotubes(16-30).

Multi -walled carbon nanotubes(MWNTs)

The other type of Carbon nanotube is double and triple Carbon Nanotube (DWNTs,TWNTs) which represent to Multi-walled Carbon Nano Tubes. Single-walled Nanotubes concenter to make double and triple walled nanotubes by interaction with each other. The interactions associations refer to interlayer vander-waals forces (weak force molecular physics interact -tion formed between atoms or molecules. At double walled Nanotubes magnitude attraction values changed attributed to the chirality conju -nction between the couples(n,m),(n 0, m 0) when Tribble walled magnitude attraction amounts modify according to the set (n,m), (n 00, m00) [16,31–47]. Range of applications of Multi – walled system give the more scientific and industrial benefits. As example, the mixing of semiconducting with metallic species exten -ded the range uses of DWNTs and TWNTs[48]. Furthermore, the efficiency of this mingling is straight linked to the Vander-Waals forces mediating the Internal layers interactions. In fact , In other words, for weakly IL interactions, the tubes which are composed the multi-walled regulations would conduct separately behavior to each other. Double walled Nanotubes can display in four properties while Tribble walled Nanotubes have eight properties[49,50]. The DWNTs and TWNTs can be either similar (if the multi-walled nanotubes own the properties of similarity and periodicity) or morphologic (if there are not symmetry or periodicity in the multi-walled Nanotubes systems occur). It makes sense to have missing the properties of similarity and periodicity in single-walled nanotubes. Therefore; there are no Vander-Waals forces (which where between the two walls of carbon Nanotubes) interactions eligible of variable the electronic and vibrational flavors of the singular Single-walled Nanotube constituting the multi -walled carbon nanotubes[50]. Moreover, IL attractions were very sturdy in symmetric regulations to synthesis the electronic and vibrational structures of the Single-walled Nanotubes while the last is shaping the multi-walled tubes[51]. At different researches, reviews and articles addressed a topic of mechanistic features of Double and trible-walled Nanotubes which were characterized under hydrostatic pressure by utilizing Raman[52]. The External tubes safeguard the internal one, for double and trible -Nanotubes, from the surrounding condit -ions especially pressure as well as of depending of the tangent pressure on diameter of the external part (the outer one of nanotube which provide the protection for the inner one) of Nanotubes. Conversely, Bacsa and Co-auth -ors agreed with Natsuki et al data and they reac -hed to the same conclusion of Internal walled of the nanotube still fixed and didn`t suffer from any outer applied conditions[52-54].

At another study by Huang, and his colleagues, suggest that IL attractions turn out within the limits of negligence when the effort of compression was rising which lead to safeguard the inner plate of double-walled nanotube[55]. Newly, Alencar and his colleagues, spotted that the behavior of triple-walled Nanotubes was similar to double-walled nanotubes when the first one be under the same conditions of temperature and pressure. Also, Single-walled Nanotubes didn`t affected with load pressure on it[56].



Different types of Single-Walled-Nanotubes [57]

Synthesis of Carbon Nanotubes:

There are different types of preparation Carbon Nanotubes and it can be illustrated as bellow:

Grow in place:

At this type of synthesis, the prepared Carbon Nano-tubes were synthesized with the presence of catalyst at reaction container.

As example, catalyst could be precipitated by usage of sundry technicalities to prepare catalyst of thinning film. One type of this technique is the evaporated method of one beam, which refer to PLD or sputtering method, or the reactant compound could be depositing by the Nano-particles. The preparation of this method illustrated by plasma as example. The catalyst was prepared and synthesized by using the thermal ways and assisted ways of chemical vapor deposited methods and the last one represented by the (CVD) as user Manual. The first benefit of this method was including of gathering concurrently with presence of catalyst particles and the catalyst spots dominate on Carbon Nano-tubes evolution status making certain way to gain straight aligned crystal Carbon Nanotubes in isolating reactant material. The nexus of the substrate for physical and the electrical were perfect. The methods of chemical vapor deposited (CVD) were experienced by finished or complement-metal–oxide–semiconductor (CMOS) manufacture. To brief all above explanation this Technique refer to growth the Carbon-nanotubes in the place. The prime block for path of the gather in spot is the jeopardy of detrimental of structures, which were be located before, during the creating of the nanotubes [58-65].

Grow then Place Methods:

Methods of Grow then Place formed of two steps successively, first one is creating of Carbone Nanotubes and the second one is transferring of prepared Carbon Nanotubes to the reactant materials. The more popular ways used at prepared this type of methods are Arc discharge way and Laser ablation which were the major techniques by which reactant substances free nanotubes were synthesized. The benefits of this way contain: No fetters on the procedure or temperature utilized for Carbon Nanotubes composition. No fetters on the procedure or temperature utilized for Carbon Nanotubes composition-capability to pretreat Carbon-Nanotubes (like nominate, refine, functionalize). The main block of the grow-then-place way is the still scanty and imperfect level of repeatability and hold to relocate Carbon Nanotubes to specified territories of a reactant material, which turns out it an improbable nominee for reactant substances-based enforcements (example: electronic equipment's) [66-72].

Electric arc discharge:

This technique used to prepare Carbon Nanotubes under high temperature degree (More than 1700°C). The higher temperature of this method result in amplification of Carbon Nanotubes, which would have scarce composition deficiencies if they are compared to other types of CNTs, prepared.

Higher purity type electrode of graphite (6-10mm optical density) as a rule the electrode will be

cooled with water cooled electrode at diameters of 6 to 12 mm which be unattached by 1-2mm in socket filled with He (of 500torr pressure) is used in arc-discharge method which refer the most utilized type method. At this method Hydrogen gas can be used instead of Helium. The chamber consists of graphite as cathode and anode beside of the evaporated molecules of carbon as well as several particles amount of the metal catalyst (like Cobalte, Nickel beside of Iron). The current is passed directed through the camber (arcing typing). 4,000 K is the heating temperature of the chamber and at the same time it will be under high pressure. At the cathode of this Chamber, by using of above procedure way and utilized of arcing method, spots or particles of half evaporated Carbon would gather at cathode. This carbon particles will be solid and of deposit configuration. The rate of precipitate of Carbon spots is 1mm per min. and the shape of Nano particles will be like cylindrical hard accumulations or like cigar shape. At this process the anode will be used. The remaining hard grey carbon will precipitate on the outer limit and gather into 'chamber grime' close to the dikes of the chamber and 'cathode smut' on the cathode. The inner center, cathode bloat and chamber soot, which will be deep color and velvet. The product should be SWCNT or MWCNTs as well as nests of polyhedral grapheme particles. The using of scanning electron microscopy (SEM) showed two various fabrics and morphologies could be Noted from the cathode stratum study; the deep and downy of internal core precipitates composed of parcel-like frames, which have at random in good order nanotubes and the gray external rind that is consisted of turned and robust of grapheme layers. At the arc discharge sedimentation and creating of CNTs, the two major unlike paths: construction by hire of assorted catalyst precursors and wanting anticipate of catalyst precursors. Produce of Multi-Wall Nanotubes can be achieved without utilize of catalyst precursors when Single walled Carbon Nanotubes will be prepared by utilizing of various types of precursors` catalyst as well as the metal anode which composed from graphite and a transition metal. There different types of transition metals like metals Cobalt, Iron, Nickle from the first row of transition metal, Silver, Platinum, palladium From the second row of transition [73-84] It can also, used mixture of metals with grapheme to prepare anode like Cobalt with Radium and with platinum, Nickle with yttrium which give yield of 90% from Single-walled of Carbon Nanotubes[85]. There are many advantages, which can be gained from using arc-discharge methods like the capability and effort of manufacturing of the nanotubes. Otherwise, one of abuse of this method is irregular producing and cannot rule on nanotubes preparation which represented the important demand to make perfect conditions for the preparation process for specified their properties and function [73].

Laser ablation method:

This technique depend on high vapored-power of laser from type of (YAG), a tube from quartz structure filled with a pure bulk of graphite which will be treated under weather of Argon and temperature of 1,200±C inside a furnace. The graphite will viper inner quartz container, which refer to the main cause of using Laser ablation method. At laser method like arc-discharge method, Metal catalyst added to the grapheme substrate as main step to catalyze the reaction and produce of Single-Walled Nanotubes. Based on previous studies, laser power determines the diameter of the carbon nanotube. The diameter of Nanotubes increased and is more thinning and individually proportional with the increasing of laser pulse power. When the pulsation power of laser increases, the thinning diameter of carbon nanotubes increase according to the previous studies. Another studies showed that increasing the fast of laser pulse power will produce a large quantity of Single-walled carbon nanotubes. The properties of the nanotube that are brought in a way of laser ablation depend on and are influenced by several influences such as the physical structure and chemical properties of the reactant compound or the target material, the properties of the laser used in the preparation process is important to specifies the prepared nanotubes properties too like the peak force, cw against to pant, a stream of particles crossing a unit area, usually expressed as

the number of particles per second, vibration wavelength , recurrence average or rate and influx and compression of the buffer gas, compression of the chamber, its chemical structure, the distance between the reactant and the source, and the surrounding temperature. These conditions, if available as required, enable the applicant to obtain Carbon Nanotubes of Single-walled with high quality of lucidity and goodness. The arc discharge and laser ablation techniques don`t have many differs and have more similarity to each other. Only the force and potential, that strikes the purity graphite as substrate which is loaded with catalyst compounds (like metals), is supplied by the laser. This method of nanotubes preparation produces high product with low percentage of defects metal catalyst because of the predisposition to evaporated of metal catalyst atom from closed end of the chamber tube. The major abuse of laser ablation that is to say the nanotubes produced by this method are branched and not straight. Economically, this method is disadvantage because of the cost of pure graphite shafts which should be provided, the high power that should be supplied too and the little amount of carbon nanotubes yield with the compare of yield from arc-discharge bath[58,86-94].

Applications of carbon Nanotubes:

Carbon Nanotubes play a main role in different industrial sectors. Carbon nanotubes own many important properties that make them useful in many areas of life. Carbon nanotubes are of great importance in the ranges of science, engineering, medicine, and mechanics, structural and electronic fields. One of the future visions is the use of carbon nanotubes in the vehicles and automotive industry by using them in the manufacture of vehicles supported by renewable hydrogen cells, which gives the exhaust of cars instead of carbon dioxide. Where the renewable fuel cell acts to deal with the explosive properties of hydrogen and make it a source of renewable energy [95].

Carbon nanotubes uses for energy Storage:

Lithium ion batteries, which were used in laptops and mobiles, were used carbon nanotubes. A small amount of powdered MWNT is added with active polymers that carry the cathodes made of (lithium cobalt oxide) and the anodes composed of graphite. Carbon nanotubes activate and increase electrical conductivity and mechanical voltage, which in turn enhances the viability of the battery life cycle. Numerous literature and research point to the normalization of the ratio between the weight of electrically active materials and carbon nanotubes, which increases the storage and density of gravity energy for uncharged batteries to improve the performance of Lithium ions cells. In the fuel cells, carbon nanotubes are used as adjuvants rather than platinum. Black carbon used 70% better results than platinum as a catalyst, with a 60% efficiency. In organic solar cells, there is much research on the possibility of using Capron Nanotubes in their manufacture instead of other materials used as carriers, which are usually undesirable materials, can enhance the potential for resistance to photosynthesis [96].

Medical and Biomedical applications of carbon Nanotubes in:

Carbon nanotubes have been an important part of medicine and medicine, especially in recent years because of their ability to carry drugs, biological molecules, and the delivery of genes to the cells and organs of the body as well as their ability to form or Regenerating the body's cells The carbon nanotubes are also used in the manufacture of biosensors or as a diagnostic and sensing agent. One of the characteristics of nanotubes is its ability to absorb or bind by the chemical or physical forces with different molecules like drugs molecules, proteins, antibodies, nucleic acids, enzymes or various biological compounds. These tubes then transfer the compounds to different parts of the body or cells Target. The way by which drug binds to the carbon nanotubes is either by adsorption on the surface of the tube or by the drug's connection to the nanotube chemical structure. There are two types of drug transfer systems using carbon nanotubes, either by exploiting the physical properties of carbon sequestration or its chemical properties. In both cases, no chemical change is made to the chemical

composition of the drug or its pharmacological efficacy and the same for non-chemically altered carbon nanotubes. Through the internal absorption pathway or the path of insertion or multiplication, the required drug enters the cell or the affected organ in the human body.

The best way to transfer the drug using a nanotube is the endocytosis method or the other path, which is through the spread or entry, by entering the drug into the cell environment made up of tiny micro-particles where they absorb the drug and this method is quite the opposite of the other method The drug is related to the surface of the nanotube and is decomposed by cytotoxic fluids before dealing with the cell environment. Doctors used the first method to treat cancer and many infectious diseases [97]. Linkage between Carbon Nanotubes and biological molecules from its hydrophilic terminal and transform this molecules to target cells and organs[98]. Then, the associated molecules enter to the injured body through the classic paths or by injection or taking by mouth. The cell devours the drug CNT caps and ultimately the nanotube slops its contents inside the cell and so the drug is delivered[99].

For carbon nanotubes with high functional constituents to carry the molecules of the drug or biological molecules through the cell membrane of the cytoplasmic target as well as the nuclear membrane of the nucleus of the infected cell without causing the penetration of the carbon nanotubes loaded with the drug any kind of poisoning of the cell or the infected body, but vice versa be more effective and safe Which would have been used if the medicine alone was prepared in the traditional way. When the drug loaded on the nanotube will come, one of the two routes will either enter the drug into the infected cell without the nanotube or enter the drug loaded on the carbon nanotube together. In addition to the ability of the nanotubes to carry the drug and penetrate the cytoplasm of the cell, it has the ability to maintain the drug healthy until it is delivered to the target cell, which reduces the amount of medication to be used by the patient in addition to reducing doses and thus reduce the toxicity of these drugs, For various cancers [100]. The researchers combined carbon nanotubes with anti-cancer drugs and tested the effectiveness of the drug in vitro and also through its experience on the body of the organism and of these drugs treated with cancer, which were formed on the carbon nanotube, and doxorubicin, cisplatin, methotrexate and quercetin [101].

Other researchers have used a complex compound of carbon nanotubes for the purpose of treating lymphoid cancer tumors, where as a system to redirect drugs on its surface, an external magnet activates the infected part. In the same way, chemical treatment materials are linked to the carbon nanotube compound, which is associated with the antibody against the antigen found on the surface of the cancer cell. By attracting antibodies to the antigen, the cancer cell takes the nanotube containing the drug before the anticancer drug is wasted. One of the most important reasons for an important obstacle to cancer treatment is the resistance shown by various drugs because of increased flow of anti-cancer drugs by p-overexpressed proteins, which gives a counter-effect of cancer [102]. A study by Lee and his colleagues showed that single-walled carbon nanotubes are antibodies to p-glycoprotein and are antibodies to doxorubicin and when compared to free doxorubicin. The researchers found that the toxicity of this formula increases significantly against cancer cells K562R, SWCNT paclitaxel gave higher efficacy in the treatment of breast cancer in mice and also had high efficacy in suppressing the growth of cancerous tumor along with a low toxicity towards healthy cells. Recent studies have shown that carbonic tubes used as a drug and drug carrier can be used as antitumor agents. This type of treatment strengthens and stimulates the immune system of the cell or body of the organism so that the immune system attacks malignant tumors or cancerous cells.

The work-study this type treatment injecting a vaccine against the tumor or cancer as a medicine for the patient or the infected person to eliminate the cancer cells before the onset of the disease. Here, the researchers took advantage of the

properties of carbon nanotubes as a carrier of drugs, where they were used to deliver the vaccine to the target cell or target organ. The team of Yang and his colleagues noticed the integration or binding of multi-walled carbon nanotubes with tumor lysate as a vaccine to enhance the effectiveness of this type of immunotherapy as the trial was performed on a rat with liver cancer [104].

Uses of Carbon nanotubes for treatment of infections

Because of the susceptibility of many microorganisms and their resistance to various types of antiviral and anti-bacterial drugs in a way that makes giving the vaccine to the individual useless or useful. Recent studies have been carried out to demonstrate the possibility of the use and capacity of carbon tubes with active groups as a carrier of agents and vaccines against different viruses or bacteria causing disease, for example, the medicine or vaccine amphotericin antifungal. The association between the drug and the carbon nanotubes has been strongly linked to reducing the toxicity of the drug or antifungal toxicity by about 40% compared with the free drug. Carbon nanotubes may have anti-viral and bacterial viability and efficacy as the nanotubes adsorption the bacteria on its surface, as in the case of E. coli as an example. The mechanism of carbon nanotube as an antibacterial to carbon nanotubes can be explained by the presence of glutathione, which has the characteristic of being an antioxidant internal of the cells, which increases the oxidative stress of the bacteria and the death of the bacterial cell in the end[105].

The carbon nanotube also has the ability to bind to the DNA and enter the infected cells to treat it. DNA releases the DNA from the binding and does the required role before the defense cells in the organism destroy it. Here the role of carbon nanotubes has emerged as an important and effective vector for gene therapy, as geometric structures in this way transfer genes into mammalian cells and also keep these genes intact. Pantarotto and his colleagues developed a compound of DNA binding with the monoclonal nanotubes to produce functional aggregates of this association. The resulting compound showed an increase in tissue regeneration and artificial transplantation compared with the free gene. This development in the field of carbon nanotubes and their use in tissue engineering and regeneration medicine have opened up new scientific horizons, such as its use with biochemistry in tissue regeneration and the work of natural and industrial polymers for tissue scaffolds because nanomaterial's are biocompatible and also resistant to biodegradation. Carbon nanotubes can also be used as additives to tissue and conductive scaffolds to strengthen their Mexican ability by combining them with the human body or organism. In the area of tissue regeneration, Macdonald and his colleagues have been able to manufacture a single-walled nanotube compound of carboxylic with collagen polymer where the resulting nanoparticle works as a scaffold [106-108].

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