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Review Article

Properties and Medical Applications of Carbon Nanotubes

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Abstract

Carbon-based nanomaterials (CNTs) have been used in pharmacy and medicine in therapeutic drug delivery systems since the beginning of the twenty-first century. Nanomaterials have been shown to be capable of transporting a variety of cargo. They have piqued curiosity because they can transport a higher spectrum of chemicals through entering live cells through cellular membranes. Advanced imaging, tissue regeneration, and drug or gene delivery are all examples of biomedical uses. As is well-known, carbon nanotubes have a variety of chemical and physical characteristics that are unique to them, and there has been a lot of research into them. In recent years, it has been investigated for uses in biology and biomedicine.

Keywords: Nanotechnology; Biomedical Applications; Carbon-based Nanoparticles

Introduction

Recently, nanotechnology and nanocomposites have been the subjects of several recent investigations. Scientists choose a fillers as well as blend it with a specifically polymers to create a custom composites. When you're going to use a nanomaterial as a filler, make sure it's a good one, composites are called a nanomaterial composite. Nano composite Nanotechnology is bringing about evolutionary changes in the world [1]. Everyday life Nanotechnology has paved the way for the future. The creation of a wide range of organic and inorganic drug carriers nanoparticles. The major value is its ability to generate new ideas structures with improved cell membrane translocation capacities as well as improved solubilization, stability, and bioavailability, as well as hence, increasing the efficiency of their delivery [2-4].

Nanotechnology

The term "nano" comes from the Greek word "dwarf", which means "little". Part. Scientific treatments at the nanoscale (atomic scale) require specialized scientific equipment. Nanotechnology has grown in popularity over the last three decades, is the name given to this equipment. The term was invented by Norio Taniguchi. In Japan, the term "nanotechnology" was coined in 1974. "Nanotechnology", he stated. It comprises mostly the separation and consolidating processing phases. as well as material distortion caused by a single atom or molecule. Nanotechnology is a broad area that investigates a variety of topics materials' structures and characteristics [5,6].

Carbons nano tubes (CNTs)

Carbons nano tubes will kind of nanomaterial made up of hollowing fibers of carbon that are cylindrical in shape (tubes). Long lengths of many hundreds of micrometers are possible they have the potential to be manufactured or developed to have specified characteristics, like wide electrical resistance, conductivity, optical transmission, or extraordinarily more tensile stress are all examples of properties. They have become employed in a variety of products, such as electronics, sensors, optics, additives as well as gas are all included in this category in a variety of other applica-

tions materials made of nanocomposites. It's worth noting that crude Carbons nano tubes are often inhomogeneous, with a lot of carbon and inorganic catalyst impurities. Commercial obstacles have arisen as a result of technological difficulties. Only a small percentage of items are thoroughly cleansed. The true purity and quality of Carbons nano tubes depending on the production process and the sort of refining that might be done, of the products [7].

Carbon nanotube structure

Carbons nano tubes are classified based on the number and the atomic structure of the sidewalls. Single-walled (SW), double-walled (DW), and multi-walled (MW) Carbons nano tubes are the most basic. It is a relatively new invention. A single-wall carbon nanotube is simple to envisage (SWNT). It is excellent in this case enough for a flawless graphene sheet to be considered (graphene is a polyaromatic material). Carbon atoms that have been sp2-hybridized and are organized into a monoatomic layer real graphite is made up of graphene layers) but also to mold it inside a cylinders (Figure 1), forming assurance the rings of hexagonal are in the right places and the contact connections are created logically, two caps are then used to close the tube's ends, every cap is a hemi-fullerene with the right diameter (Figure 2 a, b, c) [8].

Figure 1: A drawing of how to make a single-wall carbon nanotube is presented, starting with a graphene sheet.

MW Carbons nano tubes are built up of a few to a few tens of concentric cylinders stacked around a standard core hollow with regular periodic interlayer spacing. Multiwall nanotube pictures have been subjected to a real-space examination. A variety of interlayer spacing are presented (0.34-0.39 nm). Depended upon situation, inner size for (MW Carbons nano tubes) varies and on a number of layers, ranging from 0.4 nm to 0.4 nm. The outside diameter ranges generally from a few nanometers to a few micrometers from two nanometers to 20 to 30 nanometers. MW Carbons nano tubes two tips are normally closed and dome-shaped half-fullerene molecules (pentagonal) cap the ends the axial size varies from one meter to a few centimeters.

Figure 2: a, b, c Three types of SWNT structures are depicted: (a) zigzag nanotubes, (b) armchair nanotubes (c) helical nanotubes.

The function of the half-fullerene molecules (pentagonal ring defect) is to help tube closure at both ends [9]. SW Carbons nano tubes diameters, on the other hand, are smaller. Their size ranges from 0.4 to 2 to 3 nanometers, and their length is commonly measured in micrometers range. SW Carbons nano tubes may generally be combined to assemble bunches (ropes). SW Carbons nano tubes were placed hexagonal shapes to create a crystal like structure in a bundle structure [10].

Medical indication of CNTs

Carbons nano tubes were employed in pharmacy or medical for dosage forms in therapeutic since the start of the twenty century. Carbons nano tubes have been proposed for a number of biological applications, including the administration of drugs. Gene transfer to organs, cells or tissues regenerations, vectors, biomolecule diagnostics, as well as biosensors analysis are all things that researchers are working on [11]. In fact, because of their great value, sur-

face area, chemical stability, and electronic diversity. Carbons nano tubes have a polyaromatic structure that allows them to They adsorb or interact with a wide range of molecules. The Carbons nano tubes transporter may pass through the cell membrane via endocytosis or phagocytosis using the insert and diffuse mechanism. The following is the internalized method.

Surface attachment is more effective. In reality, while using the first technique. The intracellular environment destroys the drug when it enters the cells. Inside the cells, a conjugated drug releases pharmacological substances, while the surface attachment method has the potential to destroy the medication prior to the cells' internalization of physiological fluids. These innovative drug delivery methods were initially employed to bind anticancer and antibacterial medicines to carbon nanotubes for cancer and infection therapy, respectively [12,13].

Applications for anti-cancer treatment

Examples of anti-cancer medications include epirubicin, doxorubicin, and cisplatin. Conjugated medications include methotrexate, quercetin, and paclitaxel. They're carbon nanotubes that have been functionalized and tested (*in vitro*) and (*in vivo*). Chemotherapies drugs will be combined with carbon nanotubes and antigen-specific antibodies to target antigens that are overexpressed on the surface of malignant cells. This allows the medicine to be delivered only to tumor cells. Magnetically (Carbons nano tubes) complex can be created via applying coating for magnetic (Fe_3O_4) nanoparticles to the surfaces of the nano tubes. The external installed magnetic is used for pick an organs for cancer cell localization in this case. Normal equivalents can be used to manage Carbons nano tubes medicines [14].

Drug delivery, gene therapy

One use that has gotten a lot of interest is a potentially to SW Carbons nano tubes to function like transporters to tiny compounds within biology system. Over a long period of time, academic and industrial research units in certain cases, SW Carbons nano tubes has been discovered to exhibit minimal cytotoxicity. They can hold so much because of their enormous effective surface area. Compared to vesicles and other small particles, active medication molecules per weight unit vehicles that are commonly utilized in a situation where they are utilized to carry genes, SW Carbons nano tubes were shown to be capable of penetrating through the cell membrane and transferring genes to the interior and nucleus of the cell. The majority of the different variants of Carbons nano tubes based medication delivery devices are being researched. aimed towards cancer treatment [15,16] (Figure 3).

Figure 3: Pathways of carbon nanotube (Carbons nano tubes) exposure and their detrimental effects are shown. Carbons nano tubes can be absorbed into cells through inhalations, ingestions, or cutaneous exposuring. Inhaling nanoparticles shall passes via the respiratory tracts epitheliae and through interstium, where they can reach the bloodstream directly or via lymphatic pathways. Nanodrugs are transported sequentially through the bloodstream for the center nervous systems, liver, kidney, or another organses. Carbons nano tubes could also be direct ingesting or breathed in. (Carbons nano tubes) may pass through the intestines. Once absorbed into cells, carbon nanotubes can cause organ-specific toxicity.

Conclusions

Nanotechnology's usage in medicine is projected to grow dramatically. Recently, nanoparticles have been employed in the pharmaceutical sector to lower costs in recent days. Drug toxicity and adverse effects carbon nanotubes have grown in popularity. In today's world of worldwide medical research, where scientific study has proliferated, this is a regular occurrence focused on medication delivery specializations and disease sensing approaches. Treating or health care management carbon nano tubes have demonstrated

that they may be used in a variety of applications having the potential to alter and adapt the medication delivery method.

In several sectors of medicine, there is a lot of focus. Single-walled carbon nanotubes were useful because they could enhance solubility and lead to better targeting of malignancies or delivery of drugs. drug. single-walled carbon nanotubes are likewise prevented from functioning. While avoiding becoming harmful to cells or affecting immune cell activity, we it's worth noting cancer is a term used to describe a group of diseases that are characterized by uncontrolled cell proliferation. In this way, one of the diseases was investigated by looking at how it manifested itself. Carbon nanotubes were used to respond to the medication delivery method. While we should emphasize that today's cancer therapies primarily consist of surgery, chemotherapy and radiation are two treatments that can be used. It is important to keep in mind, however, that these treatment procedures cause a great deal of discomfort, and they are quite uncomfortable, they destroy a lot of cells while also causing a lot of negative effects [17,18].

Resulted in an exponential development in neurological uses of materials consisting mostly of carbon with various hybridization or topologies, carbon-based nanomaterials (CBNs) and in particular nanotubes demand special attention. CNTs and GR are perhaps the most common carbon nanomaterials nowadays, and they've been intensively investigated for their high mechanical strength, electrical and thermal conductivity, as well as optical characteristics [19-21].

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