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Chemical Preparation Methods of Nanomaterial with Their Applications

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Abstract

Scientists were not satisfied with the diagnosis, exploration, injection, and imaging through modern medical nanotechnology, but they were also able through this technology to activate smart microscopic bombs that target the cancer cell and detonate it, killing the cancer cells. This technology was tested on laboratory mice and achieved great success. Nanotechnology is the technology of the future, not only in the medical and therapeutic aspects but also in everything related to life in the environment, agriculture, water, energy, and many other areas of life. Nano-treatment technology contributes greatly to monitoring cells, diagnosing diseases, methods of treatment, and giving orders to cells to secrete hormones through certain doses to control the health status of patients. Over the past few years, nanotechnology may be known to some, others may not know it, and others may be afraid of it. Different concepts have emerged to define nanotechnology. Some describe nanotechnology as the technology capable of achieving high degrees of accuracy in the functions, sizes, and shapes of materials and their components, and this in turn helps control the functions of tools used in the fields of medicine, industry, engineering, agriculture, drugs, communications, defense, space, and others, and another defines it as the science of dealing with things smaller than smallness itself.

Keywords: Nanomaterials, medicine, carrier, drugs, drug shells

INTRODUCTION

Nanocomposites

Scientists were able to develop medical applications commensurate with nanotechnology, and activate "nanocomposites" not only to monitor diseases and inject infected cells, but also one of their functions is to order cells to secrete certain hormones to help treat diseases, as well as to strengthen and restore infected tissues so that they return to normal again and overcome the pathological symptoms that afflicted it; this technique was used in diabetic patients to inject insulin in appropriate quantities and at specific times according to the body's needs, as well as precise devices that can control red blood cells and re-pump them into the blood after cellular treatment, and thus treat a large number of diseases that are very difficult to treat from before by known techniques in diagnosis and treatment [1–3]. Nano is the science through which materials are used in an atomic or very small molecular form (a thousandth of a micro or a millionth of a millimeter). Sometimes it is dealt with through one-hundredth of a nanometer, which is something very

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small so that materials can nanoparticles enter the human cell or small bacterial materials, allowing doctors and therapists with these modern technologies to enter and target micro-diseases within the cells themselves, which greatly facilitates the treatment process. Given the wide range of possible applications of nanotechnology and the wide variety of properties exhibited by manufactured nanomaterials, a detailed discussion of the health and environmental benefits and risks of nanotechnology applications is required. In view of the rapidly growing growth of nanotechnology, all relevant stakeholders (governments, international, regional, and national organizations, industries, public interest associations, labor organizations, the scientific community, and civil society) must participate in the discussion to identify and consider policy issues. These issues include health and safety, moral and ethical concerns, social and legal concerns, and social benefits. Given the expected significant impact of nanotechnologies on the global economy, research, and society and the widespread use of nanomaterials, a study is required [4]; To develop comprehensive and proactive risk assessments. The issues of nanotechnology and manufactured nanomaterials should be seen not only as chemical industry issues, but also as an issue related to other industrial sectors (such as textiles, paints, coatings, and metals). The main focus on the impact of nanomaterials on human health and the environment should also be on their use in the entire value chain, especially for small and medium-sized enterprises [5].

PREPARATION METHODS OF NANOMATERIALS

There are several ways to prepare nanoparticles, such as:

1. *Physical methods:* by heating the material with steam or by throwing a beam of electrons at it, and it may be thermally resolved using laser technology and then cooling the steam emanating from it and subjecting it to a shock with a neutral gas; then, it is placed on a cold surface so that no crystalline building occurs, where the actual preparation of nanomaterials by means of laser [6] or chemical vapor deposition (CVD).
2. *Chemical methods:* the reactions in the vapor state are prepared in a reactor, and then the particles of the substance merge at a specific temperature. A reaction also occurs with many gases to eventually form a solid strip, and from the materials that use that method in the preparation of semiconductors, semiconductors [7].
3. *Mechanical methods (mechanical attrition):* Many methods contribute to the preparation of nanoparticles, such as monitoring and verification, following the methods of strong distortion, excision using laser, sputtering, grinding, mechanical synthesis, and electrochemical methods (attrition ball mill, planetary ball mill, vibrating ball mill, low-energy tumbling mill, and high-energy ball mill).
4. *Liquid-gel method:* British scientists have developed “drug shells” that explode clusters of cancer cells and destroy them without targeting healthy cells, as they work by heating them at a temperature of 42°C inside the body [8–10]. Researchers at the University of Manchester, Britain, explained that the new technology has proven successful in animal experiments and represents the culmination of the results of using nanotechnology in the medical field. In their study, the details of which were published in the Journal of the American Association for the Advancement of Science, they confirmed that the drug shells are small bubbles of fat that travel throughout the body and release their payload of drugs, killing cancer cells when their temperature rises. Scientists want these missiles to avoid side effects by ensuring that the drugs target only the tumor or tumors and nothing else. The leader of the research team, Professor of Nanotechnology at the University of Manchester, said that drug shells can move safely throughout the body at a normal body temperature of 37°C. Costas Costrels added that when these missiles reach cancer cells, they explode and destroy them after being heated to 42°C, which increases their effectiveness against cancer and reduces their collateral damage to healthy cells [11–14].

Methods for Industrial Preparation of Nanomaterials

Over the past few decades, great efforts have been made in the fields of science and engineering to develop new and improved energy technologies that may lead to the ability to improve lives worldwide.

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Nanofabrication is an important subfield in energy-related nanotechnology. It is the process of designing and manufacturing devices on the nanoscale, as manufacturing devices smaller than 100 nanometers helps to find and develop new ways to obtain, store, and transfer energy. This will provide scientists and engineers with a good level of control, qualifying them to solve many problems related to the current generation of energy technologies that the world faces today. Workers in the fields of science and engineering have begun to use nanotechnology to develop consumer products. The advantages of designing these products include increasing the effectiveness of lighting and heating, increasing the electrical storage capacity, and reducing pollution resulting from energy use. This gave capital investment in nanotechnology research and development a top priority [15–18].

Heating Method of Nanomaterials

And about how to heat the drug shells inside the body, The possibility of using heat pads to heat cancerous tumors on the surface of the body, such as the skin, head, or neck, and probes or binoculars can be used to heat tumors inside the body, while discussions are taking place about the use of waves Ultrasound for tumor heating [19, 20].

Chemical Composition of Nanomaterials

When manufacturing nanosized materials, the physical composition and chemical concentration of the raw materials used in manufacturing play an important role in the properties of the resulting nanomaterial, which is in contrast to what happens when manufacturing ordinary materials. They are visible or invisible to the naked eye based on their size and can be observed under a microscope. In these materials, the size of the granules varies from hundreds of micrometers to centimeters; however, in nanomaterials, the size of the granules is in the range of 1–100 nm.

There are two ways to manufacture a nano-size material, one of which is from the top-down, as this method starts with a tangible size of the material under study and gradually decreases until it reaches the nanoscale. Photoengraving, cutting, chamfering, and milling are some of the techniques used in this field. These techniques have been used to obtain microscopic electronic compounds such as computer chips, and the smallest size that can be reached is within 100 nm, and research is still continuing to obtain smaller sizes. The other method is bottom-up, which begins with single particles as the smallest unit and is collected in a larger structure. These methods are often chemical and are characterized by the small size of the products (one nanometer), lack of waste of the original material, and bonding strength for the resulting nanoparticles.

The properties of nanomaterials can be examined and studied, and their compositions confirmed using a number of scientific devices and techniques, the most important of which are transmission electron microscopy (TEM), scanning electron microscopy (SEM), atomic force microscopy (AFM) with insulators, and X-ray diffraction (XRD). Nanomaterials can be manufactured in several forms depending on their intended use [21–24].

CLASSIFICATION OF NANOPARTICLES

Nanoparticles are naturally found in environments such as manganese, clay, and volcanic ash. They are found in protein and iron storage and are indirectly due to human activity. Nanomaterials include smelting and welding activities (metal fumes), as well as fumes of polymers and nanomaterials. Their shapes and dimensions are controlled, and they are classified as nanoparticles depending on their dimensions to nanomaterials, which are classified into three categories based on their dimensions.

1. *One-dimensional:* Materials in which one of their dimensions is within the nanoscale and the rest of the dimensions are outside the nanoscale (greater than 100 nm). Examples of this type are thin films, layers, and nanocoatings.
2. *Two-dimensional:* Materials with two dimensions within the nanoscale and a third dimension outside the nanoscale. Examples of this type are nanotubes and fibers.
3. *Three-dimensional:* Materials with all dimensions within the nanoscale, such as quantum dots.

Energy Development of Nanomaterials

Technological development was a unique feature of the twentieth century. Experts unanimously agreed that the most important technological development in the last half of the century was the invention of electronics. Its development led to the emergence of what are called microchips, which, in turn, led to a scientific and technical revolution in all areas. Until the fifties of the last century, there were only black and white televisions, there were only approximately ten computers throughout the world, and there were no mobile phones, digital watches, or the Internet. All these inventions are credited to those segments after God Almighty. The increase in demand led to a decrease in prices, which facilitated its entry into the manufacturing of all consumer electronics that surround us today. In the past few years, a new term has come to light, casting its weight on the world and becoming the focus of great attention. This term is nanotechnology or, as some call it nanotechnology. This technology will enable us to create anything we can imagine by arranging particles of matter next to each other in a way that is beyond imagination. Let us imagine producing very precise computers that can be placed on the tip of a pen or pin and let us imagine a fleet of nanometric medical robots that can be injected into the blood or swallowed. To treat blood clots, cancerous tumors, and other incurable diseases [25–29].

This promising technology heralds a huge leap in all branches of science, and optimists believe that it will cast a shadow over all areas of modern medicine, the global economy, international relations, and even the daily lives of the average individual. The term "nanotechnology" is derived from the Greek language, meaning the infinitesimal world of mythical dwarves, and nanotechnology means techniques that are manufactured on the nanometer scale (Figure 1), which is the smallest metric unit of measurement and is equivalent to one-thousandth of a millionth of a meter, that is, one billionth of a meter. This represents the most accurate metric unit known to date and is equivalent to ten times the atomic measurement unit known as the angstrom. The size of the nano is approximately 80,000 times smaller than the diameter of a head hair, so it is truly miniature technology. Thomas Kenny of Stanford University described nanoscale size with many examples, such as being similar to the width of deoxyribonucleic acid (DNA), the size of ten hydrogen atoms, the growth rate of a human fingernail in one second, and the height of a drop of water after it is completely spread on a surface area of one square meter [30–32].

Medical Nano-Technology

For nanomedicine, where this technology contributes to the treatment of cancerous diseases, the exact location of the cancerous tumor is determined through the use of nanoparticles in the magnetic resonance imaging process. In addition, this technology is used in the manufacture of drugs and medicines using nanopowder, which is a compound nanometer, whose diameter does not exceed 100 nm, in addition to the technology of delivering drugs and medicines via nanotubes. These include anti-cancer drugs and antibiotics with nanosilver. This has contributed to the establishment of many industries, such as very precise machines that were manufactured to intervene in surgical operations to treat diseases that require such interventions, such as the removal of tumors. For example, the so-called electronic nose was invented through the use of carbon nanotubes, through which cancer diseases are diagnosed. The device resembles the human nose, inhaling the smell of cancer through breathing, and can determine the stage and type of disease through nanometer sensors linked to an electronic

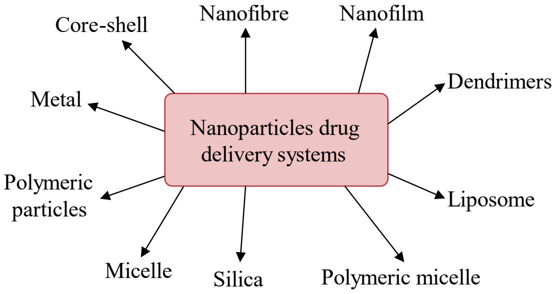

Figure 1. The delivery system of nanoparticles.

brain. It was discovered by Dr. Hossam Hayek, who won the European Malikari Award for Distinguished Scientists. The nanoengine is among the modern technologies in nanoscience, and this engine, which was manufactured by researchers at Carnegie Mellon University in America, can roam inside the blood vessels in the human body, which indicates the accuracy and size of this engine and its ability to reach the most accurate places in the human body and help doctors to perform micro-surgeries, unlike the engine, 1-micron-sized nanobots are manufactured that are controlled by doctors during surgeries, and directed in a way that allows them to assist in surgical operations, pump therapeutic materials, and waves into cells with great accuracy, and these technologies are used in all fields: medical, whether curative or preventive, and it is also used to carry accurate devices and tiny cameras that enable surgeons to see cells and tissues and pass through blood vessels, which are nanomaterials made of carbon [33–37]. Figure 1 shows the acts of the delivery system of nanoparticles.

Nanotechnology in the Preparation of Antimicrobials

In various infectious diseases, there is an obstacle to chemotherapy, namely bacterial resistance. Metal oxides can effectively function as antibacterial agents. Among the metal oxides is zinc oxide, as it shows resistance as an antibacterial and germ that causes many diseases, such as zinc oxide nanoparticles, which affect the bacterial cell membrane and become irregular owing to the effect of contact with zinc oxide. Substances that function as antibacterial agents have been developed in food, medical, and industrial fields. These agents and materials are both organic and inorganic [38–40]. Organic antibacterial agents are less stable at high pressure and temperature. Inorganic antibacterial agents are more stable, and the surface area volume is large, that is, the area ratio between the volume and surface. In these zinc oxide nanoparticles, an increase in surface area enhances their interaction with surrounding molecules. In primitive cells, they inhibit growth, while in eukaryotic cells, they promote cell death and cause the rupture of bacterial and fungal membranes due to their toxic effects. Figure 2 demonstrates the role of a nanocapsule functioning as a drug delivery system [41–43].

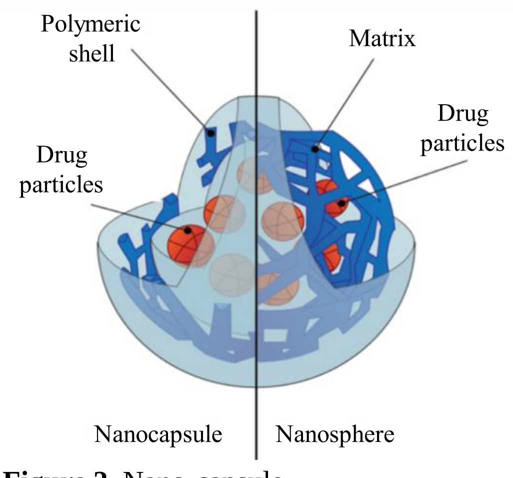

Figure 2. Nano-capsule.

Disadvantages of Nanomaterials

First, nanoparticles are very small particles. To the extent that it can infiltrate the immune system in the human body, it is sabotaged. Even more disturbing is the ability of these molecules to cross the blood-brain barrier. This is achieved through the use of nanotechnology products, such as sunblock creams, which can damage the DNA of the skin. The second part of the concern lies in the fact that the nanomolecule is self-replicating; that is, it is similar to the reproduction found in natural life, as it can reproduce without limits and dominate everything on the globe [44].

Some Caveats of Nanotechnology

The mere presence of nanomaterials does not pose any threat, but certain features make this technology risky, especially in its increased reaction kinetics. If there are certain properties of some nanoparticles that are harmful to living organisms or the environment, this will result in us facing great danger. Thus, we can say that there is nanopollution. We also need to distinguish between the two types of nanostructures when confronting the environmental and health impacts of nanomaterials, which are as follows:

1. Nanocomposites, nanosurfaces, and nanocomponents (electronic, optical, sensitive, etc.), where particles are integrated at the nanoscale into the essence of the material, the material itself, or even devices (“fixed” nanoparticles).
2. Free nanoparticles, where individual nanoparticles of a substance are present within some stages of the production and use processes. These nanoparticles may fall into one of the nanoscale categories of simple elements or compounds as well as complex compounds, where the nanoparticles are coated with another material (coated nanoparticle or uncoated nanoparticle). Hence, there is a consensus that the current concern is free nanoparticles.

Nanoparticles are also very different from their current counterparts; therefore, their diverse and multiple effects cannot be derived from the known toxicity of fine-sized materials. This raises important issues. To combat the health and environmental impacts of free nanoparticles. According to the German Federation for Environmental Protection, various studies have concluded that nanomaterials can harm human DNA under certain conditions (Figure 1). Mario Goetz from the German Federal Institute for Risk Assessment in Berlin said, “To our knowledge, materials containing nanoparticles currently on the market, which have been subjected to skin health tests, have not resulted in a direct risk to the consumer.” Goetz added that a new European Union decision would strengthen consumer protection. There are also concerns regarding environmental protection associations that raise public opinion against the application of nanotechnology, as happened against genetically modified crops, and these reservations were represented in the possibility of pollution. It is possible to design new bacteria, produce machines that can be programmed, and insert genetic information into them by using manufactured viral beads (76, 77).

There is also a possibility; to move atoms or molecules; To cause chemical reactions, this leads to the manufacture of potentially harmful compounds, which were difficult to produce using current chemistry techniques. The fear that the use of these technologies will turn to military affairs could make technology a monster that threatens all of humanity, instead of using it to raise the standard of living for all people and combat poverty, diseases, ignorance, unemployment, desertification, and so on. Is nanotechnology a double-edged sword. This is what research centers will reveal in the future. With every scientific or technological development, there is always criticism and fear about it, as happened in the first industrial revolution, the invention of the atomic bomb, and the emergence of genetic engineering. These concerns focus on two factors. The first is that nanoparticles are very small particles. It can infiltrate the immune system of the human body and destroy it. What is even more disturbing is the ability of these molecules to cross the blood-brain barrier. This is done using nanotechnology products, such as anti-sun ointments, which can damage the skin’s DNA [45]. The second part of the fear lies in the fact that the nanoparticle is self-replicating, that is, similar to the reproduction that exists in natural life. It can reproduce without limits and can control everything on the planet. Some international organizations specializing in environment and health have begun organizing conferences. Discuss the dangers of this technology and its misuse [46, 47].

CONCLUSION

And like any invention, nano has advantages as well as disadvantages because it consists of particles that are very small in size to the extent that they can sneak behind the immune system in the human body, and they can also infiltrate through the membranes of skin cells and lungs, and the most worrying thing of all is that they can cross the brain-blood barrier. The nanoparticles present in anti-sun ointments harm the skin and damage DNA. The Johnson Space Center, affiliated with NASA, conducted a study showing that the nanoparticles used in carbon tubes are more harmful than quartz dust, which in turn causes a fatal disease.

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