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DEVELOPMENT AND APPLICATION OF NANO MATERIALS IN RECENT CHALLENGES

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Abstract: Technology that can be defined as all the tools developed by human beings for the purpose of facilitating life, accelerating production, changing existing structures and conducting research and all the information belonging to these materials. I Nanotechnology is applied to the size defined as one billionth of a meter. Nanotechnology, the key technology of the 21st century, offers the latest applications that are revolutionizing in detecting and treating diseases, monitoring and protecting the environment, generating and storing energy, improving crop production and improving food quality, and building complex structures. In this review the latest points of application of nanotechnology, which has an important place in our lives, will be discussed.

Keywords: Nanotechnology, complex structures, crop production, food quality, treating diseases, revolutionizing.

I. INTRODUCTION

Non-stain fabrics, non-scratch surfaces, color-changing paints, anti-aging cosmetic products and many more can be given as nanotechnology products. In recent years, nanotechnology products have frequently attracted our attention on billboards, social media and televisions. Briefly, nanotechnology, which is defined as understanding, controlling, and making them functional at the atomic level, is perceived as a new technology revolution.

Today, more robust, higher quality, longer lasting, cheaper, lighter and smaller devices can be developed with nanotechnology. These developed products manifest themselves in production as less material, less energy, cheaper and easier transportation, more functions and ease of use (Ramsden, 2011; Lines, 2008) Nanoparticles between 1-100 nm in size, which provide a great improvement in the functionality of metal, ceramic, polymer or composite systems, form the basis of nanotechnology as well as nano-sized materials. Nanomaterials have been used in the development of many products in daily life. Ski equipment made of waterproof nanofibers and tennis balls made using clay polymer nanocomposites are some of the good examples that can be given to these products. These products, developed with nanotechnology, are more robust, longer lasting and lighter than conventional products.

Nanoparticles are widely used especially for coatings, surfaces and structures with functional properties. Self- cleaning surfaces and windows are the best examples of this. These materials coated with highly activated titanium dioxide have water repellency and anti-bacterial properties. It is another example of the first synthetic material made with nickel nanoparticle reinforced polymer composites that are touch sensitive and can heal itself quickly and repeatedly at room temperature. This synthetic material can be restored in about 30 minutes after cutting, by gently joining the cut pieces.

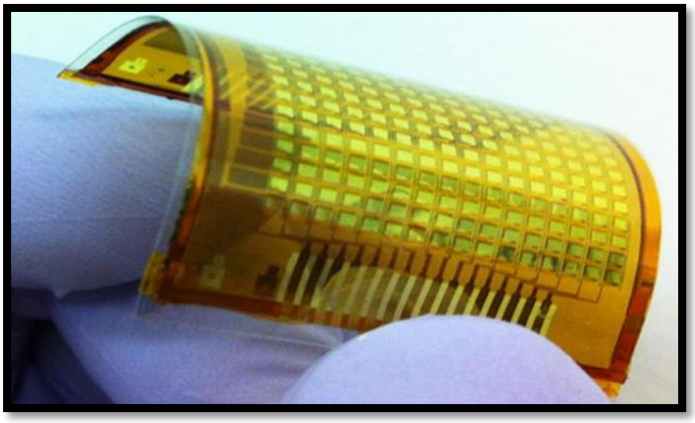

Figure 1: Self-healing synthetic material produced with nanotechnology.

Waterproof, self-cleaning, anti-sunlight or antistatic clothes can be produced with coatings applied on fabrics using nanoparticles. In addition, the use of nanoparticles in ventilation filters or washing machines ensures the protection of the laundry from bacteria.

1.1 Nanotechnology in Electronics and Information Technologies

Nanotechnology applications, whose aim is to produce economical and high-performance materials and devices, has made a significant contribution to the great advances made in the fields of information technologies and electronics and continues to do so. Thanks to nanotechnology, faster, smaller and more portable systems that can manage and store larger and larger amounts of information have been developed. The best example of this is the basic switches, transistors that activate all modern computers that have an important role in the development of computer technology. Transistors are electronic circuit elements that are used to control a voltage or current source and another voltage or current source. Transistors form the basis of all electronic devices we use every day, such as computers, smartphones and televisions.

While the typical transistor size at the turn of the century was between 130 and 250 nanometers, a team at Lawrence Berkeley National Laboratory in 2016. "Carbon nanotubes" and "molybdenum disulfide (MoS 2nd) 1 nanometer using It has managed to make a transistor of size. This transistor is the smallest transistor ever made (Desai et al., 2016).

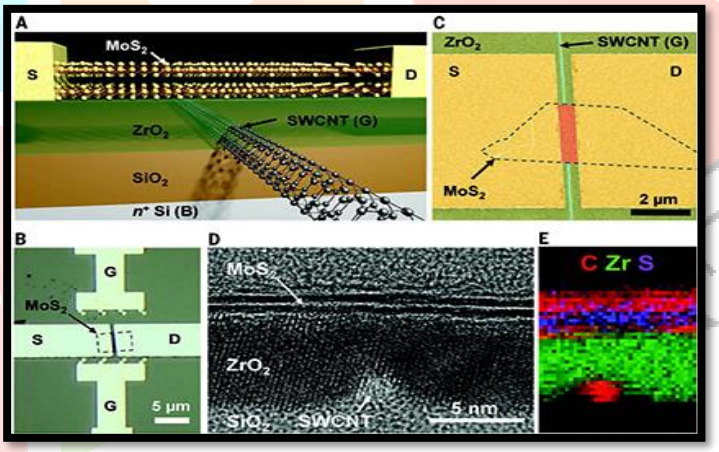

Figure 2: Carbon nanotubes and molybdenum disulfide (MoS 2nd) using the world's smallest transistor was made.

The electrical properties of carbon nanotubes, which are one millionth of a millimeter thick, made of carbon, which has been mentioned frequently in the field of science and technology recently, can be very different and advantageous compared to semiconductors such as silicon. IBM, the world's largest information technology company, is also aware of the potential of this material and has defined carbon nanotubes as the "foundation of the future beyond silicon". In nano-sized transistors, information processing can be performed with the movement of a single electron instead of millions of electrons. As a result, it is possible to save a great deal of energy. In addition, because of its small size, billions of transistors can fit into one square centimeter. Thus, computers can be run faster and their efficiency can be increased further. Briefly smaller, Faster and better transistors mean computers' entire memory can be stored in a single tiny chip (chip). With the production of electronic circuit elements at nanoscale, it is expected that nanotechnology computers will be smaller in size but larger in speed and capacity and consume less energy compared to computers produced with today's technology.

1.2 Applications of Nanotechnology in Medicine

In the field of nanomedicine, known as the applications of nanotechnology in medicine, nanoscale materials and nano-electronic biosensors are used for various purposes such as diagnosing, monitoring, treating and preventing diseases. Today, while many diseases such as diabetes, cancer, Parkinson's and Alzheimer's pose a danger to human health, it is of great importance to make the correct diagnosis first in order to make the right treatment. Nanoscale level nanosensors and nanoparticles produced with nanotechnology play a major role in accurate diagnosis and timely treatment. One of the most important applications of nanotechnology in the field of medicine is drug release and many researches are being conducted on these applications today. By injecting drugs loaded with nanoparticles into the patient's body, it becomes possible to identify diseased cells such as cancer cells thanks to these nanoparticles. Nanoparticles deliver the medicines they carry to the sick cells and ensure that these sick cells are

destroyed in the body without damaging the healthy cells. The best example of this practice today is Chemotherapy drugs loaded with nanoparticles used in cancer treatment.

Figure 3: Drug release is one of the most important applications of nanotechnology in the field of medicine.

One of the important applications of nanotechnology in medicine is Quantum dots (quantum dots) in the diagnosis and treatment of tumors in the human body.~ 36 ~ dots). Although this technique is still in development, it is a promising approach in cancer treatment. Today, cancer diagnosis can be made by determining the location of tumor tissues with iron oxide nanoparticles with magnetic properties. First, special antibodies developed against the tumor sought in the body and marked with iron oxide nanoparticles are given to the body. If the tumor is in the body, the labeled antibodies bind to the antigens on the tumor surface. Thanks to the magnetic signals sent by the iron oxide particles in the antibodies collected in the tumor tissue, these tumors are detected by the MRI device. In this way, even a very small tumor tissue in the body can be detected (Nikalje, 2015). In addition, with the emergence of new nanotechnology tools and gaining more information about polymeric drug delivery, the field of nano vaccine is rapidly developing. Developed by a group of scientists, nano vaccines consist of synthetic polymer nanoparticles containing tumor proteins that the immune system can recognize and help the person fight cancer on their own (Luo et al., 2017).

Figure 4: Nanoparticle vaccines to be used in the treatment of many diseases in the future

Another application is Buckyballs fulleren, which is a nanomaterial, is used to reduce the inflammation that occurs during allergic reactions and to retain free radicals that occur during these reactions. In addition, nanoshells are used to destroy cancer cells that are heated by infrared rays without damaging healthy cells in the body. Aluminum silicate nanoparticles with the ability to absorb water in trauma patients~ 37 ~ It is very useful to use. Because of these properties, aluminum silicate nanoparticles cause blood to clot more quickly and reduce bleeding. Nanotechnology can also be used to kill germs. Thanks to silver nanoparticles, wounds are cleared of germs. Some nanoparticles are used to treat infections. Examples of these are wound creams with nanoparticles embedded with nitric oxide gas. When these creams are applied on the wound, these nanoparticles release nitric oxide gas in their bodies and cause bacteria to die (Adnan, 2010).

1.3 **Energy, Environment and Nanotechnology** Nanotechnology has applications in the efficient use, storage and production of energy, as well as in detecting and cleaning environmental pollutants. It is obvious that nanotechnology, which has applications such as providing clean drinking water, improving the quality of the air, developing new energy sources and removing hazardous and toxic substances from the environment we live in, will obviously help create a sustainable environment.

Figure 5: Nanotechnology applications will be effective in creating a sustainable environment.

Today, as a result of increasing energy-fuel consumption day by day, the existing natural resources are rapidly being depleted. As a result, the search for alternative energy sources has increased in recent years and significant financial support has been allocated for researches on alternative energy resources in developed countries. Work this-~ 38 ~ The most important one among malar is the work on hydrogen energy. One of these studies is the generator that produces hydrogen fuel and gets its power from light while cleaning the air, done by scientists. Thanks to the nanoparticles in the catalyst of the device, hydrogen gas is produced while cleaning the dirty air (Verbruggen et al., 2017).

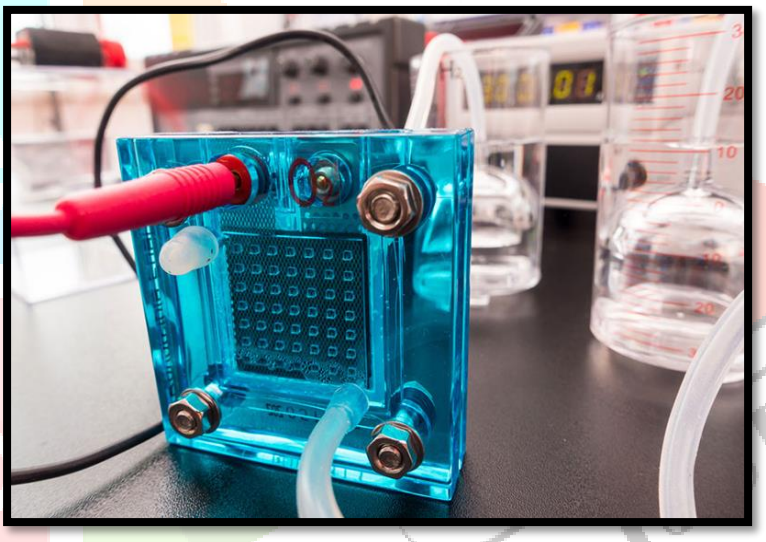

Figure 6: Generator that produces hydrogen fuel and gets its power from light while cleaning the air

It is possible to store this hydrogen gas produced and use it as fuel, and hydrogen buses are the best example of this. However, in order for the use of this energy to become widespread, hydrogen must be stored safely and in high density. However, high density storage of hydrogen is difficult and costly in many aspects. Today, scientists have shown that very high capacity hydrogen can be stored in carbon nanotubes and molecules made functional with transition elements (Pt, Pd, Ti, V, etc. (Bayındır, 2007). Environmentally friendly fuel consumption will be achieved, thus it will be possible to find a solution to the need for clean air and alternative energy. Another important development in the field of energy has been experienced in studies on the lifespan of batteries. Scientists have used nanowires, which are thousands of times thinner and highly conductive than human hair, in the structure of batteries in order to increase the life of batteries. These wires create a large surface area, providing more storage space and thus more electron transfer takes place. However, as a result of the studies carried out, it is seen that these wires are very fragile

It was revealed that it could not be charged by larca. A group of researchers coated nanowires in a combination of mangand dioxide and plexiglass-gel electrodes to overcome this problem. This mixture is safe and resistant to damage. It has been tested in more than 200,000 cycles. As a result of the tests, there was no capacity loss in the battery produced and no breakage in the nanowires used (Thai, Chandran, Dutta, Li, & Penner, 2016). Thus, it is expected that the life of commercial batteries will greatly increase thanks to this important work. With the improvements to be made, it may not be necessary in the future to replace the batteries of smartphones, computers, cars and other battery-powered vehicles.

Figure 7: use of Nano technology in water treatment

Another important application of nanotechnology is its applications in water treatment processes. Nano materials such as nano membranes, carbon nanotubes, nano clays and alumina fibers are used in the water treatment application. These materials are cheap, portable and easily cleaned systems. Nanofilters can remove water deposits, chemical waste, charged particles, bacteria and other pathogens such as viruses. It can also remove toxic trace elements such as arsenic and viscous fluid impurities such as oil (OECD, 2004).

1.4 Textile and Nanotechnology

Today, adding different properties in nanometer dimensions to the materials used in the textile industry leads to very important developments and it is expected that it will continue to open. The most common application of nanotechnology is anti-stain and anti-wrinkle products and products resistant to liquid spills. Scientists have developed titanium dioxide nanolayer particles that react with sunlight to destroy dirt and other organic materials.~ 40 ~ and they kept the fabric clean by covering this layer on cotton. Nanoparticles such as clay, metal oxide carbon black, graphite nanofibers and carbon nanotubes are used in order to increase the mechanical strength of textile products and improve their physical properties such as conductivity and antistatic behavior. The most commonly used materials among nanoscale filling materials are carbon nanofibers and carbon black nanoparticles with high chemical resistance and electrical conductivity.

Carbon nanofibers increase the tensile strength of composite fibers, while carbon black nanoparticles increase abrasion resistance and durability. On the other hand, composite fibers reinforced with clay nanoparticles, which have properties of electricity, heat, chemical resistance and ultraviolet rays, are flame retardant, One of the important developments in the textile industry in recent years is fabrics that clean themselves with light. A group of scientists found that the textile product coated with copper and silver-based nanoparticles cleans itself as a result of exposure to sunlight or any light for a while (Anderson et al., 2016).

Figure 8: Nano technology in textile filament

Thin, flexible and light filaments were developed that could generate and store electricity from the sun and weave them as textiles. another important development in the field of textile is thin, flexible and light filaments made of copper strips developed by scientists that can obtain electricity from the sun and store it as textiles. Developed with nanotechnology, these filaments have solar cells on one side and energy-storing layers on the other. Structure from fabrics woven with these fibers in the future-~ 41 ~ Thanks to the clothes, our mobile phones will be able to be charged. Maybe we will have the chance to regularly check our heart rate, body temperature and blood sugar thanks to our clothes (Li et al., 2016).

Figure 9: Nano technology in defense suits

Uniforms produced with nanotechnology will provide convenience to the military.

These developments in the textile sector have positive reflections on the defense industry and will continue to do so. In addition to the superior protection capabilities of smart uniforms and smart materials developed and continuing to be developed with nanotechnology, the fact that they are much more durable, durable, light and durable compared to traditional materials will increase the use in the military field. In the future, uniforms will gain new dimensions such as being able to generate energy thanks to the flexible and washable nanosensors integrated into the fabrics, allowing the necessary interventions to be made when necessary by detecting body temperature and alerting the soldier, and detecting chemical and biological agents. In addition, durable, light and long-lasting clothing, boots, etc. that can be worn in all seasons.

1.5 Food Industry and Nanotechnology

The applications of nanotechnology in the food industry are quite new. It is expected that the ability to use nanotechnology will allow food companies to design and manufacture cheaper, safer, more durable and more nutritious products. In addition, food companies are expected to use less water and chemicals in the preparation and production of these foods. A food company has embedded consumer stimulating nanosensors inside food packaging. When the food inside the package is contaminated or starts to spoil, the color change occurs in the nanosensor and this warns the consumer. In addition, scientists have developed a portable nanosensor that detects pathogens and toxins in food. In this way, farm, slaughterhouse, transportation,

Figure 10: Packages produced with nanotechnology will reduce food waste.

Plastics containing clay nanoparticles have been produced by some food companies. These nanoparticles in plastics prevent the passage of oxygen, carbon dioxide and moisture, and keep foods and meats fresh without spoiling (Mongillo, 2007). In addition, scientists have developed clay nanotubes that will provide better preservation of nutrients by preventing rotting and bacterial growth. Normally, due to the permeability in packages, water vapor and oxygen can enter the circulation and cause ethylene accumulation around the food and Therefore, it accelerates the spoilage and decay of foods. Polyethylene films with hollow clay nanotubes developed by scientists are the most common plastic compounds. It has been determined that the nanotubes contained in these

polyethylene films prevent the formation of ethylene gas around the food by preventing the ingress of water vapor and oxygen, and it has been determined that the food is preserved for a longer period of time (Lavars, 2017).

There are applications of nanotechnology on functional foods that can respond to body needs.

In addition to these applications, nanotechnology also has effective applications on the development of functional foods that can respond to body needs and deliver nutrients to the body effectively. Today, scientists are trying to produce optional foods in which nanocapsules are placed, which remain immobile in the body and act when needed.

Another improvement in the food processing process is nanoparticles that increase the absorption rate of nutrients (Mongillo, 2007).

A new one is added every day to these applications of nanotechnology in the field of food.

Summary

The applications of nanotechnology, which is the most important technological development of the 21st century, appear in many different fields from science fields such as chemistry, physics, biology to health, engineering, food and electronics applications. Nanotechnology is a developing technology and its applications are increasing day by day. Nanoscale materials are lighter, more robust, programmable materials, and the use of less material in manufacturing requires less energy during the production phase. One of the best examples of these applications is the production of nano-scale electronic circuit elements. Nano-scale circuit elements are produced with less energy and the computers using these circuit elements will be smaller and larger in terms of speed and capacity. Nanotechnology applications will also contribute to the sustainable environment. Since cars operating with hydrogen energy will consume less fuel, they will pollute the environment less and thus environmentally friendly fuel consumption will be realized. In addition, it will be possible to obtain clean water thanks to nano-filters that can clean water sediments, chemical wastes, charged particles, bacteria and other pathogens such as viruses. It will be possible to prevent food waste thanks to the packages produced with nanotechnology. Another important application of nanotechnology is fabrics that do not stain, do not wrinkle, are resistant to liquid spills and clean themselves with light. Today, applications of nanotechnology in the field of medicine are frequently encountered. To diagnose and monitor diseases, Nanoscale materials and nano-electronic biosensors are used for various purposes such as treatment and prevention. A new one is added every day to all these applications of nanotechnology that make our lives easier and will continue to be added.

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