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Nanoscience and Nanotechnology From Past to Present

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Abstract

Ancient civilizations, led by the ancient Egyptian civilization, reached the technology of heating metals and obtaining images of atoms through nanosciences and nanoparticles. This is found in the blue color, black ink, as well as making masks, making beer, obtaining fine hairs from the flax plant, and also in building pyramids, which is an application in engineering. These applications recently have extended to the food industry, medicine, and engineering tools in the modern era. This is not a success, but construction tools, pesticides for weeds and insects, dealing with water pipes, and other applications found in the modern era too.

Introduction

Nanoscience and nanotechnology are at the forefront of contemporary research. The rapidly growing economy in this field needs professionals with outstanding expertise in nanoscience and the ability to use this knowledge in newer products [1].

Interdisciplinary scientific training is essential to providing industry and research facilities with high-quality professionals who have a broad background in many sub-disciplines, including computers, physics, chemistry, science, and biotechnology, as well as being subject-matter specialists [2].

Nanoscience is the convergence of nuclear physics with the physics and chemistry of complex systems. Nanotechnology: The science and engineering of understanding and controlling matter on an atomic, molecular, and sup molecular scale is known as nanotechnology [3].

The boundaries of nanotechnology so that he expresses this technology by the word microscopic engineering, i.e. engineering within the limits of the electron or tunneling microscope that appears to the eye, so he says about this microscopic en-

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gineering or nanotechnology-it is a new branch of science in which engineers work in the field in which things are measured by fractions of a millimeter, and at this From the small level, a grain of sand is like a large stone, and a human hair is like a thick rope, while the mechanical foundations such as friction, erosion and lubrication take on strange meanings [3].

It is known that the whole world consists of atoms and the differences lie in the way they are arranged. Micro technology presents an embodiment of this means of control so that it achieves possibilities for health, wealth and capabilities that exceed any past perceptions that the human mind had [4].

There is a contemporary theory whose roots extend back to the time of the fathers in the 1950s. It says that there is a smaller part of the atom, which is what I call it (the nano). When ten hydrogen atoms are lined up, its length is only one nanometer). If you want to imagine the size of the nano, it is like The rate at which your nail grows in one second. This makes it a technique that changes the properties of the elements, which in turn means something very great. A frying pan in the element iron at this volume will completely change all the properties of the material, including color and chemical properties! The reason for this change is due to the nature of the interactions between the atoms that make up the element iron [5].

So nano-scales start from the single atom, and that is why some of them called nanotechnology the term one atom chemistry. Here a question arises; If nature, which is the most complete model created by God Almighty, has built all things from these atoms, then what does it mean that we rebuild the same things from these atoms? Is it not a reconstruction of nature itself? [6].

This means that manipulating the nanoscale size of iron will create an element completely different from iron..!! What is really strange is that the very ancient “alchemy” - which is the basis of chemistry - saw the possibility of converting almost everything into everything, even converting lead into gold, for example! This was impossible (like magic) for us. The use of nanotechnology to convert a piece of lead, which is known to be a poor conductor of electricity, into a tube of carbon that conducts electricity well, in addition to its ability to make carbon hundreds of times stronger than iron, which is one-sixth of its size, so that nanotechnology makes glass very strong like steel [7].

Gold in its normal size is an excellent conductor of heat and electricity, but not of light. But properly structured gold nanoparticles begin to absorb light and can convert that light into heat, hot enough to act as a miniature heat scalpel through which unwanted cells in the body, such as cancer cells, can be killed [8].

Porcelain is considered an important material, but it is fragile, and the reason for its fragility is that the space between its particles, which is made of sand, is relatively large, which reduces its cohesion. Porcelain can be taken like dishes and disassembled into its smaller atomic components, then re-paving these components in a very coherent way: The result? Porcelain is stronger than iron and can be used in making lightweight cars that do not need a lot of fuel. Petroleum, for example, shares its composition with many organic materials. Petroleum can be synthesized from any organic waste after dismantling it into its atomic components and then reassembling it to make petroleum [9].

The possibilities are endless. Titanium-the most solid metal on Earth - from which spacecraft are made, can be made from any scrap metal. It is a radical revolution in the relationship between industry and raw materials, and even the entire global economic exchange system. It seems that the picture is becoming more and clearer, and we wonder again what is the means for making these pavers?. Atoms are natural, but the precipitators are technological and human-made, so how do we understand this picture between human technologies dealing with a physical nature?

(https://arianfateh.com/en/the-use-of-titanium-in-the-spacecraft-was-effective-in-reduction-of-the-imposing-loads-en/)

Modern nanotechnology is known and its origin is ancient civilizations. It is not a term or a word that is circulated. It is the science and technology that reveals a better future. Nano is not a specific material, but rather a scale by which we measure microscopic things. It is the most accurate metric unit known so far, as it is one part in a billion part. of the metre [10].

The eye can see 10 thousand nanometers, but less than that is not seen by the eye, and we need modern devices of microscopes in order to see this small scale, and for simplicity and clarification, the thickness of one hair from the human head is equivalent to 50 thousand nanometers, and the size of the nanometer is approximately equivalent to the size of the atom itself Therefore, our work is at the level of atoms, not molecules [11].

At the outset, we must admit that there is a cultural discontinuity between what we are discovering today and what happened in ancient civilizations. The ancient Egyptian civilization knew the sciences of this era of biotechnology, nanosense, and nanoparticles [11].

That this science has existed since the days of the ancient Egyptians and the Greek civilization, and that the eye cannot see materials at the level of the nanoscale, and modern devices of microscopes are necessary in order to see this small scale, explaining that the origin of the name is taken from ancient civilizations, so in the language The ancient Greek “nanos” means a dwarf, and in the ancient Egyptian language it was said “Nun”, from which the word “Nunah” was taken, which refers to a young child [12].

The manufacture of masks among the ancient Egyptians are widely known through the mask of Tutankhamun. This indicates that the ancient Egyptians were fully aware of the art of inlaying, inlaying, and glazing. The eyelids were made of copper or bronze, and their color was either black, blue, or dark gray, and the iris was made of white, opaque, opaque glass. All of the above requires NanoSense and NanoTechnology (http://www.touregypt.net/featurestories/masks.htm).

The researcher, Tina Salguero, Assistant Professor of Chemistry in Georgia, led the research on ancient Egyptian pigments, and the results were published on the Royal Society of Chemistry website, where she confirmed that the material from which the Egyptian pigments were used (copper-calcium silicate) is capable of providing a new class of advanced nanomaterials Very modern and used today in many scientific applications such as infrared medical imaging security toner [13].

According to research published in the journal Nature Communications, the grains of calcium copper silicate in Egyptian

blue are 100 times thinner than a human hair. When the ancient Egyptian noticed that some materials were not available in abundance, such as copper ores from azurite and malachite, or his careful observation of their instability, he resorted to preparing another material that he used for coloring in blue, and the result was his production of the oldest industrially prepared material in history, which is «Egyptian blue» [14].

This material is a silicate of copper and calcium, or caprorivite (CaCuSi4O10), and it was prepared by heating a set of basic materials necessary to prepare the color, which are copper ores or some copper alloys such as bronze, especially in the era of the New Kingdom, in addition to an abundant amount of sand in addition to limestone powder and a small percentage of salt. Natron, which was mixed together in the form of balls and heated at temperatures ranging from 800 to 1000 degrees Celsius, and the final product, had a distinctive bright blue color and crystalline granules of varying sizes with a very high degree of stability [14].

One of the most famous and amazing uses of this pharaonic color was the body on the crown of Queen Nefertiti, where the crown discovered in the temple of her husband Akhenaten was studded with precious stones with a distinctive blue dye [14].

This is confirmed in his research by Dr. Gianluca Accorsi, a researcher in nanosciences at the Italian National Research Center (CNR), that when exposed to visible light, Egyptian blue emits Near-Infrared rays (NIF) (https://www.edinst.com/blog/edinburgh-instruments-spectrometers-used-to-characterise-egyptian-blue-pigment/).

In a study by researchers from Curtin University in Australia, it was found that this feature helps investigators in identifying fingerprints, especially on shiny surfaces (https://www.curtin.edu.au/news/media-release/ancient-pigment-help-solve-modern-crime/).

What scientist drew attention to this science in the modern era? He is the American Richard Feynman, who won the Nobel Prize in Physics, explaining that all materials we can convert into "nano", starting with carbon "coal", which is the locomotive of all sciences, and he will draw the strategic plan for each flag in the near future.

"Black ink"

Which the "ancient Egyptians" used to write, through modern analyzes it was discovered that it was composed of carbon nanoparticles. The ancient Egyptians used "nanotechnology" during the construction of the pyramids, by grinding sand into very fine particles to make a layer at the bottom of a single stone so that it can be fixed in place easily, so it is a science used 3 thousand years ago (https://docplayer.net/54550388-5-th-international-congress-on-science-and-technology-for-the-safeguard-of-cultural-heritage-in-the-mediterranean-basin.html).

The famous Greek vessel "Lycuroguz", which changes color according to the angle of incidence of light, is one of the oldest applications of nanotechnology, which used nanoparticles of gold that were mixed with glass..! Scientists have taken samples from this vessel and started research and study operations on it until they reached the discovery of ((nano))..!! (https://docplayer.net/54550388-5-th-international-congress-on-science-and-technology-for-the-safeguard-of-cultural-heritage-in-the-mediterranean-basin.html)

And we reveal the secret of the drawings that remained as if they were drawn today, such as (Leonardo da Vinci's drawings), and other drawings and effects that withstood under weather conditions and erosion factors, and the use of nanoparticles two thousand years ago in Rome and Athens as a dye for black hair, through what Philippe Walter and his colleagues discovered through their research on hair dyeing in the Greco-Roman era (https://docplayer.net/54550388-5-th-international-congress-on-science-and-technology-for-the-safeguard-of-cultural-heritage-in-the-mediterranean-basin.html).

As well as the manufacture of "glass crafts" in the Roman era in the fourth century AD, and this appears in the glass cup preserved in the British Museum, which depicts the death of the Roman king Lycurgus, whose color changes from green to dark red when a light source is placed inside it, and this color gradient is due the cup contains nanoparticles of gold and silver.

In the European Middle Ages, it was also used in stained glass windows. Gold nanoparticles were used, whose color varies according to their sizes, ranging from yellow to orange to purple to red or green [15].

You can imagine how ignorant we are of this science despite the progress we are making now..! Jabir bin Hayyan, the founder of the science of chemistry, had lived in a period of time in which it was widely believed among people, even chemists themselves, including Jaber, that cheap metals such as iron, copper, lead, and mercury could be converted into gold or silver, through a substance of unknown properties. Since Jaber was one of the geniuses in chemistry and one of the students of Imam Jaafar Al-Sadiq at that time, quite a few ordinary people expected that Jaber's lab would be full of gold..! Almost two hundred years later, in one of the streets of Kufa, known as the Damascus Gate, and it was being rebuilt, and during the restoration of its old buildings, the Jabir bin Hayyan factory was discovered, and in this factory a large piece of gold was found. Which it made the dream that many people have, that cheap metals can be turned into gold, to stay alive (https://www.bbvaopenmind.com/en/science/leading-figures/jabir-ibn-hayyan-great-arab-alchemist/).

Muslims also excelled in the use of nano material Through the Damascene Islamic swords" (300 BC and 1750 AD) Damascene Swords, where the early Muslims made their swords by heating at very high temperatures and then cooling them suddenly, which gave them accuracy, durability and high sharpness, and these swords are made of a type of steel called wootz 540 AD. The Europeans discovered the Damascene sword among

the Muslims during the Crusades, and all their attempts to manufacture a similar sword in Europe at that time failed (https://www.nationalgeographic.com/science/article/carbon-nanotechnology-in-an-17th-century-damascus-sword).

Robert Curl, winner of the Nobel Prize in Chemistry in 1996, for the Damascene sword that cuts a piece of silk in the air while it falls to the ground as it cuts stones, because of carbon nanotubes. The Damascene did not write down the method of making this sword, so this knowledge was lost in The middle of the 18th century A.D. The French researcher "John Robar Briand" was the first to realize that the secret of the hardness of the Damascene metal lies in carbon in the year 1821, in contrast to what "Michael Faraday" in 1819 thought that aluminum was the reason (https://www.nobelprize.org/prizes/chemistry/1996/summary/).

Dr. "Stuart Barnes" managed to manufacture a Damascene sword in 1939 and published it in the magazine Popular Science, Page 66, June 1939 in 2006. A team of researchers at the Technical University in Dresden, Germany, studied a Damascene sword dating back to the 17th century AD (made by a lion). God and it is found in the Barn Museum in Switzerland) and the result of the study was published in the journal "Nature" which is that the Damascene metal contains carbon nanotubes and nanowires, which gives it those unique properties. In addition to a picture of a stained glass window using gold nanoparticles, Cologne Cathedral Kölner Dom 1280 AD, Cologne, western Germany.

Medicine

Currently, nanotechnology is being used to help treat diseases and prevent health problems. The umbrella term for this type of nanotechnology is nanomedicine, and this science has been successfully used to treat tumors as well as to kill microbes. In the eighth century AD, some ancient civilizations used to heat metals at a high melting temperature and then extinguish them in suitable media such as herbal juices. Burnt minerals are obtained by repeating this process several times. In this process, not only are the toxic effects of metals nullified, but they are also transformed into biologically active nanoparticles that are used in the treatment of many ailments (https://www.understandingnano.com/medicine.html). Nanotechnology can be used in the medical field. Through it, it is possible to navigate the human body to perform surgery and exit without surgery! And one of the specialists stated that during the next ten years, cancer will end! Bone fractures can also be repaired in a few minutes.

In modern times, nanotechnology has attracted the attention of scientists in many fields, the most important of which is medicine. For example, gold nanoparticles combined with thermal heating (laser) have been used to treat mammary tumors in cats and dogs. When gold nanoparticles are exposed to laser beams, they absorb heat, heat up, and kill the cell. Cancerous (https://www.understandingnano.com/medicine.html).

Gold nanoparticles were used in the treatment of the tuberculosis microbe, and this bacterial microbe is very dangerous in humans and animals, and it is difficult to treat with antibiotics. The person with tuberculosis may need a treatment period ranging from 6 months to a year, and the tuberculosis microbe often activates again in the patient's lung and spreads to other places. In the body. The difficulty of treating it is due to its ability to live inside the most important immune cell in the body called the microphage. Therefore, in this research, I discovered that gold nanoparticles can enter this cell.

So, linked gold nanoparticles to antimicrobial tuberculosis (rifampicin) in this study, found that gold nanoparticles loaded with rifampicin succeeded in reaching the tuberculosis microbe at the site of infection (inside the microphage) and killing it. In view of this, gold nanoparticles can act as a carrier for antibiotics and transport them to the infection site where the antibiotic is able to do its job and kill the microbe [16].

It is noteworthy here that the Egyptian scientist Ahmed Zewail won the Nobel Prize for his invention of a camera that can visualize atom interactions within a fraction of ten nanoseconds (https://www.nobelprize.org/prizes/chemistry/1999/zewail/facts/).

There are greater possibilities than arranging atoms is the formation of molecules that do not exist in nature, but rather an attempt to overcome the separation between organic and inorganic molecules in things, for example, researchers from Hang Yang University in Seoul were able to introduce nano-silver into antibiotics, and since silver was able to kill 650 germs from Without harming the human body, it has benefited from this property organically. Researchers from IBM University, Columbia University and the University of New Orleans were also able to flatter and combine two incompatible molecules into a triangular crystal. Dimensions Thus, a material that does not exist in nature, magnesium, with light-generating properties, was invented. It is made of nano-iron oxide surrounded by selenide lead. This is a semi-conductor of heat capable of generating light. This special feature has many uses in the field of energy and batteries [17].

There is work for the Kraft food company to invent programmed drinks, so soon we can buy a colorless and tasteless drink that includes nano particles for color and taste. When we put it in the microwave at a certain frequency, it becomes lemon juice, and at another specific frequency, it becomes the same as apple juice, and so on. Through nanotechnology, a spaceship the size of an atom can be made (https://www.kraftheinzcompany.com/). Through nanotechnology, it is possible to enter into the industries of electromagnetic waves that, once in contact with the body, can hide it, such as a plane or a car, and then the radar does not see it, and announces its disappearance. It is also possible to make a car the size of an insect and an airplane the size of a mosquito. Fabrics that do not penetrate water can also be made, although it is easy for sweat to escape from them. It is also possible to manufacture cells that are 200 times stronger than blood cells, and through which you can inject the human body with 10% of his blood, these cells enable him to run for 15 minutes without breathing.

One of the great ideas for applying nanotechnology is the space elevator. Imagine a cable tied to the ground on a floating platform at the equator, and on the other hand suspended in space beyond the orbit, and the space elevator uses electric elevators moving on the cable to put missiles, space stations and equipment in Earth's orbit (https://nanografi.com/blog/space-elevator-a-futuristic-application-of-carbon-nanotubes/). Japan, Europe and America have succeeded through their engineers in manufacturing a variety of levers, rotating tools, gears and other mechanical parts that are the size of a speck of dust. Scientists still use the effects and sciences of previous civilizations and their manuscripts in technological discoveries today, all of which carry the same principle.

Agricultural production

Nanotechnology achieves a qualitative leap in agricultural production, as nanotechnology has achieved a qualitative leap with clear features in all areas of agricultural production, and the related food industries, through which high productivity rates of agricultural products were, achieved that kept pace with the steady population increase.

It was also used in the manufacture of vital monitoring devices that help farmers determine the physiological condition of the crop and the appropriate time to harvest and benefited from drought resistance. Nanotechnology was used in the agricultural field and food industries vary widely in fertilizers, pesticides, water and water treatment, and the application of nanotechnology in agriculture is relatively recent compared to its applications in other fields, and the US Department of Agriculture was the first to use nanotechnology in agriculture [18].

Food industries in 2003, which led to a radical change in agricultural production, and nano applications, improve food production as a whole, starting from the production process and ending with packaging and waste treatment, and it also has a significant impact on improving the productive efficiency of the cultivated area. In addition, new tools, equipment, and stimulating materials with a nanocomposite were manufactured and developed to treat agricultural pests and their rapid detection, and lethal pests of agricultural crops (including weeds and weeds) were eliminated thanks to the improvement and increase in the effectiveness of nanopesticides significantly, and through this technology, the susceptibility of plants was improved It absorbs nutrients and fertilizers, improves the properties of agricultural soil and restores its fertility, which leads to increased and rapid growth of plants and improving their productivity [19].

The nanocomposites used in agriculture are also characterized as environmentally friendly materials, as they do not cause any significant problems to the surrounding environment or to humans, and cover a large area when used compared to traditional materials, which reduces the quantity, concentration, or doses used, and therefore there will be no excessive use compared to traditional materials. Which reduces the quantity, concentration, or doses used, and therefore there will be no excessive use to the extent that the possibility of not showing any residual effect of pesticides in the resulting agricultural products is being studied [20].

From the economic point of view, nanotechnology contributed to increasing the productivity and production of agricultural crops and reducing costs significantly, through which practical solutions were found to many problems facing agriculture and farmers, and thus contributed to lower prices for the consumer, as fertilizers and pesticides are generally the most important elements of agricultural cost. They constitute more than 50% of the crop production costs, which in turn are high costs for the state and farms [21].

By using nanotechnology through low-cost nanometer pesticides and fertilizers, with the same effectiveness as traditional materials, production costs decrease to a large extent, and thus prices decrease. Nanotechnologies have been used in various fields in the agricultural field, including the manufacture of fertilizers, where fertilizers made of nonmaterial's can be used in agricultural fertilization operations as an effective alternative to well-known conventional fertilizers or as carriers for their components that are characterized by special characteristics, including increased control and directional control and the ability to increase plant response to these nanoscale fertilizers [22].

These fertilizers are distinguished by their prices that are competitive with traditional fertilizers, that small quantities of them meet the required purpose, in addition to being able to be stored for longer periods than traditional ones as a result of their high stability under different conditions. Nano-compounds have been manufactured as fertilizers from the micro-mineral elements (which are the extracts that the plant requires in very small quantities compared to traditional fertilizers), including nano-calcium compounds as well as nano-composites (iron, magnesium, manganese, zinc, potassium) in addition to nano-silica, which is characterized by its vitality. The plant makes it resistant to drought, diseases and insects. It was tested on mangoes, so it gave a very large production and reduced losses through the fall of the fruits. It also increased the buds in the cotton plant [23].

The use of nanotechnology provides us with the necessary protection for plants from various agricultural pests, including weeds, diseases, insects, etc., without significant harm to humans, animals, and the environment.

Therefore, the use of nanocapsules was used to encapsulate chemicals, which are characterized by their high ability to dissolve and decompose, their speed of penetration into the plant, stability and constancy within the treatment area as a result of their small size and speed of dissemination, and they use less quantities of chemicals with the same effectiveness and reduce the process of repeat treatment, and thus lower costs [24].

This nanotechnology has also been used to enhance plant defenses through genetic modification within the plant cell or modification in the forms of pesticides to make them more effective, less harmful and more widespread compounds. Nanotechnology has provided a solution to the problem of pesticides to ensure benefiting from the benefits of pesticides and prevent their dangers from reaching humans by encapsulating these pesticides in nanometer capsules from which the rate of pesticide excretion can be precisely controlled, manufacturing insecticides with nanometric size and benefiting from increasing their efficiency at the lowest possible concentrations [25].

Developing a generation a new highly specialized pesticide for certain insects and not others, whose work can be controlled remotely, in addition to that it was possible to solve many agricultural problems using nanotechnology in terms of combating many agricultural pests, including them. The use of nano-structured silica particles as a coating for the vermectin pesticide, which led to reducing the decomposition process of the pesticide compounds, and increasing its survival in the environment and its ability to store for longer periods under different conditions, as the nanometer material acts as a carrier only for the pesticide [26].

The using of silver nanoparticles eliminates diseases caused by fungi, such as rots in various vegetable crops. These compounds were able to penetrate the walls of fungal cells and hyphae pathogenic to plant tissues. They also succeeded in reducing the growth of conidia and inhibiting microbial growth. Nanotechnology is used in the control of insect pests, mites, snake worms and microbial pathogens, in the fight against rot in grapes using aluminum and silicon nanometers. Nanotechnology is used in the manufacture of materials that treat surface

water, wastewater and groundwater, as it has the superior ability to get rid of pollutants and eliminate pathogens in the water less economical. In addition to, purifying the soil from heavy elements is easy that hinder plants' absorption of nutrients and water [27].

The use of nanotechnology to treat high air temperature and drought, where plants have been produced that withstand high temperatures using techniques that help plants absorb the beneficial from the sun's rays and reverse the rest of the harmful ones, or through the development of water coolers in the form of nanometer capsules that are absorbed by the plant and retain quantities of water inside the parts of the plant to long periods of time for the benefit of the plant when it is needed [28].

Water tanks have been developed inside the parts of the plants for long periods of time that the plants benefit from when they need it, and nanometer water tanks have also been developed that store rainwater in the soil so that the plant can use it in times of drought, especially in the lands desert. The use of nanotechnology in the food industry and its accessories, where nanotechnology is used in the manufacture of food products with the aim of enhancing the arrival of food ingredients to the target sites, improving the flavor of foods, preventing the growth of bacteria, increasing the validity of food products, and prolonging the preservation period of food, and it was used in the manufacture of food preservation requirements such as packaging materials and preservatives and storage [29].

Several types of secondary food materials have been manufactured, such as canola oil, which contains nano-dots that carry vitamins, minerals, and plant chemicals, and nano-tea, in addition to diet chocolate that contains nano-blocks that improve the taste without the need to add sugar. The using of so-called nanofood (nanofoods) through the use of nanoscale packaging materials for food products, which are materials that ensure the safety of foodstuffs for the maximum possible period against microbes [30].

The application of nanotechnology in food packaging allows a greater degree of protection for foodstuffs by increasing the mechanical and thermal capabilities and anti-bacterial properties and strengthening them, and provides protection against leakage and prevents germs from entering food [30]. The research on the effect of silver nanoparticles on the growth of bacteria after an incubation period for 24 hours decreased the growth of microbes by 98%. Indicative nano-markers have been placed on foodstuffs. In frozen poultry, they are marked in the form of stickers, where the green mark means that they are fresh. When they turn orange, they are safe, and when they turn red, the preserved materials become unsafe and unfit for human consumption, and they must be destroyed immediately [31].

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