SJST
sjst.scst.edu.ly
Surman Journal for Science and Technology
ISSN: Online (2790-5721) - Print (2790-5713)
مجلة صرمان للعلوم والتقنية
Vol 6, No.2, Jun - Dec. 2024
Pages: 478 - 493

A REVIEW IN NANO CHEMISTRY AND DEVELOPING NEW MATERIALS TO COMBAT ENVIRONMENTAL POLLUTION

Asma Almabrouk Mousa[1], Mahmoud Abduesslam[2]
[1]Faculty of Education, Surman - Sabratha University - Libya
[2]Higher Institute of Science and Technology- Wadi Al-Ajal - Libya

Abstract
Nanochemistry is one of the most significant modern scientific fields, focusing on the synthesis and study of materials at the nanoscale, with dimensions ranging from 1 to 100 nanometers. This study highlights the importance of nanotechnology as a key tool in addressing urgent environmental challenges by enhancing the properties of materials used for pollution remediation. This is achieved by increasing the surface area of nanomaterials, leading to enhanced chemical and physical effectiveness. Nanoparticles also exhibit unique properties, such as higher biological activity compared to the same materials at larger scales (macroscale or microscale). These results come from a comprehensive study to provide a literature survey in the field of nanotechnology and its use in combating environmental pollution.
Keywords: Nano Chemistry, New Materials, Environmental Pollution, And Developing.

INTRODUCTION
With the rapid industrial development and population increase, environmental pollution issues have become one of the biggest challenges facing humanity, negatively affecting human health and the balance of ecosystems. Pollution manifestations vary from water pollution due to organic pollutants and heavy metals, air pollution caused by toxic gases and fine particles, to soil pollution resulting from the accumulation of harmful chemicals. Nano chemistry has emerged as a modern and effective tool to address these environmental problems [1]. This science revolves around the design and development of nanoscale materials, characterized by exceptional properties, such as high surface area and distinct chemical reactivity, making them ideal for treating various types of pollution. For example, nanoparticles allow for the efficient removal of pollutants from water, while nano catalysts are used to analyze air pollutants and convert them into less harmful substances. Also, preventing the emission of 2 million tons of carbon compounds and saving billions of dollars in energy are pleasant consequences of using semiconductor manufacturing technology using Nanotechnology is in the field of lighting, which in turn will reduce air pollution [2].
The direct and indirect effects of nanotechnology on the environment and air pollution can be studied from different aspects [3, 4]. The prospects for using this new technology are very broad. Today, nanoechnology is mentioned in the world as a key and influential technology in science, technology and industry [5, 6]. Nanochemistry is also characterized by its ability to provide

sustainable and environmentally friendly solutions, as nanomaterials can be manufactured using "green chemistry" techniques that reduce the environmental impact of the production process. However, the application of these innovations faces challenges related to high cost and potential side effects on the environment and living organisms, which requires more research and development to ensure maximum benefit from these technologies [7].

Hence, this research seeks to study innovations in nanochemistry and their applications in developing new materials to combat environmental pollution, focusing on the practical aspects and future prospects for using these materials in achieving a clean and sustainable environment. The global environment faces increasing challenges as a result of excessive pollution of water, air and soil, which threatens human health and ecosystems. With industrial development, the need for innovative technologies to treat pollution has become more urgent. Nanochemistry offers promising solutions by developing materials with unique properties that are capable of treating pollution effectively and efficiently, which is the research problem. The aim of this study was to investigate the effect of nanotechnology on the environment, especially to study pollutants and their treatment methods using nanotechnology.

The main objective is to determine the role of nanochemistry in developing innovative materials that contribute to treating various types of environmental pollution in sustainable and effective ways.

Sub-Objectives

- Study the physical and chemical properties of nanomaterials used in pollution control.
- Analyze the practical applications of nanomaterials in water purification, air purification, and soil treatment.
- Highlight recent innovations in the manufacture and use of nanomaterials.
- Discuss the technical and economic challenges facing the application of nanochemistry in pollution control.

Scientific Significance, the research contributes to enriching scientific knowledge about the use of nanochemistry as a tool to combat pollution and providing a comprehensive analysis of recent innovations in the manufacture and use of nanomaterials. Practical Significance: Helping decision-makers and researchers develop policies and technologies to address environmental pollution and provide innovative and sustainable solutions that contribute to reducing the environmental impact of pollution.

Study Terms

- Nanotechnology

The word nano is a Greek word that means dwarf or small, and thus it has become - called nanotechnology, as the term of this technology relates to understanding the physical, chemical and biological properties on the atomic and molecular scales, and controlling these properties to create new materials with functional systems and unique capabilities, with dimensions ranging between

1 and 111 nanometers that can be applied in various scientific fields such as physics, chemistry, materials science, biology, and engineering. It means techniques and tools that are concerned with the design, properties, products and applications of structures, devices and systems by managing the shape and size on the nanoscale. Nanotechnology or miniaturization technology is concerned with studying and innovating new methods and techniques whose dimensions are measured in nanometers, which is a thousandth of a micrometer [8].

- The environment

The environment is defined as the natural environment in which humans live and the different living organisms, where various social and productive activities are practiced. We can also define it as representing the environment in which humans or other organisms live, from which they derive their life components and requirements of food, shelter, clothing, and the acquisition of skills, knowledge and cultures, meaning that it includes the natural elements consisting of: "air, water, soil, and various natural resources", in addition to other human environmental elements such as industry, agriculture, farming, engineering and construction... etc. [8, 9].

- Environmental Pollution

The concept of environmental pollution (Environmental Pollution). It can be defined as an undesirable increase or decrease in the basic components of natural elements, such as air, water, or others. This change is outside the scope of natural fluctuations for any of these components, which leads to a direct or indirect impact on the ecosystem [10].

- Environmental Protection

Environmental protection can be defined as national and international efforts that contribute to reducing and limiting pollution of various types, and must include a set of policies that are mainly represented in: Protecting human societies from the harmful effects of some environmental factors Protecting the environment locally and globally from various harmful activities carried out by humans Improving the quality of the environment [11, 12].

CONCEPT OF NANOCHEMISTRY

Nanochemistry is a modern branch of solid-state chemistry, dealing with the manufacture of small materials (nano-sized) instead of traditional engineering aspects, and includes the manufacture of materials ranging from one to three dimensions in nano size. The word "nano" in the metric system means one billionth, and nanoparticles are important because of their small size. These particles can be manufactured from inorganic, organic, or organometallic components to produce new materials with optical, electronic, and magnetic properties [12].

Nanotechnology is one of the most important modern technologies in this field. Nanomaterials are characterized by an increase in their surface area as their size decreases, which makes them more effective in biological applications compared to the same materials at a larger scale (macro or micro). Nanotechnology also allows the development of novel nano-biohybrids by integrating effective and safe transport carriers with biological molecules.

- **Nanotechnology**

Nanotechnology is defined as an advanced technology based on the study of nanoscience and basic sciences, with the technological ability to manufacture nanomaterials and control their internal structure by rearranging atoms and molecules. The nanometer is used as a unit of measurement for very small things that can only be seen under an electron microscope. A nanometer is equivalent to one billionth of a meter. Nanotechnology has received great attention as a technology of the twenty-first century, and has become an essential part of chemistry, physics, engineering and biology. This technology is expected to greatly improve technological devices and develop new applications in various fields. When switching from microscopic particles to nanoparticles, a noticeable change occurs in the physical properties of these particles. The most important of these changes is an increase in the ratio of surface area to volume, as well as a change in the behavior of particles due to quantum effects on atoms on the surface of the particles. These changes affect the properties of particles in chemical and biological reactions, making them more reactive and effective [13].

1. Properties of nanomaterials and their environmental importance

The properties of materials change very significantly according to their nanocomponents. Compounds composed of nano-sized grains, whether ceramics or metals, are much stronger than their larger counterparts. For example, about (10 nm) are 7 times harder than metal (grain size). For example, metal with a normal grain size has a grain size measured in hundreds of nanometers. This significant change in the properties of materials in the nanoscale space is due to the following [13-15]:

1) Relative Increase in Area

Nanomaterials have a larger surface area when compared to the same mass of material produced in the larger space. This makes the materials more chemically active and affects their strength or electrical properties. Sometimes inert materials in the large space may be active when produced in the nano space, that is, when the particles that make up the material become smaller, a very large percentage of the atoms are present on the surface compared to those inside, so the particles with a size of 30 nm are only 5% present on the surface, while others with a size of 10 nm are 20% present on the surface, and the size of 3 nm is 50% present on the surface, and since the chemical reactions occur at the surface, nanomaterials are more active than their counterparts in the larger space.

2) Quantitative Impact

Quantitative effects begin to control the behavior of matter in the nano space, especially at the lower end, affecting the electrical, magnetic and optical properties of materials.

The following are some of the properties of nanomaterials:

Mechanical properties: Mechanical properties come at the top of the properties that benefit from the reduction in the size of the material's grains and the presence of large numbers of atoms on the faces of its outer surface, as the degree of hardness of metallic materials and their alloys increases, and their resistance to facing stresses and loads imposed on them increases. Ceramic materials are also given a great deal of durability and the ability to form and withstand stresses that were not available in them, and this means creating new types of these materials.

Chemical activity: The chemical activity of nanomaterials increases due to the presence of large numbers of atoms of the material on the faces of its outer surfaces, as they act as catalysts that interact strongly with toxic gases, which makes them candidates to play the most important role in reducing environmental pollution. Fuel cells are also one of the low-cost applications of nanocatalysts, and one of the most important sources of new and clean energy.

Physical properties: The melting point values of the material are affected by the reduction of the dimensions of its grains. The melting point of gold in its natural size, which reaches 1064 degrees, decreases to 500 degrees after reducing its grains to about 1.35 nanometers.

Optical properties: It is surprising and exciting that the color of natural gold - golden yellow - changes to a transparent color when its grains are reduced to less than 20 nanometers. Its colors also change from green to orange and then red with increasing reduction in their sizes. This property enables us to manufacture high-resolution screens with super-contrast and color purity, such as modern television, computer and mobile phone screens.

Magnetic properties: The smaller the grains of the material and the more atoms on its outer surfaces, the stronger and more effective its magnetic ability becomes, which enables us to use it in large electrical generators, ship engines, the manufacture of high-precision analysis devices, and magnetic resonance imaging.

Electrical properties: Reducing the size of the material particles to less than 100 nanometers increase their ability to conduct electrical current, which enables us to use these materials in the manufacture of micro-sensors and electronic chips.

Biological properties: Increasing the ability of nanomaterials to penetrate and penetrate biological barriers and obstacles, and improving biocompatibility and compatibility, which facilitates the access of drugs and therapeutic drugs to the affected part through membranes and blood vessels.

ENVIRONMENTAL POLLUTION

A variety of different materials can be used for the approaches described in Figure 1. To the best of our knowledge, there is no established classification regarding the different types of materials that can be employed for environmental remediation. Therefore, this review focuses on three main types of nanomaterials described in the literature: inorganic, carbon-based, and polymer-based materials.

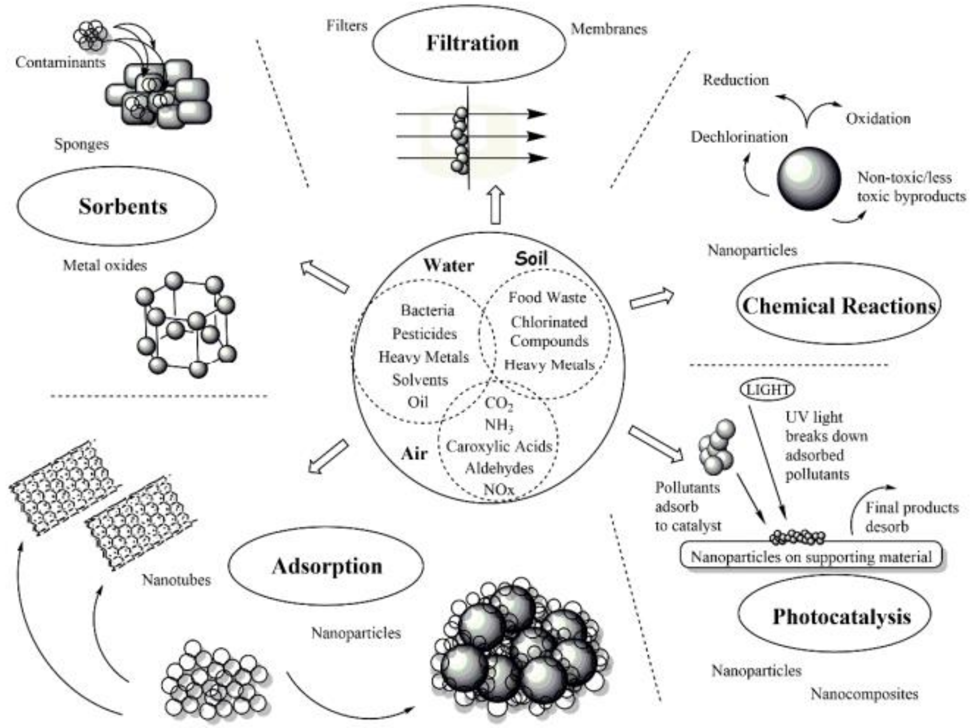

Figure 1: Environmental remediation approaches [16].

1. Water Pollution

The hydrosphere occupies about 73% of the Earth's surface and the volume of this sphere is about 269 cubic miles of water. Water pollution from a scientific perspective is: causing a disturbance and damage to the quality of water so that it becomes unfit for its basic uses and unable to contain particles, microorganisms and various wastes in its ecological system. Marine pollution has become a frequently occurring problem in the world as a result of increasing human activity and the increasing need for economic development for basic raw materials that are transported across the water environment. Most of the currently existing industries overlook the coasts of seas or oceans, and oil is considered the main pollutant of the marine environment as a result of exploration and extraction of oil and natural gas in marine areas or adjacent to them in addition to giant oil tanker accidents. Sometimes water pollution occurs as a result of mixing seawater, lakes, rivers or surface water with sewage water, toxic chemicals, gases, oils or any other materials. The danger of this mixing sometimes extends to reach groundwater, and this pollution can It causes harm to many types of plants, animals and humans. According to the World Health Organization, five million people die annually due to drinking contaminated water. The types of water pollutants can be limited as follows [13, 17, 18]:

1) Surface water pollutants Since surface water is the most common in water forms, its pollutants are numerous and divided into:

- Infectious pollutants, perhaps the most famous and dangerous of which are the pollutants found in the intestines of warm-blooded animals such as humans, such as bacteria, parasites and viruses that can transmit many diseases such as diarrhea, cholera, typhoid, and others.
- Oxygen-consuming waste: such as food residues, sewage and animal manure, which lead to an increase in oxygen consumption by decomposers and thus a decrease in its concentration.
- Nutrient enrichment: or what is called food abundance, such as increasing the concentration of phosphorus and nitrogen, which contributes significantly to water pollution. For example, lakes with low nutrient levels, if they suffer from the problem of nutrient enrichment, algae growth will flourish in them, and other types of aquatic plants will grow, which will lead to

2) Groundwater pollutants through wastewater from septic tanks or damaged sewage networks. Ocean Pollutants The waters of the seas and oceans near many beaches, river estuaries and coastal cities are witnessing pollution by toxic and non-toxic waste and oil spills, and the resulting losses are estimated at billions of dollars. The oceans are also polluted by the large quantities of waste dumped by marine transport fleets and fishing fleets. Thus, we can summarize the sources of water pollution as follows:

- Wastewater such as domestic and industrial wastewater such as inorganic industrial wastewater (crusher, cement mixers, stone quarries, etc.) and organic industrial wastewater (leather, fabrics, paper, dyes, oil refineries, etc.). There is also agricultural wastewater resulting from various agricultural activities, especially when intensive agriculture and animal husbandry are used.
- Oil pollution, which has been previously mentioned.

2. Air Pollution

The atmosphere (air) consists primarily of nitrogen (78008%) and oxygen (2009%) and small amounts of argon (0.934%), carbon dioxide (0.03%), neon (00018%), helium (0.00052%), methane (0.00015%), krypton (0.00011%), hydrogen, nitrous oxide (0.00005%), and xenon (0.000009%). The atmosphere usually extends from the Earth's surface to more than 10 km above it, and consists of four layers: the troposphere, the stratosphere, the mesosphere, and finally the upper layer called the thermal or ionic layer. Thus, it is noted that the gaseous envelope or atmosphere (air) consists of precise proportions and in the form of layers, each of which has its natural characteristics that contribute to maintaining the environmental balance on Earth in a tight and precise manner. Air pollution occurs when it mixes with certain materials such as sulfur dioxide, nitrogen oxide, and carbon monoxide [13, 19].

- Car exhaust.
- Smoke and various impurities.

- Chlorofluorocarbon compounds.
- Natural elements such as volcanoes, storms, and others.

Air pollution can harm the health of plants, animals, and humans, destroy buildings and other structures, and have some harmful effects on the environment such as acid rain and disruption of the ozone layer. The World Health Organization estimates that approximately one-fifth of the world's population is exposed to dangerous levels of air pollutants. Air pollutants can be divided, according to their production mechanism, into two sections:

1) Primary pollutants, which are a group of materials dominated by oxides produced by humans as well as nature, such as carbon oxides.
2) Secondary pollutants: These are produced by the reaction of primary pollutants with the help of ultraviolet rays to produce new substances that are hazardous to health and the environment. Therefore, these pollutants are sometimes called photochemical pollutants, such as ozone (03), peroxyacetyl nitrate, smog resulting from fog, smoke, and acid rain. This type of rain is extremely harmful to the environment.

3. Soil Pollution

It can be defined as the destruction of the healthy, productive thin layer of soil where most food grows. Healthy soil depends on bacteria, fungi and small animals to break down the waste it contains and produce nutrients. These nutrients help plants grow. Pesticides may limit the ability of soil organisms to process waste. Accordingly, farmers who overuse fertilizers and pesticides can destroy the productivity and capacity of the soil. There are a number of other human activities that can destroy soil, including, for example [13]:

- Chemical pollution of soil: In addition to fertilizers and pesticides, there are industrial organizations, heavy metal pollution, organic halogenated compounds pollution, pollution resulting from accidents, industry, chemical weapons and nuclear pollution.
- Soil irrigation systems in dry areas with a poor drainage system may lead to stagnant water in the fields. If this water evaporates, it will leave behind salt deposits, making the soil very salty, which affects crop growth.
- Mining and smelting operations may lead to soil contamination with metals.
- Major wars may contaminate soil, as in the Gulf Wars.
- Pollution of major cities may affect the soil surrounding them

THE ROLE OF NANOCHEMISTRY IN COMBATING ENVIRONMENTAL POLLUTION

Nanochemistry plays a vital role in combating environmental pollution, especially in light of the environmental challenges facing the world today, including Libya. This field relies on the unique properties of nanomaterials, such as their small size and chemical activity, which makes them effective in treating pollutants and improving environmental quality [13].

- The Applications in Combating Environmental Pollution

1. Treating polluted water: Nanotechnology relies on the use of iron oxide and graphene particles to purify water from organic pollutants and heavy metals, which has proven its efficiency in areas suffering from water scarcity, such as desert areas in Libya.
2. Air purification: Titanium dioxide (TiO2) is used as a photocatalyst to break down gaseous pollutants such as nitrogen oxides and carbon. Some studies showed the effectiveness of this technology in reducing air pollution within Libyan cities.
3. Remediation of contaminated soil: Magnetic nanoparticles help remove oil pollutants and heavy metals from soil, which has been successfully applied in industrial areas such as the Zawiya refinery.
4. Removal of industrial waste: Nanomaterials have shown their ability to decompose toxic waste from factories in environmentally safe ways, reducing environmental damage caused by chemical industries.

- **The Role of Nanochemistry in the Future of the Environment**

With the persistence of environmental problems such as water, air and soil pollution in Libya, the adoption of nanotechnology provides innovative and affordable solutions to address them. According to a study by nano-membranes can contribute significantly to improving the quality of salt water, supporting national efforts to achieve sustainable development.

- **Innovation in Nanochemistry**

The field of nanochemistry is one of the most prominent scientific fields that has witnessed great progress in recent years, as this field is used to develop innovative technologies in many environmental, medical and industrial applications. In the Libyan context, several innovative studies have emerged that focus on exploiting nanomaterials to improve the environment and public health. Examples of innovation in nanochemistry [20]:

1. Development of nanomaterials for water desalination: Developing new technologies for desalination of brackish water using nano-membranes that improve the efficiency of removing salts and heavy metals, which enhances the availability of fresh water in coastal areas in Libya.
2. Using nanoparticles to clean polluted soil: Applying magnetic nanomaterials to clean soil from oil pollutants and heavy metals, which is considered an advance in treating environmental pollution in industrial areas.
3. Innovation of nano-engines to improve environmental performance: Nanoparticles to improve air quality by removing environmental pollutants in urban areas using nano-catalysts.

- **Applications of Green Nanochemistry in Libya**

Green nanochemistry is one of the modern fields that aims to develop innovative technologies using nanomaterials to achieve sustainable environmental goals. The main goal of green nanochemistry is to reduce environmental damage resulting from the use of traditional chemicals, and to search for environmentally friendly solutions. In Libya, some distinguished studies have begun in this field, where green nanochemistry has been applied to treat pollution and improve environmental sustainability. The most prominent applications [13, 20]:

1. Water purification using green nanomaterials:

Natural nanoparticles such as zinc oxide and graphene have been used to improve the efficiency of the water purification process from organic pollutants and heavy metals. These technologies aim to treat water in areas suffering from a shortage of water resources.

2. Control of environmental pollution using nanomaterials:

Nanomaterials have been applied to reduce environmental pollution, as nanomaterials have been used to absorb toxic gases such as carbon monoxide and nitrogen oxides, which enhances the improvement of air quality in industrial areas.

3. Waste recycling using nanotechnology:

Use nanomaterials to stimulate recycling processes for plastic and organic materials, which contributes to reducing the volume of waste and preserving the environment [20].

LITERATURE SURVEY

Kamilov Sh. X. in (2023), studied the Nanotechnologies and Their Significance in Environmental Protection. Nanotechnology is an extremely wide term referring to the very minute particles which are used for the various purposes such as medicines, textiles, robotics, paint industry and various other fields, Nanotechnology may become the most demanded technology in the current and future world as it has immense potential, it have evolved in many different forms for example nanotechnology when used with in the field of medicine it open a wide area of avenue which is unexplored and can benefit many people in several ways like imaging, sensing, targeted drug delivery, and gene delivery systems, and artificial implants. The research finding shown that the nanotechnology is becoming more and more real, and there is a need for discussion about the possible advances and impacts of technology on the environment. The increase in environmental problems is visible. Nanotechnology can cause positive and significant changes to air quality, water quality, and sustainable energy generation. It can help us to repair the environment and save it [21].
Douglas M. Smith in (2013), studied the applications of nanotechnology for immunology. The engineering of nanostructure materials, including nanoparticles, nanoemulsions or nanotubules, holds great promise for the development of new immunomodulatory agents, as such nanostructures can be used to more effectively manipulate or deliver immunologically active components to target sites. Successful applications of nanotechnology in the field of immunology will enable new generations of vaccines, adjuvants and immunomodulatory drugs that aim to improve clinical outcomes in response to a range of infectious and non-infectious diseases. Nanotechnology is

currently being used to engineer specific immune responses for prophylactic and therapeutic effects. In the future, the use of nanoparticles that have unique immunological properties determined by their size, shape, charge, porosity and hydrophobicity will enable researchers to 'customize' immune responses in new and unexpected ways. Improved protection against the outbreak of pandemic viruses and other emerging or mutating pathogens will require the rapid activation of innate and adaptive immune responses, ideally within hours (for an innate immune response) or days (for an adaptive immune response) after a single priming dose of vaccine [10].

Pandey Bhawana in (2012), studied the Nanotechnology: Remediation Technologies to clean up the Environmental pollutants. Nanotechnology is the design, characterization, production and application of structures, devices and systems by controlling the shape and size at the nanometer scale; Environmental nanotechnology (E-nano) products can be developed for a wide array of urgently needed environmental remediation. The nanoparticles / nanostructures made by mechanical and /or microbial action with fundamental building blocks are among the smallest human made objects and exhibit novel physical, chemical and biological properties; which has wider application for pollution prevention, detection, monitoring and remediation of pollutants. Also, note that Environmental protection and pollution issues are frequently discussed worldwide as topics that need to be addressed sooner rather than later. There are needs to provide and fundamentally restructure the technologies currently used in environmental detection, sensing, remediation and pollution removal. Some nanotechnology applications are near commercialization: nanosensors and nanoscale coatings to replace thicker, more wasteful polymer coating that prevent corrosion, nanosensors for detection of aquatic toxins, nanoscale biopolymers for improved decontamination and recycling of heavy metals, nanostructured metals that break down hazardous organics at room temperature, smart particles for environmental monitoring and purification, nanoparticles as novel photocatalyst for environmental cleanup [22].

Fernanda D. Guerra in (2018), studies the Nanotechnology for Environmental Remediation: Materials and Applications. The study noted that the Environmental remediation relies mainly on using various technologies (e.g., adsorption, absorption, chemical reactions, photocatalysis, and filtration) for the removal of contaminants from different environmental media (e.g., soil, water, and air). The enhanced properties and effectiveness of nanotechnology-based materials makes them particularly suitable for such processes given that they have a high surface area-to-volume ratio, which often results in higher reactivity.

The review provided an overview of three main categories of nanomaterials (inorganic, carbon-based, and polymeric-based materials) used for environmental remediation. The use of these nanomaterials for the remediation of different environmental contaminants such as heavy metals, dyes, chlorinated organic compounds, organophosphorus compounds, volatile organic compounds, and halogenated herbicides is reviewed. Various recent examples are extensively highlighted focusing on the materials and their applications [16].

Vivek Polshettiwar in (2010), studied the green chemistry by nano-catalysis. This review focuses on the use of nano-catalysis for green chemistry development including the strategy of using microwave heating with nano-catalysis in benign aqueous reaction media which offers an extraordinary synergistic effect with greater potential than these three components in isolation. The review shown that the catalysts that enhance reactions rates and product yield, with good selectivity and stability are of great technological importance. Most catalysts consist of highly dispersed metal nanoparticles supported on porous silica, alumina, zeolites, mesoporous materials and other oxides and also in many cases non-supported metal nano-clusters. Nano-catalysts mimic homogeneous (high surface area, easily accessible) as well as heterogeneous (stable, easy to handle, easy to isolate) catalyst systems.

Nano-catalyst systems encompassing a paramagnetic core allow rapid and selective chemical transformations with excellent product yield coupled with the ease of catalyst separation and recovery. Nanomaterials-catalyzed transformations in an aqueous reaction medium are one of the ideal solutions for the development of green and sustainable protocols. However, execution of many organic reactions in water is not simple due to the inherent limitation of solubility of non-polar reactants in polar aqueous media, which can be overcome by using MW irradiation conditions. Thus, the fusion of a benign water medium, nonconventional MW heating, and nano-catalyst seems to be the preeminent way to develop the next generation of highly efficient processes [23].

George M. Whitesides in (2005), made review about Nanoscience, Nanotechnology, and Chemistry. Where study defined the “Nanoscience” is the emerging science of objects that are intermediate in size between the largest molecules and the smallest structures that can be fabricated by current photolithography; that is, the science of objects with smallest dimensions ranging from a few nanometers to less than 100 nanometers. In chemistry and chemical engineering, this range of sizes has historically been associated with colloids, micelles, polymer molecules, phase-separated regions in block copolymers, and similar structures—typically, very large molecules, or aggregates of many molecules. As well as, the Risks of Nanotechnology. A new technology sparks conflict between those wishing to exploit it as rapidly as possible and those wishing to wait forever, if necessary to have it proved absolutely safe. Nanotechnology is new; although parts of it are quite familiar, parts are unfamiliar, and it is not a surprise that the public is wary of its potential for harm, as well as excited by its potential for good [24].

Matthew A. Albrecht in (2006), studied the green chemistry and the health implications of nanoparticles. The study pointed out that until recently the spectacular developments in nanotechnology have been with little regard to their potential effect on human health and the environment. There are no specific regulations on nanoparticles except existing regulations covering the same material in bulk form. Difficulties abound in devising such regulations, beyond self-imposed regulations by responsible companies, because of the likelihood of different properties exhibited by any one type of nanoparticle, which are tune able by changing their size, shape and surface characteristics. Green chemistry metrics need to be incorporated into nanotechnologies at the source. This review scoped on potential health effects of nanoparticles, along with medical applications of nanoparticles including imaging, drug delivery, disinfection, and tissue repair. Nanoparticles can enter the human body through the lungs, the intestinal tract, and to a lesser extent the skin, and are likely to be a health issue, although the extent of effects on health are inconclusive. Nanoparticles can be modified to cross the brain blood barrier for medical applications, but this suggests other synthetic nanoparticles may unintentionally cross this barrier [25].

Thomais Vlachogianni in (2014), studied the Nanomaterials: Environmental pollution, ecological risks and adverse health effects. Nanotechnology ant its applications has emerged as one of the central new technologies in the 21st century. In the last decade thousands of scientists and technologists are employed in this area, a great number of patents and scientific publications have been published A large number of new nanotechnology products have flooded the market of the developed world and inevitably large amounts of money are invested in Research & Development in the most advanced technological nations.

The presentation of the most recent studies and re- views on the toxicity and ecotoxicity assessment of ENMs showed that there are not alerting human health and safety problems with nanotechnology applications. However, the emerging toxicological problems and un- certainties due to the special ENMs physicochemical characteristics give substantial new thoughts to regulators of national policies that guarantee the responsible development of nanotechnologies. The environmental pollution problems and impact to ecosystems by ENMs are at the forefront of concern of many national and international scientific and environmental organizations. Asfar as to the reliable risk assessments of ENMs is concerned, until now there is still the remaining issue to be resolved of whether or not specific challenges and unique features exist on the nanoscale that have to be tackled and distinctively addressed, given that they substantially differ from those encountered with micro sized materials or regular chemicals [26].

A. Vaseashta in (2007), studied the Nanostructures in environmental pollution detection, monitoring, and remediation. They presented preliminary results of our joint investigations to monitor and mitigate environmental pollution, a leading contributor to chronic and deadly health disorders and diseases affecting millions of people each year. Using nanotechnology-based gas sensors; pollution is monitored at several ground stations. The sensor unit is portable, provides instantaneous ground pollution concentrations accurately, and can be readily deployed to disseminate real-time pollution data to a web server providing a topological overview of monitored locations. Preliminary investigations to correlate pollution data observed from ground-based sensors and image-processed satellite images is presented. The sites under current observation are Los Angeles, CA, U.S.A.; San Francisco, CA, U.S.A., Kolkata, India, and Bangkok, Thailand. VOC emission and smog were also observed from Houston, TX, U.S.A. and Charleston, WV, U.S.A.—both known for oil and chemical refineries; using satellite images and correlated with data obtained with local emission monitoring agencies. Ground as well as satellite data indicates increased smog and VOC levels for the cities under observation. An extension of this project will include several major cities around the world. To reduce the harmful effect of environmental pollution in air and aquatic systems, air filters using activated polymer fibers are prepared. Air filtration efficiency of such filters is under investigation. For aquatic systems, iron oxides/oxyhydroxides based nanostructures embedded in zeolites were studied. Such structures have high capacity for arsenic removal and are suitable in size for use in sorption columns [27].

CONCLUSIONS

The study aimed to made a review in nano chemistry and developing new materials to combat environmental pollution. Nanotechnology is an emerging science and has widespread applications in diverse areas. For the nanotechnology to succeed on a large scale, it needs to overcome several challenges that it poses. The review indicates that nano zero valent ion, titanium dioxide, metallic nanoparticles and carbon nanotubes are the nanotechnologies which are widely applied in the areas of water treatment, wastewater treatment, groundwater remediation, management, etc. Through the review, Nanotechnology appears as a positive solution for the current environmental problems. The challenges of nano-waste, the risk to health and environment and the regulatory approach could possibly overcome after further research in this field.

There is a need for extensive research in this field to overcome the challenges of risks to health and environment, management of nano-waste and LCA of the nanomaterials. Today, nanotechnology is becoming more and more real, and there is a need for discussion about the possible advances and impacts of technology on the environment. The increase in environmental problems is visible. Nanotechnology can cause positive and significant changes to air quality, water quality, and sustainable energy generation. It can help us to repair the environment and save it.

REFERENCES

1. Guo, Y., et al., Tribological behaviors of novel epoxy nanocomposites filled with solvent-free ionic SiO2 nanofluids. Composites Part B: Engineering, 2021. 215: p. 108751.
2. Rahimi, M., et al., Improving biocompatibility and corrosion resistance of anodized AZ31 Mg alloy by electrospun chitosan/mineralized bone allograft (MBA) nanocoatings. Surface and Coatings Technology, 2021. 405: p. 126627.
3. Rasheed, T., et al., Carbon nanotubes assisted analytical detection–Sensing/delivery cues for environmental and biomedical monitoring. TrAC Trends in Analytical Chemistry, 2020. 132: p. 116066.
4. Baran, T. and A. Menteş, Production of palladium nanocatalyst supported on modified gum arabic and investigation of its potential against treatment of environmental contaminants. International Journal of Biological Macromolecules, 2020. 161: p. 1559-1567.
5. Bergmann, K. and S. Eysen, Eine empfindlichkeitsgünstige Gruppe von RC-Verstärkerfiltern zweiten Grades mit zwei Operationsverstärkern. Frequenz, 1976. 30(2): p. 32-37.

6. Alagumalai, A., et al., Environmentally benign solid catalysts for sustainable biodiesel production: A critical review. Science of the Total Environment, 2021. 768: p. 144856.
7. Beni, A.A. and H. Jabbari, Nanomaterials for environmental applications. Results in Engineering, 2022. 15: p. 100467.
8. Nie, S., et al., Nanotechnology applications in cancer. Annu. Rev. Biomed. Eng., 2007. 9(1): p. 257-288.
9. Silva, G.A., Introduction to nanotechnology and its applications to medicine. Surgical neurology, 2004. 61(3): p. 216-220.
10. Smith, D.M., J.K. Simon, and J.R. Baker Jr, Applications of nanotechnology for immunology. Nature Reviews Immunology, 2013. 13(8): p. 592-605.
11. Ali Mansoori, G., et al., Environmental application of nanotechnology. Annual review of nano research, 2008: p. 439-493.
12. Fulekar, M. and B. Pathak, Environmental nanotechnology. 2017: CRC Press.
13. Theodore, L. and R.G. Kunz, Nanotechnology: environmental implications and solutions. 2005: John Wiley & Sons.
14. Abujnah, N. and N. Ramadan, Dynamic Analysis Of A Cracked Beam Under Moving Load Based On Modified Adomian Decomposition Method. Surman Journal of Science and Technology, 2024. 6(2): p. 103-120.
15. Ramadan, N., K. Tur, and E. Konca, Design and Simulation of an Apparatus for the Post-Weld Controlled Accelerated Cooling of R350HT Head Hardened Rail Joints.". 2017.
16. Guerra, F.D., et al., Nanotechnology for environmental remediation: materials and applications. Molecules, 2018. 23(7): p. 1760.
17. Ramadan, N. and K. ali Osman, Isothermal Transformation Temperatures and Its Effect in Hardiness of Pearlite Eutectic Steels R350HT Rails. Surman Journal of Science and Technology, 2021. 3(1): p. 028-036.
18. Maiuf, A. and N. Ramadan, The Acetic Acid Production By Modeling Oxidation Of Ethylene With Aspen Plus. Surman Journal of Science and Technology, 2024. 6(2): p. 139-149.
19. Ramadan, N. and A. Boghdadi, Parametric optimization of TIG welding influence on tensile strength of dissimilar metals SS-304 and low carbon steel by using Taguchi approach. Am. J. Eng. Res, 2020. 9(9): p. 7-14.
20. Bilal, M., et al., Nanotechnology to Monitor, Remedy, and Prevent Pollution. 2024: Elsevier.
21. Kamilov, S.X., et al., Nanotechnologies And Their Significance In Environmental Protection. Евразийский журнал академических исследований, 2023. 3(4 Part 2): p. 147-152.
22. Bhawana, P. and M. Fulekar, Nanotechnology: remediation technologies to clean up the environmental pollutants. Res J Chem Sci ISSN, 2012. 2231: p. 606X.

23. Polshettiwar, V. and R.S. Varma, Green chemistry by nano-catalysis. Green Chemistry, 2010. 12(5): p. 743-754.
24. Whitesides, G.M., Nanoscience, nanotechnology, and chemistry. Small, 2005. 1(2): p. 172-179.
25. Albrecht, M.A., C.W. Evans, and C.L. Raston, Green chemistry and the health implications of nanoparticles. Green chemistry, 2006. 8(5): p. 417-432.
26. Vlachogianni, T. and A. Valavanidis, Nanomaterials: Environmental pollution, ecolological risks and adverse health effects. Nano Sci. Nano Technol. Indian J, 2014. 8: p. 208-226.
27. Vaseashta, A., et al., Nanostructures in environmental pollution detection, monitoring, and remediation. Science and Technology of Advanced Materials, 2007. 8(1-2): p. 47.