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NANOTECHNOLOGY IN OUR LIVES

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Abstract:
Nanotechnology plays a crucial role in contemporary agriculture, serving as one of its most vital tools. It is expected that agricultural food nanotechnology will become a driving economic force soon, as nano fertilizers (thanks to their high surface energy and chemical activity) provide protection for plants, control their growth, detect diseases, increase the production rate, and improve their quality. In addition to being economical, using slow fertilizers has become a new trend to save fertilizer consumption and reduce environmental pollution. Nanoparticles or direct products can clean up hazardous waste sites, protect water, treat pollutants, or detect and monitor environmental pollutants. This review explains the use of nanomaterials in our lives and their classification and manufacturing methods.

Keywords: Nanotechnology; Nanofiltration, Nanomaterials

INTRODUCTION ,

Nanotechnology is recognized for its ability to manipulate material and device smaller than 100 nanometers, allowing for the study and control their properties (Fakruddin *et al.*, 2012). The word nano is derived from the Greek word (Vavo Which means dwarf, as nano is equal to one billionth (billion) of matter, meaning that the size of nanomaterial particles is equal to 10^{-9} nanometers(Gul *et al.*,2014). Nanomaterials are characterized by having a large surface area and a larger number of atoms than ordinary materials, and this gives them several physical, chemical and biological properties such as electrical and thermal conductivity, hardness and stress resistance(Stark *et al.*,2015).

Nanomaterials possess distinctive physical and chemical properties that have attracted significant attention from researchers across various application. However, concerns persist regarding the potential toxic effects of nanoparticles due to their tendency to produce excessive amounts of reactive oxygen species (ROS) owing to their strong oxidation potential . Excess ROS caused by nanoparticles can damage biological molecules and organelles and lead to carbonic oxidation of protein. The breakage of DNA, ribonucleic acid, destroys the membrane structure, leading to mutations. Nanoparticles are synthesized by microorganisms and applied as an antimicrobial agent and as a food supplement in the animal industry (Yusof *et al.*,2019).

Nanotechnology applications exhibit a diverse range of uses across various sectors, driven by the manipulation of materials at the atomic level to acquire unique and essential properties, and nanotechnology plays a crucial role in energy, medicine, agriculture, electronics and etc.(Glenn, 2015 and Shinn, 2012).

CLASSIFICATION OF NANOMATERIAL

1-One-dimensional materials: are materials characterized by having only one dimension greater than 100 nanometers, Examples include nanomaterials used to coat the surfaces of metal products for the purpose of protecting them from corrosion and rust(Filipponi and Sutherland,2013).
2- Two-dimensional materials: are characterized by having two dimensions greater than 100 nanometers, Carbon nanotubes are one example of these materials, which are used in the manufacture of electronic devices and are characterized by their ability to conduct heat and electricity, in addition to their hardness to the materials that are included in their composition (Nikalje ,2015).
3- Three-dimensional materials: re characterized by having all dimensions greater than 100 nanometers, Examples include gold, silver, titanium, and silicon oxide nanoparticles, which have many applications. Gold and silver nanoparticles are used in treating cancerous tumors, while titanium and silicon oxide nanoparticles are used in the manufacture of electronic devices and coating materials (Al-Habashi , 2009).

MANUFACTURE OF NANMTERIALS

When manufacturing nanomaterials, small size is not the ultimate goal. There are properties and appearances others of interest to nanomaterial manufacturers are:
1- Size of materials: Size is important when dealing with nanomaterials. For example, when nano-silicon particles are 1 nanometer in size, the silicon radiates a blue color, while if the size of the particles is 3 nanometers, they radiate a red

color. Therefore, unlike materials when they are in their normal state, size does not matter and their properties do not change with... Difference in size.

2- Material shape The produced material must be of a specific and uniform shape. When the shape of the materials changes, their properties change.

3- Dimension distribution So that the dimensions of the produced material are close, whether the distribution is regular or irregular, or whether it is stable or not.

4- Composition of materials, which means that the chemical composition of the nanomaterial produced is homogeneous.

5- Degree of agglomeration (clustering) Are they far apart or close together, as there should be no agglomeration of the nanomaterial. If it occurs, the properties of the material will change (R¨osken *et al.*,2014) .

There are two main methods for manufacturing nanomaterial as follows:

a- Starting from top to bottom. In this method, the formation of nanomaterials from large objects begins with the removal of some of their components to obtain smaller scales, that is, the process of creating nanomaterials from larger objects typically begins with a tangible size of the material under study and gradually reduces the size until reaching the nanoscale.

b- From the bottom to the top, it is done by placing smaller components such as atoms and individual molecules together to form a larger and more complex system. These methods are often chemical and are characterized by the small size of the products (one nanometer) (Luangpipat *et al.*,2011).

NANOTECNOLOGY IN AGRICULTURE

The current global trend in agriculture is shifting towards reducing or limiting the use of chemical fertilizers due to their negative impacts on human health and the environment. In recent years, there has been a growing focus on integrating nanotechnology into agriculture, known as Agro-Nanotechnology. This involves utilizing nano-fertilizers to feed plants, either as an alternative to traditional fertilizers or as carriers for their components. Nano-fertilizers enhance plants' nutrient absorption and overall efficiency (Merghany *et al.*,2019). Nanoparticles typically refer to particles with internal or external dimensions within the size range of a few nanometers, preferably up to 100 nanometers. Materials smaller than 100 nanometers exhibit unique physical and chemical properties distinct from their bulk counterparts. These nanoparticles are utilized in various fields such as medicine, engineering, catalysis, and environmental remediation due to their exceptional material characteristics and applications across different sectors (Ruttkay - Nedecky *et al.*,2017).

Nanofertilizers have a high ability to penetrate various plant tissues, especially those sprayed on shoots (Tripathi *et al.*,2015). However, The entry of nanoparticles into plant cells depends on the diameter of the pores in the cell wall, which typically range from 5 to 20 nanometers, and Since the diameter of nanoparticles is smaller than the size of these pores, they can pass through the cell wall and reach the plasma membrane. The interaction between nanomaterials and the cell wall is complex, with factors like pore size, endocytosis, and electrochemical gradients influencing nanoparticle movement across the cell wall. (Kah *et al.*,2019) .

Nanomaterials are an effective tool for vertical expansion in agricultural production due to their property Gradual release of nutrients thus leads to optimal utilization of nutrients as well It is used in small quantities and has high stability(Chittaranjan *et al.,*2016). These techniques are also used to enhance plant tolerance to abiotic stress, which is believed to be beneficial It enhances plant performance under stress conditions, including salt stress, by employing nanoparticles to deliver nutrients to different parts of the plant. Recently, nanoparticles (NPs) have gained significant attention in the agricultural field due to their ability to mitigate the harmful effects of various soil stresses such as salinity and drought, which positively affect the phenotypic and physiological growth traits in plants (Tripathi *et al.*,2015).

Numerous studies highlight the significant role of nanosilver, when used in suitable concentrations, in enhancing plant growth, chlorophyll content, and photosynthesis efficiency. The application of nanosilver has shown promising results in promoting plant development and improving physiological processes crucial for plant vitality and productivity (Shelar and Chavan ,2015). Sajadinia *et al.* , 2021) found that nanofertilizers improved growth and physiological properties of plants compared to mineral fertilizers. Chourasiya et al., 2021) has demonstrated that the application of silica nanoparticles can lead to an increase in germination rate, stem height, root length, and spike length in Wheat, Pea, and Mustard seeds, and this suggests that silica nanoparticles can positively impact plant growth and development, highlighting their potential as a valuable tool in agriculture.

NANOTECHNOLOGY APPLICATIONS IN WATER PURIFICATION

Nanofiltration is a relatively recent membrane filtration process commonly used with low Total Dissolved Solids (TDS) water, such as fresh surface water and groundwater, to eliminate multivalent ions like iron and manganese in excess. It is also effective in removing substances attached to natural organic products and synthetic organic materials (Ramakrishna *et al.*,2006).

As for the nanofiltration method, it is done with fine filters and at small pressures, and the characteristics are determined Thermal stability and stability of membrane materials depend on the methods of their use, so they are mostly applied to water. Represent Nanofiltration is a technique between tapered filtration and reverse osmosis, where the pore capacity is about 2 Nanometres. Nanofilter membranes are usually estimated by a separation limit called the molecular weight limit, rather than the size of a single small pore. The molecular weight limit is usually less than 100 atomic mass units. As for the nanofiltration method, it is done with fine filters and at small pressures, and the characteristics are determined Thermal stability and stability of membrane materials depend on the methods of their use, so they are mostly applied to water. Represent Nanofiltration is a technique between tapered filtration and reverse osmosis, where the pore capacity is about 2 Nanometres. Nanofilter membranes are usually estimated by a separation limit called the molecular weight limit, rather than the size of a single small pore. The molecular weight limit is usually less than 100 atomic mass units. The Dalton unit is used as an expression. The pressure used in nanofiltration is about 3 MPa. This is a much lower pressure than the pressures used in reverse osmosis. This reduces the cost of treatment clearly. However, nanofiltration membranes are still susceptible to scaling (i.e. increased sedimentation and formation of filter cake, which slows down the filtration and spoilage process) (i.e. fungal growth and rotting), which is why so-called anti-scaling and anti-rotting agents are used with these membranes (Anjum *et al* 2016).

It is difficult for many developing countries to obtain water suitable for drinking and human use, but nanotechnology provides a solution to this crisis. While the nanofiltration process will be used to remove various pollutants from water sources and resources, it is also commonly used in the water desalination process. Many studies have been conducted From the tests, as was observed in a recent study in South Africa, using polymeric or bulk nanofiltration in conjunction with performing the reverse osmosis process to treat the oppressed groundwater. These tests resulted in the production of drinkable water, as the researchers resorted to adding nutrients to that water to crop In the end, the standard levels of dissolved water for drinking water consumption, and here it must be mentioned that the provision of nanofiltration methods in developing countries aims to increase their resources of clean drinking water in a cheap and inexpensive way compared to traditional water treatment systems. Despite this, a group of issues remain, including This is the ability of these developing countries to integrate such modern technologies into their economies without trying to rely on foreign assistance (Ding and Electrospun,2011).

NANOTECHNOLOGY AGAINST PATHOGENS

Nanoparticles are considered fairly safe compared to agrochemicals and are used to control pathogens (Gupta et al., 2019). They are also used to control pathogens and toxin-producing fungi (Jampílek and Kráĺová, 2020). Nanoparticles of zinc oxide (ZnO) and magnesium oxide (MgO) at different concentrations were found to significantly inhibit the germination of fungal spores such as Alternaria, Fusarium oxysporum, Rhizopus stolonifer, and Mucorlumbeus (Wani and Shah, 2012), and metal oxide nanoparticles, such as Fe2O3 and ZnO, showed antifungal activity. Significantly against pathogenic microbes, these metal oxides have been used as antifungals to inhibit the growth of strains such as A. ochraceus, A. niger, and to reduce ochratoxin production in ochratoxin strains (Muhammad et al., 2015). . Silver nanoparticles are added to antibiotics to increase their effectiveness, because they are able to kill more than six hundred types of germs and other types of viruses, such as hepatitis C virus and bird flu, without causing any harm to the human body (Laila, 2009). Nanoparticles also show growth inhibition of multidrug-resistant bacteria such as P. aeruginosa and S. aureus (Sundaramoorthy *et al.*, 2022).

NANOTECHNOLOGY IN OTHER APPLICATIONS

Cavalcanti *et al*. (2008) highlighted that nano-sized gold particles possess the capability to absorb light and convert it into thermal energy. This unique property has been instrumental in cancer treatment by introducing gold nanoparticles into tumors, enabling them to enter cancer cells selectively. When exposed to light, these gold particles generate heat, effectively eliminating cancer cells while preserving healthy ones. Moreover, nanotechnology has been integrated into the production of solar cells by incorporating nanoparticles like fluorene, silver, cadmium telluride, and titanium dioxide into silicon panels. This integration enhances the efficiency of solar panels in capturing various light waves, distinguishing them from conventional solar panels (Musabih, 2013).

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