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Review Article

Recent Advances and Potential Role of Novel Nanoparticles for Wastewater Treatment with Emphasize Advanced Techniques

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Abstract

Specific nanoparticles are designed in order to deliver the different materials. Controlling the size, shape of nanomaterials during nanoparticles synthesis leads to effective synthesis of nanoparticles that can be combatable to electrical system. Iron based nanoparticles are most efficient due to low cost and high adsorbent efficiency as compared to the other nanoparticles through the action of magnetic field with ionic exchange capacity for heavy metals removal. Nanofilters are used for filtering the chemical pollutants found in wastewater. Acid treatment leads to precise synthesis of nanoparticles through the formation of biopolymers that can be disintegrated into smaller components or individual's molecules. Gold nanoparticles are also much reliable as compared to the other nanoparticles as they are more influenced by the intensity of light. Scanning tunneling microscopy has become technique to provide the electric data about the specific atom or particles by following the princes of scanning under chemical investigation. X-ray spectroscopy is used for the analysis of that analysis usually heavier than oxygen. Electron energy loss spectroscopy (EELS) that detect the particular nanoparticles by loos of energy by passing through the samples or specimen.

Keywords: Nanoparticles, Chemistry, Materials, Melting Point, Physical and chemical properties.

INTRODUCTION

There are many different nanoparticles used for treatment of wastewater in order to decontamination of polluted water. Nanotechnology helps in removing the toxic metals from both drinking and wastewater [1, 2]. Nanoparticles tightly attached to the water molecules and weakens the attraction through molecular compatibility of newly discovered biomaterials. Nanoparticles are safe and reliable as compared to the traditional methods used for treating the physical and chemical treatments of water. Through advances in membrane technology and innovations in nanotechnology, different types of nanoparticles are employed for controlling the environmental pollution [3].

Three are different problems associated with the delivery of nanoparticles that leads to severe toxicity. The specific nanoparticles are designed in order to deliver the biological materials to the specific cell. It depends upon the toxicity of drugs and cellular mechanism. The toxic chemical effects of dyes leads to death of many tissues thus increasing risks of nanoparticles toxicity. There is need to designed better strategies in order to decrease the chemical and toxic effects of nanoparticles with dyes delivery systems and safe mode of inspected nanoparticles leads to better efficacy of the particular dyes [4, 5].

Magnetic resonance is the most advanced chemical technique that employed the principles of chemicals and widely used for the chemical analysis of hydrogen atoms thus helpful to treat the different diseases such as spine, bone and severe injury. MRI leads to significant development in the fields of chemical and biomedical sciences by utilizing the tools of modern chemistry to treat the disease assisted with chemical parameters as human body contains lots of chemical parameters such as calcium, potassium, side, urea, nitrogen thus helpful for early detection of infectious diseases by following the principles of resonance. It leads to significant development in chemical sciences [6, 7].

Physiochemical roles of nanoparticles in water treatment

Nickel based nanoparticles are designed in order to control the heavy metals toxicity caused by wastewater that directly discharge into the drinking water. This leads to problems of borne of water borne diseases. To solve this problem, Ni nanoparticles have different applications in excellent adsorption properties, precipitation and oxidation in the presence of dissolved oxygen, and low cost [8].

Iron based nanoparticles are most efficient due to low cost and high adsorbent efficiency as compared to the other nanoparticles through the action of magnetic field with ionic exchange capacity for heavy metals removal. Due to magnetic based properties of iron nanoparticles, they are used in physical sciences through designing of other nanoparticles preparations for water treatment. This magnetic based property also leads to catalysts, and Ferro fluids as well as in contrast agents [9, 10]. The magnetic properties of iron oxides have been exploited in a broad range of applications including magnetic seals and inks, magnetic recording media, catalysts, and ferro fluids , as well as in contrast agents for magnetic resonance imaging and therapeutic agents for cancer treatment [11]. Silver nanoparticles are also used for water treatment through chemical bonding with water molecules. They are involved in the different processes such as oxidation, photoreaction of phenol degradation among others [12].

There are different methods for the preparation of nanoparticles. Some traditional methods are costly and not reliable for treating the waster at all for controlling the environmental pollution. Nanoparticles can be synthesized through the methods following top-down and bottom-up approaches in which physical processes are operated in the top-down. Through series of consecutive steps, nanoparticles can be deigned in order to target the specific materials in waster [13]. Silver nanoparticles are 10 to 200 nm in size. They are composed of many atoms of silver in the form of silver ions due to which they show high surface reactivity.

Nanoparticles have numerous applications in degrading the pollutants in wastewater through photocatalysis can be carried out through the physical action of toxic metals and other pollutants in the presence of light source. Light source is mainly involved for degrading through with combinations of nanoparticles. In photo catalysis, there are two types of processes that occur, namely mineralization and degradation of organic pollutants [5, 12].

Nanofilters are used for filtering the chemical pollutants found in wastewater. Nanofilters are more reliable as compared to the traditional membrane methods [13]. The mechanism of action of different membranes systems allows the rejection anions, namely, negative zeta potential on the membrane under different concentrations and electrolytic conductivity. There are different sizes of filtration units used for treatment of water such as 1- 5 nm pore size that can be designed for rejecting hardness, dye and heavy metal. Nanotechnology with promising applications in the fields nanofiltration units leads to development in the physical and chemical sciences [14, 15].

There are different factors affecting the nanoparticles selection where materials chemistry of nanoparticles laying important role under chemical investigation. The selection of nanoparticles used in those experiments had six different colors as well as 10 intensities. It is enough to encode over 1 million combinations. Controlling the size, shape materials based characterizes during nanoparticles synthesis leads to effective synthesis of nanoparticles that can be combatable to the any systems such biological. Absorption of solar radiation is much higher in materials composed of nanoparticles than in thin films of continuous sheets of material [16, 17].

Scanning tunneling microscopy has become technique to provide the electric data about the specific atom or particles by following the principles of scanning under chemical investigation. These methods provide valuable information complementary to that obtained from spectroscopic studies at the ensemble and single-particle levels. These are most reliable and advanced technique that used in different industries for the analysis of nanoparticles and biological preparation of different biochips thus helpful to chemical designing of specific atom or particles based analyses throughout the process [18, 19].

X-ray spectroscopy is used for the analysis of that analysis usually heavier than oxygen. It leads to great significant in chemical sciences by emphasizing on bio analytical techniques. Different analytical techniques are used for detection of elements in order to move the analytical efficacy. Analytical techniques can be coupled to each other for better analysis [20]. The principles of these analytical techniques that coupling to each lies under the umbrella of spectroscopy. Electrons usually absorbed the energy and jump from the one orbital to the other orbitals. Magnetic, atomic absorption, inductively coupled spectroscopy are used for determination of compounds [21].

There are other spectroscopy that are used for determination of nanoparticles at the atomic level. One of the techniques is Electron energy loss spectroscopy (EELS) that detect the particular nanoparticles by loos of energy by passing through the samples or specimen. The loss of energy of appears as different colors indicating that detecting of nanoparticles at the right direction. It depends upon on the concentration of loss of energy. Higher of the energy loss from the specimen, higher connection of the course appears through the sample while on the other hand, lower of the energy

loss from the specimen lower concentration of the course appears through the sample. Selected area electron diffraction is used for atomic level determination of nanoparticles by diffracting light through the sample or specific [22, 23].

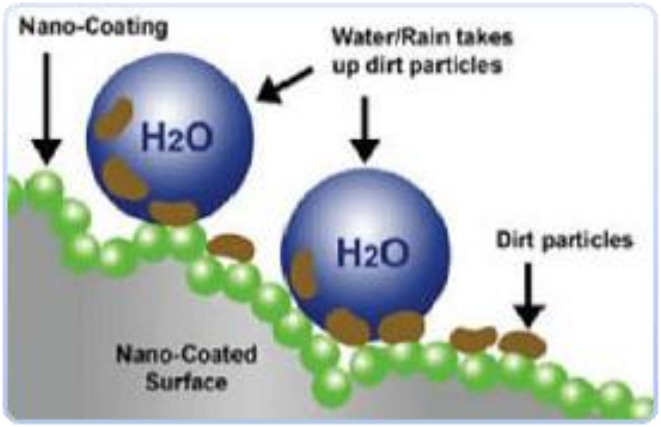

Fig-1: Shows the role of nanoparticles in water purification

Melting temperature also affecting the detection and production of nanoparticles when subjected to the modern spectroscopies under the umbrella of chemical sciences. A material may have lower melting point in nanoparticle form than in the bulk form. For example, 2.5 nm gold nanoparticles melt at about 300 °C, whereas bulk gold melts at 1064 °C. High or lower of thee melting point leads to the abnormal precision of nanoparticles as it leads to impurities in the measuring system. There is need for precisions in mechanical instruments for measuring the melting temperature even when impurities found at the extreme level [23-25].

There are different methods for synthesis of nanoparticles using the chemical and biological approach either through the acid or enzymatic treatments. Acid treatment leads to precise synthesis of nanoparticles through the formation of biopolymers that can be disintegrated into smaller components or individual's molecules. It also leads to the production of final needle like fibers called nanoparticles that can be utilized in different industries for the formation of chemicals agents and biomedical applications. This method also follows the principles of nanotechnology using advanced technological approach though series of reactions [26, 27].

There are also other methods for the synthesis of nanoparticles through chemical approach using engineering technology. Once of such method is the creation of nanoparticles is to turn a suitable precursor substance, such as a gas or aerosol, into solid particles by combustion or pyrolysis. This method follows the principles of combustion by burning the hydrogen into smaller units. This method has some disadvantages like excess of heat leads to denaturation of compounds used for the synthesis of nanoparticles. It also leads to degradation of nanoparticles as some other traditional methods are replaced due to impurities with final nanoparticles in the product formation [28, 29].

Metallic nanoparticles can be synthesized through chemical and biological methods but there are certain disadvantages of metallic nanoparticles because these can easily react to the chemical agents as they are more reactive as compared to thee other nanoparticles. They are reactive to the oxidizing agents too. This also implies that for the same moment, metallic nanoparticles can be made smaller than their oxide counterparts. There is need to precautionary measures in synthesis of nanoparticles using chemical technology through the action of chemical agents that might me cause serious reactions to the metallic nanoparticles. Colloid formation for metallic particles is also much more challenging [30, 31].

Gold nanoparticles are also much reliable as compared to the other nanoparticles as they are more influenced by the intensity of light. Absorption of light intensity leads to great advancements in gold nanoparticles by their interaction to the optically active compounds. The surface plasmon resonance can be tuned by varying the size or shape of the nanoparticles, leading to particles with tailored optical properties for different applications. They are also used in the preparation of gold based biochips to increases their catalytic activity than other nanoparticles. These nanoparticles are being used as compared to the other nanoparticles because of their strong interaction to their surface of chemical compounds [32, 33].

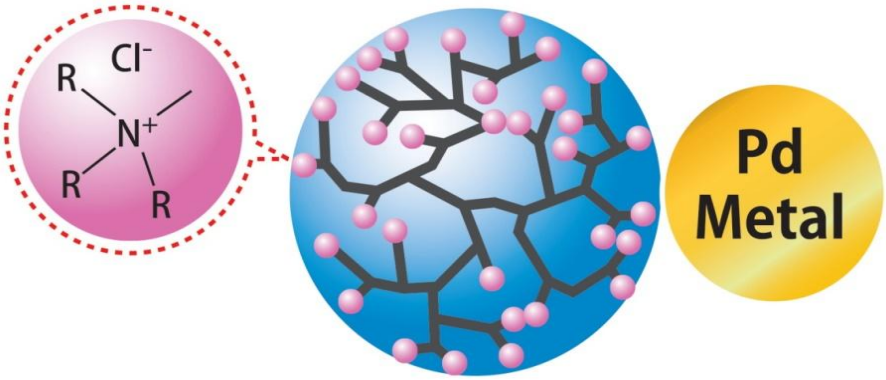

Fig-2: Shows the nanoparticle coating through the action of nanotechnology

Alkali metals can be detected through the action of nanoparticles by interacting with chemical surface of nanoparticles thus causing reaction between particular metals of each group of the periodic group [34]. Gold nanoparticles help in reaction because they are used as marker position to make a sign of reaction happening at the right direction. AuNPs functionalized with 15-crown-5 moieties to detect the physiologically important potassium ions while on the other hand, AuNPs functionalized with 12-crown-4 moieties to detect the physiologically important sodium ions. Though this system, lots of chemical reactive metals can be detect due to physiochemical properties with nanoparticles [35-38].

CONCLUSION

As different technique employed for the detection of nanoparticles due to their particle and interacting properties. The formation process of mesostructured PtRu NPs electrochemically reduced on a micro emulsion lipotropic liquid-crystallic template can be studied with of help of electron microscope. This review helpful to understand the nature of chemically active nanoparticles and their characteristic in the fields of physical sciences due to strong biocatalytic surface.

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