



NANOPARTICLES USING SPEEDOMETER

Maganti Manohar*, Arja Rohith, Garapati Preethi and Chandu BabuRao.

Priyadarshini Institute of Pharmaceutical Education and Research, 5th Mile, Pulladigunta, Guntur-522017.Andhra Pradesh, India.

Article History

Received on: 22-01-2024

Revised on: 15-02-2024

Accepted on: 14-03-2024



Abstract

It involves using extremely tiny material particles to produce new, large-scale materials. Nanoparticles are described as submicrometer (10–1000 nm) colloidal systems composed primarily of polymers, whether or not they are biodegradable. Birrenbach and Speiser (1976) developed them initially. Chemical or mechanical sensors that can be used to track physical characteristics like temperature on the nanoscale, as well as identify the presence of chemical species and nanoparticles, are known as nanosensors. When a material is in nanoparticle form, its high surface area facilitates the large-scale diffusion of heat, chemicals, and ions into and out of the particles. Conversely, the material can quickly approach homogenous equilibrium with respect to diffusion because of the tiny particle diameter. Materials that range in size from 1 to 100 nm are known as nanoparticles. They can be divided into many classes according to their characteristics, sizes, or forms. Materials in the 1-100 nm size range are called nanoparticles. The unit used to measure nanometers is nm, and they are one billionth the size of a meter.

Keywords: Nanoparticles, Nano sensor, Nano scale, Nanotechnology.

This article is licensed under a Creative Commons Attribution-Non-commercial 4.0 International License. Copyright © 2024 Author(s) retains the copyright of this article.



*Corresponding Author

Maganti Manohar

DOI: <https://doi.org/10.46795/ijhcbs.v5i1.608>

Introduction

In technological advancements is due to their adaptable characteristics and enhanced performance over their parent material there have been several initiatives in recent years to create green technology that uses natural resources instead of dangerous chemicals to produce nanoparticles numerous biological organisms such as bacteria antinomies fungi algae yeast and plants are used for the green synthesis of NPs. Nanotechnology evolved as the achievement of science in the 21st century. The synthesis, management, and application of those materials with a size smaller than 100nm(1).A particle of matter with a diameter of one to one hundred nanometers (nm) is commonly referred to as a nanoparticles or ultrafine particle Nanoparticles are in different sectors, they are the environment, agriculture, food, biotechnology, biomedical, medicines, etc. like; for treatment of wastewater and cuttingedges properties of

NPs such as; nature, biocompatibility, anti-inflammatory and antibacterial activity, effective drugs delivery, bioactivity, bioavailability, tumor targeting, and bio-absorption have led to a growth in the biotechnology(2). Nanoparticles are spherical, polymeric particles composed of natural or artificial polymers. They range in size between 10 and 500 nm.

Methodology

Tested Material & Test Specimens

1. This set-up contains an original discharge chamber, which is designed in such a way that when it is filled with treated "liquid -powder" disperse system, powder is located in the area of discharge gap. Structure and main Physico- mechanical and performance.(3)

2. Characteristics using the methodologies, different types of electrode system with different quality of anode points, through which energy stored in electric capacitor introduced in liquid as pulses, can be installed in discharge chamber

3. In the present paper two types of electrode system were used, namely "point-plane" and 3- point anode-plane usage of these two types of ES is justified by the fact that, changes of electric field configuration by us2ing different types of ES can be used to create conditions for distribution of plasma formations

through all of the volume of treated powder.

The discharge current and voltage were recorded during the studies. They were transferred to personal computer, where electric, energetic and hydrodynamic characteristics of HVED were evaluated including time dependence of electric power.(5)

SPS of treated specimens was performed on the "Gefest-10" complex, which was designed in IPPT NASU and allows consolidation of powders in graphite matrices by mechanical loading in vacuum utilizing the passage of superposition of direct and alternating (10kHz) currents with total amplitude of 1.1 kA through the powder charge under the mechanical loading to 50MPa order to obtain fine material structure with notable content of TiC and to ensure protection of ultrafine size range (from 300 to 600 nm) of TiC particles, the specimens heating rate during SPS has to be 10° C/s at current rise rate of ~25 A/s. Isothermal holding time at T=1100°C has to be no higher than 3 min, and the value of mechanical loading must be as high as possible (50MPa).

Nanoparticles are subjected to several evaluation parameters such as yield of nanoparticles, Drug Content / Surface entrapment / Drug entrapment, Particle Size and Zeta Potential, Surface Morphology, Polydispersity index, In-vitro release Study, Kinetic Study, Stability of nanoparticles.(6)

Nanoparticles are used increasingly in catalysis to boost chemical reactions. This reduces the quantity of catalytic materials necessary to produce desired results, saving money and reducing pollutants. Two big applications are in petroleum refining and in automotive catalytic converters.

The presence of a conductive support such as stainless steel provides an electron-rich environment to convert metal ions to metal nanomaterial having zero valencies [88]. Furthermore, these synthesized nanoparticles were utilized for different applications such as biohydrogen production and antimicrobial activity.

A small piece cut from a member to measure the mechanical properties of the material, product, module, etc., or to check its internal state.

Corrosion Test

1. The corrosion behavior of TiC-Ti composites was studied by accelerated model corrosion test according to ISO 11130.

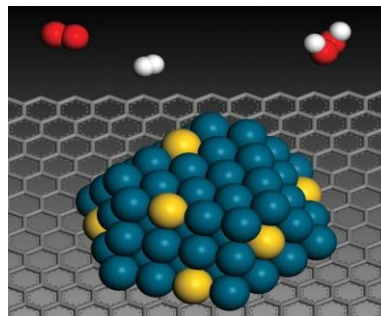
2. The corrosion test was carried out gravimetrically by the method of periodic immersion of the specimens in environment of 3.5% NaCl at temperature 21°C for total 1104 hours. The specimens were immersed for 247 hours in 3.5% NaCl and were dried for 847 hours at 25°C. The solution of 3.5% NaCl was replaced every 168 hours. Prior to the test the specimens were decreased in an organic solvent, and were dried.

3. After completing the test, the corrosion products were removed in ultrasound bath. The specimens were weighed prior to and after the testing on analytical

scale with accuracy of 10⁻⁵ g(7).

4. The corrosion rate K was calculated as $K = \Delta m / (S \cdot t)$ (g/m²h), where S (m²) is the surface area of the specimen, and t (h) is the test duration. Corrosion tests are used to study the release of waste form components into solution during waste form degradation.

5. Many corrosion test methods have been developed to study the dissolution of oxide materials, such as glasses, that do not require a preceding oxidation step. Although the viability after 3 min exposure is ≥ 50%, it is corrosive if the viability is < 15% after 60 min exposure.



Figure;1 Nanoparticles

Nanoparticle, n—in nanotechnology, a sub-classification of ultrafine particle with lengths in two or three dimensions greater than 0.001 micrometer (1 nanometer) and smaller than about 0.1 micrometer (100 nanometers) and which may or may not exhibit a size-related intensive properties. The American physicist and Nobel Prize laureate Richard Feynman introduced the concept of nanotechnology in 1959.

During the annual meeting of the American Physical Society, Feynman presented a lecture entitled "There's Plenty of Room at the Bottom" at the California Institute of Technology (Caltech). 27 Dec 2019.

Nano fluids are primarily used for their enhanced thermal properties as coolants in heat transfer equipment such as heat exchangers, electronic cooling system (such as flat plate) and radiators. Heat transfer over flat plate has been analyzed by many researchers.

Carbon Based;



Figure;2 Silver Nanoparticles

Silver nanoparticles (AuNPs) are one of the most vital and fascinating nanomaterials among several metallic nanoparticles that are involved in biomedical applications(9). AuNPs play an important role in Nano

science and nanotechnology, particularly in Nano medicine.

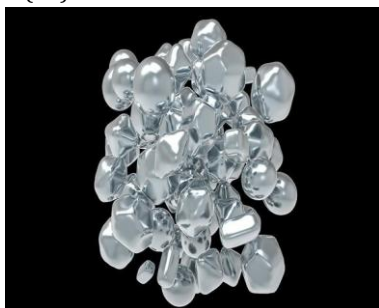
Types of Nanoparticles

- (1) carbon-based nanomaterials
- (2) organic-based nanomaterials
- (3) Composite-based nanomaterials.

Generally, inorganic-based nanomaterial include different metal and metal oxide nanomaterials.

Zinc Nanoparticles (Zn ONPs)

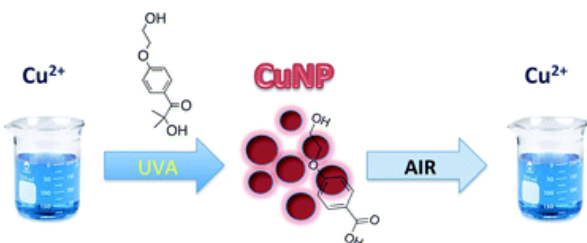
Zinc nanoparticles are particles with a size range of 1-100 nm made of zinc .Zinc oxide NPs are a wide band gap semiconductor with a room temperature energy gap of 3.37 its catalytic, electrical, optoelectronic , depositions thermal decomposition, combustion methods, ultrasound, microwave- assisted combustion method, two- step mechanochemical- thermal synthesis, iodization, co-precipitation, electrophoretic deposition, and precipitation(11).



Figure;3 Zinc Nanoparticles

Copper Nanoparticles (Cu NPs)

Copper nanoparticles comprise a size range of 1-100 nm



of copper- based particles. Cu and Au metal fluorescence have long been known to exist. For excitation at 488nm, a fluorescence peak centering on the metals interbond absorption edge has been noted.

Figure; 4 Copper Nanoparticles

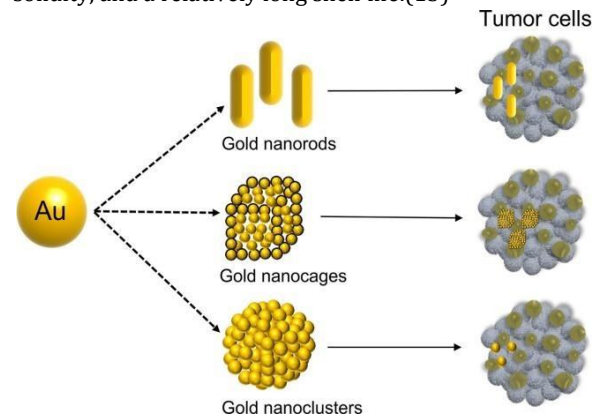
Additionally, it was noted that the fluorescence peaked at the same energy at two distinct excitation wavelengths and the high-energy tail somewhat grows with increased Photonenergy pumping. Copper nanoparticles may play a role in controlling infections. Copper nanoparticles destroy genomic and plasmid DNA, making them an ideal alternative to antimicrobial surface coatings.(12) In addition, copper nanoparticles' "contact killing" ability may also be well considered.

The preparation method starts with addition of 0.1 M copper (II) sulfate pentahydrate solution into 120 mL of

starch (1.2 %) solution with vigorous stirring for 30 min. In the second step, 50 mL of 0.2 M ascorbic acid solution is added to synthesis solution under continuous rapid stirring.

Different types of copper-containing NPs

In biomedicine, cuprous oxide (Cu₂O) and cupric oxide (CuO) are often used as antimicrobial agents. Compared with organic antimicrobial agents, copper oxide has the advantages of stable physical and chemical properties, solidity, and a relatively long shelf life.(15)



Figure;5 Gold Nanoparticles

The ultraviolet photoelectron spectroscopic analysis revealed that the work function decreased from 5.76 to 5.35 eV as the AuNPs size was reduced from 40 to 5 nm. Spherical AuNPs possess useful attributes such as size- and shape-related optoelectronic properties, 18 large surface-to-volume ratio, excellent biocompatibility, and low toxicity(16). These properties make AuNPs an important tool in bio nanotechnology.

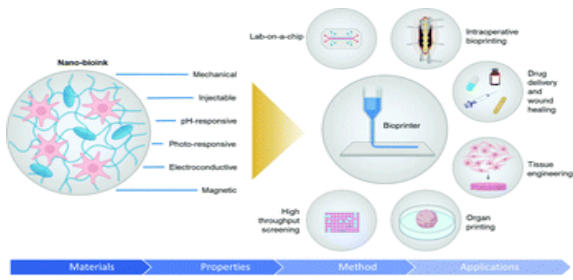
We investigated the size-dependent work function and catalytic performance of gold nanoparticles (AuNPs) decorated graphene oxide (GO).

In principle, the use of radiation for the synthesis of gold nanoparticles involves the solvent radiolysis, alternatively from the use of a chemical reductant, in which a solvent molecule is ionized and excited, thus generating a variety of reactive species that will then trigger the nanoparticle formation.

Hydrogel Nanoparticles:

Polymeric system involving the self-assembly and self-aggregation of natural Polymer amphiphiles cholesterol pollutant.

Cholesterol dextran and agarose Cholesterol groups provide cross linking points. Noncompetition. Hydrogels (NC gels) are nanomaterial-filled, hydrated, polymeric networks that Exhibit higher elasticity and strength relative to traditionally made hydrogels. Copolymerized Peptide Nanoparticle's: Drug moiety is covalently bound to the carrier instead of being physically entrapped.



Figure;6 Hydrogel Nanoparticles

Disadvantages include insufficient targeting ability and potential toxicity. The nanoparticle- based delivery systems can take advantage of the earlier mentioned enhanced permeability and retention (EPR) effect for passive tumor targeting, thus providing a promising and ready for commercialization Nano carrier to improve the therapeutic index and to decrease the side effects of paclitaxel.

Cellulosic nanomaterials have demonstrated potential applications in a wide array of industrial sectors, including electronics, construction, packaging, food, energy, health care, automotive, and defense.

Diagnosis;

Nanoparticles can be used as imaging agents to help visualize specific body areas. Such as optical, electrical, and catalytic properties and are being explored for diagnostics due to their ability to accumulate in certain cancerous tumors.

Gold and silver nanoparticles are the most used metallic nanoparticles in diagnostics. They emit strong absorption when excited with electromagnetic radiation, and their surface chemistries can be altered by grafting or conjugating various probes such as antibodies and nucleic acids (17).

Molecular diagnostics and personalized medicine have been made possible with the help of miniature micro arrays which is a product of nanotechnology. Proteins on arrays on being profiled will be used to distinguish normal cell proteins from those of cancer cells at an early stage or those of metastatic malignant.

TEM is considered the gold standard technique for nanoparticle sizing. Often, a TEM image is provided for the most convincing single characterization, and is considered the “gold standard” technique. Nanotechnology offers the potential for in-vitro diagnosis by substituting existing procedures for more economical alternatives that are easier to utilize.

Nanoparticles can operate as molecular imaging agents within those devices and input cancer-related genetic alterations and tumor cell functional features.

Nanoparticles play an important role in a wide range of diagnostic devices and testing methods to increase performance (e.g. sensitivity, speed) or to enable a detection method that would not be possible without nanotechnology.

Tissue Engineering:-

Tissue Engineering is used in Dentistry. It is used in cardiovascular repair, neural repair, skeletal muscle

repair, etc. Thus the growing development of tissue engineering needs to solve four main problems: cells, engineering development, grafting and safety studies.

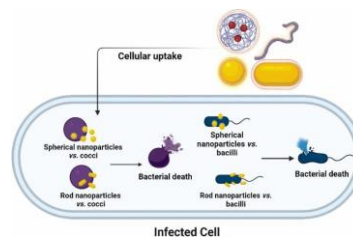
They range in size between 10 and 500 nm. As a consequence of their spherical shape and high surface area to volume ratio, these particles have a wide range of potential applications. The goal of tissue engineering is to assemble functional constructs that restore, maintain, or improve damaged tissues or whole organs.

Artificial skin and cartilage are examples of engineered tissues that have been approved by the FDA; however, currently they have limited use in human patients.

Components of Tissue Engineering

Thus the growing development of tissue engineering needs to solve four main problems(18)

Cells



Figure;7 Antimicrobials

- engineering development
- grafting
- Safety studies.

Applications of tissue engineering

Tissue engineering applications.Produced via hydrolysis of poly (vinyl acetate), biocompatibility, high water solubility, resistance to most organic solvents. Soft contact lenses, eye drops, embolization particles, tissue adhesion barriers and incartilage replacement.

Conclusion

Based on the known physico-mechanical and performance characteristics of consolidated specimens, technological techniques for generating Ti-Tic system MMC by SPS in the regime with the temperature of T = 1100° C and holding period of 180 s were devised. The consolidation of a Ti-Tic powder mixture treated with a specific energy of 10 MJ/kg was discovered to allow for an increase in the Tic content in the consolidated material from 24% to 30% after HVED treatment in kerosene using a P-P electrode setup. When Ti-Tic powder mixture is consolidated in ethanol using a P-P electrode system following HVED treatment, the Tic content remains unchanged compared to when the same regime is applied in kerosene.

Author contributions

All authors are contributed equally.

Financial support

None

Declaration of Competing Interest

The authors have no conflicts of interest to declare.

Acknowledgements

None

References

1. Musić S, Dragčević Đ, Maljković M, Popović S. Influence of chemical synthesis on the crystallization and properties of zinc oxide. *Materials chemistry and physics*. 2003 Jan 15;77(2):521-30.
2. Castro Alarcon N, Herrera Arizmendi JL, Luis Alberto MC, Guzman Guzman IP, Perez Centeno A, Santana Aranda MA. Antibacterial activity of nanoparticles of titanium dioxide, intrinsic and doped with indium and iron.
3. Rani TT, Brahmaiah B, Revathi B, Nama S, Baburao C. TARGETING OF ANTI CANCER DRUGS THROUGH NANOPARTICLES.
4. Musić S, Dragčević Đ, Maljković M, Popović S. Influence of chemical synthesis on the crystallization and properties of zinc oxide. *Materials chemistry and physics*. 2003 Jan 15;77(2):521-30.
5. Sahoo SS, Rao C, Mehta A. Formulation development and optimization of nanosuspension of simvastatin for improved solubility by nanomilling. *J. Pharm SciTech*. 2015;5(2):78-86.
6. Marquis G, Ramasamy B, Banwarilal S, Munusamy AP. Evaluation of antibacterial activity of plant mediated CaO nanoparticles using *Cissus quadrangularis* extract. *Journal of Photochemistry and Photobiology B: Biology*. 2016 Feb 1;155:28-33.
7. Taylor R, Coulombe S, Otanicar T, Phelan P, Gunawan A, Lv W, Rosengarten G, Prasher R, Tyagi H. Small particles, big impacts: A review of the diverse applications of nanofluids. *Journal of applied physics*. 2013 Jan 7;113(1).
8. Chowdary KP, Chandra DU, Mahesh N, Reddy TM, Gopaiah KV. Enhancement of dissolution rate and formulation development of pioglitazone-a BCS class II drug. *J. Pharm. Res*. 2011 Nov;4:3862-3.
9. Lang C, Schüler D, Faivre D. Synthesis of magnetite nanoparticles for bio-and nanotechnology: genetic engineering and biomimetics of bacterial magnetosomes. *Macromolecular bioscience*. 2007 Feb 12;7(2):144-51.
10. Jun YW, Seo JW, Cheon J. Nanoscaling laws of magnetic nanoparticles and their applicabilities in biomedical sciences. *Accounts of chemical research*. 2008 Feb 19;41(2):179-89.
11. Klem MT, Mosolf J, Young M, Douglas T. Photochemical mineralization of europium, titanium, and iron oxyhydroxide nanoparticles in the ferritin protein cage. *Inorganic chemistry*. 2008 Apr 7;47(7):2237-9.
12. Zou D, Xu C, Luo H, Wang L, Ying T. Synthesis of Co₃O₄ nanoparticles via an ionic liquid-assisted methodology at room temperature. *Materials letters*. 2008 Apr 30;62(12-13):1976-8.
13. Zou D, Xu C, Luo H, Wang L, Ying T. Synthesis of Co₃O₄ nanoparticles via an ionic liquid-assisted methodology at room temperature. *Materials letters*. 2008 Apr 30;62(12-13):1976-8.
14. Namballa M, Adimulapu A, Jesudasan RE. QbD Assisted Optimization of Microwave-assisted Synthesis of Polyacrylamide Grafted Tragacanth: Characterization and Instrumental Analysis. *Current Microwave Chemistry*. 2024 Apr 1;11(1):16-29.
15. Haija MA, Ayesh AI, Ahmed S, Katsiotis MS. Selective hydrogen gas sensor using CuFe₂O₄ nanoparticle based thin film. *Applied Surface Science*. 2016 Apr 30;369:443-7.
16. Rout CS, Hegde M, Rao CR. H₂S sensors based on tungsten oxide nanostructures. *Sensors and Actuators B: Chemical*. 2008 Jan 15;128(2):488-93.
17. Wang T, Sun Z, Huang D, Yang Z, Ji Q, Hu N, Yin G, He D, Wei H, Zhang Y. Studies on NH₃ gas sensing by zinc oxide nanowire-reduced graphene oxide nanocomposites. *Sensors and Actuators B: Chemical*. 2017 Nov 1;252:284-94.