Issue 3

JRCS

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Department Of Chemistry
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Delhi University - 110007

Research Newsletter : Issue 3

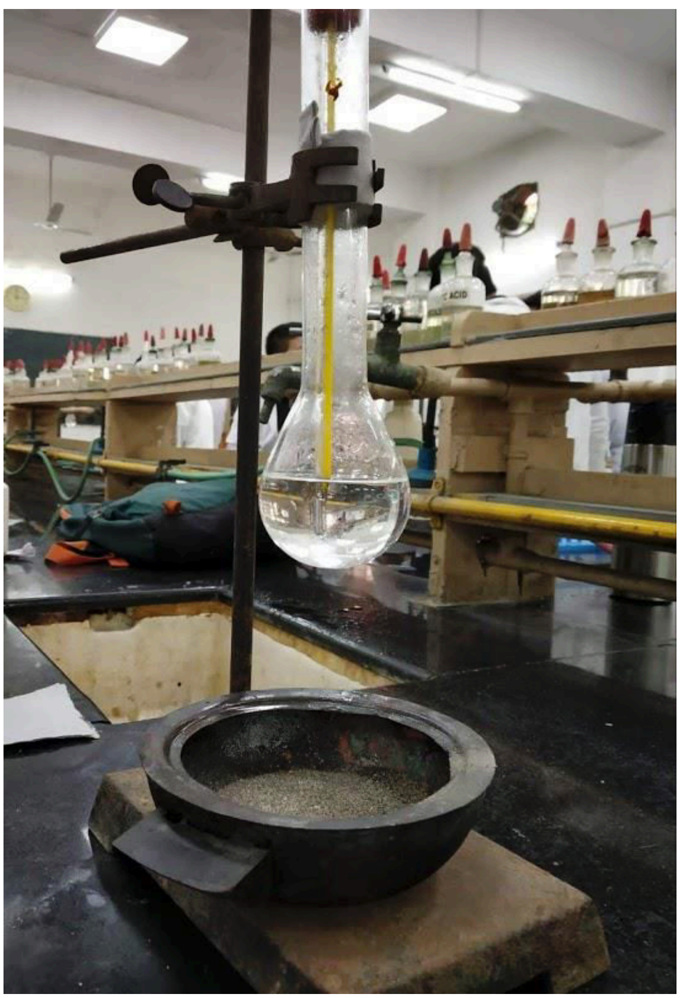
EDITORS' REMARK

Aloha Readers!

We are highly grateful for the affirmative responses conferred on the second issue of JRCS- Journal of Rasayanatva, the chemical society of Hansraj College. Chemistry isn't something that is merely confided to a laboratory, it's something that is within you. From its essential contributions to humanity in food and medicines, clothes and housing, energy and raw materials to its breakthrough publication of the genetic code for SARS- CoV-2, its omnipresence cannot be gainsaid.

"Modern Chemistry with its far-reaching generalizations and hypothesis is a fine example of how the human mind can go in exploring the unknown beyond the limits of human senses."

~ Horace G. Deming.



Being the students of Chemistry, we can staunchly vouch for the aforesaid quote. The consequences of Chemistry are patently comprehensive!

Continuing our lore, we are obliged to introduce the third issue of our journal which comprises of every comprehensive detail about 'NANOPARTICLES'. The journal is bound to satiate your mind with an eclectic range of topics of nanoparticles and quench your thirst for scientific literature.

Hope you have an enriching read!

Editors-in-chief

Anandika Gupta

Ritul Sharma

JRCS

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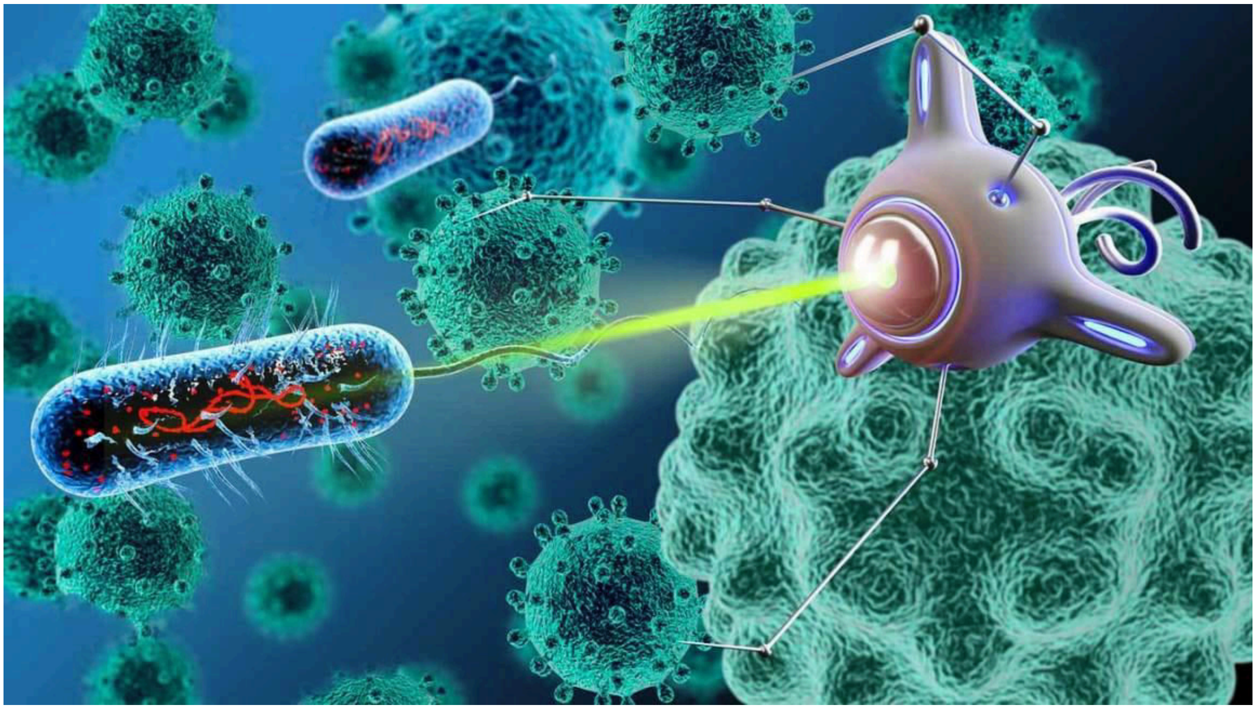


GREEN NANOPARTICLES – FUTURE SCOPE

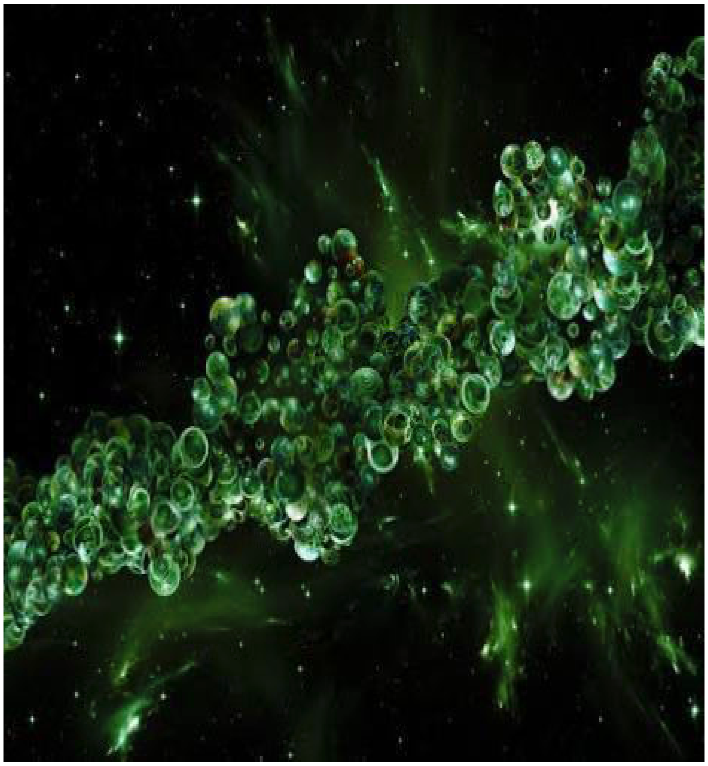
BY Pritam kumar (Department of Chemistry, Hansraj College)

ABSTRACT

Due to growing awareness of the need for environmental sustainability and safety issue ,the importance of manufacturing and applying green nanoparticles has gained significant recognition . Nanoparticles are the basic elements of nanotechnology as they are the primary source used in the design of nanostrucured devices and materials . Nanotechnology has attracted a great interest in recent years due to its expected impact on many areas such as energy, medicine, electronics ,and space industries . This review provides the knowledge of nanoparticles and its adavantages ,and nanotechnology which will continue to take place in coming decade.

INTRODUCTION

Science and technology are going at a very fast rate these days . Environmental engineering science is witnessing drastic changes . In a similar manner, nanotechnology and green nantechnology are moving from one visionary paradigm towards another. Green nanotechnology is the frontier of science and engineering today. Nanotechnology is an emerging science which is expected to have rapid and strong future advancement . The increased surfaces of these nanoparticles are responsible for their different chemical , optical ,mechanical ,magnetic properties as compared to large bulk materials and due to these properties nanoparticles have become significant in many fields .



GREEN NANOPARTICLES

The meaning of the term nanotechnology is any technology operating on the nanoscale which has application in the real world ,i.e to employ single atom and molecules to form functional structures .The field of nanotechnology involves the creation and utilization of chemical ,physical and biological systems with structural features between single atoms or molecules to submicron dimensions and also the assimilation of resultant nanostructures into larger systems. With the help of nanotechnology we can alleviate major sustainability issues. Sustainable development is the utmost need of hour. Broadly speaking , green nanotechnology refers to the use of nanotechnology to enhance the environmental sustainability of process, producing veritable negative externalities. It also encompasses the use of products of nanotechnology to enhance sustainability.

PRODUCTION OF NANOPARTICLES

There are numerous chemical , physical and biological protocols for the synthesis of nanoparticles. Chemical method of synthesis is advantageous as it takes short period of time for synthesis of large quantity of nanoparticles but chemical reagents used in this processs are toxic and forms byproducts which are concern for environment . so, the need for eco-friendly non –toxic methods to synthesis is developing interest in biological approaches which are free from the use of toxic chemicals as byproducts. A variety of natural resources are there for metal nanoparticle synthesis including plants ,fungi, yeast, actinomycetes , bacteria etc.

ADVANTAGES OF NANOPARTICLES

1.The biosynthesis of nanoparticles has been proposed as a cost effective and environmentally friendly alternative to chemical and physical methods .

2.Nanoparticles synthesized using biological techniques or green technology have diverse natures, with greater stability and appropriate dimensions since they are synthesized using a one step procedure

3. Nanoparticles made by green technology are far superior to those manufactured with physical and chemical method on various aspects.

ENVIRONMENTAL APPLICATION

This experiment supported the possibility of the origin of life through chemical evolution. Chemical Reactions Justifying the results The silver nanoparticles can be used for the treatment of water to avoid contamination of the environment . Environmental friendly antimicrobial nanopaint can be developed . Inorganic composites are used as preservatives in various products. Silver nanoparticles can be used as for water filtration . The silver nanoparticles used as an anti bacterial agents and wide range of application from disinfecting devices and home appliances to water treatment

FUTURE PROSPECTS OF NANOTECHNOLOGY

The future applications of nanotechnology could occur in different fields, including nano chemistry for the synthesis of new polymeric materials , nano-physics for the development of new electronic devices and in nano-biotechnology and nano-medicine .However , nanoscience and nanotechnology have demonstrated promising applications such as targeted drug delivery systems in cancer and disease therapy , nano-biosensors in diagnosis and detection of diseases, and tissue engineering in the fabrication of artificial organs in regenerative medicine which are related to nanobiotechnology and nanomedicine since these practical applications are directly involved in halth and life science. It can further be helpful for the development of nanobots i.e superminiatured robots assembled , atoms by atoms , to encourage our lost or damaged tissues to regenerate. It may also be helpful in the field of computer science , brain- machine interfaces to designate direct connection systems between the brain and a computer.

CONCLUSION

The science and engineering of green nanotechnology are moving towards newer knowledge dimensions and are crossing visionary boundaries. Environmental engineering science and environmental sustainability are veritably changing the landscape . The future progress of science and academic rigor lies in nanotechnology or green nanotechnology in particular. This article gives a brief glimpse of the science of green nanotechnology with a greater emphasis on sustainable development . The targets of science and the immense success of nanotechnology applications will surely open windows of innovation for the furtherance of science in years to come ..

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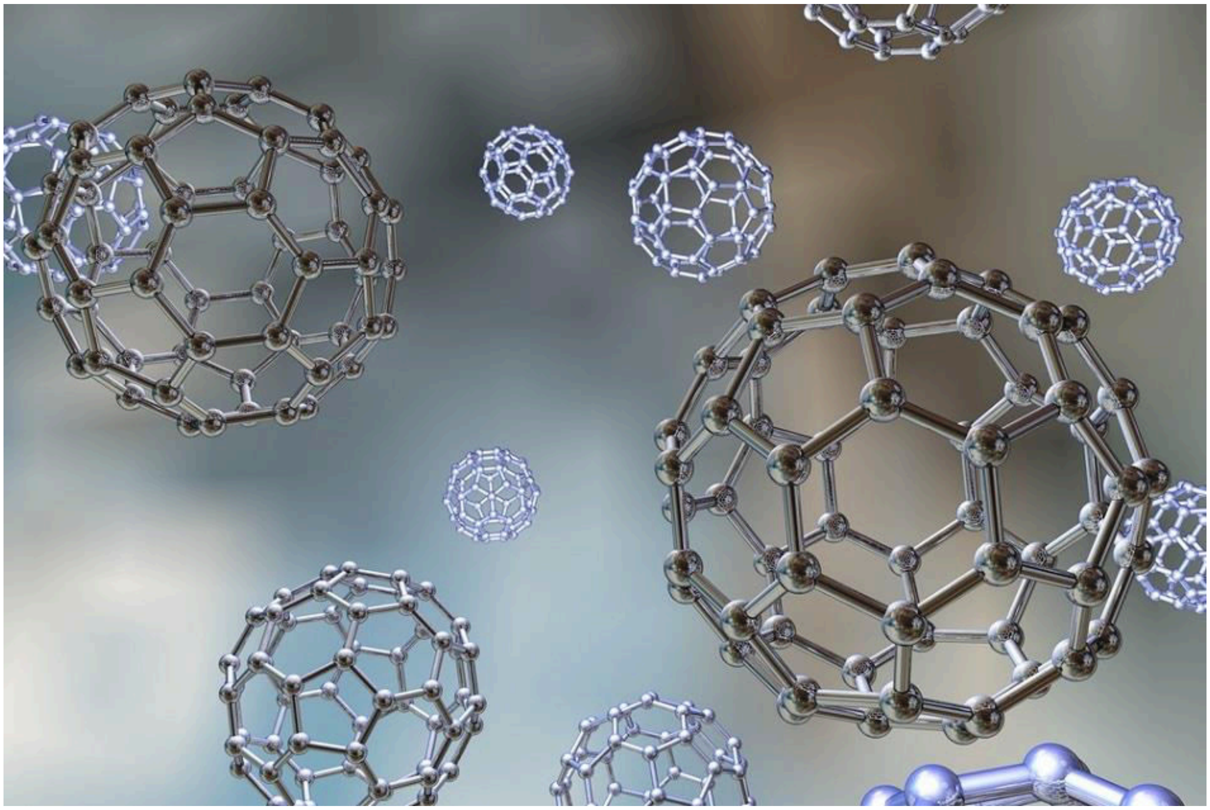
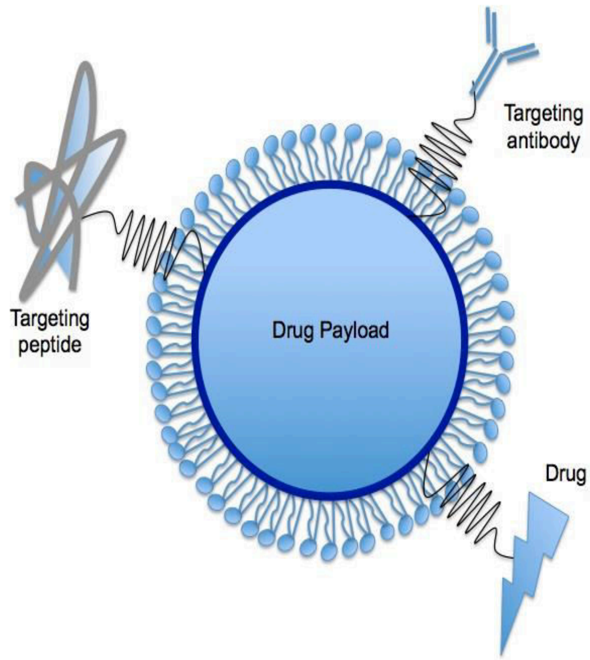


Administration of Nanoparticles in past, present and future

BY HRIDIK DINESH (Department of Chemistry, Hansraj College)

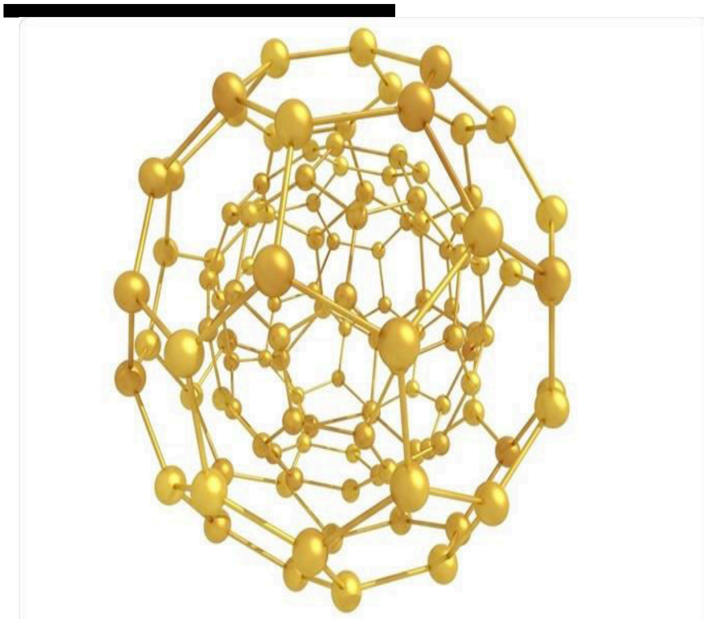
ABSTRACT

Nanoparticle are mainly included in medicine and in drugs. As in the past the idea about the nanoparticle were in a few numbers and the development were too low. The drug research and biomolecular effects of particles were not that much known which made difficulties in understanding various diseases. As nanoparticles have a major role in medicine, its difficult to identify its special role or target organ without specialised objects. The discovery of antibiotics in the beginning of 20th century had a major role in developing certain bioactive drugs and had led to find its target organ using various methods. The development in the science field especially in molecular level in genetics lead to the gene therapy using molecular biology has made the increase in usage of nanoparticles. The use of nanoparticles was unpredictable in older days. As the increase in drug research and related aspects lead to the discovery of various nanoparticles. These nanoparticles were in different forms. Mostly they were in colloidal form in olden days. The usage of such forms and its stability issues created several side effects. The other forms were difficult to make due to the unavailability of devices. Due to the toxicity level of the synthesised molecule, it cannot be produced. Instead of synthesising the new products they used the natural products which are available in the nature itself. It used commonly in all over the world due to no or less side effects, easily availability and all. Even though it has so many limitations the usage of such products was high and most of the compounds had only one target organ and some inhibits other body functions. Isolation and application of such bioactive nano particles is too much hard. Today at present the efforts in research of nanoparticles and related compounds made a dramatic change in various in medical and pharmaceutical fields. As from the natural products which were used in olden days, their activity and molecular structure were identified due to the development in nanotechnology field. It created the availability of vast knowledge of nanoparticles its uses and effects. Even though at present we use natural, similar compounds can also be created artificially. Hence nanotechnology plays a major role in advance medicine/drug formulations, targeting arena and their controlled drug release and delivery with immense success.



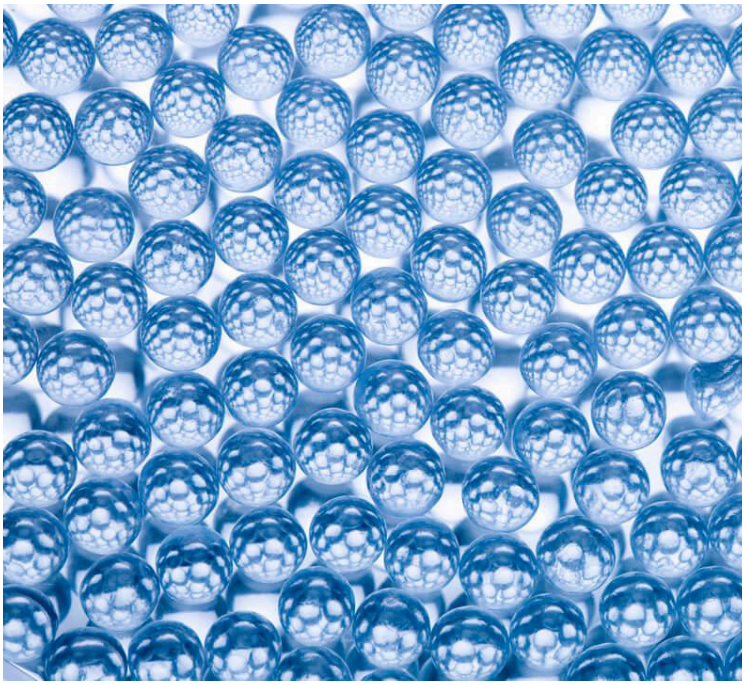
1.APPLICATION IN DNA TECHNOLOGY

Nanoparticles is widely using in DNA-based nanobiotechnology as they are used in fabrication and construction of nano structures used for genetic replication. It employs nanoscale principles and techniques to understand and transform biosystem and uses biological principles and materials to create new devices and system integrated form the nanoscale. Nanotube structure of carbon and properties of gold are widely used in cytology as the gold can reflect light in its nano forms which helps in destroying cancerous cells by altering the genetic constitution. In the modern era, the use of DNA to assemble metals or semiconducting nanoparticles has been achieved through various steps (colloidal property and charge of the molecules)..



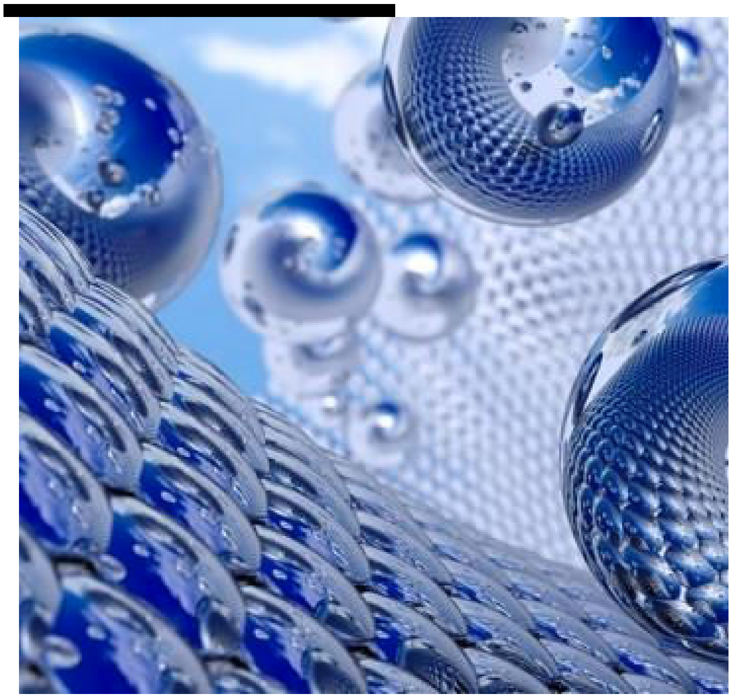
2.STRUCTURE OF A NANOPARTICLES

As the advancement in technology at present, nanoparticles and its various structure, chemical, mechanical, magnetic, electrical, and biological properties have been identified. Artificial synthesis of such molecules in laboratory helped to analyse its effects in a wider range. Such improvement in compounds made to the fast commercialisation and availability across people. The knowledge regarding effects and its target arenas these particles can be used by various methods like oral ingestion, inhalation, dermal penetration and intra vascular injection. The effect of nanoparticles in curing microbial infections and inhibitors of cell division its is used in almost all medicines.



3.NANOPARTICLES DESTROYING CANCER CELLS

The property of the nanoparticles is its size which gives the molecule stability and better orientation for reacting at certain targets. Not only in biological fields but in many other fields we r applying the nanoparticles. Limitations are also there in compounds of nanoparticles. As many of the compounds still create side effects to the living beings and creates pollution to the environment. Some compounds are not biodegradable which creates pollution and if some inhaled, it may cause damage to the respiratory system as well as the internal organs.



4. NON BIODEGRADABLE NANOPARTICLES

The applications of nanoparticles are large but still it creates certain side effects which needs to be studied. It has a wide range in controlling pollution as well as creating it. As these particles are small it can be converted from one to another. In the modern days and in future it can be mostly applicable in conversion of compounds. Thus, at the molecular level most of the compounds can be recycled hence the resource management can be done better. By this method most of the crises like pollution, resource recycling, space management can be resolved. By the improvement in technology, especially in nanotechnology some problems can be neutralised and create a better future. Thus, can create a peaceful and happy society.

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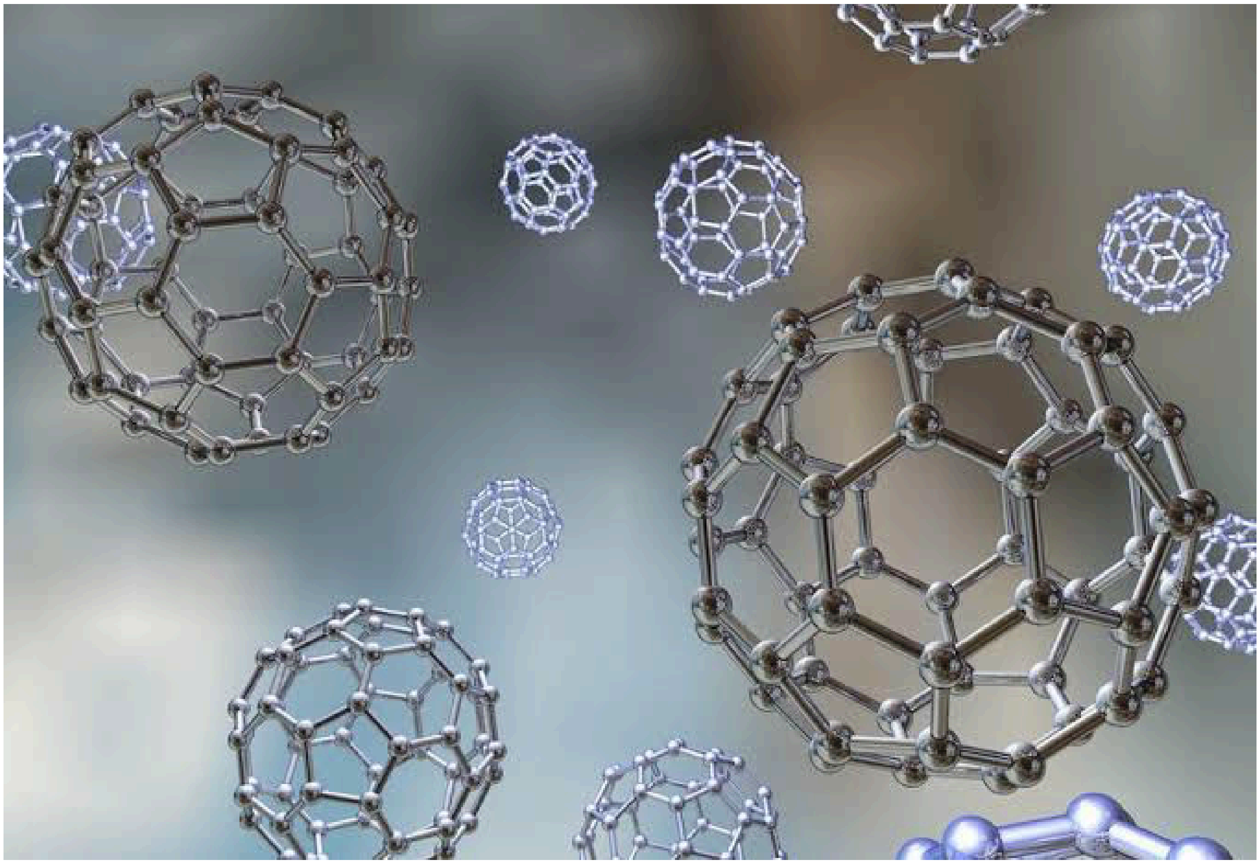


NEW APPROACHES IN SYNTHESIS AND PURIFICATION OF NANOPARTICLE

BY NEHANTH YENNETI (Department of Chemistry, Hansraj College)

NANOPARTICLE:- A Nanoparticle is a small particles that ranges between 1-100 nanometeres in size. Nanoparticles can be created by products of combustion reactions. Nanoparticles are subionized colloidal structure composed of synthetic or semisynthetic polymers.

TYPES OF NANOPARTICLES

NANOSPHERES – Nanospheres are matrix system in which the the drug is physically and uniformly dispersed.

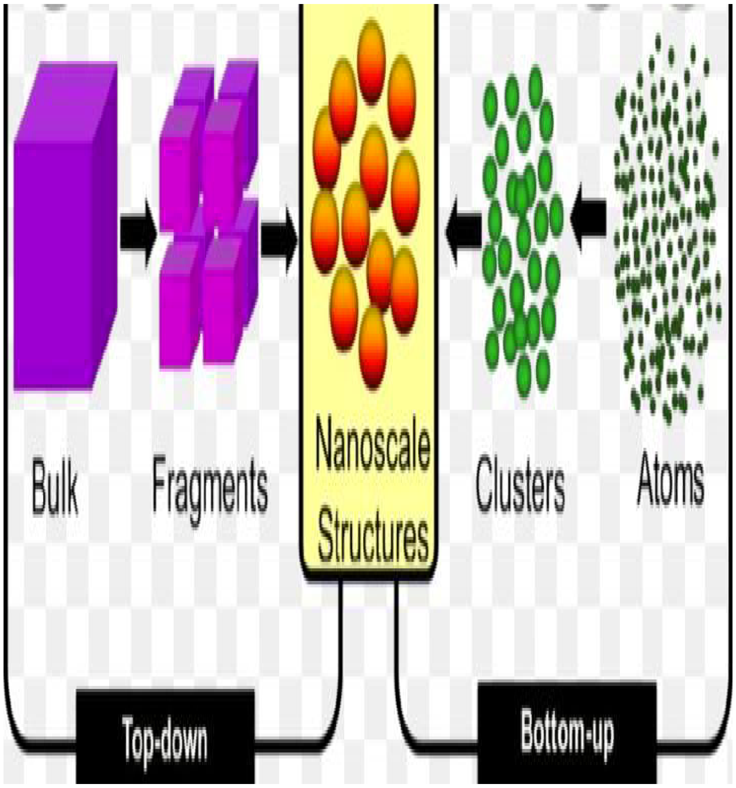
NANOCAPSULES – Nanocapsules are systems in which the drug is confined to a cavity surrounded by a unique polymer membrane.

METHODS OF SYNTHESIS OF NANOPARTICLES

Nanostructure materials have attracted a great deal of attention because their physical, chemical, electronic and magnetic properties show dramatic change from higher dimensional counterparts and depends on their shape and size.

• Many techniques have been developed to synthesize and fabricate nanostructure materials with controlled shape, size, dimensionality and structure.

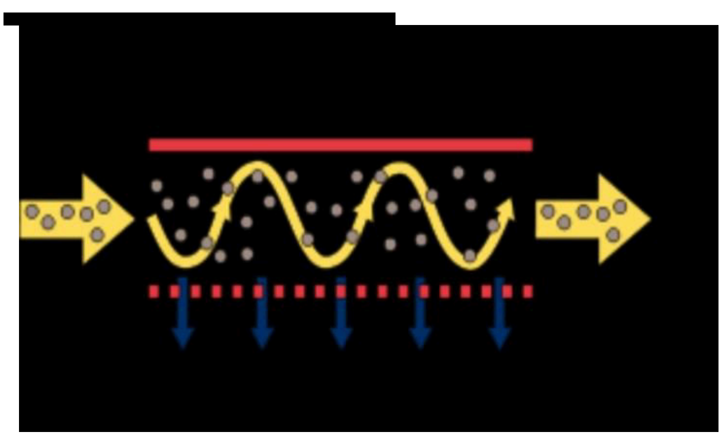
Basically nanoparticles are synthesised by two approaches i.e Top -Down Approach and Bottom – Down Approach



TOP DOWN SYNTHESIS

A Layer molecule (bulk in size) is decomposed to a small molecule and then it is further transferred to nanoparticles. Grinding , physical vapor deposition and other destructive methods are used in top – down synthesis

1) **Thermal Decomposition Method** – An endothermic process in which a chemical bond of a compound is broken by heat which is produced during chemical decomposition. At specific temperature , decompositions of meta results nanoparticles
2) **Mechanical/Ball Milling Method**-In this method , heat energy is transferred from medium of grind to the material which is under reduction.By using consolidation and compaction (industrial process in which nanoparticles are put together), materials which enhanced properties are formed.
3) **Lithographic Method –** This method is capable A Layer molecule (bulk in size) A Layer molecule (bulk in size) is decomposed to a small molecule and then it is further transferred to nanoparticles. Grinding , physical vapor deposition and other destructive methods are used in top – down synthesis
4) **Laser Ablation-** The irradiation of different metal submerge in solution by laser beam condense a plasma to produce nanoparticles.
5) **Sputtering-** In this method , the deposition of nanoparticles occurs by effecting particles .For deposition, annealing is very useful. Also shape and size of nanoparticles depends upon factors like temperature, thickness of layer, duration of annealing and substrate etc.



BOTTOM UP SYNTHESIS

It is also known as constructive method.Basically it is opposite of Top down method from simple substances, nanoparticles are formed.

1) Chemical Vapour Deposition- In this method , a thin film of gaseous reactant is deposited on the substrate , the deposited thin film is carried out of a chemical reaction takes place. When combining gas is contact with heated substrate . As a result, a thin film of product is produced on the surface.

2) Sol -Gel Method- As the name suggests ,sol means a colloid formed from solid particles in continuous liquid. Gel is a solid macro molecule dissolved in solvent. It is the most preferred method .

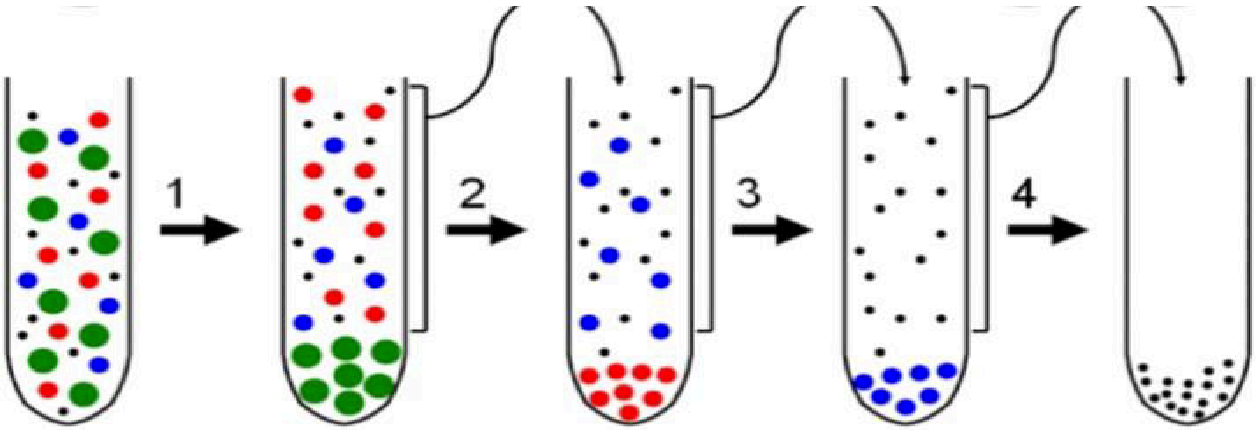
3) Spinning – In this method , SOR(Spinning disk reactor) is used which consist of rotating disc which can control temperature . Due to spinning , fusion of molecule or atoms takes place then they participated and collected and the dried to get nanoparticles . Particles size range from 3 to 12nm.

PURIFICATION OF NANOPARTICLES

1) DIFFERENTIAL CENTRIFUGATION

2) CROSS FLOW FILTRATION

3) DIALYSIS



1) CROSS FLOW FILTRATION- It is used for purification of nanoparticles in industrial point of view.In this method nanoaparticle suspension is filtered through membranes, with the direction of fluid being tangential to the surface of the membrane. As a result clogging of filters is avoided.

2) DIFFERENTIAL CENTRIFUGATION- Centrifugation is one of the most commomnly used techniques in bioscience research , mostly for separation of mixtures by size and density. Differential centrifugation is used to separate multiple fractions within a sample. In this method ,the mixture is centrifuged multiple times, and after each run the pellet is removed and the supernatant is centrifuged at a higher centrifugal force.

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SURFACE ENGINEERING OF NANOPARTICLES

BY KASHISH (Department of Chemistry, Hansraj College)

ABSTRACT

Surface engineering is the process of modifying or coating the surface of a component to enhance its properties, and has an important role to play in tribology. This chapter reviews a large number of surface engineering processes in a logical manner, moving from processes that modify the surface with no change in composition, to those involving compositional change, and then to the application of coatings. In each case the physical and chemical principles of the process are explained, practical examples of its implementation are provided and the properties of the resulting surface and its tribological applications are discussed. Examples of the processes included range from transformation hardening and surface texturing, through carburizing, nitriding and anodizing, to electroplating, weld hardfacing, thermal spraying and physical vapour deposition (PVD). A very wide range of materials is covered.

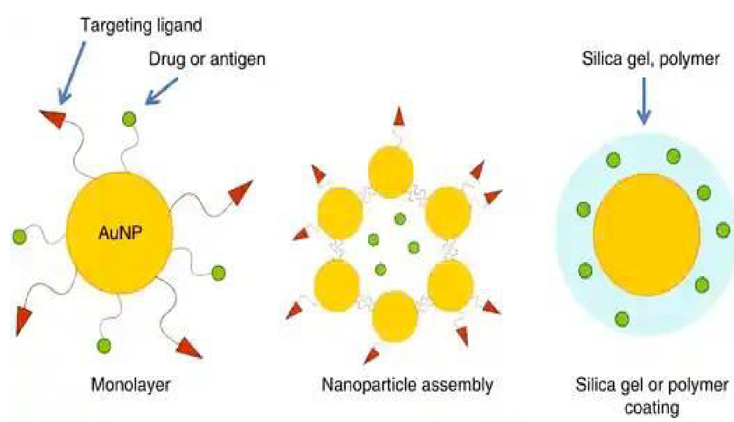
APPLICATION OF SURFACE ENGINEERING

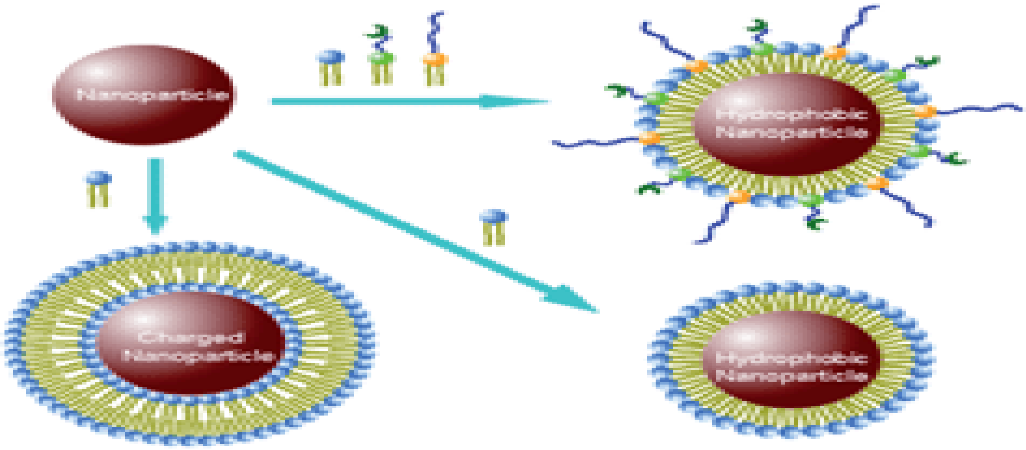
1.**SURFACE ENGINEERING OF NANOPARTICLES FOR THERAPEUTIC APPLICATIONS**

Therapeutic applications of polymer particles with diameters ranging from several nanometers to one micron have become an extremely important research topic. These nanoparticles are referred to as 'therapeutic nanoparticles' and commonly function as drug molecule carriers. For example, drug-loaded polymeric micelles with diameters of 30 nm can reach poorly permeable pancreatic tumors to deliver an antitumor drug load.

2.**SURFACE ENGINEERING OF NANOPARTICLES FOR BIOMEDICAL APPLICATIONS**

Engineered nanoparticles (NPs) play an increasingly important role in biomedical sciences and in nanomedicine. Yet, in spite of significant advances, it remains difficult to construct drug-loaded NPs with precisely defined therapeutic effect, in terms of release time and spatial targeting. The body is a highly complex system that imposes multiple physiological and cellular barriers to foreign objects. Upon injection in the blood stream or following oral administation, NPs have to bypass numerous barriers prior to reaching their intended target. A particularly successful design strategy consists in masking the NP to the biological environment by covering it with an outer surface mimicking the composition and functionality of the cell's external membrane. This review describes this biomimetic approach.





TYPES OF SURFACE ENGINEERING

1. MAGNETICALLY GUIDED NANOPARTICLES

During recent years, there has been much interest in novel materials in the area of nanotechnology. Magnetic nanoparticles belong to the group of nanotechnology-based materials with an impact in fields of analytical chemistry, biosensing, and nanomedicine. It has been nearly fifteen years since Pankhurst and colleagues wrote their famous review on magnetic nanoparticles in biomedicine . More than 50 reviews with the phrase "Magnetic nanoparticle" in the title have been published in the last decade (according to the Web of Science). The four applications they have described for magnetic nanoparticles and microparticles aided in diagnosis and treatment of diseases in the following years.

Application : -

(i) Magnetic separation of biological entities contributed to the development of diagnostics.

(ii) Magnetic nanocarriers contributed to drug delivery.

(iii) Magnetic resonance imaging (MRI) applications.

2. BIOADHESIVE GUIDED NANOPARTICLEs

Bioadhesive nanoparticles have been proposed as carriers for the oral delivery of poorly available drugs and facilitate the use of this route. This work summarises some experiments describing the bioadhesive potential of Gantrez nanoparticles fluorescently labeled with rhodamine B isothiocyanate. The adhesive potential of Gantrez was found to be stronger when folded as nanoparticles than in the solubilised form. Conventional nanoparticles displayed a tropism for the upper areas of the gastrointestinal tract, with a maximum of adhesion 30 min post-administration and a decrease in the adhered fraction along the time depending on the given dose. The cross-linkage of nanoparticles with increasing amounts of 1,3-diaminopropane stabilised the resulting carriers and prolonged their half-life in an aqueous environment; although, the adhesive capacity of nanoparticles, the intensity and the relative duration of the adhesive interactions within the gut as a function of the cross-linking degree. Finally, nanoparticles were coated with either gelatin or albumin.

Application :-

(i) Bioadhesive nanoparticles can be engineered to precisely deliver drugs, light, and heat to specific cells in the body to treat cancer and other illnesses.

3 . **ANTIBODY GUIDED NANOPARTICLES**

Solid particles, liquid droplets, gas bubbles, and liquid films between them in colloid systems have been known for decades to possess size-dependent properties that differ from those of the same material in bulk when size is smaller than about 100 nm. Recent advances in physics, chemistry, materials sciences, engineering, and molecular biology, have allowed the development of nanoparticles (size 1 to 100 nm) by combining atoms or molecules one at a time in arrangements that do not occur in nature. Such particles have attracted much attention because of their unique mechanical, electrical and optical properties. This resulted in a renewed interest to various nanoparticles already known for many years, e.g., liposomes, and to the development of new ones, e.g., quantum dots and gold nanoshells . Such particles conjugated to antibodies can improve their binding or/and effector functions or confer new functions, e.g., cytotoxicity, size-dependent fluorescence and light scattering. Compared to engineered antibody based on fusion proteins or chemical conjugates made with other compounds, the nanoparticle-antibody conjugates have the fundamental capability of separating compounds loaded inside the particle.

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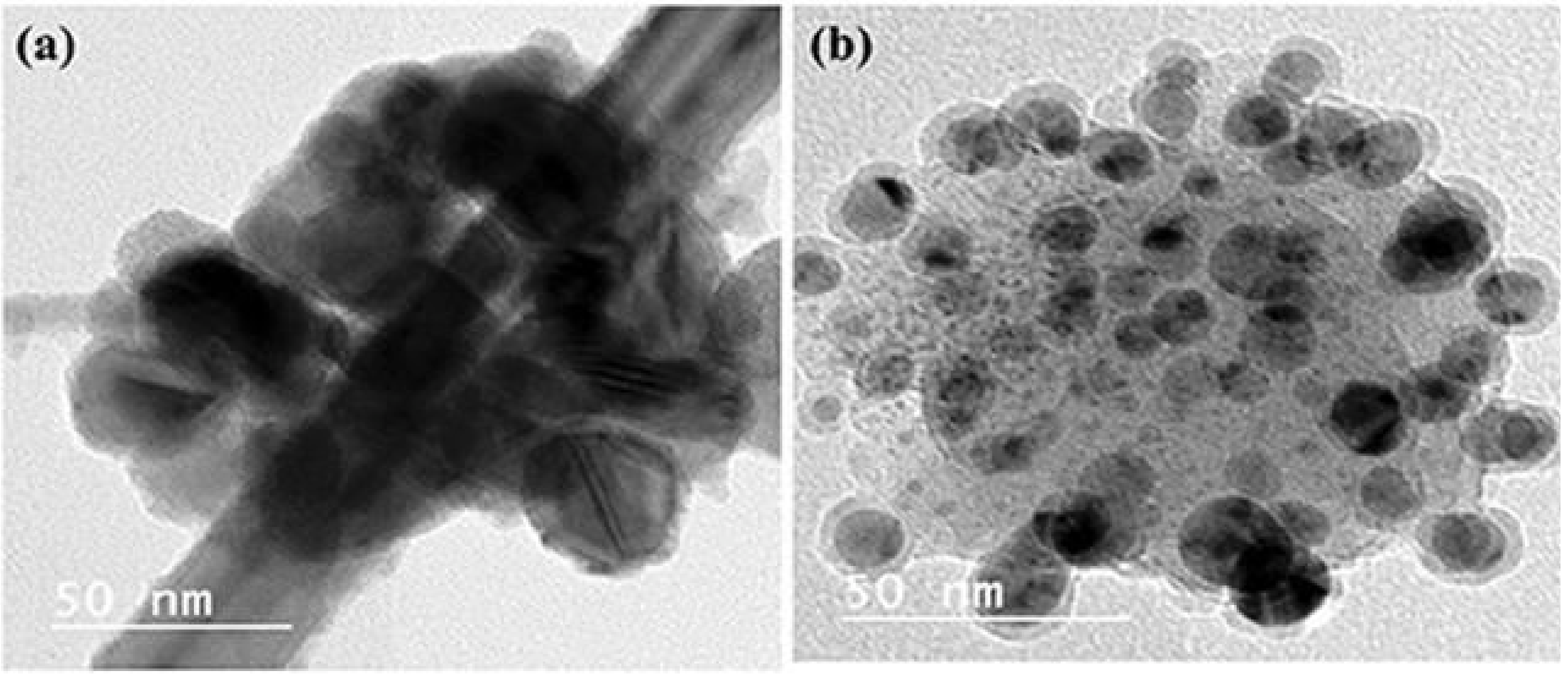

WASTE-DERIVED NANOPARTICLES

By Kartikeya Sharma

Nanoparticles, though very simple and subtle, have found many applications in basic as well as applied sciences. We have already seen some of its applications in fields like medicine, sports and even inside the human body.

Though they have found a lot of applications in many fields, their synthesis can, sometimes, be little cumbersome and tedious. The generation of waste right now in our country, let alone the planet, is increasing exponentially. Hence, it is vital that we start synthesizing nanoparticles from these waste products and use them for our benefit.

Synthesis of Nanoparticles from Waste and their Applications

From Industrial Waste: -

Since the beginning of the industrial revolution in England in the 1960s, we have been striving to maximise our output with the minimum formation of side-products which may harm the ecological balance of the ecosystem. According to a website https://recoverusa.com/industrial-waste-management/ USA alone produces about 7.6 billion tonnes of industrial waste annually. We can only believe how much the entire planet produces annually. Therefore, a major chunk of nanoparticle generation can be done from industrial waste. One of the best chemical methods to generate nanoparticles, especially from industrial waste (predominantly metallic in nature), is by reduction of the waste with sodium borohydride ($NaBH_4$). This method was developed in 2011. The nanoparticles produced were rinsed with ultrapure water and absolute alcohol. The nanoparticles thus produced can be used effectively in the adsorption and removal of dyes.

Also, since the beginning of the digital revolution in the latter half of the 20th century, electronic waste generation has also become a major problem. According to the United Nations University, Tokyo, the planet is generating approximately 45 million tonnes of E-waste annually. In 2018, copper nanoparticles were obtained by reducing samples of $CuSO_4$ obtained from Waste Printed Circuit Boards.

From plant extracts: -

India, still being a majorly agrarian state, generates a lot of waste when it comes to agriculture. Metallic nanoparticles, especially that of silver can be generated very easily using plant extracts and AgNO3 sol. The silver nanoparticles thus generated are being used for anti-microbial, anti-fungal etc. purposes. These silver nanoparticles are also being used in the diagnosis and treatment of cancer as well. The silver nanoparticles produced through this can be stabilized using various organic molecules like polysaccharides, α-amino acids etc.

Carbon nanoparticles generation: -

Carbon based waste like plastics, hydrocarbons and other plant related waste have also been used for generation of carbon-based nanoparticles, majorly graphene, which has a single layered structure of sp2 hybrid carbon has been accomplished over the last decade. One of the simplest chemical methods for generation of these nanoparticles, developed in 2011, is by using wastes like Styrofoam, grass blades, food waste. An approximate 10mg of the start products were heated at a temperature of about 1000oC in an inert atmosphere of argon and hydrogen and graphene growth was found.

The graphene nanoparticles thus found can be used in electrical conductivity, mechanics etc..

Sustainability Considerations: -

Nanoparticles have proven to be a boon for the 21st century. Their vast applications and uses can be used for various purposes. The sustainability issues which are currently in our front can be effectively addressed by using waste derived nanoparticles discussed above. But we must keep in our minds that every method cannot be completely 'green'. We must develop a mechanism in which every by-product produced in these methods is carefully disposed or used back or some other purpose. That's how we will be able to achieve the fundamental objectives Of Green Chemistry..

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NANOSTRUCTURES IN INSECTS

BY ANURAG SINGH (Department of Chemistry, Hansraj College)

There is no doubt that scientists have always looked up to nature ad its biology for bringing up efficient innovations. One such thing which has widened up the scope of research in the field of chemistry is the nanostructures present in insects .The pattern and arrangement of nanostructures on insects have led up to numerous discoveries and researches. Some of the nanostructures which are of a particular importance includes structures which imparts antiwetting , anti-reflection, self cleaning ,adhesion, specific cell attachment properties to the insect's body.

PROPERTIES OF NANOSTRUCTURES IN INSECTS

The arrangement of nanostructures on the wings ,cuticle, thorax ,head and abdomen of insects have important properties which help the insects to adapt in the environment in which they are living .Some of this properties imparted by arrangement of nanoparticles are discussed below in brief :-

1)**Anti-Reflection Property** : The regular arrangement and size of nanostructures on the surfaces of certain insect's eyes or wings is responsible for their antireflection properties. The researchers found that the nanopillars are irregularly arranged with an average spacing of 120 nm and have random heights in the range of 400–600 nm. They proved that randomness in the arrangement and size of the nanopillars is the cause of the omnidirectional antireflection.

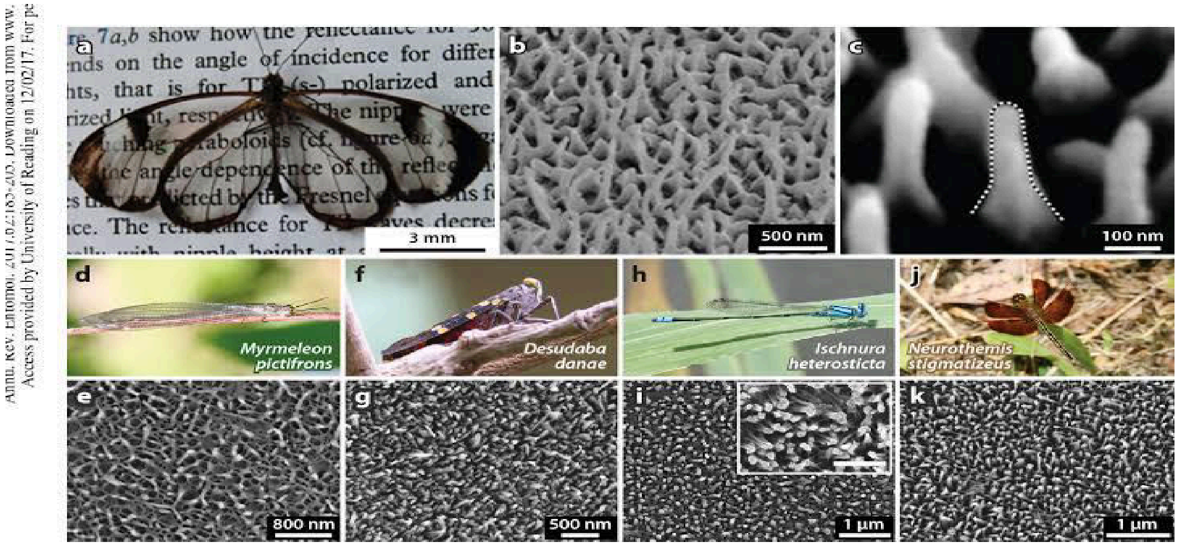

Fig. 2. Microscopic view of nanostructure on cuticle of wings of insects .

2)**<u>Anti-Wetting Property:</u>** The nanostructures present on cuticle have been shown to exhibit remarkable properties of which Hydrophobicity or anti-wetting are worth mentioning. The arrangement of nanostructures on the cuticle reduces contact with wetting surfaces and other adhesive contaminants(e.g. wings of Cicada). The intricate hierarchical array design of these insect wings achieves anti-wetting properties with water bodies of various sizes by reducing contact area and thus adhesion. Insects uses an array of hairs with a specially designed nanoarchitecture, which we demonstrate is critical for anti-wetting property.

3)<u>Specific cell attachment and antimicrobial property</u> : The spectacular array of nanostructures in insects provides it the ability to stick to specific cells.This is due to some nanofibers which makes up a nanocomposite material providing adhesive property and specific cell attachment property to insects wings. This structures also provide antimicrobial action to insect's body .

DISCOVERIES INSPIRRED FROM NANOSTRUCTURES IN INSECTS

A number of discoveries have been made in the field of science which are inspired from various properties provided by nanostructures in insects .Some of such discoveries are discussed below :

- Researchers who study the physical and chemical properties of insect wings have reproduced the nanostructures that help cicada wings repel water from their surface . This nanostructures will be used by scientists to produce high-tech waterproof materials in future.
- Scientists have discovered how nanomaterial inspired from wings of dragon fly and cicada are able to destroy bacteria on contact by stretching ,slicing and tearing them apart. New antibacterial surfaces are being developed by mimicking the nanopatterns on insect's wings which will be of great importance in future.
- Insects eye (compound eyes) are particularly notable for their optical characteristics and this nanostructures are being studied by scientist to develop new types of imaging system and optical components .

To conclude ,nanostructures in insects provide ample resources to study. Scientist are working on this nanostructures and employing the nano patterns to bring out new innovation in the field of science which will be benificial to mankind in one way or other.

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SILVER NANOPARTICLES

SNEHA WADHWA

Abstract

Recent advances in nanoscience and nanotechnology radically changed the way we diagnose, treat, and prevent various diseases in all aspects of human life. Silver nanoparticles (AgNPs) are one of the most vital and fascinating nanomaterials among several metallic nanoparticles that are involved in biomedical applications.

Introduction

Nanotechnology is rapidly growing by producing nanoproducts and nanoparticles (NPs) that can have novel and size-related physico-chemical properties differing significantly from larger matter. Silver nanoparticles (Ag-NPs or Nano silver) have attracted increasing interest due to their unique physical, chemical and biological properties compared to their macro-scaled counterparts. Ag-NPs have distinctive physio-chemical properties, including a high electrical and thermal conductivity, surface-enhanced Raman scattering, chemical stability, catalytic activity and non linear optical behaviour . These properties make them of potential value in inks, microelectronics, and medical imaging . Besides, Ag-NPs exhibit broad spectrum bactericidal and fungicidal activity that has made them extremely popular in a diverse range of consumer products, including plastics, soaps, pastes, food and textiles, increasing their market value .

Synthesis of silver nanoparticles

Generally, the synthesis of nanoparticles has been carried out using three different approaches, including physical, chemical, and biological methods.

In physical methods, nanoparticles are prepared by evaporation-condensation using a tube furnace at atmospheric pressure. Conventional physical methods including spark discharging and pyrolysis were used for the synthesis of AgNPs . Chemical methods use water or organic solvents to prepare the silver nanoparticles. This process usually employs three main components, such as metal precursors, reducing agents, and stabilizing/capping agents. Basically, the reduction of silver salts involves two stages (1) nucleation; and (2) subsequent growth. The biological synthesis of nanoparticles depends on three factors, including (1) the solvent; (2) the reducing agent; and (3) the non-toxic material. Biological methods seem to provide controlled particle size and shape, which is an important factor for various biomedical applications.

APPLICATIONS OF SILVER NANOPARTICLES

1. Biosensing and imaging
2. Antifungal
3. Antidiabetic
4. Anti- inflammatory
5. Antiviral
6. Wound healing
7. Tissue regeneration
8. Antiproliferative.

SILVER NANOPARTICLES IN CANCER TREATMENT

Presence of phytochemicals on the surface of green synthesized silver nanoparticles is attributed to their antimicrobial and anticancer activities. By keeping in view the expanding burden of cancer globally, several research groups have synthesized variety of metallic nanoparticles via green approach. Plant mediated AgNPs have been exhibiting potential anticancer activities against various types of carcinoma cells.

Such as banana leaf mediated AgNPs exhibited anticancer potential against A549 and MCF7 cell lines, Mangifera indica seed mediated AgNPs against Hela and MCF7, AgNPs formulated by Heliotropium bacciferum showed anticancer potential against HCT-116 and AgNPs using Zingiber officinale displayed anticancer potential against AsPC-1, PANC-1 and MIA PaCa-2 cell line.

The magnificent selectivity of AgNPs is due to biocompatibility of Ag0 and phytochemicals from plant source that attached on their source. Moreover, recent researches have revealed that plant mediated AgNPs shown their anticancer activity by decreasing the proliferation rate of cancerous cell via cell cycle arrest.

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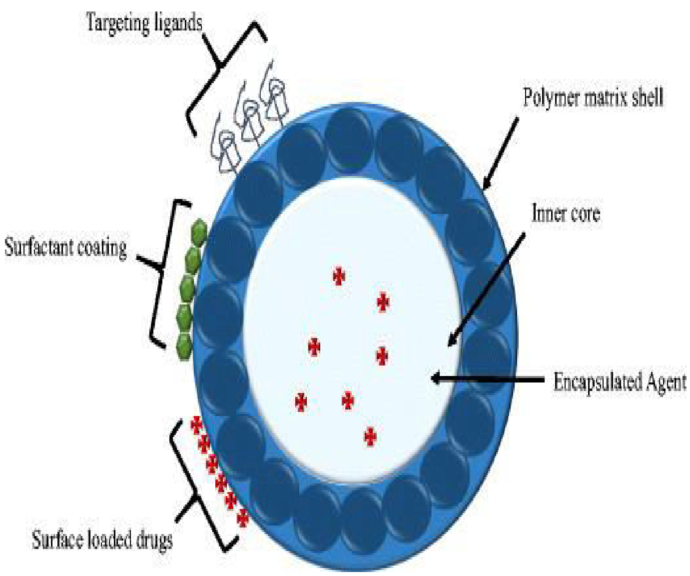
Radioactive Nanoparticles and their Activity

BY TANUJA (Department of Chemistry, Hansraj College)

ABSTRACT

The term nanoparticles describes a sub-classification of ultra-fine solids well defined in shape and size with dimensions from 1nm to 100 nm and novel properties that distinguish them from bulk materials. They can be near infrared (NIR)-fluorescent or can have magnetic properties. These optical or magnetic properties can be exploited for use in thermal therapy and molecular imaging. Nanoparticles, containing radioactive isotopes, are what we know as Radioactive Nanoparticles. Isotopes of metallic gold, iodine and technetium salts, CeO_2 and other lanthanide and actinide compounds, as well as several p- (P, C, F, Te) and d- (Fe, Co, Cu, Cd, Zn) elements form most common radioactive nanoparticles



INTRODUCTION

Radiolabeled nanoparticles are promising objects for a series of biomedical and chemical applications, first of all in medicine for cancer detection and treatment with radiopharmaceuticals, targeting to deposit in certain organs. They could also

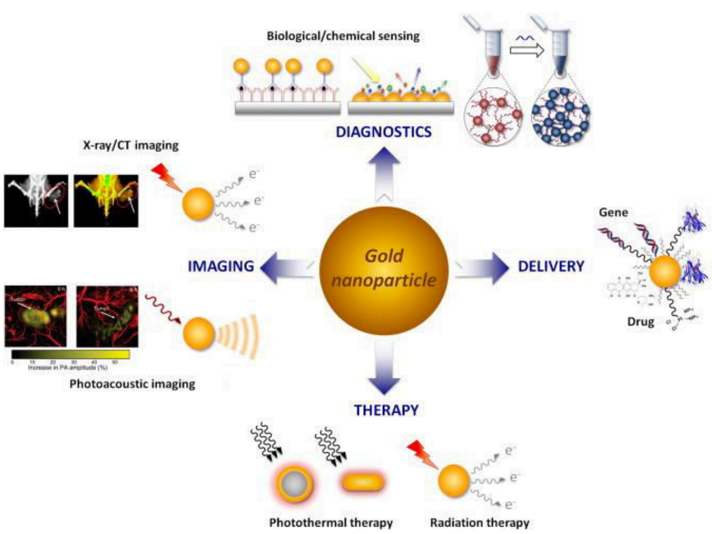
be used for detection of biomolecules or for human inhalation studies.Taking into account the challenges of hazard controls of nanoparticles and that of radioactive materials, for radioprotection reasons, when radioactive nanoparticles are administered, γ-emitters and β-emitters are preferred for diagnostic applications, and β and α-emitters are sometimes used for diagnostic uses, if their radioactive emissions are low energetic. The various nanoparticle radionuclides consist of polymeric nanoparticles, liposomal carriers, magnetic iron oxide nanoparticles, silica nanoparticles, carbon nanotubes and inorganic metal based nonformulations. Between these nano-platforms, polymeric nanoparticles have gained attention in the biomedical field due to their excellent properties, such as their surface to mass ratio, quantum properties, biodegradability, low toxicity and ability to absorb and carry other molecules.

APPLICATIONS OF RADIOACTIVE NANOPARTICLES

[*99m Sulfur Colloid Bone Marrow Imaging For Diagnosing Musculoskeletal Infection*]

Radiolabeled nanoparticles have proven to be promising tools in the diagnosis and therapy of malignant processes like anti-tumor therapies, cancer radiotherapy, tumor imaging, radioimmunotherapy and radioimmunoimaging of cancer. Physical radiation from radioactive species is responsible for the radioactive polymeric nanoparticle emission with beta (β) or alpha (α) emitters for therapy purposes while polymeric nanoparticles with gamma (γ) or positron emitters are used for diagnostic targets. The ideal radioactive polymeric nanoparticle should be able to target tissues and restrict radiation from spreading to other healthy tissue around the target. In addition, radioactive polymeric nanoparticles should remain in a body for a short period of time so as to avoid prolonged patient exposure to radiation but long enough to allow the acquisition and processing of images via computers as well as therapeutic active agents.

1. Radioactive nanoparticles provide not only functional and molecular images but are also useful in diagnosis by taking into account that therapeutic applications of theranostic nanoparticles have raised expectations.
2. For imaging objectives, radioactive polymeric nanoparticles can be designed by two possible methods. The first method involves the incorporation of a radioactive element in a nanosized cluster. Despite the advantages of the omnipresent method, complications like oxidization of radioactive elements or eluding the nanoscale imaging remains a challenge. Noble metals such as gold can be bombarded with neutrons in a nuclear reactor to generate radioactive core nanoparticles.
3. The second method involves attaching a radioactive metal to a nanoparticle (also known as radioalabeling of a particle). This method is versatile and can incorporate various radioelements of choice into a ligand on the nanoparticle surface using functionalization chemistry.
4. These radioactive nanoparticles have the potential to significantly improve the medical outcomes of several therapies and diagnostic by enhancing the accumulation of the drug imbedded into diseased tissue target sites through passive or active targeting.
5. These systems are also used for studies in numerous diseases such as ischemia, cardiovascular diseases, angiogenesis and infectious diseases among others.
6. 99mTc-colloid is a nano-colloid albumin that gets attention for being the first case of radioactive nanodrug



approved for lymph nodes imaging in European Union and a modified version of the original 99mTc-Nanocall using sulphur in the colloidal state has been approved in USA for nodal detection in prostate and breast cancer.

7. The 99mTc-SnF2 registered under the name of Hepatate is a nanoparticle approved formed of Stannous fluoride colloid radiolabeled with technetium 99m clinically used for lymphoscintigraphy; gastrointestinal, liver and spleen.

8. Finally, radioactive gold nanoparticles have shown to be an excellent radiosensitizer for great variety of cancer cells..

CONCLUSION AND FUTURE OUTLOOK

As it is seen above, nanoparticles containing radioactive isotopes are currently used mainly for medical purposes. Whole number of radioactive nanoparticles, which are nowadays applied for industrial purposes is limited due to corresponding difficulties in their operation, toxicity of their nanometric-size composites, and possibility of large pollution events. As future developments, it is expected that additional more sophisticated methods will be applied for their production. In addition to that list of mentioned radionuclides, more short life isotopes are expected to be used in biomedicine and biotechnology as a part of nanotechnology.

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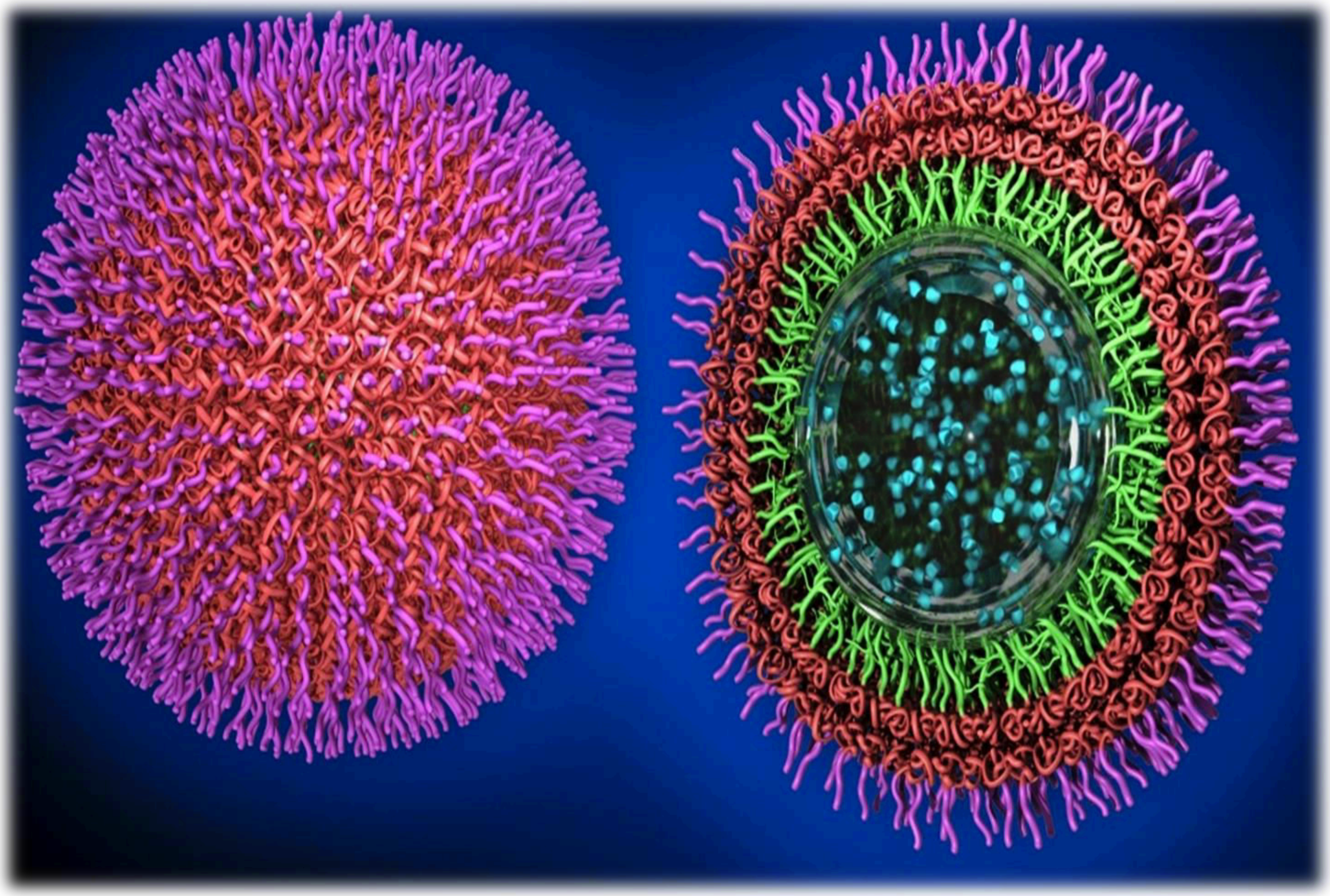
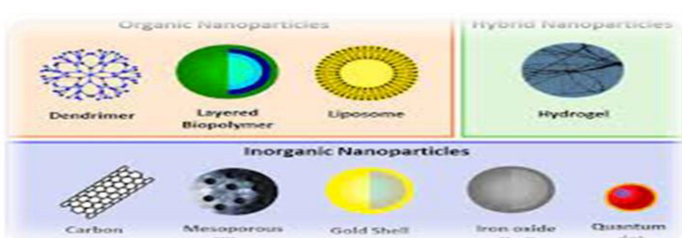


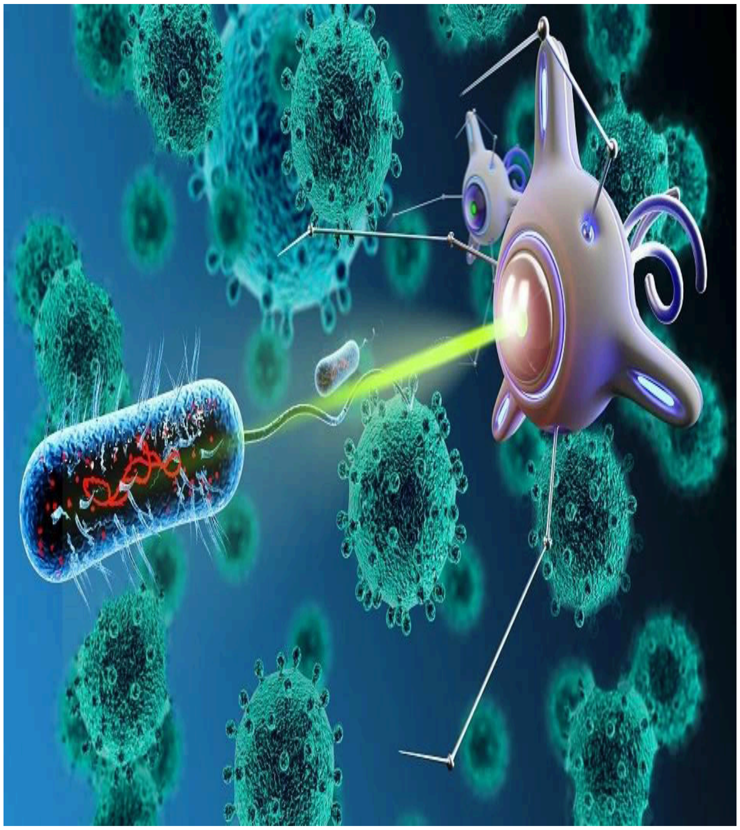
APPLICATIONS OF NANOPARTICLES

BY VISHAKHA (Department of Chemistry, Hansraj College)

WHAT IS NANOPARTICLES?

Nanoparticles is a small particle that ranges between 1 to 100 nanometers in size. Nano derives from the Greek word “nanos”, which means dwarf or extremely small. Nanoparticles are now being used for instance in the manufacture of scratchproof eyeglasses, crack-resistant paints, anti-graffiti coatings for walls, transparent sunscreens, stain-repellent fabrics, self-cleaning windows and ceramic coatings for solar cells. Nanoparticles can contribute to stronger, lighter, cleaner and 'smarter' surfaces and systems. Synthetically produced nanoparticles play an important role in nanotechnology and find use in many applications. This includes dispersions in gases (e.g., as aerosols), as ultrafine powder, for thin-films, distributed in fluids (dispersed, for example ferrofluids) or embedded in a solid body (nanocomposites).





APPLICATIONS OF NANOPARTICLES:

Medicines The small size of nanoparticles is especially advantageous in medicine; nanoparticles can not only circulate widely throughout the body but also enter cells or be designed to bind to specific cells. Those properties have enabled new ways of enhancing images of organs as well as tumours and other diseased tissues in the body. They also have facilitated the development of new methods of delivering therapy, such as by providing local heating (hyperthermia), by blocking vasculature to diseased tissues and tumours, or by carrying payloads of drugs. Magnetic nanoparticles have been used to replace radioactive technetium for tracking the spread of cancer along lymph nodes. The nanoparticles work by exploiting the change in contrast brought about by tiny particles of superparamagnetic iron oxide in magnetic resonance imaging (MRI). Such particles also can be used to kill tumours via hyperthermia, in which an alternating magnetic field causes them to heat and destroy tissue on a local scale. Nanoparticles can be designed to enhance fluorescent imaging or to enhance images from positron emission tomography (PET) or ultrasound. Those methods typically require that the nanoparticle be able to recognize a particular cell or disease state

Sports Nanomaterials such as carbon nanotubes (CNTs), silica nanoparticles (SNPs), nano Clays fullerenes, etc. are being incorporated into various sports equipment to improve the performance of athletes as well as equipment. Each of these nanomaterials is responsible for an added advantage such as high strength and stiffness, durability, reduced weight, abrasion resistance, etc. in sporting equipment. Nanotechnology being a disruptive technology has impacted every sphere of our daily life and sport is no exception. Nano-enhanced sporting equipment are much more performance-enhancing and superior in terms of strength, stiffness, and durability as compared to conventional sporting equipment. Various companies are coming up with more innovative ideas to implement nanotechnology for improving sports equipment even further. Many prominent sportspersons are opting to have nano-incorporated sporting equipment to enhance their performances. However, being an expensive technology, nano-enhanced sporting equipment cannot be afforded by each and every sportsperson and unless each competent athlete is given the same sporting equipment, it would be unfair and difficult to judge the natural sporting ability and human spirit

Ophthalmology Some applications of nanotechnology to ophthalmology are include treatment of oxidative stress, measurement of intraocular pressure, used for treatment of choroidal new vessels, to prevent scars after glaucoma surgery, and for treatment of retinal degenerative disease using gene therapy.

Surgery Nano particles can be used as flesh welders. In this technique green liquid containing gold coasted nano shell is allowed to dribble along the seam and two sides are weld together using laser. This method can be used for arteries which have been cut during organ transplant. Moreover, nanoparticles are also used in gene delivery, drug delivery, detection and diagnosis, molecular imaging, biomarker mapping etc.

Human Body The interaction of nanoparticles with living systems is also affected by the characteristic dimensions. In living systems, they may immediately adsorb onto their surface some of the large molecules they encounter as they enter the tissues and fluids of the body. Nanoparticles may be used effectively to deliver genes to cells, to treat cancer, as well as in vaccination. The use of nanoparticles as drug carriers may reduce the toxicity of the incorporated drug but it is sometimes difficult to distinguish the toxicity of the drug from that of the nanoparticle. Toxicity of gold nanoparticles, for instance, has been shown at high concentrations. In addition, nanoparticles trapped in the liver can affect the function of this organ.

Despite of all advantages, nanoparticles has raised standard of living but at the same time, it has increased pollution which includes air pollution. Nanoparticles can cause lung damage. Inhaled particulate matter may get deposited throughout the human respiratory tract and many more.

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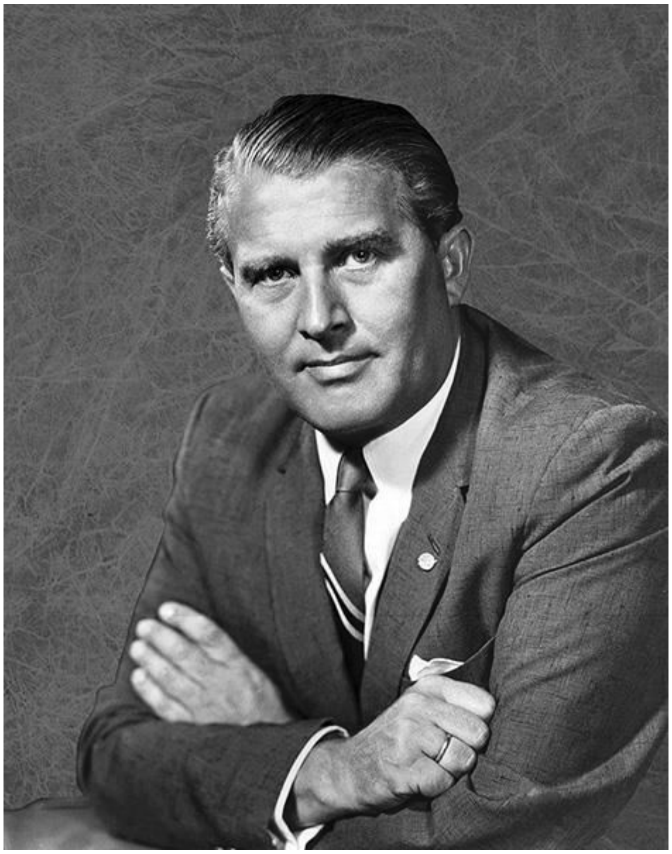
ABOUT THE SCIENTIST

GILBERT N. LEWIS



He was one of the most important American scientists of the 20th century. His work produced a structural revolution in chemical studies, thanks to the many contributions he made throughout his life to the development of science.Among the contributions of this physicochemical, the formula that bears his name stands out, with which the pairs of electrons alone are graphically represented. Lewis's research work was extensive, although his fame was basically due to the theory of chemical bonds and the definition of acid-base formulated in 1923.Gilbert Newton Lewis was born in Weymouth, Massachusetts, on October 23, 1875. His parents were Frank Wesley Lewis and Mary Burr White Lewis. During his early years he was taught in his own home and at age 10 he entered public school, graduating in 1889.In 1884 Lewis had to settle with his family in Lincoln, Nebraska. At age 13, he was admitted to the University of Nebraska High School.Upon graduation, he pursued his university studies for two years, then enrolled at Harvard University in 1893.Initially he was interested in economics, but eventually he opted for physics and chemistry. Gilbert earned his degree in chemistry in 1896 and for a year he taught at Phillips Academy, a private school in Andover.

George Olah studied organic chemistry at the Technical University of Budapest. He completed his doctorate in 1949 under Géza Zemplén, a former student of Nobel prize winning chemist Emil Fischer. He began his career at the Technical University as an assistant professor, and in 1954 became head of organic chemistry and associate scientific director at the Central Research Institute of the Hungarian Academy of Sciences in Budapest.He returned to Harvard for graduate work and master's degree in 1898 with his thesis on The electron and a molecule. A year later he obtained his doctorate and his thesis was titled Some electrochemical and thermochemical relationships of zinc and cadmium amalgams".At Harvard he served as an instructor for a year, then travelled to Europe on a scholarship. He studied with the great physicochemical of the time.In 1899 he travelled to Germany to study with Wilhelm Ostwald Leipzig and later with Walter Nernst at the University of Göttingen; then he worked for the Philippine government.Between 1999 and 1906 he taught chemistry at Harvard University and later was hired by the Massachusetts Institute of Technology, where he was from 1907 to 1912.He later became a professor of physical chemistry at the University of California (Berkeley), where he obtained the degree of dean of the School of Chemistry.In 1908 he published his first article on the theory of relativity in a parallel with Albert Einstein. In this he establishes that there is a link between energy-mass, but in a different direction from that used by Einstein.On June 21, 1912 Lewis married Mary Hinckley Sheldon, with whom he had three children: Margery S. Lewis, Edward S. Lewis, and Richard Newton Lewis.His work in California was interrupted by the outbreak of the First World War. In 1917 he was commissioned to work for the US Army, where he became chief of the Defense Division of the Chemical Warfare Service.Lewis's dedication and ability to work allowed the army to reduce the number of casualties it had hitherto suffered from the use of gas by enemy armies. At the end of the war, he was decorated with the highest honors for his services.

Some of the most important contributions of Gilbert Newton Lewis to science are the following:

Lewis structures

There are several methods that serve to represent the structure of a molecule. In these the symbols of the elements represent the atoms, while the dots represent the electrons that surround them. An example of this is the representation of hydrogen, helium, and carbon.

Lewis was the first to propose the idea that atoms could stay together by comparing pairs of electrons; for this reason he created the symbolism of the structures.The broad bond theory proposed by Lewis served to group all types of chemical bonds into a single concept. In this way it was possible to demonstrate the relationships between ionic, molecular, covalent and metallic substances. Until then these elements had not had any conceptual connection.

Covalent bond

He conceptualized the covalent bond that is formed between two atoms when they join to achieve the stable octet and share electrons of the last level, except for hydrogen, which manages to achieve stability by having 2 electrons.

Octet theory

It was enunciated by Lewis in 1916. In this it is established that the ions belonging to the elements of the periodic system tend to complete their last energy levels with a number of 8 electrons. This allows them to acquire a very stable configuration.

Photon

He was the creator in 1926 of the term photon to designate the smallest unit of light energy. This particle of energy transmits all existing forms of electromagnetic radiation (X-rays, infrared, gamma, ultraviolet, microwave, radio waves, etc.).

Chemical attraction and valence

Together with his chemist colleague Irwing Langmuir, he developed the theory of chemical attraction and valence, which is known as the Langmuir-Lewis theory. For this he relied on the atomic structure of substances.

Heavy water

Lewis was also the first scientist to study and produce heavy water (deuterium) in its pure state. He was also the first to apply the principles of thermodynamics in the study of chemical problems.

Theory of solutions

Likewise, Lewis is recognized for his work on the theory of solutions; that is, the homogeneous mixtures that are obtained from the interposition of the atoms, molecules or ions present in two or more substances. These substances called components are involved in varying proportions

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