An Introductory overview of nanotechnology

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Abstract -

Nanotechnology is the process of taking advantage of a material's unique properties at the nanoscale. Nanotechnology is growing in popularity across several industries as a result of the better quality and smarter products it offers. The use of nanotechnology in healthcare and medicine is known as nanomedicine, and it has been used to treat some of the most prevalent diseases, including heart disease and cancer. A summary of recent changes in the current article, nanotechnology in the fields of imaging and drug delivery is discussed.

Keywords –

Nanotechnology, Nanoscience, Medicine, Cardiovascular disease.

Introduction -

Utilizing this understanding to create or alter unique objects is known as nanotechnology. The study of the unique characteristics of materials between 1 and 100 nm is known as nanoscience. Because atomic-scale structures can be changed, nanomaterials can be created. Nanomaterials can be used for a variety of purposes, including as electronics and medicine. display unique nanoscale optical, electrical, and/or magnetic properties. they provide a high surface Nanomaterials are outstanding in terms of area to volume ratio. Quantum mechanics rules govern the behavior of nanomaterials. the classical rules of physics and chemistry instead of mechanics, as opposed to typical large-scale systems and manufactured items. In its most basic form, nanotechnology entails the production of useful items and functioning atomic- or molecular-scale systems.

Since nanotechnologies offer better-built, safer, cleaner, longer-lasting, and smarter goods for agriculture, communications, everyday life, and other industries, they have significantly impacted practically all sectors of the economy and society. There are two main categories of how nanoparticles are used in common items. First, by incorporating some of its special

features into a pre-existing product, nanomaterials can enhance the composite products' overall performance. Otherwise, due to their unique features, nanomaterials like nanoparticles and nanocrystals can be used directly to produce sophisticated devices with high power.

Nearly all industrial areas may be impacted by the advantages of nanomaterials in the future.Sunscreens, cosmetics, athletic goods, tyres, electronics, and many other commonplace objects all make use of nanoparticles for good. A further example of how nanotechnologies have significantly impacted medical advancements is how they have completely changed diagnostic techniques, imaging, and drug delivery.[1]

Definition of nanotechnology -

The Greek prefix "nano" means "dwarf" or "very small" and stands for one millionth of a meter (109 m), or one billionth of a meter. The two terms, nanotechnology and nanoscience, must be distinguished. applying nanotechnology. Nanoscience is the discipline of technology that examines structures and molecules on scales between 1 and 100 nm in order to create things like electronics and other products.[2]

Application in medicine -

It should be able to build machines on the micrometer size from components on the nanoscale scale within the next 10 to 20 years. Such devices may incorporate helpful robotic subassemblies like 100 nanometer manipulator arms, 10 nm sorting rotors for reagent purification on a molecule-by-molecule basis, and smooth, ultra-hard surfaces formed of automatically perfect diamond.

The vital duty of turning on, off, and controlling such nanomechanical devices would fall to nanocomputers. Nanocomputers would store and retrieve information to assure the safe operation of the nanomechanical devices. execute mission plans, take in and analyze external signals and stimuli, talk to other nanocomputers, or Obtaining contextual awareness and using external controls and monitoring equipment. Such technology has significant consequences on the domains of medicine and dentistry.[3]

With the use of programmable nanorobotic devices, medical personnel could perform precise treatments at the cellular and molecular level. Improved respiratory health, mechanical reversal of atherosclerosis, and brain damage, enabling almost immediate homeostasis, boosting the immune system, replacing or rewriting DNA sequences in cells, healing massive cellular injuries whether brought on by irreversible Medical nanorobots have been suggested, either by biological tissue cryogenic preservation or procedures.

Mechanism of drug delivery

Blood transports the medications contained inside the nanoparticle to the desired location in the bones. In order to create efficient methods of medication delivery and localisation, NP drug encapsulated encapsulation offers a number of benefits. Np characteristics like particle size and surface charge are crucial in developing efficient NP delivery systems that work via a variety of mechanisms.[4]

Mechanism of nanoparticle brain drug delivery

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Toxicology

Safety and toxicological concerns require complete attention if nanotechnology is to be used to its full potential in nanomedicine. To improve the so-called therapeutic ratio or index, which is the difference between the dose required for clinical efficacy and the dose causing harmful side effects (toxicity), particular drug delivery formulations may be used in the pharmaceutical industry. However, a toxicological assessment is required for these particular formulations as well. This is especially true for the use of nanoparticles in medication delivery applications. Particles are purposefully introduced into the environment and human body in various applications, and some of these novel applications are anticipated to significantly improve healthcare.[5]

Role of nanoparticles in Alzheimer's Disease -

The second most common neurological ailment is Parkinson's disease, which has difficulties with reliable drug administration in both diagnosis and therapy. Levodopa, the conventional Parkinson's disease medication, has a restricted bioavailability and poor transport to the brain, which is its most puzzling drawback. Innovative solutions to this problem come from nanotechnology, which takes the lead. PD can be treated with a variety of There are various types of nanoparticles employed, including metal nanoparticles, organic nanoparticles, liposomes, and gene therapy.These nanoparticles enable drugs to cross the blood-brain barrier (BBB) in a number of different ways.

Bhattamisra et al. demonstrated that Rotigotine medicine was loaded on chitosan nanoparticles in human SH-SY5Y neuroblastoma cells and delivered by the nose to the brain using a rat model of Parkinson's disease. A examination of the pharmacokinetic data indicates that route is the best method for delivering rotigotine to the brain in a straight channel.[5]

Polymeric Nanoparticles -

Tacrine was delivered intravenously after being placed onto polymeric nanoparticles. It also decreased the total dose while increasing tacrine concentration in the brain.

The medication rivastigmine was placed onto polymeric nanoparticles and given intravenously. It improved one's capacity for memory and learning.[5]

Solid lipid nanoparticles -

SLNPs enhanced drug retention in the brain area, raising absorption across the BBB . Some of the drug’s effects are listed below.

Piperine drug is loaded on solid lipid nanoparticles through an intraperitoneal route inside the brain to decrease plaques and masses and to increase AChE enzyme activity .Huperzine A improved cognitive functions. No main irritation was detected in rat skin when the drug was loaded on SLNPs in an in vitro study .[5]

Effects of nanoparticles on cardiovascular system

Engineered nanoparticles with ligand coatings are being investigated and exploited as molecular imaging agents or drug delivery techniques, as we previously stated. This has greatly advanced our understanding of the characteristics of particles that can influence tissue penetration without impacting tissue function.Anionic particles are frequently fairly non-toxic, however cationic NPs, such as polystyrene and gold, have been shown to induce hemolysis and blood clotting. coagulation. This conceptual understanding could be used to reduce the potential effects of accidental NP exposure. To increase drug half-life or minimize side effects, drug-loaded nanoparticles have also been used. showed which particle characteristics must be altered in order to permit distribution while maintaining biocompatibility.[5]

Conclusion -

Numerous scientific domains have been touched by the growth of nanoscience and nanotechnology. For instance, several microscopes may currently examine objects at ranges ranging from micro to nano in physics. In Carbon dots are visible at ranges ranging from micro to nano in chemistry. Room-sized computers have been supplanted in computer science by small, tiny laptops. Furthermore, a single complex biomolecule can be investigated in biology. on a nanoscale. All of these developments in science have been thoroughly examined.

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