

CHEMISTRY

ASSIGNMENT

Name: Soumeshver. M,

Department: Computer Science,

College: United Institute.

of Technology,
Date of Submission: 10-01-2022.

Assignment on Nanochemistry

1. Describe the term nanochemistry and nanotechnology

Nanochemistry:

Nanochemistry refers to the study of nano-sized particles which generally consists of numerous structures of matter having dimensions of the order of a billionth of a meter. It is also closely associated with the synthesis of building blocks of matter which always depends on the size, surface, shape, defects etc. of the nano-sized particles.

The term "Nano" in the word nanochemistry means a billionth (1×10^{-9} m). It can also be expressed as 10^{-9} Å units. Nanochemistry is being largely used in chemicals, materials of day-to-day use, physical as well as in engineering, biological and medical applications.

Nanochemistry deals with the concepts and various proactive methods that can be

used to create carbon nanomaterials such as carbon nanotubes (CNT), graphene and even fullerene which have gained more demand in the recent years and it has occurred only due to their remarkable mechanical and electrical properties.

The mechanical properties of nanoparticles dealing with nanochemistry are that they have less defects compared to the bulk materials which also increases their mechanical rigidity. It is only due to this property that they find applications in making of the spark plugs and micro drills. They are also very stronger, harder, wear resistant and corrosion resistant.

The ~~set~~ electrical properties of nanoparticles dealing with nanochemistry are that they are possessed with excellent insulating properties due to which they

are used as separators in batteries. They can also hold more energy than the bulk materials. They are also used in polymeric fibres due to their electrical conductivity.

Here, usually electrical conductivity decreases with respect to the surface scattering, but, if better ordering of microstructures are done in the nanomaterials, then they can be used effectively in manufacturing of ^{the} polymeric fibres.

Nanotechnology:

Nanotechnology is the process that refers to the designing, characterization, production and application of nanostructures, nanosystems and nanodevices by controlling their numerous properties (especially size & shape) at 10^{-9} m (which can also be denoted as 1 to 100 nm that gives the nanoscale range) or at the single-atomic level.

Nanotechnology that provides atomic, molecular and supermolecular properties are used for all industrial purposes. The main goal of nanotechnology is manipulating atoms and molecules for fabrication of macroscale products also referred to as molecular nanotechnology. An initiativeⁱⁿ by name National Nanotechnology Initiative has actually defined manipulation of nanomatter in a detailed manner. Quantum mechanical effects are referred to as a mandate because they give the quantum-realm scale that helps to effectively research a lot more interesting attributes in the field of nanotechnology. An interesting fact is that the nanomaterials, nanostructures etc involved in nanotechnology have special properties like provide a large surface area as also their size remains below the given threshold size which in turn make them a future prospect in real-time applications in this modern technology guided world.

2. What are nanobots?

Nanotechnology that is closely related with the research-aided and development-aided progress pertaining to the structures that are approximately 1-100 nanometres and such that if they focus on creating robots that are in the nanoscale range, then it refers to developing the nanorobots (or simply nanobots). These nanobots are said to approximately be 0.1-10 micrometers in size. Even then, nanobots are also ^{minute} items that interact with objects at the nanoscale range and manipulating nanoscale items. Thus, even if the device itself is much larger, it may be considered a nanorobotic instrument.

Most of the nanorobotics and nanobots is still in the theoretical phase, with research focused on solving the various problems of construction at such a small scale.

The nanomachines and prototype and nanomotors have been designed and tested.

Most currently existing nanorobotic devices fall into one of four categories, namely: switches, motors, shuttles, and cars.

Nanorobotic switches ^{are} operated by being prompted to switch from an "off" state to an "on" state. Environmental factors are used to make the machine change shape, a process called conformational change. Alterations are done in the environment by using the chemical reactions, ultraviolet radiations, temperature etc and thus the nanorobotic switches shall be transformed into numerous forms with unique properties that help to accomplish any particular important tasks.

The Nanomotors are complex than nanoswitches and they use and utilize the energy created from the effects related to the conformational & transformational changes that ultimately produce locomotivity of molecules in the surrounding environment.

Shuttles are nanobots that transport chemicals (especially drugs) to the regions of interested their target sites. If shuttles and nanobot motors are confined together in phase, they can attribute to a greater degree of movement ^(locomotion) through an environment.

Nanorobotic cars are the most advanced nanodevices and are capable of moving independently with prompts from electroma-
-gnetic ^{and} chemical catalysts. They also include driving of the nanobotic cars; steering, applying brakes, transmission of good fuel ~~to~~ in the engine and other necessities. There are also many researchers ^{are} who ^{are} experimenting on the various nanorobotic control methods.

3. Explain in detail nanobots guided by Artificial Intelligence

Artificial Intelligence nanobots:

Artificial Intelligence nanobots are very tiny machines. They are so minute that thousands of such nanomachines (mainly nanochips,

nanosensors, nanocircuits etc) can fit even across the diameter of a single human hair. Many researches have also been undertaken in analysing and documenting the potential characteristics of these nanobots that can help to improve nutrition and human health. We are still a long way from hypothetical applications, but effective progress is always being made. In 2017, scientists had created nanobots that would target the cancer cells, attacking them with a miniaturized drilling needle and killing them. Another flamboyant example, ^{is that} in 2021, researchers from ITMO University had joined hands in developing a nanobot ^{structure} that comprises of DNA fragments capable of destroying the pathogenic RNA strands.

DNA-based nanobots are currently capable of transporting molecular cargo. The nanobot used for this purpose is designed with three different DNA sections, maneuvering with a DNA "leg" and carrying specific molecules to the target sites with use of "arm-like

DNA - structures"

DNA origami nanorobot aided with Artificial Intelligence:

It is a structural DNA nanotechnology nanobot that is generally taking place due to the molecular self-assembly process. This process is called the DNA origami nanobot and it is mainly guided by all the 21st century's artificial intelligence.

It is used to fabricate nanodevices with complex nanoscale geometry, just by defining the placement of molecular functionalities. It is a versatile approach that is programmed mechanically and it also offers various dynamic properties.

The scientists have already began using this wonderful, creative and unique technology to design structures on scales of viruses and cell organelles in human body.

4. Elaborate the future possibilities of AI guided nanobots with example

- ★ Nanorobots can be used for the purpose of environmental remediation.
- ★ Nanorobots can be used to remove toxic heavy metals and plastics from water bodies that helps to prevent water contamination, water pollution and environmental degradation.
- ★ Nanorobots can be possibly used in nanobot navigation. Nanobot researchers and engineering are also continuously investigating and inventing and applying these techniques.
- ★ Nanorobots could be used for utilizing ultrasonic signals for ^{their} detection and deployment in nanomaterials.
- ★ Nanorobots could be used in Magnetic Resonance Imaging (MRI) devices.

Possibilities of Nanorobotic Medical Applications:

- * Nanorobotics can be used for diagnosing disorders in the human body and testing.
- * Nanorobotics could be used in Gene Therapy.
- * Nanorobots could be widely-used with better stoichiometric enhancements for cancer detection and its treatment.
- * Nanobots could be used to prevent and cure diabetes.
- * Nanobots might be used for parasite removal.
- * Nanorobots might be used for curing the deficiencies present in the cracking of kidney stones.
- * Nanorobotics would definitely be used in Atherosclerosis.
- * Nanorobotics could be used for breaking

up of blood clots.

Nanorobots in surgery:

- * Surgical nanorobots can be used to search for pathogens and then in diagnosing them.
- * In this process, they are also very important and ^{of high} priority in introducing capsules (that contains the ~~heat~~ healing toxins) into the human body through the cardio-vascular systems or through the other cavities.

Nanorobots in heart surgery:

- * Blood vessels are very important because they supply blood to all parts of the body.
- * Since the food that we consume at times can contains excess salts in it, these shall be deposited as fatty globules on the walls of blood vessels which hinders movement of blood throughout the body.
- * This may damage vital organs and shall also leads to heart attacks. If nanobots, guided with

AI are used, then such problems can be prevented.

Nanorobots in diabetes monitoring:

* Diabetes patients are to consume small blood samples (in packets) many times in a day to maintain glucose levels.

* To solve this uncomfortable and extremely time-consuming phenomena, a scientist by name Adriano Cavalcanti along with his colleagues ^{had} published a detailed thesis about medical nano robot hardware architecture and for blood, sugar level monitoring.

Nanorobots in nanobiosensors:

* Nanorobots combined with embedded nanobiosensors can be used to cure blood pressure as well as diabetes.

* The advantage it provides is that the information could directly be sent to

the patient's mobile using special RF signals which increases its efficiency.

Nanorobotics in infection:

* Nanorobots that destroy bacteria in our bodies much faster than the normal could be used to eliminate bacterial infections (like fungus formation).

* ~~Microbiophage~~ nanorobots could be used to attach antibodies to the specific target sites of bacterial infections to cure them.

Nanorobotics in kidney stones:

* They might be used to carry small ultrasonic signal generators to deliver frequencies to kidney stones.

* They can be used to cure the problems caused by ^{formation of} kidney stones.

Conclusion:

Nanorobots guided by Artificial Intelligence are remaining very versatile and user-friendly to humankind in so many such real-time applications. So, it will always remain very useful in the future.

Also, nano robot production has ^{shown} development and ^{being at} from a nascent stage a few years ago, hopefully there are many probable chances of functional autonomous nano robots coming into usage, ^{especially} in medicine and in industries and in the pharmaceutical areas in the near future ~~or~~ or in the next few decades.