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Nanorobots

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KEYWORDS:

Introduction

Nanorobotics is the technology of creating machines or robots at or close to the microscopic scale of a nanometer (10-9 meters). More specifically, nanorobotics refers to the still largely hypothetical Nanotechnology engineering discipline of designing and building nanorobots, devices ranging in size from 0.1-10 micrometers and constructed of nanoscale or molecular components. As no artificial non-biological nanorobots have yet been created, they remain a hypothetical concept.

The names nanobots, nanoids, nanites or nanomites have also been used to describe these hypothetical devices. Nanorobots are nanodevices that will be used for the purpose of maintaining and protecting the human body against pathogens. Nanorobots might also produce copies of themselves to replace worn-out units, a process called self-replication.

A major advantage of nanorobots is thought to be their durability. In theory, they can remain operational for years, decades, or centuries. Nanoscale systems can also operate much faster than their larger counterparts because displacements are smaller; this allows mechanical and electrical events to occur in less time at a given speed.

Nanorobotics works

Nanorobotics plays vital role in the development of efficient robots. It uses nano components and there objects to build the structure of robots. Its nano nature allows scientists and engineers to engineer the mimic of human beings. Most complex parts of robots can be constructed well with the help of nanorobotics.

The devices which are created with the help of nanorobotics is known as hypothetical devices, names such as nanobots, nanoids, nanites or nanomites. Nanorobotics permits robots for presicions and interactions of different function with nano scale objects, all the robots with nanoscaling are operated at nanoscale resolution. Each part and component of a robot from infra structure chip to external body is configured at atomic scale. Although nanorobotics makes structure of the robot complex but it facilitates the device with extra ordinary intelligence and efficiency.

Instruments used in nanorobots

Nanorobotics has incredible applications in the field of science and technology. With the assistance of this diverse technology, world is now able to see and utilize the instruments which were nerver seen before. Some of the most famous nanorobotics instruments and applications are as under.

- Atomic force microscope
- Nano macro or microscale robots
- Nanomachines
- Toxicity detectors
- Single molecule car
- Nubots

Atomic force microscope

Atomic force microscope is an instrument which could be considered as nanorobotic instrument. It is configured and manipulated at nanoscale and also used to view the particle of an element or material at the smallest level. In the field of medical sciences atomic scope microscope is used to diagnose the cancer and other fatal bacteria.

Nano macro or microscale robots

Nanomacro and micro sale robots are also the invention of nanorobotics. These robots can move with the nanosclae presicion and can detect and scan the objects and obstacles in the way at completely without leaving a single particle. Nanotechnology delivered excellent applications such as microscopic robots that automatically gather the other devices or travel inside the human body to transfer drugs or do microsurgery. These robots are so fast that they can shake the most viscous fluids just in matter of seconds.

Nanomachines

Nanomachines are widely in research these days. Researchers have developed some of the testifying samples; one of the example of these molecular machines is the sensor having capability of counting particular molecule in the chemical compounds. There is no implementary application present in the medical field but these machines if properly developed for the medical applications, they could greatly help the doctors to destroy the cancer cells.

Toxicity detectors

Another useful application is the detection of toxic chemicals and the measurement of concentrated substances in the environment these detectors will be very useful and beneficial for the chemists in order to manage and reduce the toxicity of chemicals**.**

Single molecule car

Recently, another demonstration of nanorobotics is the single molecule car which has nano infra structure. These cars are developed by chemical process and have buck ball wheels. It is configured by controlling the temperature in the air and also by positioning the scanning tunnel microscope.

Nubots

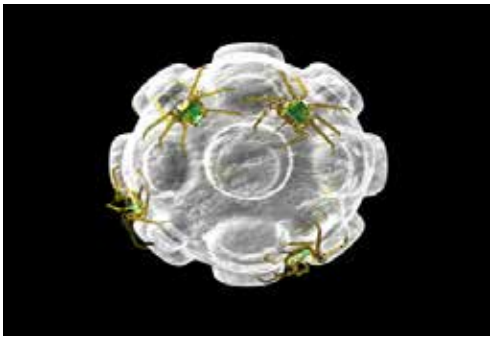
Scientific field has given new type of robots to the world which are known as nubots. Nubot is the abbreviation of "nucleic Acid Robots". These devices are operated at nanoscale and are highly beneficial for demstrataing the DNA test and blood cell detection.

Capabilities of Nanobots

Since this tiny size gives them the ability to interact at the bacteria and virus level, nanobots main function will probably be medical. They have the potential to revolutionize the medical community in almost every way. Nanorobots are so tiny that they could be easily injected into the bloodstream, where they would then float through the circulatory system in order to locate and fix problem areas of the body.

Nanobots Can Repair Damaged Tissue

The burgeoning field of nanotechnology has many useful and direct applications for the medical industry, and **nanorobots** are no exception to this rule. The medical science wants to create nanobots that can repair damaged tissue without pain and trauma.



Many of the medical procedures employ today are very traumatic to the human body and do not work in harmony with our natural systems. Chemotherapy wreaks havoc on humans and nearly kills them in the quest to kill off their malignant cancer cells. Invasive surgical procedures are also quite common today, with associated traumas that cause many patients to die on the operating table rather than survive and heal.

Nanorobots are so small that they actually interact on the same level as bacteria and viruses do and so they are capable of building with the very particles of our bodies- atoms and molecules.

Nanobots Are Made Out Of?

Nanotechnology as a whole is fairly simple to understand, but developing this universal technology into a nanorobot has been slightly more complicated. Many of the nanobot prototypes function quite well in certain respects but are mostly or partly biological in nature, whereas the ultimate goal and quintessential definition of a nanorobot is to have the microscopic entity made entirely out of electromechanical components.

In fact, researchers anticipate that due to the complicated nature of their construction, nanobots will only fully emerge after several generations of partly-biological nanobot forerunners have been constructed in order to make them.

Nanorobots are essentially an adapted machine version of bacteria. They are designed to function on the same scale as both bacteria and common viruses in order to interact with and repel them from the human system. Biological nanobots have technically been created, as have large or conventionally-sized robots with the ability to work on the nanoscale. But the traditional idea of nanorobots involves them being all or mostly mechanical, and these types of nanobots are the next step in nanotechnology.

There are many scientists and research groups currently hard at work on shrinking and adapting the conventional robot and they've gotten them pretty small, but not quite down to the nanoscale. The main problem seems to be the robotic power source for such a tiny machine.

Traditionally, most robots have a solar cell or some kind of battery pack, but obviously these are many times too large for nanobot. Researchers consider it highly likely that when equipped with a thin film of radioactive material, nanobots will be able to fuel themselves on particles released by decaying atoms. This fuel technology is easily scaled down to nano-size. It also proves immensely efficient because with such a self-driven system in place, nanobots would be able to function indefinitely and never require a replacement fuel cell as they would with batteries or solar power.

Silicon has always been the first choice for delicate electronics and has the right qualities to make a successful scaled-down robot, even one as tiny as a few hundred nanometers. It is strong enough to last and conduct electricity on a regular basis, but also flexible enough to be manipulated in various ways; this makes it the universal one-size-fits-all electronic material.

However, constructing nanobots out of silicon would subject them to the same issues that other silicon electronics face, one of which is that they are not biodegradable. If nanobots were to be produced on a large scale their enduring materials would not be as dangerous as all the microchips and computer electronics currently sitting in our landfills, but they would still be another small drain on our natural resources.

Silicon can be recycled into low-grade products like solar cells, but the process is long, complicated and usually costly. One of the issues associated with the final creation of the nanobot is autonomy. A suggested alternative to silicon components is installing a system whereby small clusters of molecules react to forces in their environment, convert these reactions into power, and use the resulting energy in order to move themselves forward.

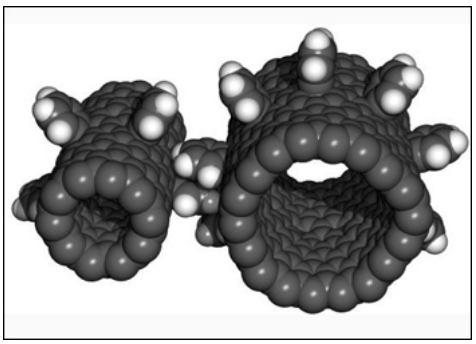
Hard oxides and metals that are typically used for electronics will be essential, but many of them (including silicon) have to be effectively reduced to the nanoscale before any serious work can go forward. Prototypes have been built using biological components, but the ultimate goal is to achieve a purely electromechanical model.

Future Effects of Nanotech on Health Care

- Creation of cell-repair-machines
- Early-disease-detection
- Treating cancer cells without damaging the cells
- Brain Aneurysm
- Treating arteriosclerosis
- Breaking up blood clots and helping the body clot
- **F**ighting cancer

Creation of cell-repair-machine

Present-day nano-scale manufacturing techniques leading to bacteria-sized mechanizations that could tell one cell from another by touch, repair DNA within a cell, and even are directed by computers to complete multiple missions in the same body. The possibility of actual nano-scale robots would completely change medicine.

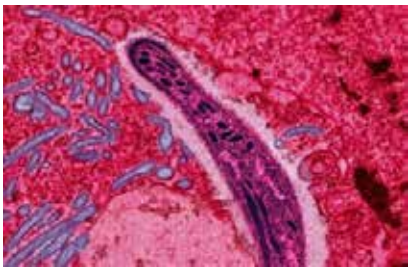


Made from carbon for its strength, such robots would have to be no larger than 3 nanometers at their largest dimension, so they can fit through capillaries and other passage ways of the human body critical for their transportation and use. Such robots could be injected into the body, controlled by "nanocomputers", and monitored by MRI.

Early-disease-detection

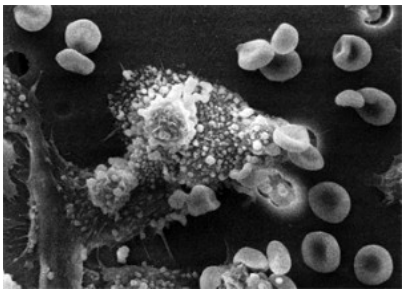
Nano devices could soon test for ailments on a cellular level via sensor testing chips holding thousands of "nanowires".

These little devices would be able to detect proteins and other biomarkers left by cancer cells. As a result, they could help detect such diseases in their early stage. All from a few drops of the blood.

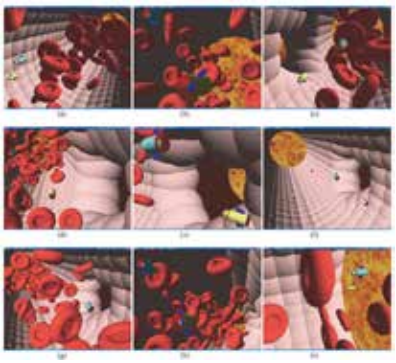


Treating cancer without damaging cells
Treating cancer these days often means subjecting one's entire body to chemotherapy and the toxic wake it leaves behind.

At between 10 and 100 nanometres, specialized nanoparticles could "cook" cancer cells with the help of radio waves or lasers, or do away with tumors by dropping folic acid "lures" directly into cancer cells, leaving adjacent healthy cells undamaged.



Nanorobot for Brain Aneurysm
The idea of nanorobots floating throughout our arteries to fight diseases and deliver drugs is migrating from science fiction to medical fact, at least in virtual 3D simulations. Nanorobotics pioneer Adriano Cavalcanti and his colleagues report progress with their nanorobot control design (NCD) software which helps them simulate the behavior of future nanorobots. The team released a new paper that proposes a model for how a nanorobot should help with the early detection of cerebral aneurysm. The process within each of the but the figure below illustrates the process neatly for you:



Nanorobots used to detect brain aneurysm: **(a)** the nanorobots enter the vessel and flow with the bloodstream **(b)** the nanorobots are moving through the vessel with the fluid **(c)** the aneurysm saccular bulb begins to become visible at the vessel wall **(d)** nanorobots move closer to the vessel deformation **(e)** mixed with the plasma, NOS (nitric oxide synthase) signals can be detected as the chemical gradient changes, denoting proteomic overexpression **(f)** the same workspace viewed without red cells **(g)** the nanobiosensor is activated as the nanorobots move closer to the aneurysm, emitting RF signals sent to the cell phone **(h)** as the nanorobots keep flowing, the chemical signals become weaker, deactivating the nanorobot transmission **(i)** red cells and nanorobots flow with the bloodstream until they leave the vessel.

An advanced nanomechatromics simulator, using a three-dimensional task-based environment, is implemented to provide an effective tool for device prototyping and medical instrumentation analysis."

First the research team, which includes the Center for Automation in Nanobiotech (CAN) along with Bijan Shirinzadeh from Monash University, and Toshio Fukuda and Seiichi Ikeda from Nagoya University, had to select an approach to developing nanorobots for common use in medicine. Instead, the team chose a nano-integrated circuit version that uses hybrid materials, photonics, and wireless communication for manufacturing and control.

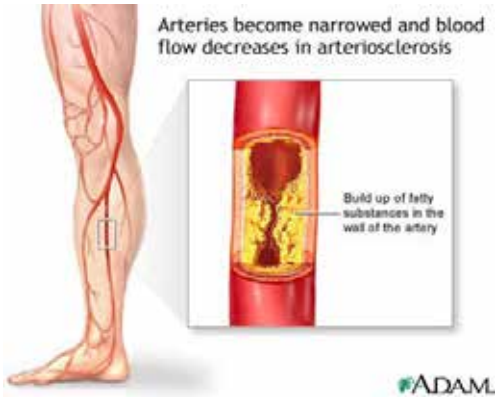
Then they identified and applied the following three key required pieces to advance the development and implementation of medical nanorobotics, according to the paper published by The International Journal of Robotics Research:

1. Equipment prototyping:
Computational nanotechnology provides a key tool for the fast and effective development of nanorobots, helping in the investigation to address major aspects on medical instrumentation and device prototyping.

2. The manufacturing technology:
For manufacturing purposes, the nanorobot should be integrated as a biochip device.

3. Inside-body transduction:
Cell morphology, microbiology, and proteomics are used as parameters for nanorobot morphology and inside-body interaction. Changes on chemical gradients and telemetric instrumentation are used for medical prognosis, with the nanorobots activation based on proteomic overexpression.

Treating arteriosclerosis:
Arteriosclerosis refers to a condition where plaque builds along the walls of arteries. Nanorobots could conceivably treat the condition by cutting away the plaque, which would then enter the bloodstream.



Nanorobots may treat conditions like arteriosclerosis by physically chipping away the plaque along artery walls.

Breaking up blood clots and Helping the body clot:
Blood clots can cause complications ranging from muscle death to a stroke. Nanorobots could travel to a clot and break it up. This application is one of the most dangerous uses for nanorobots the robot must be able to remove the blockage without losing small pieces in the bloodstream, which could then travel elsewhere in the body and cause more problems. The robot must also be small enough so that it do

One particular kind of nanorobot is the **clottocyte**, or artificial platelet. The clottocyte carries a small mesh net that dissolves into a sticky membrane upon contact with blood plasma. According to Robert A. Freitas, Jr., the man who designed the clottocyte, clotting could be up to 1,000 times faster than the body's natural clotting mechanism [source: Freitas]. Doctors could use clottocytes to treat hemophiliacs or patients with serious open wounds doesn't block the flow of blood itself.

Fighting cancer:

Doctors hope to use nanorobots to treat cancer patients. The robots could either attack tumors directly using lasers, microwaves or ultrasonic signals or they could be part of a chemotherapy treatment, de-

livering medication directly to the cancer site. Doctors believe that by delivering small but precise doses of medication to the patient, side effects will be minimized without a loss in the medication's effectiveness.

Advantages of Nanotechnology

- Nanotechnology can actually revolutionize a lot of electronic products, procedures, and applications. The areas that benefit from the continued development of nanotechnology when it comes to electronic products include nano transistors, nano diodes, OLED, plasma displays, quantum computers, and many more.
- Nanotechnology can also benefit the energy sector. The development of more effective energy-producing, energy-absorbing, and energy storage products in smaller and more efficient devices is possible with this technology. Such items like batteries, fuel cells, and solar cells can be built smaller but can be made to be more effective with this technology.
- Another industry that can benefit from nanotechnology is the manufacturing sector that will need materials like nanotubes, aerogels, nano particles, and other similar items to produce their products with. These materials are often stronger, more durable, and lighter than those that are not produced with the help of nanotechnology.
- In the medical world, nanotechnology is also seen as a boon since these can help with creating what is called smart drugs. These help cure people faster and without the side effects that other traditional drugs have. You will also find that the research of nanotechnology in medicine is now focusing on areas like tissue regeneration, bone repair, immunity and even cures for such ailments like cancer, diabetes, and other life threatening diseases.

Disadvantages of Nanotechnology

- Included in the list of disadvantages of this science and its development is the possible loss of jobs in the traditional farming and manufacturing industry.
- The development of nanotechnology can also bring about the crash of certain markets due to the lowering of the value of oil and diamonds due to the possibility of developing alternative sources of energy that are more efficient and won't require the use of fossil fuels.
- Atomic weapons can now be more accessible and made to be more powerful and more destructive. These can also become more accessible with nanotechnology.
- Since these particles are very small, problems can actually arise from the inhalation of these minute particles, much like the problems a person gets from inhaling minute asbestos particles.
- Presently, nanotechnology is very expensive and developing it can cost you a lot of money. It is also pretty difficult to manufacture, which is probably why products made with nanotechnology are more expensive.

Applications Using Nanorobots

Some possible applications using nanorobots are as follows:

- To cure skin diseases, a cream containing nanorobots may be used. It could remove the right amount of dead skin, remove excess oils, add missing oils, apply the right amounts of natural moisturising compounds, and even achieve the elusive goal of 'deep pore cleaning' by actually reaching down into pores and cleaning them out. The cream could be a smart material with smooth-on, peel-off convenience.
- A mouthwash full of smart nanomachines could identify and destroy pathogenic bacteria while allowing the harmless flora of the mouth to flourish in a healthy ecosystem. Further, the devices would identify particles of food, plaque, or tartar, and lift them from teeth to be rinsed away. Being suspended in liquid and able to swim about, devices would be able to reach surfaces beyond reach of toothbrush bristles or the fibres of floss. As short-lifetime medical nanodevices, they could be built to last only a few minutes in the body before falling apart into materials of the sort found in foods (such as fibre).
- Medical nanodevices could augment the immune system by finding and disabling unwanted bacteria and viruses. When an invader is identified, it can be punctured, letting its contents spill out and ending its effectiveness. If the contents were known to be hazardous by themselves, then the immune machine could hold on to it long enough to dismantle it more completely.

Conclusion

Nanorobots are nanodevices that will be used for the purpose of maintaining and protecting the human body against pathogens. Noteworthy, this development was the result of a highly collaborative effort and a synthesis of several advanced technologies: "The current study establishes proteomics, nanobioelectronics, and electromagnetics as the basis to advance medical nanorobotics." "The nanomachine platform design was based on clinical data, proteomic signals, cell morphology, and numerical analysis. For the proposed model, the nanorobots were able to recognize chemical gradient changes in the bloodstream, retrieving information about the position inside the vessel as intracranial aneurysm detection. An important and interesting aspect in the current development is the fact that this platform, presented in terms of device prototyping and system architecture integration, can also be useful for a broad range of applications in medicine."

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