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NANOROBOTICS, THEIR MAKEUP & APPLICATIONS – A REVIEW

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ABSTRACT

Nanorobotics is the emerging technology field creating machines or robots whose components are at or close to the scale of a nanometer (10^{-9} meters). More specifically, nanorobotics refers to the nanotechnology engineering discipline of designing and building nanorobots, with devices ranging in size from 0.1–10 micrometers and constructed of nanoscale or molecular components. The names nanobots, nanoids, nanites, nanomachines or nanomites have also been used to describe these devices currently under research and development. Nanomachines are largely in the research-and-development phase, but some primitive molecular machines have been tested. An example is a sensor having a switch approximately 1.5 nanometers across, capable of counting specific molecules in a chemical sample. The first useful applications of nanomachines might be in medical technology, which could be used to identify and destroy cancer cells. Another potential application is the detection of toxic chemicals, and the measurement of their concentrations, in the environment. Rice University has demonstrated a single-molecule car developed by a chemical process and including buckyballs for wheels. It is actuated by controlling the environmental temperature and by positioning a scanning tunneling microscope tip. Another definition is a robot that allows precision interactions with nanoscale objects, or can manipulate with nanoscale resolution. Such devices are more related to microscopy or scanning probe microscopy, instead of the description of nanorobots as molecular machine. Following the microscopy definition even a large apparatus such as an atomic force microscope can be considered a nanorobotic instrument when configured to perform nanomanipulation. For this perspective, macroscale robots or microrobots that can move with nanoscale precision can also be considered nanorobots.

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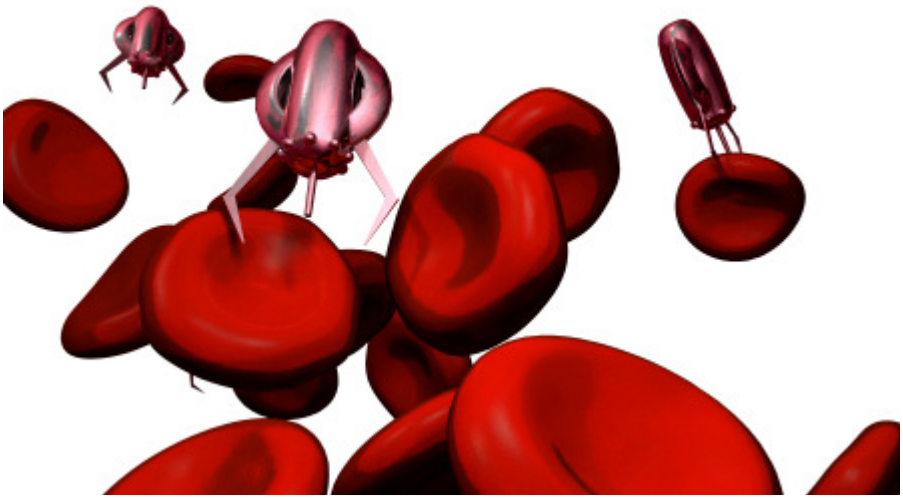
NANOROBOTICS MAKEUP:

Nanotechnology as a whole is fairly simple to understand, but developing this universal technology into a nanorobot has been slightly more complicated. To date, scientists have made significant progress but have not officially released a finished product in terms of a nanorobot that functions on an entirely mechanical basis. 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. Since they are so small that you can't see them with your naked eye, they will also possibly be used to perform "miracle" functions such as cleaning your kitchen ("the kitchen that cleans itself!") invisibly weaving fabric, cooking food slowly but steadily, and essentially performing other functions that humans *could* do, but—let's face it—will probably be too lazy to do ourselves by the time these nanobots become functional.



Since the best way to create a nanobot is to use another nanobot, the problem lies in getting started. Humans are able to perform one nano-function at a time, but the thousands of varied applications required to construct an autonomous robot would be exceedingly tedious for us to execute by hand, no matter how high-tech the laboratory. So it becomes necessary to create a whole set of specialized machine-tools in order to speed the process of nanobot building. Researchers have been chipping away at this problem for decades. In 1989 they discovered how to manually operate the system; a group of IBM engineers lined individual atoms up one by one until they had spelled out their company's name. In doing so they not only created the smallest business logo in history, but also discovered for themselves just how long and grueling the process of hand-building even a single nanobot would be. True, nanobots measure more like six atoms across, but they are far more complicated in design and need to be engineered in such a way that they are autonomous. The ideal nanobot consists of a transporting mechanism, an internal processor and a fuel unit of some kind that enables it to function. The main difficulty arises around this fuel unit, since most conventional forms of robotic propulsion can't be shrunk to nanoscale with current technology. Scientists have succeeded in reducing a robot to five or six millimeters, but this size still technically qualifies it as a macro-robot. One possible solution is to adhere a fine film of

radioactive particles to the nanobot's body. As the particles decay and release energy the nanobot would be able to harness this power source; radioactive film can be enlarged or reduced to any scale without a drop in efficiency occurring. Another nice side effect of this system is its ability to renew automatically. With the constant circulating nuclear energy it would supply, this fuel cell would never need to be replaced. This puts it several notches above solar cells or conventional battery packs of any size, which were previously the other two options being considered for equipping the nanorobot. The other problem with constructing a successful nanorobot lies in breaking its materials down small enough. Metal that might be used for the robot's construction behaves one way in relatively large quantities and a completely different way on the nanoscale—in fact, this is the entire basis for nanotechnology as a discipline. Experts believe that silicon might make the ideal material, especially since it has been traditionally used for delicate electronics, particularly small computer parts. Microscopic silicon components called transducers have so far been successfully built into nanorobot legs. Scientists are hard at work on designing a body built out of transducers; they are encountering slight problems in agreeing on what the final shape of the standard nanobot should be. Very few researchers support the biped-humanoid design, since this has given test robots a strange, clumsy shuffle. The nanobot needs to be fast, aerodynamic and smooth-moving in order to complete its functions. Some people think that a spider-like body would work best, but many nanorobot researchers also think that a smaller version of the centipede might be best. They hope that by equipping the nanobot with several sets of fast-moving legs and keeping its body low to the ground, they can create a quick, efficient machine that would also be suitably shaped for introduction into human blood vessels to perform functions such as clearing away built-up cholesterol or repairing tissue damage. These tasks are key to the concept of a nanorobot, since it is anticipated that many of their most useful applications will be in the medical field. Doctors and researchers expect nanobots to be useful for a wide variety of things, since a robot this small can actually interact with materials on their molecular and atomic level. Because of this special capability, the nanobots can build or destroy particle by particle. They could rebuild tissue molecules in order to close a wound, or rebuild the walls of veins and arteries to stop bleeding and save lives. They could make their way through the bloodstream to the heart and perform heart surgery molecule by molecule without many of the risks and discomfort associated with traditional open-heart operations. Likewise, researchers hope that nanorobots will have many miraculous effects on brain research, cancer research, and finding cures for difficult diseases like leukemia and AIDS. Although standardized nanorobot production has not yet been fully realized, scientists are hard at work developing a system for constructing these tiny helpers. Chances are good that sometime in the next 25 years they will make their public debut.

HOW NANOROBOTICS WORK?

Nanorobotics is one of the technology which came into being with the advancement in nanotechnology.Its a technology for creating automatic machines,respondent devices and robots at the atomic scale of 10-9 nanometers.Nanorobotics is one of the major discipline of largest and most complex engineering and designing nanorobots.Nanorobots are constructed with the molecular components ranging from 0.1 to 10 micrometers and with the help of nanorobotics ninety nine percent human like non biological robot can be constructed.At present nanorobotics has emerging applications in the field of medicine and technology. 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 are also used to explain the machines by nanorobotics. 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 nanorootics makes structure of the robot complex but it facilitate the device with extra ordinary intelligence and efficiency.

NANOROBOTICS APPLICATIONS & INSTRUMENTS:

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.

1) Atomic force microscope

Atomic scope microscope is on the instrument which could be considered as nanorobotic instrument. It is configured and manupulated at nanoscale and also used to vie 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.

2) Nano macro/microscale robots

Nano macro and micro sale robots are also the invention of nanorobotics.These robots can move with the nanosclae precision 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 gathers 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.

3) 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 particlular 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.

4) Toxicity detectors

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

5) Single molecule car.

Recently, another demostration of nanorobotics is the single molecule car which has nano infra structure .This car is devleoped by chemical process and have buckyball wheels.It is configured by controlling the tempertaure in the air and also by positioning the scanning tunnel microscope.

6) Nubots

Scientific field has given given new type of robots to the world which are known as nubots. Nubot is the abbrevation of “nuclic Acid Robots.” These devices are operated at nanoscale and are higly benificail for demstrataing the DNA test and bloddcell detection.

MEDICAL NANOROBOTIC APPLICATIONS

Applications of nanorobots are expected to provide remarkable possibilities. An interesting utilization of nanorobots may be their attachment to transmigrating inflammatory cells or white blood cells, to reach inflamed tissues and assist in their healing process. Nanorobots will be applied in chemotherapy to combat cancer through precise chemical dosage administration, and a similar approach could be taken to enable nanorobots to deliver anti-HIV drugs. Such drug-delivery nanorobots have been termed “pharmacytes” by Freitas . Nanorobots could be used to process specific chemical reactions in the human body as ancillary devices for injured organs. Monitoring and controlling nutrient concentrations in the human body, including glucose levels in diabetic patients will be a possible application of medical nanorobots. Nanorobots might be used to seek and

break kidney stones. Another important possible feature of medical nanorobots will be the capability to locate atherosclerotic lesions in stenosed blood vessels, particularly in the coronary circulation, and treat them either mechanically, chemically or pharmacologicall . The coronary arteries are one of the most common sites for the localization of atherosclerotic plaques, although they could be found in other regions as well.

FUTURE POTENTIAL USES FOR NANOROBOTS:

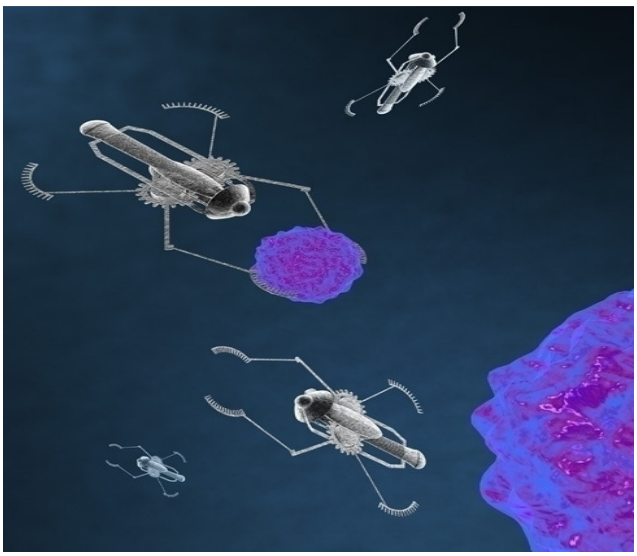
Most science fiction movies depict nanorobots in a swarm, predominantly in medical or extreme military uses. Some of these depictions are based on nanotheory that allows nanorobots to rebuild matter and to be able to create food, protein, or even other microprocessors if programmed appropriately. Another potential use for the technology is to use nanorobots to build new nanorobots in a self/automatic replication form, which can be coupled with swarm theories to accomplish tasks. Most nanorobot research is focused on the medical sciences. Since nanorobots can operate at the same scale as viruses, cancers, and bacteria, they hold the promise of being able to directly fight these intrusions to the human body, conduct health scans, or to ensure the body's tissues and organs are working at its optimal level.

Cancer patient could be injected with a specific type of nanobot that will look for and eradicate cancer cells. This sort of treatment will eliminate the side effects of hair loss, nausea and tiredness usually associated with conventional cancer treatment such as radiation and chemotherapy. Another good application would be to use nanobots to clear

blocked arteries. They could also act as antibodies for patients with weak immune systems. Nanobots can also be used in electronics and manufacturing industries to build small form factor devices or large industrial installations. Nanobots can be used in environment cleanup initiatives such as cleaning of oil spills, toxic dump sites, polluted water sources and so on.

Potential Military Roles of Nan robots?

Nanorobots research in the military is mainly focused on protecting individual soldiers while in combat. They can be used as an improved body armor that is capable of self repair if damaged. This body armor would not be the super suits seen in some recent science fiction films. Rather, they would be a generational leap in protective capabilities over the current body armors deployed to the field. Nanorobots will be used in the near future to rapidly repair injured people and damaged equipment on the battlefield and as eavesdropping devices that are practically undetectable. Nanorobots could prove to be one of the largest developments in war technology since the advent of the atomic bomb in World War II, due to the expected difficulty in countering the first weapons developed with the technology.



CONCLUSION:

Research in nano-robotics will allow for a better understanding of the functioning of the human body at molecular and nano-metric level. There is controversy generated by the possible toxic health effects of nano-particles. Immobilized nanostructures inside or on surfaces of medical devices, such as surgical implants, are expected to pose a minimal risk provided they remain fixed. While nanotechnology-based products are already in use, further research is needed on the potential risks to human health that could be associated with this new technology. As we know Nanorobotics have tremendous use in treating many diseases, more research should need to be carryout in this way to make these possibilities applicable to human being. Developing nanotechnologies are being pursued for general cellular processes such as ubiquitous signaling pathways that may benefit numerous physiological systems, as well as being targeted toward the particular challenges of specific disorders such as diabetes mellitus, Cancer, Alzheimer's, arteriosclerosis, and AIDS.

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