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Review Article

NANOROBOTS: A HUGE FUTURE FOR SMALL INNOVATION

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Nanorobots are theoretical microscopic devices measured on the scale of nanometers (1 nm equals one millionth of a millimeter). When fully realized from the hypothetical stage, they would work at the atomic, molecular and cellular level to perform tasks in both the medical and industrial fields that have heretofore been the stuff of science fiction. Nanorobots are expected to enable new treatments for patients suffering from different diseases, and will result in a remarkable advance in the history of medicine. Recent developments in the field of biomolecular computing have demonstrated the feasibility of processing logic tasks by bio-computers There are some works on how to enable manufacturing of inorganic nanorobots. The nanorobots, nanoplastics and nanofibers are of same class and we have tried to discuss here in detail.

Key words: Nanorobots, nanofibers, nanoplastics, medical field.

INTRODUCTION

A nanorobot is a tiny machine designed to perform a specific task or tasks repeatedly and with precision at nanoscale dimensions, that is, dimensions of a few nanometers (nm) or less, where 1 nm = 10^{-9} meter. Nanorobots have potential applications in the assembly and maintenance of sophisticated systems. Nanorobots might function at the atomic or molecular level to build devices, machines, or circuits, a process known as molecular manufacturing. Nanorobots might also produce copies of themselves to replace worn-out units, a process called self-replication.

Nanorobots are of special interest to researchers in the medical industry. This has given rise to the field of nanomedicine. It has been suggested that a fleet of nanorobots might serve as antibodies or antiviral agents in patients with compromised immune systems, or in diseases that do not respond to more conventional measures. There are numerous other potential medical applications, including repair of damaged tissue, unblocking of arteries affected by plaques, and perhaps the construction of complete replacement body organs.

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.

1. Nanorobot for Medicine

Organic nanorobots are the work on ATP and DNA based molecular machines, also known as bionanorobots [1]. In this case the idea is the development of ribonucleic acid and adenosine triphosphate devices, and even the use of modified microorganisms to achieve some kind of biomolecular computation, sensing and actuation for nanorobots. Another approach for the development of molecular machines is the inorganic nanorobot.

1.1 Manufacturing Technology

A nanorobot must be equipped with the necessary devices for monitoring the most important aspects of its operational workspace. Depending on the case, different gradients on temperature, concentration of chemicals in the bloodstream, and electromagnetic signature, are some of relevant parameters when monitoring patients. Teams of nanorobots may cooperate to perform predefined complex tasks on medical procedures. For such aims, computing processing, energy supply, and data transmission capabilities can be addressed through embedded integrated circuits, using advances on technologies derived from VLSI design [2]. CMOS VLSI design using deep ultraviolet lithography provides high precision and a commercial way for manufacturing nanodevices and nanoelectronics.

1.2 Temperature Sensor

Integrated nanothermoelectric sensors could be implemented as CMOS devices with promising uses for pattern identification [3]. Such approach may permit a large production of infrared thermal sensors applied into different ranges of wavelength [4]. Nanorobots using temperature sensors open new medical possibilities for clinical diagnosis, as well as for ubiquitous data collection, with pervasive patient monitoring.

1.3 Chemical Sensor

Manufacturing silicon and chemical based sensor arrays using two-level system architecture hierarchy have been successfully conducted in the last 15 years [5]. Application ranges from biomedical uses, automotive or chemical industry with detection of air to liquid element patterns recognition through embedded software programming. Through the use of nanowire significant costs of energy demand for data transferring and circuit operation can decrease around 60%

1.4 Energy Supply

The most effective way to keep the nanorobot operating continuously is to establish the use of power generated from the available sources in the environment where it must be working. Some possibilities to power it can be provided from ambient energy. Kinetic energy can be generated from bloodstream due motion interaction with designed devices embedded outside the nanorobot. Electromagnetic radiation from light could be another option for energy generation in open workspaces, but not for medical nanorobotics.

1.5 Data Transmission

The application of devices and sensor implanted inside the human body to transmit data about the health of patients can enable great advantages on continuous medical monitoring [6]. For communication in liquid workspaces, depending on the application, it is worth to quote acoustic, light, RF, and chemical signals as possible choices for communication and data transmission.

2. Risks of Nanoscience:

Nearly all scientific research comes with risks, and nanoscience is certainly no different in that regard. The risks of nanoscience can sound more frightening than other scientific research, though, because they often sound more like science fiction than fact. The risks most often associated with nanoscience include uncontrolled nanomachines, nanoweaponry, and worst, unforeseen risks. Whether any of these risks are very serious remains to be seen[7].

Nanoscience is the study of microscopic machines, each with the ability to perform functions on the cellular level, the molecular level, or even the atomic level. Nanoscience creates these tiny machines with the goal of performing functions that would seem almost miraculous with standard procedures. Nanomachines have the potential to perform delicate surgery, cure previously unstoppable diseases, convert toxic waste into harmless and useful materials, and build nearly anything imaginable from basic materials. If it reaches its full potential, nanoscience may change the world in fantastic and wonderful ways [8].

3. Nanorobotics theory

Since nanorobots would be microscopic in size, it would probably be necessary for very large numbers of them to work together to perform macroscopic tasks. These nanorobot swarms, both those which are incapable of replication (as in utility fog) and those which are capable of unconstrained replication in the natural environment (as in grey goo and its less common variants), are found in many science fiction stories, such as the Borg nanoprobes in *Star Trek*, nanogenes in the Doctor Who episode "The Empty Child", nanites in "I, Robot", "Stargate SG1" and nanobots in Red Dwarf. The T-1000 in Terminator 2: Judgment Day may be another example of a nanorobot swarm. The word "nanobot" (also "nanite", "nanogene", or "nanoant") is often used to indicate this fictional context and is an informal or even pejorative term to refer to the engineering concept of nanorobots. The word nanorobot is the correct technical term in the nonfictional context of serious engineering studies.

Some proponents of nanorobotics, in reaction to the grey goo scare scenarios that they earlier helped to propagate, hold the view that nanorobots capable of replication outside of a restricted factory environment do not form a necessary part of a purported productive nanotechnology, and that the process of self-replication, if it were ever to be developed, could be made inherently safe. They further assert that free-foraging replicators are in fact absent from their current plans for developing and using molecular manufacturing.

In such plans, future medical nanotechnology has been posited to employ nanorobots injected into the patient to perform treatment on a cellular level. Such nanorobots intended for use in medicine are posited to be non-replicating, as replication would needlessly increase device complexity, reduce reliability, and interfere with the medical mission. Instead, medical nanorobots are posited to be manufactured in hypothetical, carefully controlled

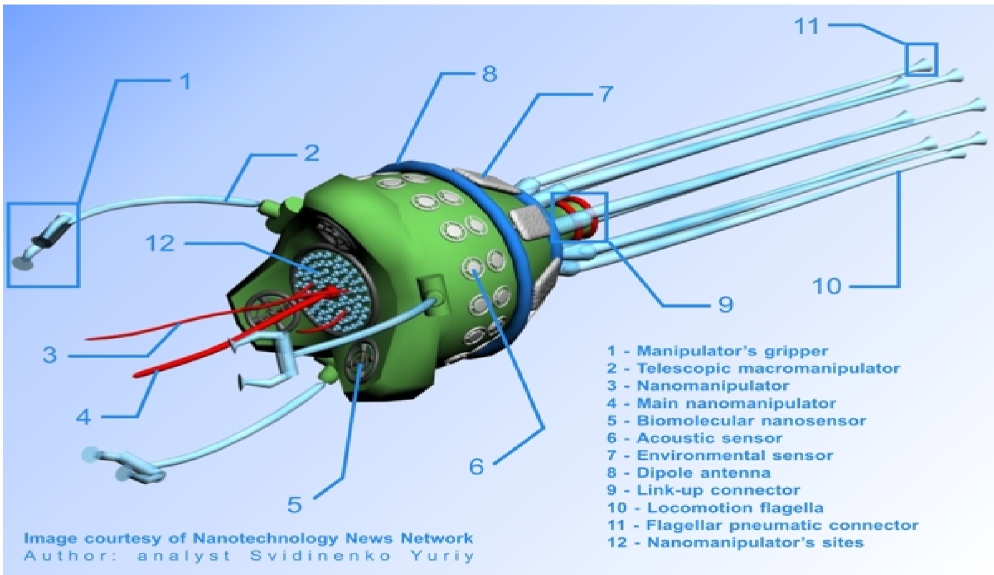

Fig. 1: Explanation for nanorobot

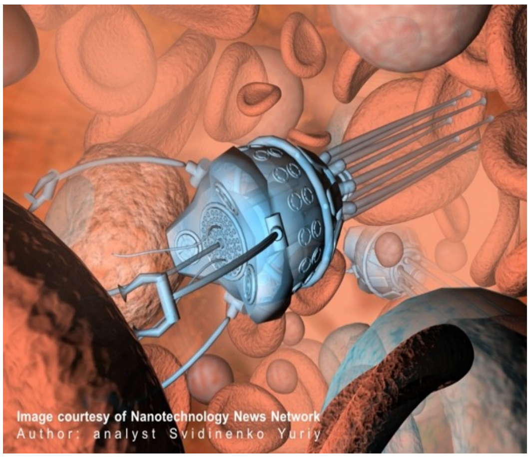

Fig. 2:Nanorobots in bloodstream

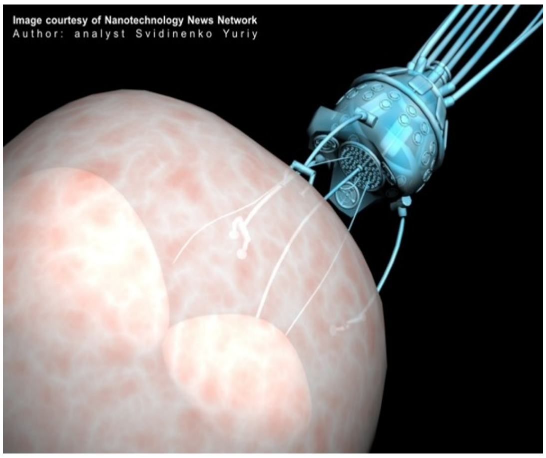

Fig. 3: Cell surgery

nanofactories in which nanoscale machines would be solidly integrated into a supposed desktop-scale machine that would build macroscopic products [9]. The most detailed discussions of nanorobotics, including specific design issues such as sensing, power communication, navigation, manipulation, locomotion, and onboard computation, have been presented in the medical context of nanomedicine by Robert Freitas. Although much of these discussions remain at the level of unbuildable generality and do not approach the level of detailed engineering, the Nanofactory Collaboration, founded by Robert Freitas and Ralph Merkle in 2000, is a focused ongoing effort involving 23 researchers from 10 organizations and 4 countries that is developing a practical research agenda specifically aimed at developing positionally-controlled diamond mechanosynthesis and a diamondoid nanofactory that would be capable of building diamondoid medical nanorobots.

As a secondary meaning, "nanorobotics" is also sometimes used to refer to attempts to miniaturize robots or machines to any size, including the development of robots the size of insects or smaller.

4. Cell Repair Nanorobot Design and Simulation

In this study I'll try to simulate simple mobile cell-repair nanorobot and try to analyse some kind of it's subsystems. A complete functional design of an artificial cell-repairer is beyond the scope of this paper. Here, I want to focus on the purely simulation aspects of the cell repair nanorobot's functions and parts [10].

What kind of robot will be this nanomedical device?

- Due to it's functions in human bloodstream and tissues it must be mobile and have powerful navigation system.
- It may have a wide range of sensors to navigate through human body and to fast molecular and cell identification.
- It may have powerful transport subsystem to molecular deliver system (it must deliver molecules and atoms to the working nanomanipulators from storage systems).
- Wide range of computer-guided nano-manipulators also required.
- It may be manufactured from flawless diamondoid due to biocompability with human body.
- It may have broadcasting system which can connect to other nanorobots and to macro computers.

Finally, it may have long telescopic manipulators to holding cells or surfaces.

CONCLUSION

Nanotechnology will prove to be one of mankind's epic challenges. It can on one hand be the solver of our greatest problems, or on the other hand, the creator of our greatest disasters. Every technology has a downside, and invariable, someone will figure out ways, either knowingly or unwittingly, to use it in ways that will harm us.

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