INFORMATION TECHNOLOGIES OF THE FUTURE: NANOROBOTS

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The article discusses the purpose of nanorobots, or nanites, in modern society, which introduce new paths for the development of science and all areas of society, including medicine, education, military technology, and space exploration. Particular attention is paid to the history of creation and the prospects for the study of nanites, as the revolutionary technology of the future, capable of completely changing the world and the lives of people beyond recognition. However, at the moment one of the most promising and popularized areas of research activity of scientists is the development of technology based on nanites. The main goal of their creation is the performance of important tasks in completely different spheres of human life. Previously, nanotechnology was considered by mankind as a literary fiction, beyond understanding and beyond capacity. But thanks to the scientific progress and attention of the developed countries of the world, this impossible dream, which can shake all world science, can become a reality in the near future. These microscopic machines perform the actions specified in their program that were obtained during the creation process. Nanorobots can be found in areas such as medicine, space exploration, military technology, etc. Prospects for the use of this technique are considered in our study.

Keywords: nanorobots, atoms, cell level, diagnostics, nanoparticles

Nanobots are human-made automatic devices that are no larger than a molecule.

Each prototype nanomachine fulfills a specific goal. Basically, the essence of such devices is to act at the molecular level.

One way or another, at the moment, not a single case of interaction with ideally working nanorobots is known.

For a long time, man has dreamed of subjugating nature, even the smallest of its particles. This was the starting point for the development and active research of nanotechnology – a person decided to subjugate the atom[1].

It is from the size of the atom, which is no more than a tenth of a nanometer, that the term "nanotechnology" came.

The desire to subordinate particles of matter of this size led to the study of the manipulation of single particles of matter. For this purpose, numerous materials were created from the atoms of the elements in the laboratories, which earlier did not exist at all.

The history of the invention of nanorobots begins with a project to develop an electron microscope with the ability to move atoms along electromagnetic fields. Already later, in the eighties of the 20th century, a pair of rotating gears of carbon atoms the size of a nanometer was assembled. After analyzing that the project on the development of nanites can be successful, scientists begin to create the first nano-motor that operates on electric propulsion.

In 2016, American scientist Fraser Stoddart, French scientist Jean-Pierre Sauvage and Dutch scientist Bernard Fehring receive the Nobel Prize for developing a molecular device 10 thousand times smaller than a human hair, which can perform a certain range of human-programmed actions[2].

The invention of the nano-motor gave a new impetus to the development of nanotechnology. In the opinion of the Nobel Committee on the importance of the invention of a nanomotor is not inferior to the creation of an electric motor. In the future, the developers hope to process the microscopic motor into a manipulator that can rearrange atoms in places, thus facilitating work in laboratories. So, nanorobots will be able to give humanity a tool for managing nature through changing the internal molecular structure of any material.

Nanobots can be divided into several groups: with the ability to self-copying and without the ability to self-copying. Although there are some concerns about the independent reproduction of machines, scientists assure that nanites will have a strictly limited reproduction limit by an internal program.

Speaking of artificial reproduction, one cannot but turn to the study of the behavior of living cells.

In his article "The problem of behavior at the cellular level – cytoetology" of 1970, biologist V.A. Yakovlevich suggested that "cellular organelles and the cells themselves have their own little, but soul".

Indeed, the behavior of nanorobots is similar to the behavior of living cells, which made humanity think about whether they are creating a "living system" with their free will and consciousness [3].

Now the production of nanorobots is quite expensive. To save resources, companies began working in collaboration to develop nanofactories – undeveloped nanometer-sized devices that can construct an unlimited number of complex structures from a small amount of material. The term "nanofabrika" was introduced by

Eric Drexler and in the modern world it is often used in literary fiction and cinema. According to the author of the term, the nanofactory can be programmed for replication.

In addition to nano-replications, there are such methods of producing nanobots as 3D printing on specialized printers and two-photon lithography.

Today, 3D printing is used in different areas of human life. It creates physical objects of any size using drawing and 3D modeling. The three-dimensional model of the nanobot must be accurate to microscopic details, so for the production with the help of three-dimensional printers need a highly qualified specialist and high-tech equipment[4].

Two-photon lithography uses 3D printing technology, its main difference is in higher detail. In lithography, liquid rubber is used, solidifying at the point where the laser beam was focused. The focal point of the laser moves through the rubber and leaves behind a solid line no wider than nano wide.

Today, the most useful and important area for the use of nanobots in the modern world is medicine. Because of its size, nanorobots can be used as emergency suppliers of drugs and beneficial substances to the body directly into the cells, as well as to terminate the affected organs and repair damaged tissue. Thanks to this use of nanotechnology, it is possible to deal with genetic disorders at the level of molecules and atoms.

Medical nanobots are designed to accurately diagnose and analyze diseases, collect data on the state of the human body[5].

Now in nanomedicine are considered such prospects as:

– Direct delivery of drugs to an organ or system at the cellular level.

– Artificial immunity enhancement or its weakening to combat allergic reactions.

– Surgery with microscopic incisions, which will accelerate the period of overgrowth of postoperative sutures.

– Diagnosis and treatment of cancer.

– Safe and easy distribution of vaccine components in the body.

These methods have already been tested on animals in laboratories, and at the moment scientists are ready to begin testing in humans. There is no denying that the success of treatment by nanites will forever change world medicine[6].

Due to the delivery of the components straight to the cells, or rather to their cytoplasm, the consumption of the drug itself and the chance of side effects of potent drugs will decrease many times, since they will not affect other organs and body systems. Vaccination will also be simplified; besides, immunoglobulins can be replaced by nanorobots, which will fight off any infections that enter the body from the outside.

To date, attempts have already been recorded to use nanotechnology in medicine, and specifically to combat cancer. For this, special nanites were created – liposomes. Liposomes deliver the chemotherapeutic nature of the substance straight to the inside of the cancer cells, destroying them from the inside. For the first time this method has been used and is currently used for the treatment of ovarian cancer, HIV Kaposi's sarcoma and myeloma.

Almost any problem of terminating the "deficiencies of the human body" can be solved with the help of nanorobots. With a sufficiently developed nanotechnology, people can finally get rid of diabetes and allergic reactions, which greatly facilitate the lives of the population.

Another example of nanorobots in medicine is artificial phagocyte circulating in a person's bloodstream. The phagocyte "digests" pathogenic viruses and harmful bacteria. There is also a respirocyte capable of withstanding a pressure of 1000 atmospheres. The ability to transport oxygen with this nanobot is 256 times greater than the ability of an ordinary red blood cell.

High hopes are pinned on the femtosecond laser FEMTO-LASIK, used in vision correction.

The laser is a microscopic "scissors", carrying out the finest evaporation of nano-volumes of corneal tissue without any damage to adjacent tissues. It is also used to remove certain parts of the genome in nanosurgery of individual chromosomes [7].

The very first femtosecond laser that received a certificate from the US Department of Health in 2001 was the laser company IntraLase. In 2004, a similar certificate was obtained by installing Femtec from Perfect Vision. In 2008, Z-LASIK is certified by the manufacturer Ziemer.

Before the development of Femto-LASIK, the formation of a cornea flap occurred with the help of keratome – growths on the skin of a benign nature. After the introduction of new technology in ophthalmology, this operation was performed using a femtolaser in a completely non-contact manner. This minimized the chance of distortion or loss of vision, including the acquisition of corneal astigmatism[8].

With the beginning of the active use of nanites, medicine will expand the range of services

provided to patients, because nanotechnologies offer a chance to look inside a living cell, study healthy and damaged tissues.

But do not forget that the introduction of nanomaterials into practice requires a deep understanding of the potential risks and side effects due to the imperfection of nanotechnology. The production of new materials can cause the accumulation of waste that can cause toxic and mutagenic effects on the human body. Scientists have not left this problem without attention: this is how the branch of science appeared that was connected with the study of the safety of nanomaterials used, which was called nanotoxicology[9].

Thus, this science considers methods for the penetration of nanoparticles into the human body: oral, inhalation, parenteral and percutaneous. Such types of human contact with nanomaterials occur at the stage of production, use and processing. Nanoparticles are able to overcome huge distances in the air environment, it follows from this that they can easily enter the body through the lungs and penetrate through sedimentation on the skin. However, as the size of the particle itself increases, its probability of penetration through the alveoli of the lungs decreases. The increase in airborne microscopic particles creates more opportunities for human contact with the skin or intestinal tract[10]. An obvious example of the penetration of nanoparticles into the skin is the use of cosmetics and sunscreens. However, a study on the titanium oxide nanoparticles contained in sunscreens as an absorber of ultraviolet radiation showed that the particles do not pass beyond the horny epidermis. The study of the skin toxicity of nanoparticles and the materials used did not reveal negative side effects when various components were applied to the skin. The toxicity studies themselves are few, and nanomaterials can be classified as low-toxic and moderately toxic. Thus, nanotoxicology as an area of nano-medicine at a given time is only at the beginning of development.

Conclusion

According to the American inventor Ray Kurzweil, by 2030 the global "cohabitation" of nanorobots and humans will take place. In the future, there will be a huge number of ways to launch millions of nanites into the human circulatory system. Nanomachines will begin to restore old cells and create new material. Thus, scientists can talk about slowing body wear and eliminating signs of aging.

Speaking about the joint future of people and machines, it is worth mentioning such a term as cyborgization.

Cell cyborgization is a gradual replacement of a cell by nanostructures and artificial material. If the cellular material can be replaced with a synthetic analogue – nanorobots, then the process of cyborgizing neurons is much more complicated. This process will allow people to increase brain productivity and overcome its limits.

Nanotechnologies offer a lot of new opportunities and discoveries in medicine. In military science and space exploration, microscopic machines still seem fantastic, but with the development of science, science fiction can become a reality. Perhaps it is nanorobots that will make global changes to human life and all its spheres.

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