ПОДСЕКЦИЯ 1
ПРОБЛЕМЫ МЕЖЪЯЗЫКОВОЙ ПРОФЕССИОНАЛЬНОЙ КОММУНИКАЦИИ В УСЛОВИЯХ ГЛОБАЛИЗАЦИИ

APPLICATION OF NANOTECHNOLOGY IN VARIOUS FIELDS OF SCIENCE AND ENGINEERING

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Nanotechnology is a cutting-edge branch of science and technology that has been intensively evolving over the past decades. It involves development and application of the materials, devices and engineering systems whose operational principle is based on the nanostructure, i.e. well-organized nanoparticle structures. It can be stated that nanotechnology is a science that studies the changes of matter at the atomic, molecular, and macromolecular levels, in the length scale of approximately 1 to 100 nm range. It is aimed at developing new techniques, with the dimensions being measured in nanometers. This size is much smaller than that of bacteria and a living cell. However, nanotechnology does not relate to biology mainly, its application varies from semi-conductors to completely state-of-the-art methods which operate on molecular self-assembly. This peculiar dimension that can be considered as a limitation, in fact, contributes to broadening the range of materials being used, since nanotechnology is concerned with any phenomena at the nano level. Therefore, nanoscience and nanotechnology are considered the branches of materials science and they can be attributed to physics, mechanical engineering, bioengineering, and chemical engineering.

The issue of developing and implementing nanotechnologies into technological processes of various engineering fields is of significant importance. Over the past decades this short word «nano» has become an integral part of world scientific community. There are a lot of pseudoscientific opinions and approaches to nanotechnology. Therefore, it is of particular importance to examine the applications of nanotechnologies in various fields of engineering and science.

The aim of the current article is to approach nanotechnology as a certain branch of science and engineering, precisely the focus is on the way nanotechnology is applied in various spheres of modern human life. To achieve the aim, the following objectives should be tackled:

1) to give a brief overview of nanotechnology development;
2) to analyze the use of nanotechnology in medicine and engineering;
3) to drive to the conclusion about the advantages and disadvantages of nanotechnology.

Nanotechnology became a part of scientific world in 1982. During the next two decades the scientists were carrying out various experiments trying to go deeper into the essence of nanotechnology. As known, R. Smalley, a professor at Rice University in Houston, evaporated graphite due to heating by the laser beam. In 1995, the scientists of Kirov Institute of Physical Chemistry developed nanocomposite films for the sensor capable of identifying various substances in the atmosphere (ammonia, spirit, water vapor). Since 1998 nanotechnology has been intensively developed. For example, the Japanese scientists defined nanotechnology as a main category of engineering in the 21st century. C. Dekker took biological molecules such as deoxyribonucleic acid (DNA) as the basis for introducing the nanotube in order to obtain a uniform nano mechanism [3]. The first quantum computer was invented in 2006.

It is well known that there are a lot of diseases which have no cure or there are some certain limitations, for example, poor sensitivity and drug toxicities. One of such diseases is cancer. According to the recent studies, nanotechnologies could become rather efficient in curing cancer. First of all, a modern and advanced methods of cancer detection based on nanoparticles are currently being developed. These nanoparticles are planned to be used as contrast agents, fluorescent materials, and molecular research tools. Paramagnetic nanoparticles, quantum dots, and nano shells could be used for diagnostic purposes. Secondly, a certain drug has been developed. It can act specifically at the target tissue. A new drug is based on the use of material known as nano silicon which is characterized by porous structure that makes it suitable for various biomedical applications [1]. As the target tissue is reached, the bio silicon starts breaking out, while the drugs start working. Drugs that are used to block cancer are characterized by high toxic potential. This nanotechnology may grant chemotherapeutic drugs with a better safety profile. Finally, there are other therapy techniques such as heat induced ablation of cancer cells and gene therapy that are currently being developed. Thus, it can be stated that nanotechnology is used both in diagnostics and therapeutics.

It is obvious that nanomedicine in future would become an integral part in the treatment of human diseases. Today, nano medicine is represented within the following spheres:

1) enhanced and specific drug delivery;
2) DNA nanostructure;
3) artificial ferments and antibodies;
4) artificial cells, organs, artificial functional polymers. This sphere is closely connected with the idea of artificial life and artificial intelligence, development of robots capable of healing themselves at molecular level.
5) nanorobots-surgeons that can carry out basic surgical procedures.

Nanotechnology has been also widely applied in engineering. There is a great number of various applications aimed at improving human life. One of the first examples is carbon nanotube body armor. It is used to ensure higher protection against serious traumas. One of the main parts of this invention is a rigid facing that includes ceramic inserts, steel and titanium plates, as well a ballistic fabric backing. Scientists believe that this technology would make conventional bullet-resistant materials more efficient. The main reason for this is nanoscale carbon tubes that are introduced into this kind of materials.

Another example of nanotechnology implementation in engineering is surface protection materials. The main purpose of these materials is to provide some kind of a shield in order to protect the surface these materials are applied to. Nanorepel which is made of pure quartz glass is characterized by resistivity to temperature and corrosive materials. Therefore, the main application of nano repel is to improve surface flexibility and elasticity and as a consequence, to decrease the risk of stress damage. The products with the same characteristic features may also be used in order to decrease adhesive properties so that they may contribute to removing dirt, stains, and oily substances from various surfaces.

The next example is solar panels that make it possible to generate electricity from the sun without producing waste. However, the process of solar cell production is rather energy intensive itself, as a result, a large amount of waste can be produced. Today the scientists are trying to solve this problem by introducing nanotechnology. Precisely, they have developed photovoltaic solar cells which are made from layers of expensive crystalline silicon treated with caustic chemicals. To generate the current, the Gretel cell was developed. It is based on a sensitizer dye and nano particles of the semiconductor Titanium dioxide (TiO2). Titanium dioxide is known as a cheap and widely available material having highly porous nanoparticles.

It is necessary to mention food products and packaging. Scientists are currently trying to elaborate new methods to tailor the smallest particles of food in order to ensure a specific taste, texture, and nutrient density. For instance, if a company wants to make its mayonnaise thinner, a portion of the fat content could be easily replaced by water content. With the use of flaky clay nanoparticles, it is possible to make beer bottles tighter, as tiny clay particles prevent gases from escaping or entering the beer bottle, thus, contributing to longer flavor.

Finally, nanotechnology is widely used in various water applications. In this regard nanotechnology can be used along three main lines: water treatment and remediation; sensing and detection; and water pollution prevention.

It is obvious that nanotechnology like any other method, device or idea has advantages and disadvantages. The first apparent fact is that nanotechnology can make a real breakthrough in science, engineering and human everyday life. The areas that benefit from the continued development of nanotechnology are as follows: nano transistors, nano diodes, OLED, plasma displays, quantum computers, and etc. Nanotechnology can also significantly contribute to the energy sector. Due to nanotechnology it is possible to produce more effective energy-related products. Such items as batteries, fuel cells, and solar cells could be smaller, but at the same time more efficient. The materials used in manufacture of barrios products can also involve nanotechnology that would make them stronger, more durable, and lighter.

Despite the obvious advantages, it is possible to state several disadvantages of using nanotechnology. First of all, atomic weapons can now be more accessible and made to be more powerful and more destructive. These can also become more accessible with nanotechnology. As these particles are very small, they could be easily inhaled. Then, nanotechnology requires money and time to be developed. Finally, the manufacture process should be adjusted to implement new nanotechnologies.

To conclude, the apparent advantages of nanotechnology is of no doubt. However, as the development of this technology could present certain risk, the humanity should be ready to assume the responsibility for the inventions and try to be careful in implementing them in everyday life.

References

1. Gao F., Botella P., Corma, A., Blesa, J. Monodispersed mesoporous silica nanoparticles with very large pores for enhanced adsorption and release of DNA *J. Phys. Chem*. B, 113 (6) (2009), pp. 1796-1804
2. Indian Journal of Medical Research. Dec2009, Vol. 130 Issue 6, p689-701. 13p. 1 Chart.
3. Williams KA, Venhuizen PTM, De la Torre BG, Eritja R, Dekker C. Nanotechnology: carbon nanotubes with DNA recognition. *Nature.* 2002: 420 (6917): p. 761.