# SUPPLEMENT OF NANOTECHNOLOGIES AND NANOMATERIALS

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***Abstract:*** *In this article, the theoretical and practical issues of the use of nanotechnology in solving the main problems of the energy sector and environmental protection were analyzed. Nanotechnology has a huge economic potential for use in all areas of energy, and it is said that it will help to increase efficiency and environmental cleanliness in all stages: in all types of energy sources, in the production, storage and transformation of energy, in its transmission and use.*
***Key words:*** *nanotechnologies, nanomaterials, physics, chemistry.*

"Nano" is a prefix indicating that the initial value must be reduced by a billion times. For example, 1 nanometer is one billionth of a meter (1 nm=10-9 m). With this prefix, they define a new era of technology development, sometimes the fourth industrial revolution - the era of nanotechnology.

At the first stage of nanotechnology development, priority was given to probe microscope devices. These devices are like the eyes and hands of a nanotechnologist. In the 21st century, nanotechnologies penetrate into all spheres of human life. In this science, there is a new word, new opportunities, new quality and standard of living. The rapid development of nanotechnologies on a global scale is their great importance in the development of civilization. Nanotechnologies and nanotechnologies are the most promising directions in the development of Russian and foreign science. Nanomaterials have created a real breakthrough in many fields and penetrated into all aspects of our life.

Goods and products can be created based on them, their use will modernize all sectors of the economy. Objects we may see in the near future include nanosensors for detecting toxic waste from the chemical and biotechnology industries, drugs, chemical warfare agents, explosives, pathogenic microorganisms, as well as nanoparticle filters and other cleaning tools. or neutralize them. Another example of promising nanosystems in the near future is carbon nanotube main power cables, which conduct high-voltage current better than copper wires and at the same time weigh five to six times less.

Nanomaterials will significantly reduce the cost of automotive catalytic converters, which clean exhaust from harmful impurities, because they can be used to reduce the consumption of platinum and other precious metals used in these devices by 15-20 times.

Nanotechnology has applications in various fields such as physics, chemistry, medicine, engineering and mechanics. The development in this field allows to improve many products and opens up new opportunities. For example, in the field of security, nanotechnology allows the development of microsensors, which are more efficient

Non-technology has the potential to make a significant contribution to the production and storage of energy through the use of renewable energy sources.

A selection of dye-sensitized solar cells.

**A dye-sensitized solar cell (DSSC, DSC, DYSC[1] or Gratzel cell)** is a low-cost thin-film solar cell of the solar cell family.[2] It is an electrolyte formed between a photosensitive anode and an aphotoelectrochemical system. The modern version of the dye solar cell, also known as the Gratzel cell, was originally invented in 1988 by Brian O‘Regan and Michael Gratzel at Berkeley[3] and later developed by the aforementioned scientists at the École Polytechnique Fédérale de Lausanne (EPFL). Until the publication of the first high-performance DSSC in 1991.[4] Michael Gratzel was awarded the 2010 Millennium Technology Award for this invention.[5]

DSSC has a number of attractive features; It is simple to prepare using conventional roll-to-roll printing techniques, semi-flexible and semi-transparent, offering a variety of uses not available to glass-based systems, and most of the materials used are affordable. In practice, the difficult disposal of a number of expensive materials, particularly platinum and ruthenium, poses a serious challenge to making liquid electrolyte cells suitable for use in all weather conditions. Although it’s conversion efficiency is less than the best of thin-film cells, in theory its price/performance ratio should be good enough to allow them to compete with fossil fuel electricity generation by achieving grid parity. Commercial applications made due to chemical stability problems,[6] are projected in the Photovoltaic Roadmap of the European Union to contribute renewable electricity generation until 2020.

**Organic Solar Cells -** Obtaining energy from renewable energy sources has become a global demand. The future of humanity depends on renewable energy sources, because non-renewable energy sources will be completely exhausted on earth by 2081 if humanity continues to use them in this way. Among the renewable energy sources, the most widely used is the solar cell. That is, converting solar energy into electricity is cheap and convenient for us. To date, many types of solar cells have been invented. Silicon-based, perovskite, organic, etc. Among them, the one that is being produced on a large scale is the silicon-based solar cell. Because silicon element is the most common and cheap raw material on earth. In addition, the production technology is also cheap. But the coefficient of useful work in production is 19.6%. Other types of solar cells have an efficiency of 20-40% in laboratory conditions, but are much more expensive. This prevents its application for large-scale production. It is worth noting that the inventions being made should first of all be useful for society. So we need to design solar cells mainly made of cheap and widely available materials. The most common way to increase the efficiency of solar cells is to improve their optical properties, that is, to increase the absorption coefficient. We know that the optical properties of semiconductors strongly depend on the wavelength of light.

The molecules used in organic solar cells can be solution-processed at high throughput and are cheap, resulting in large-scale production costs. Combined with the flexibility of organic molecules, organic solar cells are potentially cost-effective for photovoltaic applications. Molecular engineering (eg, changing the length and functional group of polymers) can change the band gap, allowing electronic tuning. Organic molecules have a high optical absorption coefficient, so a large amount of light can be absorbed by a small amount of material, usually on the order of hundreds of nanometers. The main disadvantages associated with organic photovoltaic cells are low efficiency, low stability and low power compared to silicon solar cells.

Compared to silicon-based devices, polymer solar cells are lightweight (important for small autonomous sensors), potentially disposable and cheap to manufacture (sometimes using printed electronics), tunable at the molecular level, and potentially less harmful to the environment. The disadvantages of polymer solar cells are also serious, they are 1/3 of the efficiency of solid materials and undergo significant photochemical degradation. The problems of inefficiency and stability of polymer solar cells, combined with their low cost and increasing efficiency, make them a popular field in solar cell research.

Types of solar panels - Depending on the type of silicon used in the production of semiconductors, solar panel modules are divided into two categories: polycrystalline and single crystal. The first is in the form of a flat square with different surfaces due to the presence of dissimilar crystals. Silicone solutions are used for their production. First, raw materials are poured into special forms, and then the blocks obtained as a result of melting are cut into square plates. During the production process, the molten silicon mass is gradually cooled.

Monocrystalline panels are more efficient and produce more energy in the same dimensions, but polycrystalline panels are cheaper. The module consists of 36 or 72 polycrystalline plates. A panel consists of a collection of such nodes. The technology is relatively simple, does not involve the use of expensive equipment and does not require large financial investments. The minuses of these modules are one - the efficiency does not exceed 18%.

The priority demand for them is explained by their cheapness. Unlike the previous ones, the surface of single crystal panels is homogeneous. They are thin plates, which are cut square in the corners. To obtain them, silicon crystal is artificially grown. The solar cells used in this case consist of silicon cylinders.

Peroxide Solar Cells-"Semiconductor Solar Cells" laboratory has been engaged in scientific and practical research, development of GaAs and Si-based semiconductor photoelectric phenomena and production technology of solar cells since 1975.

Until now, the technology of making solar cells based on GaAs with an efficiency of up to 22% has been developed. The technology for the production of photovoltaic batteries with a capacity of 2-150 W has been developed and orders for the production of photovoltaic systems have been received.

Photoelectric devices are assembled and prepared in a complete set together with an electronic control and control system (accumulating system, inverter and controllers) in the laboratory.

Quantum dot solar cells-Quantum dots (QDs) are semiconductor particles a few nanometers in size, with optical and electronic properties that differ from large particles due to quantum mechanics. Their central theme is nanotechnology. When quantum dots are illuminated with UV light, the electron in the quantum dot can be excited to a higher energy state. If a semiconductor quantum dot, this process is the conduction band for the valence band of the electron. An excited electron can drop into the valence band and release its energy by emitting light. This light emission (photoluminescence) is illustrated in the figure on the right.

The conduction band and valence band depend on the color of this light and the energy difference between them. In the language of materials science, nanoscale semiconductor materials tightly confine electrons or electron holes. Sometimes quantum dots are called artificial atoms, emphasizing their uniqueness, having bound, discrete electronic states, like naturally occurring atoms or molecules. He showed that electron wave functions resemble real atoms in quantum dots. By combining two or more quantum dots, an artificial molecule can be made, exhibiting hybridization even at room temperature.

Quantum dots have properties intermediate between bulk semiconductors and individual atoms or molecules. Their optoelectronic properties vary as a function of both size and shape. Larger QDs with a diameter of 5–6 nm emit at longer wavelengths, with colors such as orange or red. Smaller QDs (2-3 nm) have shorter wavelengths and produce blue and green colors. However, the specific colors vary depending on the exact composition of the QD. Possible applications of quantum dots include single-electron transistors, solar cells, LEDs, lasers, single-photon sources, second harmonic generation, quantum computing, cell biology research, and medical imaging.

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