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POSSIBILITIES OF NANOTECHNOLOGIES IN THE CREATION OF NEW DEVICES AND MATERIALS

(REVIEW-RESEARCH)

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Abstract
The paper provides an overview of the emergence of nanotechnologies that make it possible to create the latest materials with unique properties, control their properties at the atomic and molecular levels, and ensure the production of a wide variety of technical devices, as well as microchips with a size of less than 100 nanometers.

Keywords: doping, carbon nanotubes, nanotechnology, nanoparticles.

Introduction
We live in an age where technology is changing rapidly. What seemed like science fiction yesterday is reality today, and tomorrow it will turn into an obsolete technology. So, at the beginning of the 20th century, a television set was developed and put into production. The basis of the device is physical effects based on the application of the Lorentz force. On the same basis, an oscilloscope was created, cardiograph. Some hundred years have passed (a moment by historical standards) and those TVs that surprised our grandparents have turned into museum exhibits. In other words, new technologies are being replaced by supernovae, and this is a requirement of the time. Today, the creation of modern technologies for the creation of new materials and devices is ruled by nanotechnology. Let's take a closer look at the emergence of these technologies using historical examples. Let's take a closer look at the history of Damascus steel. This is exactly the case when micro-daobavs of one substance into another radically change the properties of the second substance. This is how humanity learned to process iron ore and got iron. But according to some of its characteristics, people ceased to be satisfied with it, and they began to improve the resulting metal. It was noticed that during annealing followed by cooling, iron acquired completely different, better properties than that of iron. During annealing, the iron was doped with carbon. "Alloying" means the addition of impurities. The smallest additions of carbon radically changed the property of iron - this is how steel was obtained. At that time, people did not even imagine that they were on the verge of nanotechnology. The first finds of Damascus steel date back to the XIV-XIII centuries BC. It began to be created in Western Asia. 500 years later, the technology was picked up by Europeans, and a little later it appeared in China. The advent of

the cheese furnace made it possible to process iron ore and turn it into steel. In essence, steel is iron that has been cleaned and lightened with carbon. Production began with a process in which iron and high-carbon steel were combined to produce a material that made up for the deficiencies of both original steels. This resulted in alternating layers of metal with very high and very low carbon content. The former acquired greater hardness during hardening, while the latter, on the contrary, did not harden at all and served as a shock-absorbing substrate. Soft iron layers prevented the metal from being too brittle, And the high-carbon layers gave the necessary elasticity and sharpness. The diffusion of carbon also averaged its distribution in the billet to some extent. The main and important disadvantage of Damascus steel is its low corrosion resistance, due to the high carbon content in the forging components and the almost complete absence of alloying elements. Production Process Steel is an iron-carbon alloy that contains at least 45% iron and 0.02 to 2.14% carbon.To produce steel, you first need to extractor and coal, and then process them in a special way. Iron ore needs to be beneficiated. To do this, it is crushed, and then the pieces in which the metal is present are separated with a magnet. With coal, too, not everything is so simple, since in its natural form it contains a large number of impurities, Therefore, it is also ground and then dried in a special "oven" to obtain coke.

When the enriched iron ore and coke are prepared, they are mixed with lime and sent to a furnace where pig iron is smelted at a high temperature And steel is made from cast iron. Cast iron is enriched with carbon, which gives the alloy brittleness. Also, it still has a lot of unnecessary impurities. Therefore, the main tasks in the production of high-quality steel are to remove as many unnecessary substances as possible from the composition, as well as to reduce the concentration of carbon to the required values (from 0.02 to 2.14%). Thus, using the example of the creation of steel, we have observed that alloying with carbon transforms the substance in a cardinal way. But what is burnt in a furnace carbon? How do the properties of carbon change depending on the structural arrangement of atoms? We know from the course of hmia that carbon can exist in several forms: **diamond,** graphite**, carbine, amorphous carbon. These carbon modifications, like the recently discovered fullerenes and lonsdaleite, are allotropic In addition, carbon is a part** of complex compounds – carbonates, natural, combustible fossil fuels (coal, oil, gas, etc.), and is a component of plants and living organisms (about 17.5%). In the form of compounds with nitrogen and hydrogen carbon is found in the atmospheres of planets, found in stony and iron meteorites [1]. Let us consider the atomic structure of simple substances such as diamond, graphite, coal, and fullerene.

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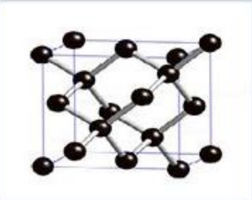
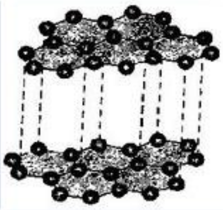
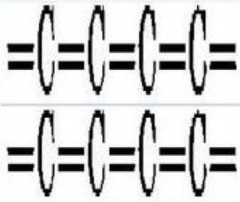
Критерии сравнения	Алмаз	Графит	Фуллерен	Карбин
Пространственная структура				
Гибридизация орбиталей	sp^3	sp^2	sp^2	sp

Fig1.Allotropic Carbon Modifications (or Polymorphism) and Orbital Hybridization

Thus, substances that have the same composition but different crystal structure are called allotropic. In other words, allotropy is called polymorphism (many forms) - the formation of different structures by the same atoms. Graphite leaves a trace on the paper due to the peeling off of the layers that remain on the paper. -(GIVE A PICTURE).

Rice. 2. Allotropic Carbon Modifications

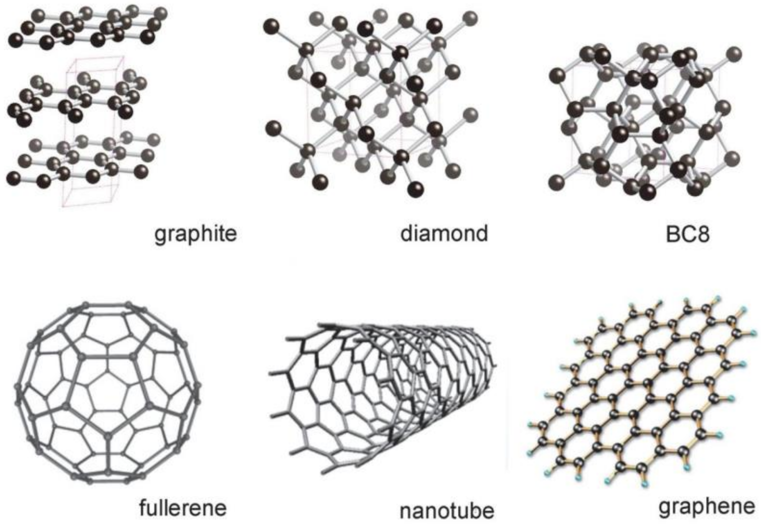


Figure 2. Allotropic modifications of carbon are presented, among which we see graphene and carbon nanotubes

Consider the trace of a pencil on the paper, or peel it off and look at it under a microscope with high magnification. We will see contours that resemble honeycombs – i.e. flat (2D) cells of carbon atoms packed with a hexagon. Such a canvas is called graphene. Carbon nanotubes (CNTs) are nanoscale cylinders formed by a coiled graphene sheet. In a tubular CNT molecule, each carbon atom is in a state of mixed sp^2-sp^3 hybridization. The coiled graphene layer in a carbon nanotube is represented by a hexagonal structure consisting of carbon hexagons, in which carbon atoms are bonded to each other.other strong covalent bond. The size of the tubes is measured in nanometers, i.e. 10-9 m. As a rule, carbon nanotubes are obtained by thermal sputtering of a graphite electrode in the plasma of an arc discharge in a helium atmosphere.

The cathode precipitate contains nanotubes of a wide variety of structures (single-walled, multi-walled) and properties (conductors, semi-conductors).

Structure and Types of Carbon Nanotubes: Carbon nanotubes can be divided into two main types:

1. Single wall carbon nanotubes consisting of a single graphene sheet rolled into a tube;
Multi-walled carbon nanotubes, which consist of multiple graphene layers wrapped around each other.

In the case of single-walled CNTs, each of the carbon atoms contains a pair of π-electrons that do not participate in the formation of a bond and form a conjugate π-electron cloud along the entire length of the CNT. Single-walled CNTs have a diameter of 0.7 to 2 nm and a length of a few microns to a few millimeters. Depending on the direction in which the graphene sheet is folded, different chiralities are possible. It is determined by the angle chirality between the carbon hexagons and the tube axis. The radius vector is characterized by a pair of chirality indices n and m, which are integers corresponding to the number of unit vectors along the two directions in the lattice of graphene forming a carbon nanotube.[2]

What are nanomaterials used for? Today, nanomaterials are widely used in a wide variety of products, such as food, cosmetics, personal care, antimicrobials, disinfectants, clothing, and electronic devices.[3] According to the 7th International Conference on Nanotechnology (Wiesbaden, 2004), the following types of nanomaterials are distinguished

- nanoporous structures;-nanoparticles;-nanotubes, nanofibers and nanoribbons;-nanodispersions (colloids);-nanostructured surfaces and films; - nanocrystals and nanoclusters.[4]

Nanoparticles can be formed by the decomposition at high temperature of solids containing metal cations, molecular anions or organometallic compounds. This process is called thermolysis. For example, lithium nanoparticles can be produced by decomposing lithium azidate LiN3.[5] As a conclusion: Thanks to nanoscale materials, the cost of production is reduced in almost all industries. They are already widely used, and, in the future, will be even more in demand in the automotive industry, the production of packaging materials and tools, and consumer goods. The low weight of nanomaterials makes it possible to significantly save money on transportation, energy supply, and significantly reduce the polluting effect of production on the environment.

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