Nanotechnologies and Nanomaterials in Automobile Repair Manufacturing

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Abstract. The paper considers an important scientific and practical problem, aimed at the restoration and surface hardening of worn car parts, based on the use of electroerosive materials, including nanoscale particles.

1. Introduction
It should be noted that the society began to think long enough about the prospect of researching nanotechnologies and the formation of nanomaterials. Russian author N.S. Leskov presents an almost traditional example of nanotechnology for the production of a "mechanical flea" in his famous work about mechanic Levsha. In this situation, there is a mysterious coincidence - in order to study the "nano-nails" in flea horseshoes, according to Leskov, it was necessary to increase an object up to 5 million times, that is, the limiting value of the capabilities of modern atomic microscopes, which were one of the key means of studying the used materials.

2. Material and methods
The word "nanotechnology" was first proposed by the Japanese N. Taniguchi in 1974. The right of forming materials with particle sizes less than 100 nm, having a large number of additional properties, when compared with the classical microstructured used materials, was indicated by the German scientist G. Gleiter in 1981. Gleiter, and regardless of him, the Russian scientist I.D. Morokhov, included in the scientific literature concepts of nano-crystals. Later G. Gleiter also introduced into general scientific life definitions of nano-crystalline materials, nanophase, nanostructured, nanocomposite, etc. [1-11].

In our time, interest in a new class of materials used in area of applied and fundamental science, as well as in industry and business, is constantly growing. This phenomenon is due to these factors: the propensity to reduce products; exceptional qualities of materials in the nanostructured state; the need to create and implement the latest materials with new properties; the formation of new technological methods and techniques, that are based on methods of self-organization and self-assembly; practical introduction of modern instruments for studying and controlling nanomaterials (X-ray methods, probe microscopy, nanohardness); development and introduction of new technologies (ion-plasma technologies for surface treatment and creation of thin layers and films, etc.).

Formation of basic and applied views about nanotechnologies and nanomaterials in the near future will probably lead to decisive changes in numerous spheres of social activity: in material science, electronics, power engineering, computer science, medicine, engineering, agriculture, ecology. Along
with computer-information technologies and biotechnologies, nanotechnologies are considered the basis of the scientific and technological revolution in the 21st century.

A characteristic feature of the current stage of the foreign science of nano-state is considered to be a high technological degree of study, a detailed description of the obtained properties of elements, structure and composition, ensuring large selectivity in the volume of nanoparticles, and protecting the plane of nanoparticles from inclusions. Abroad, the main aspiration is to study and apply nanocrystalline elements and materials to the field of nanotechnology, i.e., the formation of products and devices with nanoscale particles.

The key areas for the use of nanoscale particles are medicine, electronics, chemical pharmaceuticals and biology. Studies in medicine and biology conducted in our time seemed fantastic have not so long ago - it is the development of micro-pumps and micro-devices to deliver medicines directly to the affected cells of any organ, as well as other nanostructures of biological and artificial origin and various multifunctional purposes.

Nomenclature according to nanotechnology and nanomaterials in our time is just being introduced. There are a number of approaches to how one can establish what nanomaterials are.

Nanomaterials - are materials that include structural elements, whose geometric dimensions, at least in one dimension, do not exceed 100 nm, and which have qualitatively new properties, operational and functional characteristics. Materials that have small (10 ... 100 nm) scales of structural components (blocks, sub-grains, grains, parts, etc.) are also interesting to scientists in connection with anomalous changes in characteristics (properties) (Figure 1).

![Figure 1](image-url) Probable unnatural changes in the mechanical, technological, physico-chemical properties of classical and new used materials, when they reach nanoscale conditions.

By now, in fundamental researches in the field of nanomaterials and nanotechnologies Russia is still lagging behind developed countries.

3. Results
To eliminate this fact, a research and educational center "Powder Metallurgy and Functional Coatings" was created in Southwest State University, where young scientists carry out advanced researches and developments, aimed at obtaining multifunctional materials, including nanomaterials from waste of conducting materials, using a resource- and energy-saving, non-waste and environmentally friendly technology of electroerosive dispersion (EED), protected by a patent for an invention [11-18].

Figure 2 shows examples of electroerosive powders, including nanosized.
Figure 2. Examples of electroerosive powders, including nanosized: a) hard alloy; b) copper; c) ball-bearing steel; d) fast-cutting steel; e) aluminium; f) bronze.

4. Discussion
For this period, the degree of investigation of the EED method has reached of initial industrial production. But, despite this, the extensive application of the method of electroerosive dispersion for the purpose of processing conductive materials wastes into powders for their repeated use can not be
used, because of the absence in the scientific and technical literature of complete data about initial composition, installation conditions and media for obtaining powder materials with the necessary properties, effective equipment that could allow stable production of powder materials with prerequisite properties, as well as technologies for their subsequent use in engineering, medicine and additive technologies. For this reason, with the aim of investigate the technologies for reusing powder materials, obtained from waste of conducting materials, as well as conclusions about the effectiveness of their application, it is necessary to conduct complex experimental and theoretical studies on their validation [12-15].

After attestation of the obtained electroerosive materials, their practical application follows in car-repair production, namely: when restoring and hardening of worn car parts and their use as a reducing antifriction and antwear additive to automotive oils and lubricants (Figure 3).

At this time, dispersed powders of various metals with a small hardness are often manufactured and introduced on the market, and their properties against wear were found even in the Soviet period. Experiments that were conducted by Professor D.N. Garkunov found that, when you add powder of bronze, copper or brass to the glycerin or grease CIATIM-201, you can see thin films, which appear on the surface of the friction-affected steel products, consisted of the used powder materials.

There are two principles of the effect of powders:

- Powder materials capitally adhere to the surface and form the conditions for the flow of the selective transfer regime. For example, powder materials of bronze or brass during the friction are dissolving (alloying components interact with lubricants), and the plane, as a consequence, is covered with a thin copper film.
- Powder material adheres to the plane and, as it were, smooths out uneven areas of the surface of parts subject to friction.

![Areas of application of electroerosive powder (EEP) in auto-repair production](image)

**Figure 3.** Practical application of electroerosive materials in car-repair production.

The first principle was named - adhesive, and the second principle - mechanical. Proceeding from this, due to the development of base materials for lubrication, it is expedient to study the effect of components from particles of non-solid metals on their tribotechnical properties.
5. Conclusion
The paper considers an important scientific and practical problem, aimed at the restoration and surface hardening of worn car parts, based on the use of electroerosive materials, including nanoscale materials.

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