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A Systematic Study in the Formation of Nanostructured Materials

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Abstract: A large number of methods and methods for obtaining nanomaterials have been developed. This is due to the variety of composition and properties of nanomaterials, on the one hand, and on the other hand, it allows to expand the range of this class of materials, creating new and unique samples. The formation of nanostructures can occur in the context of processes such as phase transitions, chemical reaction, recrystallization, deformation, high mechanical loads, and biological synthesis. As a rule, the formation of nanomaterials is possible in the presence of significant deviations from the equilibrium conditions of existence of the substance, which requires the creation of special conditions and, often, complex and precise equipment. The improvement of previously known methods and the development of new methods for obtaining nanomaterials led to the identification of the main requirements The method should ensure the receipt of a substance of a controlled composition with reproducible properties; The method should ensure the temporal stability of nanomaterial's, i.e. primarily, protect the surface of the particles from spontaneous oxidation and sintering during the manufacturing process; The method should have high throughput and cost-effectiveness.

Keywords: nanomaterial's, formation, manufacturing, composition, fundamentally.

INTRODUCTION

In the past few years, nanotechnology has come to be seen not only as one of the most promising branches of advanced technology, but also as a system component factor in the 21st century economy - an economy based on knowledge, not on the use or manipulation of natural resources. In addition to the fact that nanotechnology stimulates the development of a new paradigm for all production activities ("bottom-up" - from individual atoms - to the product, and not "top-down", like traditional technologies, where the product is obtained by cutting materials In excess of a more massive piece of work), it is itself a source of new approaches to improving the quality of life and solving many social problems in a post-industrial society. According to most experts in the field of science, technology and investment policy, the nanotechnology revolution that has begun will cover all vital areas of human activity (from space exploration , from national security to the environment and agriculture), and its consequences will be broader and deeper than the computer revolution of the last third of the twentieth century . All this sets out tasks and questions not only in the scientific and technical field, but also before administrators at various levels, potential investors, the education sector, government bodies, etc.

General Features

The structure and, accordingly, the properties of the nanomaterials are formed at the stage of their manufacture. The importance of technology as a basis for ensuring stable and optimal performance of nanomaterials is quite evident; This is also important from the point of view of their economy.

The technology of nanomaterials, in accordance with the diversity of the latter, is characterized by a combination of mineral, physical, chemical and biological methods on the one hand, and, on the other hand, from mainly traditional and new technologies. Therefore, if the vast majority of methods for obtaining embedded nanomaterials are quite traditional, then processes such as the manufacture of, for example, "quantum pens" using scanning tunneling microscopy, the formation of quantum dots by self-assembly of atoms, or the use of ion-path technology depend To create porous structures in polymer materials using fundamentally different technological methods.

Molecular biotechnology methods are also very diverse. All this complicates the presentation of the basics of nanomaterials technology, given the fact that many technological details ("know-how") are described by the authors only in general terms, and the message is often of an advertising nature. Moreover, only the main and most outstanding technological methods are analyzed.

METHODS

Methods for studying nanoorganisms are primarily aimed at determining the size and structure of nanoparticles, and determining the effect of size effects on the properties of nanomaterials.

There are currently many different methods of diagnosis and methods of studying physical and chemical properties

Solid nanostructures for these purposes, traditional methods are widely used: electron microscopy, methods X-ray and diffraction spectroscopy,

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Auger spectroscopy, neutronography, etc. A major breakthrough in research The microscopic state of matter is associated with the creation of scanning probes

Classification of Electrochemical Methods for Obtaining Nanostructured Materials

Electrolytic precipitation has been used for a long time to obtain protective coatings. It is based on the redox reactions that occur on the electrodes in an electrolyte solution when an electric current is passed. Most modern electrochemical methods are used to obtain materials with a nanostructure such a scheme; It can traditionally be attributed to classical electrochemical methods.

The electrochemical method can be applied to obtain materials with nanostructures in three versions:

1) Electrochemical anode processing of semiconductor materials to obtain nanoporous structures (pits, processes progressing on structural defects);
2) Obtaining aluminum and titanium oxide nanofilms in acidic solutions;
3) Cathodic electrochemical reduction of electrolyte solutions; Electrochemical deposition of metals, alloys and semiconductor materials in membrane pores (template installation)

But in addition to the above classical electrochemical methods, there is a method of local probe oxidation of metal films. This method appeared in connection with the development of scanning tunneling microscopy.

Classic Electrochemical Method

Electrochemical Oxidation (Etching) of Semiconducting Materials

The production of nanostructures based on semiconductor materials is based on the method of electrochemical etching. Nanopores can be created in silicon, silicon carbide (SiC), SiGe, gallium arsenide (GaAs), gallium phosphide (GaP), indium phosphide (InP).

However, porous silicone is the most interesting example because it has a number of unusual properties. Quantum confinement and surface effects in porous silicon nanostructures lead to the fact that this material, unlike single-crystal silicon, behaves like a direct-gap semiconductor, which indicates a rather intense optical and electric glow. This is used to create light-emitting devices combined with monocrystalline silicon.

Porous Silicon Obtaining Porous Silicon

During the anodic polarization of monocrystalline silicon in solutions of hydrofluoric acid (HF), a monitoring network of voids (pores) of various shapes, size and direction in their size is formed.

Porous silicon is obtained by anodic polarization in special electrochemical cells, the designs of which can be different.

The simplest cell for electrochemical treatment consists of a chemically inert bath filled with a HF solution, in which a silicon wafer and a platinum electrode are placed. The cell body, as a rule, is made of PTFE, and the electrodes are made of platinum. To initiate the electrochemical dissolution, a positive (anodic) voltage attached to the platinum electrode is applied to the silicon wafer.

The electrochemical treatment process is carried out at a certain anode current density, which allows to obtain the required porosity, the thickness of the porous layer and ensure its reproducibility from one process to another.

The chemical shifts responsible for the local electrochemical dissolution of silicon in HF-based electrolytes indicate the participation of the (h +) - electron (e-) hole exchange in them, which takes place according to the following scheme:

CONCLUSION

The electrical, magnetic, optical and mechanical properties of nanomaterials have provided many fascinating applications. Research is still ongoing for these properties. The properties of the nanomaterials are different from those of the bulk model. Here are some advantages of nanomaterials.

A semiconductor nanomaterial with q-particles exhibits quantum confinement effects, giving it the property of fluorescence.

Compared to coarse-grained ceramics, nano-ceramics are more flexible at higher temperatures. The cold welding property of metallic nanopowders along with its ductility is very beneficial in metal-metal bonding.

Magnetic single nanoparticles provide a supermagnetic property. The monomeric nanostructured metallic clusters act as precursors to heterogeneous catalysts.

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