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## **EFFECTIVENESS OF USING NANOPRODUCTS IN THE RESTORATION OF ARCHITECTURAL MONUMENTS**

**Abstract:** *This article describes the methods and results of using nanotechnological products, the latest innovative technology, in the repair and restoration of architectural and cultural heritage monuments, preservation of architectural heritage, their effective use and service life extension.*

**Key words:** Nanoproduct, nanotechnology, restoration, nanopowder, nanovarnish, nanopaint, coating, wood, murals, enamel

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## **ЭФФЕКТИВНОСТЬ ИСПОЛЬЗОВАНИЯ НАНО ПРОДУКТОВ В РЕСТАВРАЦИИ АРХИТЕКТУРНЫХ ПАМЯТНИКОВ**

**Аннотация:**

*В статье описаны методы и результаты использования нанотехнологических продуктов, представляющих собой последние инновационные технологии, в ремонте и реставрации памятников архитектурного и культурного наследия. Рассматриваются вопросы сохранения архитектурного наследия, его эффективного использования и продления срока службы.*

**Ключевые слова:** нанопроduct, нанотехнология, реставрация, нанопорошок, нанолак, нанокраска, покрытие, дерево, фрески, эмаль.

*Intraduction.* Humanity is on the threshold of the next technological revolution. In recent years, the development of science and technology has reached such an important milestone that it is even able to radically change the living conditions of a person. This is due to the fact that nanotechnologies have started to be applied to all sectors of the economy. The word "nanotechnology" is composed of two words - "nano" and "technology", "Nano" is "nannos" in ancient Greek, and in Uzbek it means "small", "tiny", and "technologies" means "art, skill" means.

It follows that nanotechnology is the science of tiny particles and their enormous capabilities, meaning art and creativity. Even textbooks on nanotechnology have been created [1]. Nanotechnology works with the smallest particles, the size of which does not exceed thousands of nanometers (tenths to ninths of a meter). With their help, we can save time, spend less, and have more material wealth and treats. [2]. [figure 1].



Fig. 1.

*Main part.* We can see this in the example of the Arabic inscriptions written on the walls of the complex. For many centuries, the memorial buildings of the Timurid period have been surprising even foreign tourists with their appearance, beauty and the presence of a divine atmosphere that attracts people. We know that today we have accumulated enough experience in the field of restoration and construction, which gives us the opportunity to preserve architectural masterpieces. Unfortunately, time, nature and man are the main factors that shorten the life of historical structures. In such cases, the demand for the use of innovative

technologies becomes stronger. In this field, the use of innovative technologies, in particular nanoproducts, leads to unexpected efficiency.

Long-term protection of walls and preservation of the beauty of monumental structures, nanomaterials that provide specific properties of damaged parts - transparent coatings, nanopowders, nanoenamels, steam and laser cleaning devices, hydroxide nanoparticles have been identified, which help to restore the architectural monument to its original state and permanently prevent damage in the future. is the main factor in obtaining [figure 2]. The use of these products leads to high efficiency in the repair of damaged parts of historical buildings.



Fig.2.

Today, more than a thousand enterprises in various fields are engaged in the production of nanoproducts. Nanotechnology enables the creation of new and improvement of existing technologies and materials, with the help of nanotechnology it is possible to obtain coatings combining properties such as elasticity and high hardness, as well as most colorfast materials. For example - lotus effect - or a self-cleaning surface created on the basis of the effect of minimal wetting of the surface. This material is based on a structural imitation of the lotus leaf plant, and is characterized by moisture and water resistance, while also being self-cleaning and capable of killing any microbes. It is mainly used as a coating in objects.

Nanotechnology makes it possible to create paint materials that can be used as self-cleaning materials. As a result of their movement, under the influence of UV rays, free radicals that oxidize organic substances are formed on the surface of nanoparticles. In Russia and Germany, paints and colored materials capable of

creating non-flammable, heat-resistant coatings with low thermal conductivity are being developed and produced [3,4]. Such coatings are able to slow down the process of heating the building structure to its critical temperature for some time. Such coatings can be easily applied to concrete and wood. In the event of a fire, such paint quickly swells, expands and prevents heat from penetrating into the base layer. Thus, it provides protection. Smart nanoparticles in these products perform different tasks at the same time, that is, a coating is formed that prevents the main material from various external influences - dust, dust, microbes, sharp rays of the sun, extreme cold temperature, and parts such as wood, tiles, domes, murals are created in the original way. plays an important role in maintaining the status quo. It also has the ability to kill various microbes and removes traces of many pollutants. Easily removes stains of biological origin (fat, sauce, blood), as well as traces of pencil, ink, watercolor [figure 3].



Fig.3.

Despite the external influences, the paint always keeps a new look. Due to the presence of nanoparticles, it gives the painted surface breathability, which is important for the care of the facade. These nano-paints are environmentally friendly, easy to apply and have good antibacterial properties, these paints are used not only in the process of renovation, but also in hospitals, kindergartens, schools, hotels , can be used as an ideal facade and interior coating for restaurants and residential buildings. A bioactive coating developed with the help of silver nanoparticles is a water dispersion paint with biocidal properties, which ensures the biological activity of the nanomodified coating and has been successfully proven to fight against a number of pathogenic bacteria, viruses, fungicidal

pollutants and other microflora. These paints are "smart wall coverings" with unique properties[5]. Nanotechnologies make it possible to purposefully change the properties of surfaces in such a way that they can perform practically any required function. The use of nanotechnology has given unique properties to paints and created such types of paint nanomaterials as facade paints, interior paints, as well as primers and fire-resistant paints.

It has the ability to burn sticky harmful substances, eliminating traces of nicotine, soot and other pollutants. Due to the presence of nanoparticles, it gives the painted surface breathability, which is important for the care of the damaged facade. This nano-paint is environmentally friendly, easy to apply and has good antibacterial properties, and this coating is an ideal coating for renovation of hospitals, kindergartens, schools, hotels, restaurants and residential buildings.

In order to protect the walls, wood, varnish and plaster in the interior of historical buildings from cracking and mold, it is necessary to provide the rooms with the necessary microclimate in every season. In this case, the use of electrically conductive nano-paints allows more efficient use of energy for heating the room. Ordinary water-based latex paint is made electrically conductive by carbon nanofibers. Can be applied to wall, wood, paper, glass or metal by brush or spray.

*Results.* New technologies are active and successful to restore the image of cities and local cultural attractions. There are also new inorganic nanoparticles that both restore interior decoration and protect it from further damage[6].



Figure 4.

This nanoproduct is hydroxide nanoparticles that can be applied to frescoes and other fine art samples, not only as an effective barrier against subsequent

damage to murals and antiques that are part of an architectural monument, but also to help restore them [figure 4].

The new coating is very easy to use, first the nanoparticles are dispersed in isopropanol, then the suspension is brushed or sprayed on the surface of the damaged part, if the damaged part is very thin, Japanese paper (large hole paper) is placed on the surface, and the nanoparticles are delivered to the damaged part through the holes in the paper.

There are also calcium, strontium, barium, and magnesium hydroxide nanoparticles, all of which are used effectively for various purposes. For example, calcium and magnesium hydroxides can be used to preserve paper, wood and other cellulose. hydroxide nanoparticles can be used to protect all types of surfaces except metal [7]. This method is a new nanotechnological approach that can be used not only in the preservation and restoration of ancient monuments, but also in the future protection of cultural heritage objects from external influences. In memorials, windows are an integral part of the building, wooden and glass structures are the first to be damaged and require restoration. This is an important and understandable situation considering their continuous operation and direct interaction with the environment. Therefore, in most cases, the original windows are replaced with new windows that repeat the shape and color, but made of modern materials.

Recovery glass meets requirements such as thermal insulation, strength, sound insulation and durability. After all, it is designed not only to replace the old structure, but also to provide reliable protection of the interior from the destructive effects of weather disasters and the harsh atmosphere of the modern city. This protects the building from overheating in the summer, that is, wood, wall paintings and decorations, as well as varnishes in the interior of the building prevent drying, cracking and loss of their properties, and in the winter it protects from overheating, i.e. from rusting, mold and cracking. . In addition, the window should fully match the style of the building, its decorative and architectural appearance. According to



experts, plastic windows are the best solution that ensures the fulfillment of all these conditions. The peculiarity of this material is that it becomes elastic when heated, which makes it possible to create any shape - arch, round, cross-shaped, etc. [8]. The main reason for this is the use of nano ions in the glass surface coating. This nanoproduct is especially important for protecting the interior of historical buildings from external factors. Also, wood products from external negative effects. The use of titanium dioxide nanoparticles for protection against harmful substances is of great importance. Products created on the basis of titanium dioxide nanoparticles, including nanovarnish and nanoenamels, have self-cleaning properties, do not absorb any negative effects, namely dust, mold, strong rays of the sun and extreme cold temperature, and pass the protective agent. This is very important for any type of cultural heritage. In addition, it is proposed to use nanoemulsions of water-insoluble biocides to protect products made from this material against biological damage[9].

*Conclusion.* The 21st century is considered the century of nanotechnology, and as in all other fields, great achievements are being made in the field of architecture and construction. It is shown that these products bring unexpected results not only in modern memory styles and volumetric spatial images, but also in the repair and restoration of historical memory objects, restoring facades to their original condition. Based on the results of the research, it was found that in the architecture of Uzbekistan, in particular, the repair and restoration of historical monuments, prolonging their life is one of the urgent issues, and the use of special types of nanoproducts as a solution to these problems is considered the main factor in preserving the unique masterpieces of memory. State support and targeted funding programs allow the preservation of the historical appearance of any city for future generations.

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