Journal of Materials, Processing and Design (2024)
Clausius Scientific Press, Canada

DOI: 10.23977/jmpd.2024.080209
ISSN 2516-0923 Vol. 8 Num. 2

Application of Nano-new Materials in Building Field

Yan Pan

School of Urban Construction, Yangtze University, Jingzhou, 434023, China
1834084287@qq.com

Keywords: Nano new materials, Construction field, Application

Abstract: Since 1980s, the research of nanotechnology has been highly valued all over the world, and some technologies have been put into practical use. Nano-new materials bring an unprecedented revolution to the development of building materials with their unique optical, electrical, thermal and magnetic properties. A new coating developed by using the phenomenon of color change with angle of nano-new materials, an antibacterial and mildew-proof coating developed by using the self-cleaning function of nano-new materials, and a PPR water supply pipe. Thermal insulation attempts to study the application of nano-new materials in the construction field, but nano-new materials have important applications in glass, cement and thermal insulation materials. It not only improves the quality level of construction projects, but also strengthens the functionality and applicability of buildings. Nanotechnology will have a great impact on society and economy security in the new century.

1. Introduction

Nano-new material is a high-tech with profound theoretical value and broad application prospect, and is regarded as one of the most promising industrial technologies in this century. Since the 1980s, the research on nanotechnology has attracted great attention all over the world, and some technologies have been put into practical use. Nano-new materials have brought unprecedented revolution to the development of building materials with their unique optical, electrical, thermal and magnetic properties. A new coating developed by using the angular discoloration phenomenon of nano-new materials, an antibacterial and mildew-proof coating developed by using the self-cleaning function of nano-new materials, PPR water supply pipe [1]. Nano-new materials not only have considerable theoretical research value, but also have broad application prospects at present and in the future, and are one of the most promising technologies for development and research in the past decade. As a new science, it has a great influence on building materials, which not only improves the quality level of building projects, but also strengthens the functionality and applicability of buildings. Nanotechnology will have a great impact on society, economy and national security in the new century. As early as the end of 1980s, the research and development of nanotechnology has attracted the attention of all countries in the world, and even some cutting-edge countries have realized the application of this technology [2-3]. Due to the limitation of technology and energy, the thermal insulation materials currently used in China will do some harm to human body, such as polyurethane foam, asbestos and fiber products containing carcinogens, which will release toxic gases after burning. The new thermal insulation materials developed through nanotechnology can effectively avoid the problems existing in traditional materials. With the development of nanotechnology, it has become a

socialized technology that affects industrial development and national competitiveness. The safety, comfort and convenience of traffic around buildings will become a factor that cannot be ignored in modern architectural art. Nano-thermal insulation board made of nano-new materials has good light stability, toughness and thermal stability, so it has broad application prospects and can well meet the requirements of high strength and corrosion resistance of waterproof materials. At the same time, it is also used in people's daily life [4]. In developed countries, nano-new materials have already existed in cosmetics, clothing and other products closely related to people's lives, effectively improving people's living environment. They are a kind of green thermal insulation material. Due to the limitation of technology and energy, the thermal insulation materials currently used in China will do some harm to human body, such as polyurethane foam, asbestos and fiber products containing carcinogens, which will release toxic gases after burning. The new thermal insulation materials developed through nanotechnology can effectively avoid the problems existing in traditional materials. Nano-functional materials have become a hot research topic at home and abroad. At present, the research and development work are in the early stage, and there are still many problems that have not been well solved [5].

2. Generation and development of new nano-materials

The rapid development of nanotechnology was the microscopic characterization, atomic manipulation and processing technologies such as scanning tunneling microscope and atomic force microscope invented in the late last century and early 1980s, which can directly observe the atomic structure on the surface of substances. In July 1990, the first international nano-science and technology conference officially identified nano-materials science as a new branch of materials science, and since then, the research and application of nano-materials have entered a brand-new stage [6]. Nano new materials, as an emerging discipline, have provided strong support for the development of new technologies and have become the most promising and promising technology currently. Nano new materials not only play a powerful role in the development of building materials, but also involve a wide range of design concepts when calculating various types of high-rise structures, such as the assumption of stiffness and elasticity of floors, adjustment of stiffness of connecting beams and frames, reduction of cycles, determination of constraint types or degrees of components, and selection and simplification of structural models. Due to the special structure of nano-new materials, the materials themselves have small size effect, quantum effect, macroscopic quantum tunneling effect, surface and interface effect, etc., which makes them have many different physical and chemical properties from traditional materials. According to the combination of nanotechnology and traditional disciplines, it is subdivided into nano-materials, nano-electronics, nano-biology, nano-chemistry, nano-mechanics and nano-processing.

Nanometer is a unit of length, 1nm=10- 9m. Nano-particles refer to ultra-fine particles with the particle size of nano-scale. Their particle size is larger than that of atomic groups and smaller than that of ordinary particles, generally within the range of 1~100nm. They are in the transitional area at the boundary between atomic clusters and macroscopic objects, and are a typical mesoscopic system [7]. As shown in Figure 1, due to the special structure of nano-materials, the materials themselves have small size effect, quantum size effect, surface effect, macroscopic quantum tunneling effect and so on, which makes them have many special physical properties different from traditional materials.

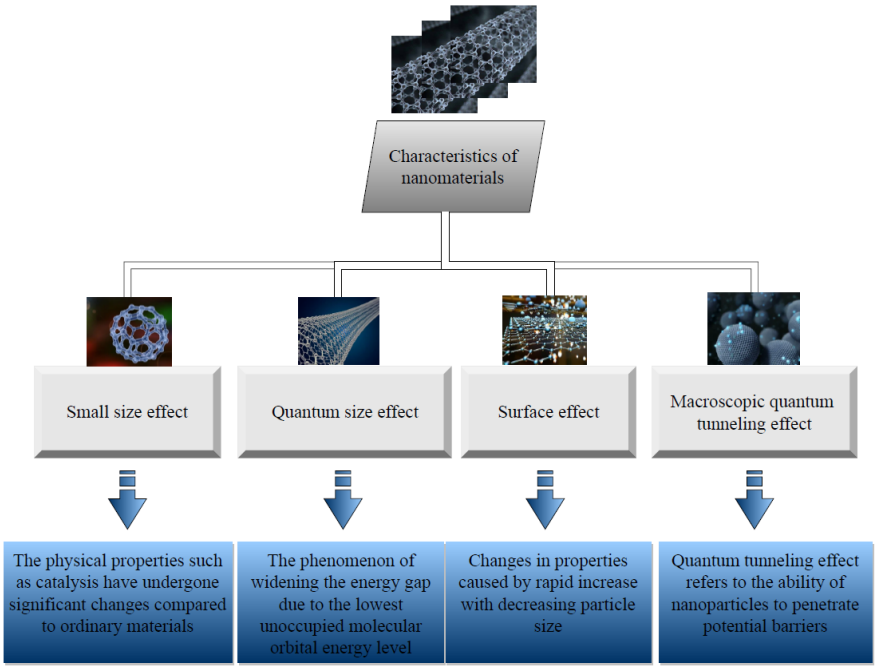

Figure 1: Characteristics of nanomaterials

According to the combination of nanotechnology and traditional disciplines, it can be subdivided into nano material science, nano electronics, nano biology, nanochemistry, nano mechanics and nano processing and other research fields. By comparing with conventional materials, we need to identify the special laws of nanotechnology, establish new concepts and theories to describe and characterize nanotechnology, develop and improve the scientific system of nanotechnology materials, and develop the application fields of new nanotechnology materials [8-9]. The unique properties of nano new materials have laid the foundation for their widespread application. By combining nano materials with special functions with building materials, various building materials can be prepared. In addition, with the development of science and technology and the improvement of human living standards, people have increasingly pursued high-end, comfortable, and health building materials.

3. Application of Nano-new Materials in Building Field

3.1 Application in glass

Ordinary glass is difficult to clean because it is easy to adsorb organic matter during use, and it will form organic dirt. At the same time, it is easy to form water mist in rainy days or in the process of cleaning with water, which seriously affects the reflectivity of glass. However, the glass made of nano-new materials is hard and has strong light transmission performance. Using nano-glass with science and technology as residential glass and screen glass can greatly save the process of manual cleaning [10]. As shown in Figure 2, in view of the shortcomings existing in the use of glass curtain wall and outdoor engineering glass and the market demand, after years of research and exploration, Nano-coating New Materials Company has successfully developed a nano-coating composite coating specially used for cleaning glass curtain wall and outdoor engineering glass.

In addition, nano glass has excellent transparency and mechanical strength. For example, glass is prone to water mist, which greatly limits visibility. However, by using thin film plating on both sides of the flat glass, the impact of such defects can be effectively resolved [11]. In addition, as a photocatalyst under the action of sunlight, it can also decompose and eliminate harmful substances

such as formaldehyde and ammonia.

Figure 2: Nano-coated glass

3.2 Application in Cement

Ordinary cement concrete often has greater rigidity, but lacks flexibility, which makes it difficult to solve the inherent defects of cement, and often leads to cracking and other damage problems in the future construction process. The users of nanotechnology have effectively solved this kind of problem. Compared with ordinary concrete, nano-concrete has significantly improved its strength, hardness, aging resistance, durability and other properties. At the same time, it also has waterproof, sound absorption, electromagnetic wave absorption and other properties, so it can be used in some special building facilities. Coatings are usually used to paint the interior and exterior walls of buildings. Traditional coatings usually have defects such as insufficient smoothness and poor suspension stability, while new nano-composite coatings add nano-powder into coatings to achieve the characteristics of aging resistance and radiation resistance, which shows unique charm in the construction industry [12]. As shown in Figure 3, the strength, hardness, aging resistance and corrosion resistance of concrete are effectively strengthened by applying nano-new materials to cement, and at the same time, electromagnetic waves and sounds can be effectively absorbed, which meets the requirements of buildings for sound insulation effect. At the same time, this kind of material has also been applied to some special buildings, and the appearance of nano-concrete has effectively solved this problem.

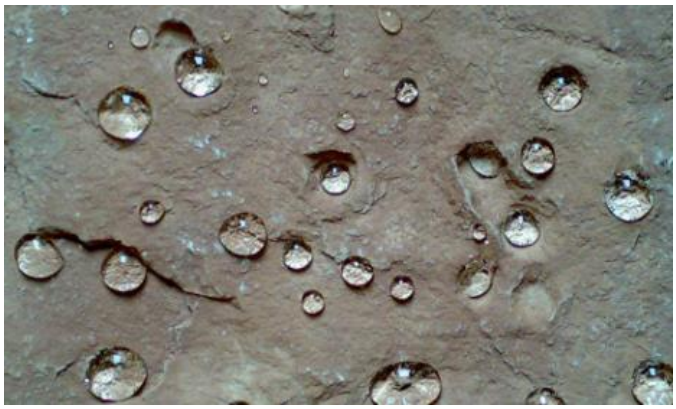

Figure 3: Nanocement

Compared with ordinary concrete, nanoconcrete has been applied in many industries and fields, greatly improving the construction quality of construction projects and providing convenience for people's production and life.

3.3 Application in insulation materials

People's pursuit of material life and spiritual life also has a higher standard, and the living environment is an important part that affects the quality of human life. Therefore, the safety, comfort and convenience of surrounding traffic of buildings will become factors that cannot be ignored in modern architectural art. As shown in Figure 4, the nano-thermal insulation board made by applying nano-new materials to thermal insulation materials has good light stability, toughness and thermal stability, so it has a wide application prospect and can well meet the requirements of high strength and corrosion resistance of waterproof materials.

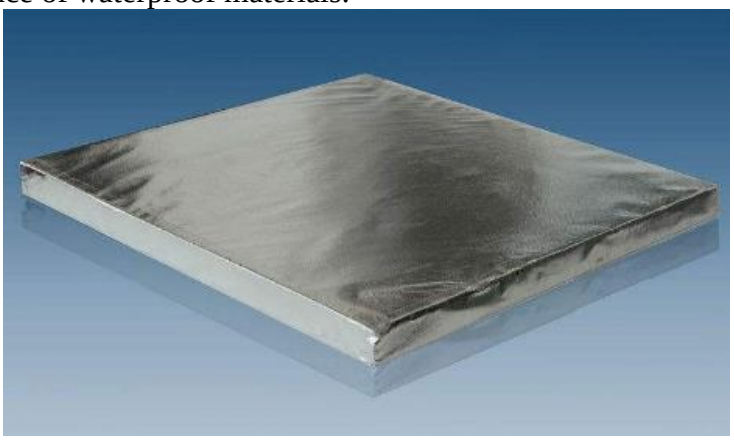

Figure 4: Nano-thermal insulation board

This material is a nano-level functional material formed by high temperature and high pressure, which has good thermal insulation, but at the same time it has stable chemical properties and will not cause harm to human body. It is a green environmental protection thermal insulation material advocated by China at present. By developing insulation materials using nanomaterials, these drawbacks can be avoided. For example, insulation materials modified with high-temperature and high-pressure nano functional materials based on inorganic silicates not only have good insulation effects, but also have no harm to the human body. They are a green and environmentally friendly insulation material. Due to the limitation of technical level and energy resources, the thermal insulation materials currently used in China will do some harm to human body, such as the release of toxic gases after the combustion of polyurethane foam, asbestos and fiber products containing carcinogens, and the new thermal insulation materials developed through nanotechnology can effectively avoid the problems existing in traditional materials.

4. Conclusions

Nano-new materials, as a new discipline, provide strong support for the development of new technologies and have become the most promising and promising technologies at present. Nano-new materials not only play a powerful role in the development of building materials, but also involve a wide range of design concepts when calculating various types of high-rise structures, such as the assumption of floor stiffness and elasticity, the adjustment of coupling beam and frame stiffness, the reduction of cycle times, the determination of constraint type or degree of components, the selection and simplification of structural models, etc. At the same time, it is also used in people's daily life. In developed countries, nano-new materials have already existed in cosmetics, clothing and other products closely related to people's lives, effectively improving people's living environment. Nano-functional materials have become a hot research topic at home and abroad. Nano-new materials not only have considerable theoretical research value, but also have broad application prospects at present

and in the future, and are one of the most promising technologies for development and research in the past decade. As early as the end of 1980s, the research and development of nanotechnology has attracted the attention of all countries in the world, and even some cutting-edge countries have realized the application of this technology. At present, the research and development work is in the early stage, and there are still many problems that have not been well solved. It is necessary to further accelerate the research and popularization of nano-materials. I believe that in the near future, we will enter a new era of materials-the era of nano-materials.

References

[1] Ovsyannikov S I, Dyachenko V Y. Wooden Nano-Composite Materials and Prospects of their Application in Wooden Housing Construction [J]. Materials science forum, 2022, 68(15):41-62.

[2] Ren J. Constructing a novel nano-TiO2/Epoxy resin composite and its application in alkali-activated slag/fly ash pastes [J]. Construction and Building Materials, 2020, 232(66):117218-117244.

[3] Jing Y, Han Q, Zhang P, et al. Comprehensive review of the properties of fly ash-based geopolymer with additive of nano-SiO2 [J]. Nanotechnology Reviews, 2022, 11(1):1478-1498.

[4] An J , Xu C , Li L ,et al.The unique spontaneous polarization property and application of ferroelectric materials in photocatalysis [J].Nano Research, 2024, 17(5):3571-3585. DOI: 10.1007/s12274-023-6357-8.

[5] Wang J G, Liu H, Zhang X, et al. Elaborate construction of N/S-co-doped carbon nanobowls for ultrahigh-power supercapacitors [J]. Journal of Materials Chemistry A, 2018, 6(4):11-30.

[6] Ahmed B, Gharib N. Paths towards Energy Efficient Buildings Using Nano Architecture [J]. IOP Conference Series Materials Science and Engineering, 2020, 974(69):012019-012030.

[7] Tong Y. Application of Carbon Fiber Reinforced Materials in Construction Engineering [J]. China Plastics Industry, 2021, 39(15):40-57.

[8] Jun J I, Liu X S, Nie J K, et al. Application status and development trend of silico-manganese slag in construction materials field [J]. China Metallurgy, 2022, 16(5):19-34.

[9] Ahmed H, Tiznobaik M, Huda S B, et al. Recycled aggregate concrete from large-scale production to sustainable field application [J]. Construction and Building Materials, 2020, 262(November):119979-119988.

[10] Gadkar A, Subramaniam K. Rheology control of alkali-activated fly ash with nano clay for cellular geopolymer application [J]. Construction and Building Materials, 2021, 283(4):11-20.

[11] Jonbi J, Tjahjani A, Meutia W, et al. Mechanical properties of nanogrout as advanced material for construction[J]. Journal of Physics Conference Series, 2020, 1469(52):012037-012044.

[12] Dla B, Wei J A, Zya C, et al. Nano-engineering of construction materials using molecular dynamics simulations: Prospects and challenges [J]. Composites Part B: Engineering, 2018, 14(11):282-291.