

Classification and development of modern inorganic nonmetallic materials

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Abstract: Inorganic non-metal is a non-metallic element oxide, carbide, nitride, silicate and aluminate and other substances composed of materials, with high melting point, high hardness, corrosion resistance, wear resistance characteristics, and has good electrical conductivity, heat insulation and light transmission, has been widely used in the fields of architecture, ceramic art, aerospace and mobile communication. With the rapid development of modern industrial civilization, modern inorganic non-metallic material refining technology continues to improve, people continue to research and develop new inorganic non-metallic materials, research and development of new glass, to meet the needs of construction, electrical and electronic industry development; Improve the traditional ceramic art, research and development of high-performance ceramics, to promote the development of aerospace and electronic industries; Research and development of artificial crystals to meet the development needs of high-tech industries, and further improve the development and production technology of modern inorganic non-metallic materials in China.

Key words: modern inorganic non-metallic materials; Material classification; Material characteristics; Development trend

With the rapid development of modern science and technology, chemical purification methods continue to improve, scientists on the traditional silicate material purification methods were optimized, in the 1940s developed inorganic non-metallic materials, further promote the construction industry, electronics and aerospace industry development. The crystal structure of inorganic nonmetallic materials is more complex, there is no free electron, mainly to ionic bonds and mixed bonds. Traditional inorganic non-metallic materials have the advantages of structural stability, high temperature resistance, corrosion resistance, etc., but the quality is brittle and can not withstand thermal shock. In order to further improve the performance of inorganic non-metallic materials, scientists began to develop new inorganic non-metallic materials. In the middle of the 20th century, scientists developed a new type of inorganic non-metallic materials, this material has the advantages of high strength, high hardness, but also has good optical and electrical properties, as well as good biological functions, is widely used in aerospace, medical device manufacturing, electronics, mobile communications and other fields.

1. The characteristics of modern inorganic non-metallic materials

1.1 Characteristics of ordinary inorganic non-metallic materials

Due to the relatively stable crystal structure of inorganic non-metallic materials, no free electrons, composed of mixed bonds and ionic bonds, which determines that ordinary inorganic non-metallic materials have the advantages of pressure resistance, high strength, high temperature resistance and corrosion resistance, but this material has low breaking strength, poor ductility, and belongs to the brittle material, which limits the scope of use to a certain extent. Cement, glass and ceramics are typical inorganic nonmetallic materials, cement has good gelling performance, corrosion resistance and high temperature resistance; Glass has good optical properties and high temperature resistance, which can meet the needs of building lighting and noise reduction; Ceramic materials have the characteristics of good high temperature resistance, high strength and high hardness, and are widely used in the field of aerospace. Ordinary inorganic non-metallic materials need to add different types of chemical materials in the refining and production process, strictly control the temperature, smelting time, etc., and the manufacturing process is more complex.

1.2 Characteristics of special inorganic non-metallic materials

Special inorganic non-metallic materials refer to materials made of oxygen, nitrogen, boron, sulfide and various inorganic non-metallic compounds by special advanced technology, which are mainly used in the field of aerospace and national defense construction. For example, alumina and beryllium oxide ceramics have good high-frequency insulation characteristics, higher melting temperature, mechanical strength, can be used in the field of modern engineering and technology. Optical fiber has good optical and conductive properties, which can quickly transmit network signals and data in a short time, and can be used in mobile communication network construction, satellite navigation and other fields. Ferrite is a kind of metal oxide with special ferromagnetism, divided into permanent magnet ferrite, soft magnetic ferrite and gyromagnetic ferrite three kinds, with good resistivity and dielectric properties, with good permeability, is widely used in high frequency weak current field.

2. The classification of modern inorganic nonmetallic materials

2.1 Classification according to molecular structure

According to the molecular structure, inorganic nonmetals can be divided into two categories: crystal and amorphous, and crystals can be subdivided into single crystals and polycrystals. Common monocrystalline inorganic nonmetallic materials include diamond, monocrystalline silicon, etc. These monocrystalline structures are relatively stable, with strong hardness, strength and corrosion resistance,

and are widely used in manufacturing and communication fields. For example, diamond is the hardness of the highest material in nature, can be used in mechanical and technological cutting process, quickly cut all kinds of materials, improve the cutting process accuracy and work efficiency. The common single crystal compound is mainly bismuth telluride, which has good electrical conductivity and magnetism, and can be used in semiconductor and electronic component manufacturing to further improve the sensitivity and conductivity of electronic components. Ceramics are the most common inorganic non-metallic materials, can be divided into traditional ceramics, new ceramics and natural stone three categories, traditional ceramics follow the traditional porcelain firing method, the use of special clay, adding silicon oxide, the porcelain into a special kiln for firing. The new ceramics have better hardness, strength and corrosion resistance, and are widely used in the fields of daily ceramics, building ceramics and aerospace ceramics. Amorphous mainly refers to glass, can also be subdivided into elemental and compound glass, with the improvement of inorganic non-metallic manufacturing process, the introduction of sensitive glass and biological glass.

2.2 Division according to chemical composition

Inorganic nonmetallic materials can be divided into two categories: elemental and compound. Inorganic nonmetallic materials include monocrystalline silicon, diamond and other materials, mainly used in integrated circuits and industrial manufacturing and other fields; Polysilicon includes polycrystalline stone ink, which is mainly used in the manufacture of photoelectric materials and conductive materials, such as solar panels; Elemental selenium conductivity changes with the intensity of light, will not be oxidized at room temperature, can be used to make glass. Compounds include dialumina, cobalt dioxide, silicon nitride, aluminum nitride, biogallass and barium titanate. The combination of different metal elements will change the original properties of metal elements, thereby improving the performance of inorganic nonmetallic materials.

2.3 Divided according to function

According to the function of inorganic non-metallic materials, we can divide inorganic non-metallic materials into two categories: engineering materials and functional materials. Engineering materials can be divided into high strength and high toughness materials, high temperature and thermal shock resistant materials and wear and corrosion resistant materials; Functional materials are divided into electrical materials, optical materials and biological materials. For example, we are familiar with the semiconductor material, the room temperature resistance value is in the conductor (resistance value of about 10-42m) and insulator ($\geq 101m$) between, is the radio electronic technology, computer chips and other high-tech indispensable in the important material. At present, semiconductor materials, artificial crystals, new ceramics and silicate materials are the most widely used inorganic non-metallic materials, but also the focus of research and development of new materials in the world, according to the different needs of construction, electronics, communications, aerospace and medical fields, research and development of inorganic non-metallic materials with different functions is the main development trend in the future.

3. The prospect of classification of inorganic non-metallic materials

3.1 Research and development of composite low-dimensional inorganic nonmetallic materials

With the acceleration of the transformation and upgrading of China's manufacturing industry, the research on inorganic non-metallic materials has become more in-depth, and technicians have begun to try to integrate metal materials, inorganic non-metallic materials and organic polymers and other materials to further develop new composite low-dimensional inorganic non-metallic materials, further improve the performance of inorganic non-metallic materials, and meet the needs of various industries. China's inorganic nonmetallic materials are developing in the direction of thin film materials and fiber materials, such as the application of thin film materials in microelectronics and institutional materials, as well as the application of fiber materials in optical signal amplification and modulation. For example, technicians combine glass and traditional steel, combine the advantages and properties of these two types of materials to form a composite structure, and develop FRP materials to meet people's requirements for building glass lighting, noise reduction, and further improve building comfort. In addition, composite inorganic non-metallic materials are also widely used in the field of smart industry. For example, glass ceramic materials have good electrical conductivity, high temperature resistance and optical properties, which can improve the electrical conductivity of electronic equipment in high temperature environment, and carry out electronic circuit grinding treatment, and the performance of electronic products is more stable and the service life of electronic products is extended. Compound inorganic non-metallic materials also have official applications in the field of medical restoration, such as the development of new resin materials, used to make artificial joints, improve the wear resistance and stability of artificial joints, reduce patient rejection reaction, LiKO materials can also be used to make dentures, dental crowns, etc., to improve the wear resistance and comfort of oral restoration materials.

3.2 Ecological and energy saving transformation

Inorganic non-metallic materials are very wide range of materials, equipment technology, purification equipment and other requirements are relatively high, due to the backward equipment of individual enterprises, the lack of professional personnel, in the process of producing inorganic non-metallic materials caused pollution to the environment, virtually waste a lot of raw materials, which and China's energy conservation and emission reduction strategy. First of all, in order to implement the call for energy saving and emission reduction, improve the performance of inorganic non-gold metal materials, researchers should establish the concept of ecological energy saving development, explore the use of waste materials synthetic inorganic non-metallic materials methods, to achieve waste recycling, further reduce the production of inorganic non-metallic materials finished products, reduce the damage to the environment in the production process. For example, researchers can develop new ceramic materials, make new granular ceramic materials, and apply them in the construction of external walls of building projects, improve the thermal insulation performance and insulation of buildings, reduce the use of

cement, reduce the generation of construction waste, effectively improve the load capacity of building structures, reduce the indoor energy consumption of buildings, and implement the concept of green building. Further improve the ecological and environmental protection type of building engineering. Secondly, the researchers also developed inorganic non-metallic cement materials, the use of industrial waste slag as raw materials, add special chemical elements, reprocessing into a new type of cement material, reduce the cost of cement production, recycle industrial waste slag, reduce the production of industrial waste. In addition, the researchers can further optimize the inorganic non-metallic coating, the coating on the surface of building materials, to avoid the problem of flow stains dripping, the new coating and diatomite combined to improve the absorption of building external walls, to avoid coating mold, to solve the problems of mold and discoloration of building external walls in rainy and humid areas.

3.3 Intelligent development

Intelligent development is the inevitable trend of the development of inorganic non-metallic materials in the future. The use of artificial intelligence technology to improve the research and development and manufacturing process of inorganic non-metallic materials, further improve the performance of materials, and expand the application range of inorganic non-metallic materials. First, in recent years, China has developed a number of piezoelectric, piezoelectric ceramics and other intelligent materials, to further promote modern industrial production. Piezoelectric ceramics can convert mechanical energy and electrical energy into each other's ceramic materials, but also has good dielectric property and elasticity, can be used in medical imaging, acoustic sensors and ultrasonic motors, speed up the conversion of mechanical energy and electrical energy, reduce energy efficiency consumption rate, and promote the development of high-tech industry. Second, inorganic non-metallic materials are widely used in aerospace, intelligent manufacturing and other fields, which is an important basis for the development of high-tech industries. Researchers can apply artificial crystals in the fields of communication, laser weapons and submarine communications to further improve the quality of communication in special fields and ensure the stability and integrity of data transmission. At the same time, the new ceramic material has the advantages of high temperature resistance, high toughness and high strength, which can be used in satellite remote sensing and aerospace engine manufacturing to further promote the development of China's aerospace industry. Researchers should establish the concept of intelligent development, based on the development of high-tech industries such as aerospace, intelligent manufacturing, and medical biology, and develop new inorganic non-metallic materials to meet the development needs of high-end manufacturing, artificial intelligence, aerospace and other industries, and lay a good foundation for the development of high-tech industries in China.

4. Conclusion

With the rapid development of science and technology, inorganic non-metallic materials research and development and manufacturing technology continue to update, China should seize the development opportunity, and actively develop artificial crystals, new glass, semiconductor materials and new ceramics and other new inorganic non-metallic materials, to further improve China's inorganic non-metallic materials research and development and production level. Researchers should establish intelligent, compound and environmental protection energy-saving scientific research concept, the traditional inorganic non-metallic materials transformation, based on China's semiconductor, electronic communication, aerospace, construction and medical biology and other fields of material demand, and constantly develop new inorganic non-metallic materials, improve China's scientific research and innovation ability and international competitiveness. At the same time, enterprises should increase investment in the research and development of inorganic non-metallic materials, establish a good cooperative relationship with colleges and universities, based on the development status of inorganic non-metallic materials in China, and gradually develop energy-saving environmental protection, compound and intelligent inorganic non-metallic materials, reduce material costs, improve economic benefits, so as to promote the sustainable development of China's inorganic non-metallic materials industry.

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