
Original Research Article

Introduction to the future of new environmentally friendly materials—— phase change materials

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Abstract: Phase change materials reflect the progress of human science and technology, the future will be a huge development, China's research and development of phase change materials has entered a period of rapid development, but the public's understanding of phase change materials is still very little, in fact, there are many similar example of phase change materials from ancient China to modern times, this paper tries to talk about the past, present and future of phase change materials in a simple and obvious way to provide valuable references to the development of environmental protection materials in the future of mankind.

Keywords: Phase change materials; Ice and water; Curing reactions; Solid-liquid reactions; Solid-gas reactions

1. Introduction

Ancient Chinese science and technology masterpiece “Kaogongji”^[1] begins with this sentence: “Heaven sometimes, the earth has the gas, the material has the beauty, the work has the cleverness, the combination of these four, and then you can be good.” The charm of materials is not only the art of craftsmanship, but also an ancient discipline with strong comprehensiveness, and even closely related to the development of mankind. In the long river of time, the application of materials in different times has divided the lineage of human history, and the history of human civilisation is also the history of evolution of material science. Chinese and foreign historians usually divide human history into seven eras, since the ancient apes used natural materials for hunting in the Stone Age, to the half-slope of the human face fish pots unearthed to bring slash-and-burn pottery era, and then the emergence of metal smelting will be mankind's generation into the Bronze Age, followed by the arrival of the Iron Age to promote scientific and technological change, the invention of the steam engine will be mankind's rapid substitution of the iron and steel era, the second industrial revolution led to the century's electrical, silicon, information technology three times a century across, from the blood to the thriving, every change of the times are accompanied by scientific and technological changes, but although the times are different, but the material has always been as the cornerstone of the building of civilisation of the human society, and will always occupy a place.

Iteration of materials to promote the progress of social civilisation, we often say that modern civilisation has three pillars, they are: materials, energy, information technology, and the iteration of materials in the new era appears to be more prominent, if there is a new type of material, not only has the function of the conversion of energy, but also has a green energy-saving and environmental protection characteristics, then, in the history of the future development of mankind will be in the cusp of the development of the wind and waves Today, let's get to know about this hot thermal conductivity heat-storage of the new material——phase change materials.

2. Definition of phase change materials

In fact, in our daily life, there are simple phase change materials, common water is a natural phase change

material, for example, at a constant natural temperature, a cup of water filled with ice whose temperature is 0 degrees Celsius, with the passage of time the ice in the water cup melting, as long as the melting continues to occur, even if only 1 piece of ice, the water temperature in the cup still stays in the 0 degrees Celsius, the ice is absorbing heat and melting, but the ice-water Why does the temperature of ice and water not change? Because of the physical “phase change” phenomenon, with the phase change of Landau theory can be explained in this way, we compare the ice as a house, ice is unable to flow objects, because the internal water molecules like a house of steel skeleton as a solid articulation with each other, want to dismantle the structure of the steel frame, you need to workers to knock off the articulation part, the process of loosening will occur “liquefaction”, and knock off the link workers is “heat”, the entire ice house structure before disappearing, so you need to workers to knock off all the links. The process of loosening will occur “liquefaction”, and knock off the link of the workers is “heat”, the entire structure of the ice house in the disappearance of the workers need to knock off all the links, so the ice in the absorption of heat before the complete melting of water, the temperature will not rise because the heat is going to knock off the internal water molecules. Heat all go to knock off the internal links to go, so less ice and more ice water to drink is the same cold, which is why the winter snow instead of very cold, while the snow will feel colder when melting, because the water into ice need to release heat, ice melting into water need to absorb heat. So assuming that this heat can be absorbed and utilised, what effect will it achieve? Also take ice and water as an example, 1kg of ice at 0 degree Celsius wants to melt into water at 0 degree Celsius, it needs to absorb 336 kilojoules of heat, and 336 kilojoules of heat can make 1kg of water heated up to 80 degree Celsius, so it can be seen that phase-change materials not only conduct heat, but also store heat, and if you understand this, you will be able to understand the definition of phase-change materials.

Phase change material (PCM) ^[2] is defined as a class of materials that can absorb or release a large amount of energy when a phase change occurs. As phase change material is the use of latent heat energy storage, heat storage density, heat storage device structure is compact, and in the process of phase change itself, the temperature is basically unchanged, easy to manage, with the global energy conservation awareness of the improvement of this material once widely used in human life, will become the best energy saving and environmental protection of the best green carriers.

3. Phase Change Materials in Ancient China

The above is only a simple interpretation of solid and liquid phase change, the phase change process of materials also exists liquid and gas phase change, solid and gas phase change, solid and solid phase change and other classifications, and the ancients early on mastered some of the solid and solid phase change materials manufacturing, such as Sima Qian in the “Five Emperors in the Chronicle”^[3] is recorded: “The emperor picks the first mountain of the copper casting sword, to the astronomical ancient word inscriptions former Gertian Lu of the mountain, hair and out of gold; Chi received and system, thought the sword armour, the beginning of this sword also.” At the same time, the “Warring States Strategy”^[4] for the power of the sword of Wu-Yue also recorded: “The sword of Wu Gan, meat test is broken cattle and horses, the gold test is cut off the disc washbasin; thin columns on the strike, it is folded for three, the quality of the stone on the strike, it is shattered for a hundred.” According to China’s Hubei Province unearthed the national level of cultural relics of the Spring and Autumn period of the Yue Wang Goujian sword, unearthed without rust, as if just built the sword, the scene test can easily cut 23 layers of paper, can fully corroborate the “Strategies of the Warring States,” the said cut off all things of the power of the more subtle, more subtle is the discovery of a modern particle accelerator testing,

the two Yue Wang sword sword testing the body of the metal of the dendritic tin crystalline This is in line with the characteristics of phase change materials rich in tin fine crystals, and this technology needs to be produced to reach the symbiosis of solid-liquid critical point, to be solidified after the molten soup crystal species stereotypes to achieve, currently limited to the production of raw materials for chips, it is difficult to imagine that 2793 years ago from the present time, can be manufactured through the thermodynamic principle of class modern materials items, so through the scientific unlocking of the sword through the millennia of the mystery of the immortality of the sword will be conducive to the development and development of solid and solid phase change materials.

4. Phase Change Materials in Modern China

Phase change materials, green, environmentally friendly and other energy efficient advantages, in recent years has always been internationally recognised as the new direction of the future energy storage materials, although Europe and the United States for the material's phase change materials started earlier, but under the leadership of the party and the country, along with the "Carbon Peak Action" of the implementation of the landing and implementation of the phase change materials level of China's gradual emergence of a later trend of the trend of upward mobility, involving The scope of the field is also expanding, in addition to aerospace, military, communications, power and other fields, in recent years, phase change materials are also used in construction, electric vehicles, refrigeration equipment and other research and development areas, and even will be in the furniture and decoration, works of art, fashionable clothing and other areas of integration of the use of common, such as the popularity of the summer clothing, is the phenomenon of the phase change in the life of the application of the subtle. The traditional sense of ice feeling clothes, is made of good thermal conductivity of nylon fibre or viscose fibre, but its thermal conductivity brought about by the ice cold is only a momentary, ice cold only in the upper body before the existence of a few seconds, but if made by the phase change material of the cool feeling clothes, there is a very big difference, it is worth noting that China's independent research and development of temperature control in the field of thermoregulation textiles, thermoregulation yarn phase change material, has begun to popularise and to the international community. Its coolness QMAX value reaches 2.6 times of the international standard requirement, and the synthetic phase change substance does not use the traditional fossil raw material, but uses the 100% bio-based material developed by ourselves to make. Fully embodies the perfect combination of science and technology and environmental protection. It is believed that in the near future, along with the development of science and technology and the popularisation and promotion of phase change-related scientific knowledge, the magical heat storage and thermoregulation function of phase change materials will no longer be exclusive to the cutting-edge field, and it will not be a fantasy to wear it on the body to keep the constant temperature in all seasons.

5. Summary

The research of phase change materials will be a focus of human science and technology in the future, as human science and technology continues to deepen, the scope of the disciplines covered by phase change materials has been more than just the scope of physics, which thermodynamics, solid state electronics, dynamics, lattice dynamics, elastic mechanics, microscopic morphology and other disciplines of the integration of the phase change materials of the future research will produce breakthroughs, so whether it is phase change materials, organic to inorganic, or implicit phase change to explicit phase change, phase change materials will play a huge potential in the future. materials from organic to inorganic, or implicit phase transition to explicit phase transition,

the future of phase change materials will play a huge potential, I hope that this paper's brief discussion of the research and promotion of phase change materials has some reference significance.

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