News Release

NIPPON SHOKUBAI

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Promotion of the development of high-speed, high-density heat storage devices that contribute to curbing global warming

－ Joint research by Nippon Shokubai, Hokkaido University, and AIST －

Nippon Shokubai (Headquarters: Osaka, Japan, President: Yujiro Goto, hereinafter "Nippon Shokubai"), together with Associate Professor Takahiro Nomura of the Center for Advanced Research of Energy & Materials, Graduate School/Faculty of Engineering, Hokkaido University (hereinafter "Hokkaido University"), and the National Institute of Advanced Industrial Science and Technology (President: Kazuhiko Ishimura, hereinafter "AIST") have obtained a contract for the research and development of high-speed and high-density heat storage technology based on alloy-based latent heat storage microcapsules under the NEDO New Energy and Environmental Technology Development Program.

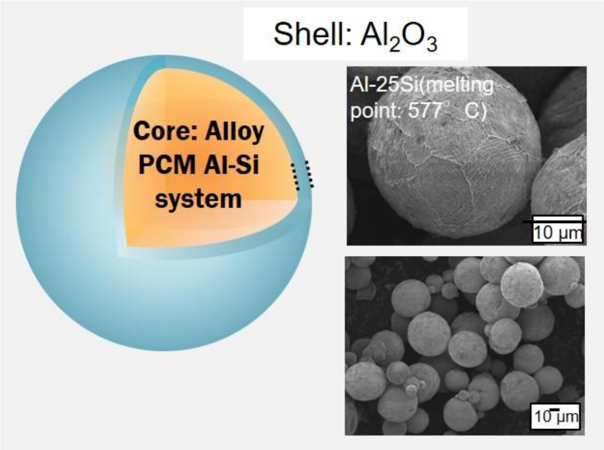
The purpose of this project is to process high-temperature, high-density, high-thermal-conductivity latent heat storage powders into molded forms, obtain their thermal storage characteristics under actual use conditions, and evaluate their presumed superiority in actual applications for social applications.

In order to prevent global warming, the use of renewable energy sources and energy conservation efforts are advancing. However, since renewable energy sources are affected by sunlight and wind conditions and frequently fluctuate, it is necessary to balance supply and demand by using energy storage technology.

Batteries that store energy in the form of electricity have been used as a means of energy storage, but their high cost has hindered their widespread use. On the other hand, heat storage, which stores energy in the form of heat, is considered an inexpensive means of storing energy. In recent years, the Carnot battery, which stores electricity in the form of heat and then generates electricity again, has been attracting attention such that it has been featured in the International Energy Agency's (IEA) Energy Storage Technology Collaboration Programme.

In addition, heat energy accounts for half of the final form of energy consumption, meaning that it is an energy that is used in a very wide variety of ways. Meanwhile, the time and place where the heat is generated does not necessarily match the time and place where it is needed, so a large amount of excess heat is currently being disposed of. By using heat storage technology, this gap between supply and demand can be bridged, and the excess heat can be reused to achieve significant energy savings.

In this contracted project, the alloy-based latent heat storage microcapsules (h-MEPCM*) developed by Associate Professor Nomura of Hokkaido University will be processed into a molded form using Nippon Shokubai's catalyst manufacturing technology, and the physical properties of a prototype module produced using this molded form will be evaluated at Hokkaido University. Based on the data, a simulation model and an application module are going to be constructed at the AIST. The project aims to obtain data on the performance of the thermal storage molding as a device and to promote development and application.



The h-MEPCM consists of a metal core sealed by a ceramic (alumina) shell with a particle diameter of around 30 microns. The metal core dissolves at around 600°C and stores heat as latent heat. This type of heat storage is called latent heat storage and has the characteristic of high heat storage density. On the other hand, general latent heat storage has practical challenges such that it requires the handling of two phases (liquid and solid), and the heat conduction of each phase differs greatly, making it difficult to design equipment. Because h-MEPCM has an alumina shell with a melting point of more than 2000°C, it can be used as latent heat storage material while maintaining its solid appearance. The h-MEPCM combines the ease of handling of a solid sensible heat storage material with the high heat storage density of a latent heat storage material. In addition, it has extremely high thermal conductivity because of its metal core, which allows the heat inside to be quickly transferred to the surface; thus, the heat can be released at high output without loss while maintaining the outlet temperature.

Although h-MEPCM has high basic thermal properties, the powder form would make it difficult to be separated from gases or liquids that would transfer heat in and out of the heat storage. Thus, it was necessary to mold the powder into an appropriate shape for practical use. Nippon Shokubai possesses catalyst molding technology to mold inorganic powders with various characteristics into shapes that are advantageous for the heat exchange through its catalyst manufacturing business. In this project, the company plans to use the accumulated know-how to produce h-MEPCM moldings in various sizes of pellets, rings, honeycombs, and other shapes. An evaluation of various properties in a practical model becomes possible by using the molded bodies. Therefore, in addition to obtaining basic physical properties of heat storage density and heat transfer characteristics, the team plans to measure thermal characteristics in use, such as output characteristics and repeated durability to present specific performances. Furthermore, in order to promote the application of the technology in society, the team plans to conduct simulations for expected uses to demonstrate its superiority over existing technologies in terms of carbon dioxide reduction and cost reduction effects.

In addition to energy-saving applications of the use of regenerative burners, which is an energy-saving technology for high-temperature industrial furnaces, the reuse of electric furnace exhaust heat, the adjustment of heat and electricity supply and demand in cogeneration, and thermal storage for EV heating, as well as combination with renewable energies, the project outcome is expected to be used in the stable use of renewable concentrated solar power (CSP), which can generate stable power 24 hours a day, and heat storage power generation, which replaces coal-fired combustors with heat storage.

* h-MEPCM: Microencapsulated phase change materials The "h-" indicates Hokkaido University.
* CSP: Concentrated solar power
* Regenerative burner: A method in which the heat from the exhaust gas of a high-temperature furnace is recovered in heat storage and used for preheating of the intake gas. Its energy saving effect is said to be more than 30%.
* Cogeneration: A method of supplying both electricity and heat at the same time, and by storing the heat, it is possible to fill in the gaps between the times when each is needed and use the energy effectively.

About NIPPON SHOKUBAI Co., Ltd.: Since 1941, Nippon Shokubai has grown up its business with unique catalyst technology. Nippon Shokubai has supplied, for example, ethylene oxide, acrylic acid, automobile catalysts, process catalysts and so on. Among all, our global market share of superabsorbent polymers is the largest in the world now. Nippon Shokubai is a global chemical company operating under its corporate mission "TechnoAmenity-Providing affluence and comfort to people and society with our unique technology."
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