High-performance Thermal Pad with Synthesized SGCNTs and Rubber Developed for Mass Production
An innovative thermal interface material (TIM) to address heat generated by servers and power devices

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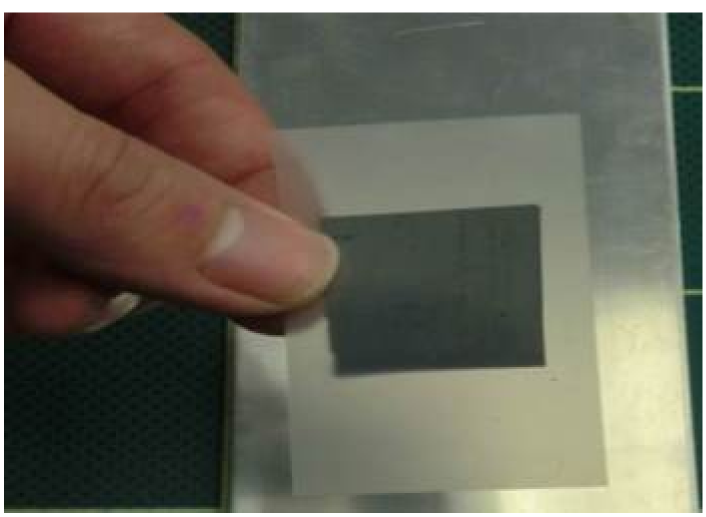
Zeon Corporation (Zeon) (President: Kimiaki Tanaka) has developed for mass production a high-performance thermal pad (thermal interface material*1, or TIM) in a NEDO project by synthesizing SGCNTs (super-growth carbon nanotubes, product name: ZEONANO™ SG101) and rubber. This achievement follows the start of operations at an SGCNT mass production plant in November 2015.

Although the new TIM is in the form of a solid pad, it achieves lower heat resistance and higher operability and reliability compared to conventional thermal grease. Demand is expected to surge for the material, as it could address the major problem of heat generated by servers and power devices.

In addition, Zeon is constructing a pilot plant for mass production of the new TIM, capitalizing on the results of the project. The plant is scheduled to be completed in December 2016.



New SGCNT thermal pad

1. **Summary**

With continued expansion of data-processing capacity of semiconductor chips used in servers and power devices, countermeasures for the heat problem are drawing increasing attention. This requires efficiently transferring the heat to a heat dissipating component, such as a heat sink*2. Subsequently, interface heat resistance must be reduced by inserting a TIM between the chip and component. The TIM must exhibit high thermal conductivity relative to its thickness and superior flexibility. The conventional thermal grease generally used is produced by adding a highly thermal conductive filler*3 to a semi-solid substance. However, thermal grease is subject to operability and reliability problems, as ensuring even coverage is difficult. The new thermal pad is expected to address these problems.

In the NEDO project "Nanocarbon Material Practical Application Project to Achieve a Low-carbon Society" (FY2010 to FY2016), Zeon applied a technology for achieving low heat resistance by synthesizing SGCNTs*4 and rubber. As one of the project's achievements, Zeon developed an innovative thermal pad that exhibits lower heat resistance than thermal grease. Its superior features were achieved by improving thermal conductivity through a new thermal conduction pathway using SGCNTs and by creating a new thermal conduction pathway with a relatively small quantity of SGCNTs.

The new TIM is able to significantly reduce the temperature of semiconductors in servers and power devices that have been increasingly subject to extreme heat generation and is therefore expected to contribute to the realization of a "smart society."

Zeon plans to complete a pilot plant for mass production of the new, low heat resistant thermal pad in December 2016. In addition to the SGCNT mass production plant that it currently operates, the company plans to further develop its carbon nanotube (CNT)*5 business focusing on SGCNTs.

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2. Achievements

In a project sponsored by the Incorporated Administrative Agency New Energy and Industrial Technology Development Organization (NEDO), Zeon successfully developed a new thermal pad that demonstrates high thermal conductivity relative to its thickness. This was achieved using a method for manufacturing a material featuring both superior flexibility and high thermal conductivity relative to its thickness, based on a ternary compound of SGCNTs, graphite, and rubber. The method was jointly developed by Zeon and the Incorporated Administrative Agency National Institute of Advanced Industrial Science and Technology (AIST) along with Zeon's proprietary dispersion process and compound and processing technologies for rubber.

In addition, thermal conductivity can be adjusted in the range of 10–100 W/m·K by creating a thermal conduction pathway of graphite with an SGCNT mesh structure and adjusting the volume and form of added SGCNTs and graphite. High flexibility can be maintained with a new mixing technology, allowing for superior adhesion even under a low pressure of 0.1 MPa, and thereby realizing excellent thermal resistance of 0.05°C/W, which is lower than the 0.10°C/W characteristic of thermal grease.

The replacement of thermal grease with the new thermal pad is expected to provide advantages such as the streamlining of fabrication processes and improved productivity for semiconductors.

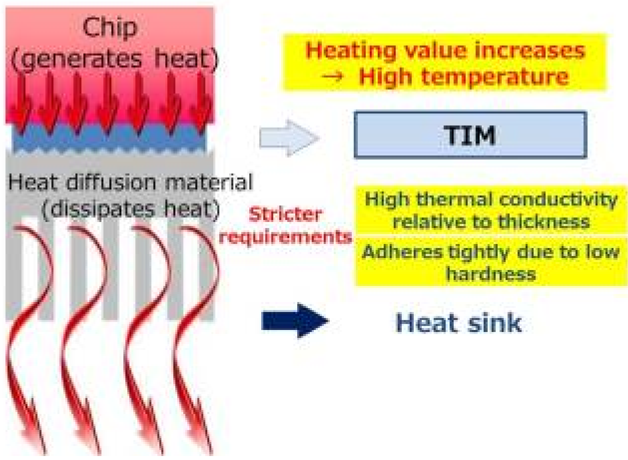

Figure 1 TIM as a Solution for Heat Generation

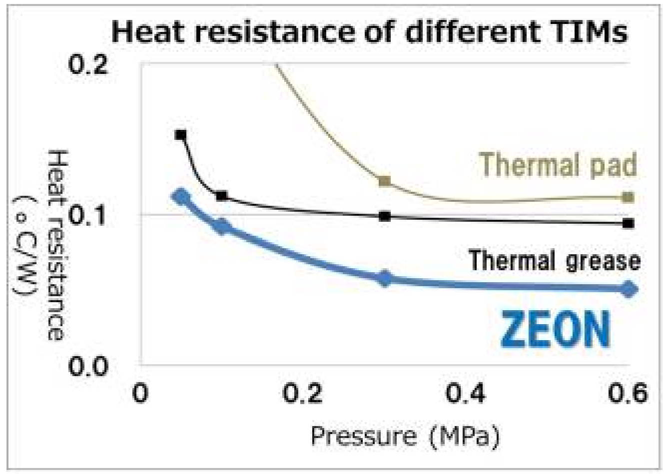

Figure 2 Heat Resistance of New SGCNT Thermal Pad

Glossary

*1 Thermal Interface Material (TIM)
A material used to fill the tiny void between a heat source and a heat dissipation component. Given the thermal insulating property of air, a thermal conductive TIM that adapts its form to fill the space between a heat source and heat dissipation component is essential for heat dissipation.

*2 Heat Sink
A structural component that dissipates or absorbs heat generated by a component, thereby cooling the latter.

*3 Filler
Filling material added to rubber and resins. Metals with high thermal conductivity or inorganic particles are commonly used for the application described above.

*4 Carbon nanotubes (CNTs) using the Super Growth (SG) method (SGCNTs)
CNTs were discovered by Dr. Kenji Hata of the National Institute of Advanced Industrial Science and Technology (AIST) in 2004. They are manufactured by synthesizing single-walled CNTs. The SGCNT method synthesizes these nanotubes through chemical vapor deposition, significantly improving the activity and operating life of a catalyst by adding a small amount of moisture when synthesizing single-walled CNTs in a heated furnace.

*5 CNT
A CNT is a one-dimensional nanocarbon material with a diameter of 0.4–50 nm and consisting solely of carbon atoms. Its chemical structure is expressed as rolled and linked layers of graphite. A CNT with a single layer is a single-walled CNT with a metallic or semiconducting electrical structure, depending on the helicity (or rolled structure) of the graphite layer.

For further information

Zeon Corporation,
Department of Corporate Communications

Contact form

Tel: +81-3-3216-2747