Future heatsinks may employ carbon nanotubes

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Engineers have created carpets made of tiny cylinders called carbon nanotubes to enhance the flow of heat at a critical point where computer chips connect to cooling devices called heat sinks, promising to help keep future chips from overheating.

Researchers are trying to develop new types of "thermal interface materials" that conduct heat more efficiently than conventional materials, improving overall performance and helping to meet cooling needs of future chips that will produce more heat than current microprocessors. The materials, which are sandwiched between silicon chips and the metal heat sinks, fill gaps and irregularities between the chip and metal surfaces to enhance heat flow between the two.

Purdue University researchers have made several new thermal interface materials with carbon nanotubes, including a Velcro-like nanocarpet.

"The bottom line is the performance that we see with nanotubes is significantly better than comparable state-of-the-art commercial materials," said Timothy Fisher, an associate professor of mechanical engineering who is leading the research. "Carbon nanotubes have excellent heat-conduction properties, and our ability to fabricate them in a controlled manner has been instrumental in realizing this application."

Recent findings have shown that the nanotube-based interfaces can conduct several times more heat than conventional thermal interface materials at the same temperatures. The nanocarpet, called a "carbon nanotube array thermal interface," can be attached to both the chip and heat sink surfaces.

"We say it's like Velcro because it creates an interwoven mesh of fibers when both sides of the interface are coated with nanotubes," Fisher said. "We don't mean that it creates a strong mechanical bond, but the two pieces come together in such a way that they facilitate heat flow, becoming the thermal equivalent of Velcro. In some cases, using a combination of nanotube material and traditional interface materials also shows a strong synergistic effect."

Findings related to the combination of carbon nanotubes and traditional interface materials are detailed in a paper appearing in the May issue of the International Journal of Heat and Mass Transfer. The paper was written by mechanical engineering doctoral student Jun Xu and Fisher.

Heat is generated at various points within the intricate circuitry of computer chips and at locations where chips connect to other parts. As heat flows through conventional thermal interface materials, the temperature rises about 15 degrees Celsius, whereas the nanotube array material causes a rise of about 5 degrees or less.

It will be necessary to find more efficient thermal interface materials in the future because as computer chips become increasingly more compact, more circuitry will be patterned onto a smaller area, producing additional heat. Excess heat reduces the performance of computer chips and can ultimately destroy the delicate circuits.

The nanotubes range in diameter from less than one nanometer to about 100 nanometers. A nanometer is a billionth of a meter, or about the distance of 10 atoms strung together.

The nanotube carpets also might have military and other commercial applications for cooling "power electronics," which are systems that control and convert the flow of electrical power so that it can be used for various purposes on an aircraft, ship or vehicle.

The research has been funded by Purdue's Cooling Technologies Research Center, supported by the National Science Foundation, industry and Purdue to help corporations develop miniature cooling technologies for a wide range of applications, from electronics and computers to telecommunications and advanced aircraft. Applications in power electronics are being supported by the Air Force Research Laboratory in association with the Birck Nanotechnology Center at Purdue's Discovery Park.

The technology is ready for commercialization and is being pursued by several corporate members of the cooling research center, including Nanoconduction Inc., a startup company in Sunnyvale, Calif., which is a new member of the cooling center.

Courtesy: Physorg.com

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nice read...

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i wish they'll use c-14 isotopes to make these carbon nanotubes .
next wud be hw about utilising a hsf into small beta generating machines which can be used to produce electricity ..xD xD.