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Nanotube "Velcro" aids in chip cooling, say researchers

May 4, 2006 - A new type of "thermal Velcro" placed between silicon chips and metal heat sinks could be the answer to enhancing heat transfer in future high-powered microchips to keep them from overheating, according to researchers at Purdue U.

The research findings, published in the May issue of the *International Journal of Heat and Mass Transfer*, describe how heat is generated at various points of computer chip circuitry and at connection points to other parts. Engineers created a "carbon nanotube array thermal interface," a film of carbon nanotubes with diameters ranging from <1-100nm, woven into a carpet and sandwiched between the chips and heat sinks to fill gaps and irregularities between the chip and metal surfaces, thus improving heat flow. Temperatures were seen rising by about 15°C as heat flowed through conventional thermal interface materials, but rose about 5°C or less across the nanotube array material.

The material is colloquially dubbed "thermal Velcro" because it creates an interwoven mesh of fibers when both sides of the interface are coated with nanotubes, although the material does not share any mechanical bonding properties with its fabric adhesive namesake, noted Timothy Fisher, associate professor of mechanical engineering and research team leader. "The two pieces come together in such a way that they facilitate heat flow, becoming the thermal equivalent of Velcro," he stated. "In some cases, using a combination of nanotube material and traditional interface materials also shows a strong synergistic effect."

Researchers note that the technology is "ready for commercialization" and is being pursued by a number of companies that are members of university's Cooling Technology Research Center. Applications are seen in military and commercial markets for cooling systems that convert and control the flow of electrical power for various purposes on aircraft, ships, and vehicles.

The work is funded by Purdue's cooling research center, and supported by the National Science Foundation and industry. The US Air Force Research Laboratory and Purdue's Birck Nanotechnology Center are supporting development of the technology for applications in power electronics.

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