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*Nextreme Thermal Bump*

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*Thermal bump is the newest circuit design tool for hot spot thermal management...*

## **NEXTREME ANNOUNCES MANUFACTURING PROCESS FOR CHIP-SCALE COOLING USING THIN-FILM MICRO- REFRIGERATOR**

**DURHAM, N.C. (March 6, 2009)** — Nextreme Thermal Solutions, the leader in microscale thermal and power management products for the electronics industry, today announced that they have integrated thin-film thermoelectrics into the package of an active silicon microchip for on-demand hot spot thermal management. Areas of high heat within semiconductor packages are limiting progress in the semiconductor industry today and are becoming more widespread in electronics as devices become smaller with higher heat densities. With the evolution of the thermal bump - a thin-film thermoelectric layer embedded in a standard solder bump - thermal management of hot spots is now possible using the high-volume, low-cost semiconductor manufacturing process.

In a recent paper published in *Nature Nanotechnology*, researchers at Nextreme, Intel, Arizona State University, and RTI International reported cooling a hot spot on an active silicon microchip using thermoelectric thin-films. The thermoelectric cooler, a device that pumps heat when current flows through it, cooled a 0.16-square-millimeter hot spot on a 140-mm<sup>2</sup> chip as much as 15°C. Nextreme has now commercialized the technology using the copper pillar bumping process, an established electronic packaging approach that scales well into high-volume manufacturing.

Nextreme began production manufacturing of its thin-film thermoelectric product line in July 2008 when the company introduced localized cooling solutions deep inside electronic components using thin-film thermoelectric structures known as thermal bumps.

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The thermal bump was developed as a method for integrating active thermal management functionality at the chip level in the same manner that transistors, resistors and capacitors are integrated into conventional circuit designs today. The thermal bump is made from a thin-film thermally active material that is embedded into flip-chip interconnects (in particular copper pillar solder bumps) for use in electronic packaging. The thermal bump uses the thermoelectric effect to cool or heat objects, or to generate electricity.

At the chip, package and system level, higher densities, more features, higher speeds and miniaturization are all contributing to more heat and higher power densities emanating from our electronics. There is a significant need for site-specific and on-demand cooling in electronic and optoelectronic devices, where cooling is currently achieved by the use of bulky and/or over-designed system-level solutions.

Thermal issues in the semiconductor industry were echoed recently by AMD President and CEO Dirk Meyer in a key-note speech at the 2009 International CES tradeshow. Meyer stated that their CPUs have hit a thermal-induced clock speed ceiling. "Throwing more and more transistors at the performance problem in the form of increasing core counts, burgeoning cache sizes and the like is producing diminishing returns." As another example, Nvidia Corp., a major producer of graphics processors, said that some of its notebook-use graphics chips failed because of packaging materials that could not withstand the "extreme thermal environments," a combination of limited thermal management and frequent power cycling seen in notebook computers. The company took a one-time charge of \$150M-\$200M during its second quarter (2008) to resolve the problem with its customers.

### **New Functionality for New Circuit Designs**

Nextreme developed the thermal bump to provide electronic circuit designers with a new design element that can cool (or generate power) on demand. Circuit designers use resistors, capacitors, inductors and transistors to design their circuits. Now they have a new design element that will allow them to add cooling and heating functionality as part of their circuit design. There could be as few as 10-20 or as many as 600-1200 thermal bumps strategically placed on the chip to achieve a localized, dynamic cooling effect. For example, this approach could be used to design in on-demand cooling of semiconductor hot spots on CPUs and GPUs, or even entire chips such as MOSFETs. Once designed in, the thermal bump will be implemented as part of the standard solder bumping process – a seamless part of the overall manufacturing sequence for high volume, low cost implementations.

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"In the past three years we've made huge steps from delivering essentially hand-assembled devices to Intel – that performed very well – to now delivering semiconductor manufacturing-based thermal bumps that perform even better," said Dave Koester, vice president of engineering at Nextreme. "This positions us to provide hot spot cooling in high volume and at a low cost at a time when it is being acknowledged that microprocessor performance is thermally limited."

Today Nextreme uses its thermal bump technology to produce discrete cooling and power generation devices. Nextreme offers several thermoelectric coolers, such as the OptoCooler HV14 and UPF40 that are capable of cooling and heating in ranges from 0.4 watts to 4 watts in an active footprint as small as 0.55mm<sup>2</sup>. Modules for electronics cooling and power generation are available for order now. Pricing is available upon request.

Nextreme has over 33 patents, pending and provisional for the micro fabrication of thermoelectric cooling and power-generation devices.

More information can be found at [www.nextreme.com](http://www.nextreme.com) or contact Nextreme at 3908 Patriot Dr., Suite 140, Durham, NC 27703-8031; call (919)-597-7300; or e-mail [info@nextreme.com](mailto:info@nextreme.com).

### **About Nextreme Thermal Solutions™, Inc.**

Nextreme Thermal Solutions designs and manufactures microscale thermal and power management products for the electronics, telecommunications, semiconductor, consumer, and defense/aerospace industries. The company uses breakthrough thin-film thermoelectric material to embed cooling, temperature control and power generation capabilities into the widely accepted copper pillar bumping process used in high-volume electronic packaging. Nextreme's headquarters and manufacturing facility are based near Research Triangle Park, North Carolina.

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