Tiny refrigerator taking shape to cool future computers

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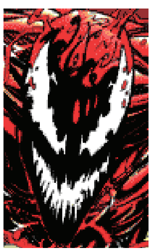

Carnage

VR-ZONE Moderator
Join Date:Jan 2006
Posts:2,926
Trade rep:**0 (0%)**

Tiny refrigerator taking shape to cool future computers bbmf Aug 17th, 08, 07:44 PM #1

Miniature refrigeration system

Researchers at Purdue University are developing a miniature refrigeration system small enough to fit inside laptops and personal computers, a cooling technology that would boost performance while shrinking the size of computers.
Unlike conventional cooling systems, which use a fan to circulate air through finned devices called heat sinks attached to computer chips, miniature refrigeration would dramatically increase how much heat could be removed, said Suresh Garimella, the R. Eugene and Susie E. Goodson Professor of Mechanical Engineering.
The Purdue research focuses on learning how to design miniature components called compressors and evaporators, which are critical for refrigeration systems. The researchers developed an analytical model for designing tiny compressors that pump refrigerants using penny-size diaphragms and validated the model with experimental data. The elastic membranes are made of ultra-thin sheets of a plastic called polyimide and coated with an electrically conducting metallic layer. The metal layer allows the diaphragm to be moved back and forth to produce a pumping action using electrical charges, or “electrostatic diaphragm compression.”
In related research, the engineers are among the first to precisely measure how a refrigerant boils and vaporizes inside tiny “microchannels” in an evaporator and determine how to vary this boiling rate for maximum chip cooling.
The research is led by Garimella and Eckhard Groll, a professor of mechanical engineering.
“We feel we have a very good handle on this technology now, but there still are difficulties in implementing it in practical applications,” said Garimella, director of the Cooling Technologies Research Center based at Purdue. “One challenge is that it’s difficult to make a compressor really small that runs efficiently and reliably.”
Findings will be detailed in two papers being presented during the 12th International Refrigeration and Air Conditioning Conference and the 19th International Compressor Engineering Conference on July 14-17 at Purdue. The papers were written by doctoral students Stefan S. Bertsch and Abhijit A. Sathe, Groll and Garimella.
New types of cooling systems will be needed for future computer chips that will likely generate 10 times more heat than today’s microprocessors, especially in small “hot spots,” Garimella said.
Miniature refrigeration has a key advantage over other cooling technologies, Groll said. “The best that all other cooling methods can achieve is to cool the chip down to ambient temperature, whereas refrigeration allows you to cool below surrounding temperatures,” he said.
The ability to cool below ambient temperature could result in smaller, more powerful computers and also could improve reliability by reducing long-term damage to chips

One complication is that the technology would require many diaphragms operating in parallel to pump a large enough volume of refrigerant for the cooling system.
"So you have an array of 50 or 100 tiny diaphragm compressors, and you can stack them," Groll said.
The researchers conducted laboratory experiments with the diaphragms in Garimella's Thermal Microsystems Lab, developed a computational model for designing the compressor and validated the model with data from the lab. Findings showed that it is feasible to design a prototype system small enough to fit in a laptop, Garimella said.
The model enables the engineers to optimize the design, determining how many diaphragms to use and how to stack them, either parallel to each other or in series.
"If you stack in one direction, you get more pressure rise, and if you stack in the other direction, you get more volume pumped," Groll said.
Learning how to manufacture the devices at low cost is another major challenge, with industry requiring a cost of about $30 each.
"We can't currently produce them at this price, but maybe in the future," Groll said.
Another portion of the research focuses on learning precisely how refrigerant boils and turns into a vapor as it flows along microchannels thinner than a human hair. Such evaporators would be placed on top of computer chips.
Bertsch, the doctoral student who led work to set up experiments at the university's Ray W. Herrick Laboratories, observed how refrigerant boils inside the channels and measured how much heat is transferred by this boiling refrigerant. He also created mathematical equations needed to properly design the miniature evaporators.
"This overall project represents the first comprehensive research to carefully obtain data showing what happens to heat transfer in arrays of microchannels for miniature refrigeration systems and how to design miniature compressors," Garimella said. "Eventually, we will be able to design both the miniature compressors and evaporators."
Some of the research was performed at the Birck Nanotechnology Center in Purdue's Discovery Park.
The research is funded by the Purdue-based National Science Foundation Cooling Technologies Research Center, a consortium of corporations, university and government laboratories working to overcome heat-transfer obstacles in developing new, compact cooling technologies. Groll's research is based at Herrick Laboratories.

Writer: Emil Venere, (765) 494-4709, venere@purdue.edu
Sources: Eckhard Groll, (765) 496-2201, groll@ecn.purdue.edu
Suresh Garimella, (765) 494-5621, sureshg@ecn.purdue.edu
Purdue News Service: (765) 494-2096; purduenews@purdue.edu
Note to Journalists: Electronic copies of the research papers are available from Emil Venere, (765) 494-4709, venere@purdue.edu

http://news.uns.purdue.edu/x/2008a/0...aMinicool.html

alpha1ma

Moderator

VR-ZONE Super Moderator

Join Date: Feb 2008
Location: Bishan
Posts: 16,193
Trade rep: 69 (100%)

alpha1ma Aug 17th, 08, 09:42 PM #2

this will be great..

[Project Log] Fiery Black Ki7ight (Trilogy)

Intel Core i7 930 Processor | 3 x Asus GTX 280 1GB in 3 Way SLI | 3 x 2GB Corsair Dominator GT DDR3-2000 8-9-8-24 | EVGA X58 Classified E760 3 Way SLI | 3 x Western Digital VelociRaptor 300GB HLFS in Raid 0 | 3 x Western Digital 2.0TB EARS 64MB in Raid 1 | Pioneer DVR-213LS | Lite-On DH-4O1S Blu-Ray | Auzentech X-Fi Prelude | Windows 7 Ultimate 64 Bit Retail | Silverstone Zeus ZM1200M | Corsair Obsidian 800D | Dell Ultrasharp 3008WFP | Logitech Z-5500 5.1 | Logitech G9x | Microsoft Sidewinder X6

Custom Watercooling System | Custom Radiator | No more heating up the room =D | 2 x MCP655-B | EK | Bitspower | Tygon