Engineers develop cooling device for computer IC

Posted: 02 May 2006 Print Version SHARE Subscribe

Keywords: John Walko

Engineers at Purdue University have developed a MEMS-based micro-pump cooling device small enough to fit on a computer chip that circulates coolant through channels etched into the chip.

The device has been integrated on to a silicon chip that is about 1cm^2. The prototype contains numerous water-filled micro-channels, grooves about 100µm wide. The channels are covered with a series of hundreds of electrodes, electronic devices that receive varying voltage pulses in such a way that a traveling electric field is created in each channel.

The traveling field creates ions, or electrically charged atoms and molecules, which are dragged along by the moving field.

"Our goal is to develop advanced cooling systems that are self-contained on chips and are capable of handling the more extreme heating in future chips," said Suresh Garimella, director of Purdue's Cooling Technologies Research Center.

The center, supported by the National Science Foundation, industry and Purdue, was formed to help corporations develop miniature cooling technologies for a wide range of applications, from electronics and computers to telecommunications and advanced aircraft.

An article about the cooling device is scheduled to appear in the May issue of *Electronics Cooling* magazine. The article was written by doctoral student Brian Iverson, Garimella and former doctoral student Vishal Singhal, who recently graduated and co-founded Thorrn Micro Technologies Inc.

"Say every sixth electrode receives the same voltage, these varying voltages from one electrode to the next produce a traveling electrical field that pulls the ions forward, causing the water to flow and inducing a cooling action," Garimella said. "Essentially, you are pumping fluid forward."

The pumping action is created by electrohydrodynamics, which uses the interactions of ions and electric fields to cause fluid to flow. "Engineers have been using electrohydrodynamics to move fluids with electric fields for a long time, but it's unusual to be able to do this on the micro-scale as we have demonstrated," Garimella said.

The researchers have also added a feature to boost the force of the pumping action. A thin sheet of piezoelectric material, which expands and contracts in response to an electric current, was glued on top of

Top Ranked Articles

Asian companies seek solar cell crown
Umeox displays solar-powered Android phone
Smart meter chipsets increase accuracy
High-quality Articles

Hot Article

Microcontroller delivers 'highest performance' for ARM Cortex-M3
Reference design eases smart meter development
ASIC processor surpasses 2.4GHz
CUDA C compiler targets x86 platforms
1ch Full-Speed USB UART touts enhanced capabilities

Resource Center

Programmable Signal Generator with advanced function, pulse, and arbitrary waveform capabilities
Fundamentals of Semiconductor C-V Measurements
Keithley Model 4200-SCS Semiconductor Characterization System Technical Data
Fundamentals of Semiconductor C-V Measurements
Keithley Pulse Solutions Brochure

the cover of the liquid-filled channels. "This material acts as a diaphragm that deforms up and down when you give it a voltage, causing it to push additional flow through the channels," Garimella said.

"We have developed mathematical models that show this piezo action enhances the electrohydrodynamic performance." The diaphragm has enhanced the pumping action by 13 percent in the current prototype, but the modeling indicates a possible enhancement of 100 percent or greater, he said.

However, the researchers concede several major challenges remain. "One big challenge is further developing mathematical models that are comprehensive and accurate because this is a very complicated, dynamic system," Garimella said.

Other challenges include sealing the tiny channels to prevent water leakage and designing the system so that it could be manufactured under the same conditions as semiconductor chips.

- **John Walko**
EE Times

I like it votes: 1 Add to Favorites

O2Micro granted power converter pate... O2Micro granted patent continuation ...

Article Comments - Engineers develop cooling device for...

Username: Visitor (To avoid code verification, simply login or register with us. It is fast and free!)

Comments:

***Verify code:**

SUBMIT

Talkback

eeForum:
Demystifying Vietnam NEW

What does Vietnam offer that a rising number of top-tier semiconductor companies are setting up and expanding operations there?

more

Top tech resources

1. Web server design using soft processor (1,287views)
2. Address challenges in DVB-H (1,254views)
3. Using GMR sensors with scan interface (974views)
4. Simple glass breakage detector (970views)
5. Serial flash boot loader (883views)

India Newsletter

1. Broadening the Indian market
2. Unshackling broadband in India
3. IEEE 1394 networks car infotainment
4. Network your home entertainment with HomePNA

Highly Recommended Articles

- MMIC power amps extend X-Band frequency range (26/05/10)
- Flexible OLED display is rollable (28/05/10)
- Power amps support complex modulation schemes (24/05/10)
- 32-/64Mbit SRAMs deliver 12ns access time (27/05/10)
- Junction box tailored for PV solar modules (25/05/10)

Most read articles last week

- Fujitsu, Microsoft cooperate on cloud computing (19 Jul 2010)
- IMEC's GaN-on-Si team gains new members (20 Jul 2010)
- Telstra, Huawei 1,800MHz LTE demo Australia's first (19 Jul 2010)
- Taiwan maker demonstrates 3D vertical gate NAND device (23 Jul 2010)
- Nokia Siemens Networks buys Motorola assets (21 Jul 2010)
- ON Semi to buy Sanyo Electric chip subsidiary for $366M (19 Jul 2010)
- LG Electronics, Toshiba get into ZigBee steering group (20 Jul 2010)
- China mobile growth lags behind target (22 Jul 2010)
- TI buys Japan wafer fabs to grow analog biz (19 Jul 2010)
- Researchers reduce battery recharge time to 10 minutes (19 Jul 2010)

· **Broadening the Indian market**
· **Unshackling broadband in India**
· **IEEE 1394 networks car infotainment**
· **Network your home entertainment with HomePNA**
· **Find relevant datasheets**
· **Download related application notes**
· **Attend IIT lectures on broadband**

Embedded Design

Locking down IP in embedded systems
Learn about past, current and new options for protecting IP

- Optimise performance, power with dynamic power management
- Managing digital motor control systems' quantisation errors
- How to give your PLCs a boost
- Design for scalability with evolving machine requirements

more Embedded Design...

Power Design

Multiplier circuit gauges real power in high-frequency PWMs
Learn about a power measurement circuit capable of measuring the power dissipated in a PWM-driven motor.

- Manage the portable equipment power chain's slippery slope
- How to implement ATCA board power systems
- Electronic rheostat provides decades of load resistance
- Integrate switching DC-DC supplies with inductor multipliers

more Power Design...

Webinars

On-Demand Webinars
• How to Make Electrical Resistivity Measurements of Bulk Materials: Conductors, Insulators and Semiconductors new! **Register Now!**
• National Semiconductor SIMPLE SWITCHER® Power Module and Easy to Use Design Tool **Register Now!**
• Protect your new generation designs from ESD with innovative NXP solutions **Register Now!**
• Overcoming the Electrical Measurement Challenges of High Brightness LEDs **Register Now!**

Go to top

global sources | EE Times Group

eMedia Asia	EE Times - India | Embedded Design India | Power Design - India | 电子工程专辑 | 電子工程專輯 | 전자엔지니어
Global Sources	环球资源企业网 | 环球资源内贸网 | 世界经理人 | Electronic Components | Computer Products | Trade Show Center
EE Times Group	EE Times | EBN | EE Times JAPAN

RSS Feed RSS | Site Feedback | Site Map | Help | About Us | Contact Us | Terms of Use | Privacy Policy | Security Commitment