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Miniature cooling technologies focus of Purdue-industry center

WEST LAFAYETTE, Ind. – Purdue University is forming a new National Science Foundation center to help industry develop miniature cooling technologies for a wide range of applications, from electronics and computers to telecommunications and advanced aircraft.

The Compact High-Performance Cooling Technologies Research Consortium, in operation since 1999, is now becoming an NSF Industry/University Cooperative Research Center. The new NSF center's planning meeting will be Oct. 29-30 at Purdue.

"The idea is to enlarge the scope of the existing consortium," said Suresh Garimella, the center's director and an associate professor of mechanical engineering at Purdue. "We have invited a large number of companies to come here for a couple of days and listen to us speak about our capabilities and facilities, but more importantly, to critique what we do."

The planning meeting will begin at 8:45 a.m. Oct. 29 in Stewart Center, Room 322, with a welcoming address by Purdue President Martin C. Jischke.

The consortium, founded by Garimella while he was a faculty member at the University of Wisconsin, now has eight corporate members, including Apple Computer and electronics and telecommunications giants Nokia Research Center, Philips Electronics and Delphi Delco Electronics Systems.

"Industry comes to us with a technical problem, and we conduct research to help solve those problems," Garimella said.

The NSF will provide $75,000 annually for the center. Corporate members pay $30,000 a year, and additional funding will be provided by Purdue.

Researchers at the center are working on technologies that could have a variety of applications, including new batteries for electric cars, automotive and military electronics, cellular base stations for mobile phones and high-performance electronic equipment used for distributing electricity.

Examples of the technologies studied are innovative types of tiny fans that use 1/300th the electricity of conventional fans, "phase change" materials that turn from solid to liquid as they absorb heat, minuscule "heat pipes" that cool electronics with internally circulating fluid and chips that cool electronic components by using "microchannels" as small as the width of a human hair.

It is important to cool electronic circuits because heat reduces performance and will eventually destroy the delicate circuitry.

"Even if it's just a bit overheated, its performance and reliability goes down," Garimella said. "Another reason for cooling is to improve performance as you go to smaller and smaller devices."

A major obstacle to making smaller electronic devices is the need to remove heat, Garimella said.

The concentrated circuits in a semiconductor computer chip can generate more heat per square centimeter of chip area than the surface of the sun.

"That is kind of mind-boggling," Garimella said. "The fact that it's in such a tiny area is the nature of the problem. If that same amount of heat were distributed over a larger area, cooling would not be so difficult."

Besides computer technology, research at the center has many other promising applications, including the use of phase change materials to keep a car's engine warm overnight and technologies that improve food processing.

"Thermal management is really what it is," Garimella said. "We are dealing with the management of heat, either in heating or cooling applications."

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