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New Findings Could Help Hybrid, Electric Cars Keep Their Cool

By
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– June 25, 2010**Posted in:** General, Science, Technology

Understanding precisely how fluid boils in tiny "microchannels" has led to formulas and models that will help engineers design systems to cool high-power electronics in electric and hybrid cars, aircraft, computers and other devices.

Allowing a liquid to boil in cooling systems dramatically increases how much heat can be removed, compared to simply heating a liquid to below its boiling point, said Suresh Garimella, the R. Eugene and Susie E. Goodson Professor of Mechanical Engineering at Purdue University.

However, boiling occurs differently in tiny channels than it does in ordinary size tubing used in conventional cooling systems.

"One big question has always been, where is the transition from macroscale boiling to microscale boiling?" said doctoral student Tannaz Harirchian. "How do you define a microchannel versus a macrochannel, and at what point do we need to apply different models to design systems? Now we have an answer."

Findings will be detailed in a research paper by Garimella and Harirchian and a keynote address to be presented by Garimella on Oct. 8 during the conference Thermal Investigations of ICs and Systems, or Therminic, from Oct. 7-9 in Leuven, Belgium. The researchers also have published several related papers in peer-reviewed journals.

Indiana's 21st Century Research and Technology Fund has provided $1.9 million to Purdue and Delphi Corp. in Kokomo, Ind., to help commercialize the advanced cooling system using microchannels for electronic components in hybrid and electric cars. The research also 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.

The new type of cooling system will be used to prevent overheating of devices called insulated gate bipolar transistors, high-power switching transistors used in hybrid and electric vehicles. The chips are required to drive electric motors, switching large amounts of power from the battery pack to electrical coils needed to accelerate a vehicle from zero to 60 mph in 10 seconds or less. The devices also are needed for "regenerative braking," in which the electric motors serve as generators to brake the vehicle, generating power to recharge the battery pack; to convert electrical current to run accessories in the vehicle;

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