

Heat transfer between materials is focus of new research grant

Managing heat is a major challenge for engineers who work on devices from jet engines to personal electronics to nano-scale transistors.

A team led by a University of Michigan mechanical engineer has received a five-year, \$6.8-million grant from the Air Force to examine this problem, which is a barrier to more powerful, efficient devices.

Led by Kevin Pipe, an assistant professor in the Department of Mechanical Engineering, the team has received a Multidisciplinary University Research Initiative (MURI) award from the Air Force Office of Scientific Research. The research group includes nine scientists and engineers from three universities, including Brown University and the University of California at Santa Cruz.

"The processes by which heat is transferred at interfaces between different materials are poorly understood," Pipe said. "But in many systems, the ability to either efficiently transfer or block heat flow from one material to another is critically important to performance and reliability."

Inefficient heat flow is a main roadblock in the development of lasers and transistors that can attain higher powers. On the other hand, blocking heat exchange can dramatically improve the efficiency of thermoelectric energy conversion for compact power sources.

Pipe's group will use ultrafast lasers in a special X-ray technique developed by David Reis, a team member and associate professor in Physics at U-M. The technique allows researchers to actually watch the vibrations of the atoms that carry heat energy across an interface.

Using nanotechnology, Pipe and his colleagues will reengineer the surfaces of materials to regulate the flow of heat.

"A broad range of military and commercial applications stand to benefit from thermal interface control, including heat sinks for high-power electronics, thermal barrier coatings for aerospace components, and thermoelectric materials for power generation," Pipe said.

In addition to Pipe, the U-M team includes materials science and engineering professors Rachel Goldman and John Kieffer, and assistant professor Max Shtein, as well as physics professor Roberto Merlin and associate professor David Reis. Other members of the team include physics professor Humphrey Maris and engineering professor Arto Nurmikko of Brown University and electrical engineering associate professor Ali Shakouri of U-C Santa Cruz.

The Air Force MURI program is designed to focus on large multidisciplinary topic areas that intersect more than one traditional discipline, bringing together scientists and engineers with different backgrounds to accelerate both basic research and transition to application.

Source: University of Michigan

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