

Researchers developing new thermal interface materials

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In the microelectronics world, the military and private sectors alike need solutions to technologic challenges. Dr. Mustafa Akbulut, assistant professor of chemical engineering, and two students lead a project funded by DARPA to create thermal interface materials (TIMs) that have a superior ability to transfer heat and a strong capacity to keep cool.

In evaluating a [central processing unit](#), as an example, there are many pieces that individually need temperature management. "As you get smaller and smaller, there is higher heat dissipation per unit area. Locally, you have higher temperatures...you have a harder time operationally—you need better thermal interface materials. This is especially important for radars, laser systems and also for military electronics," said Akbulut.

Essentially and most critically, the device needs the ability to avoid overheating. As Akbulut asserts, "unless you cool it, it fails."

In evaluating an electronic device and a cooling system that need to be placed together as they function, if there is an absence of thermal material in between, the heat created by the electronic device can potentially erode the device. According to Akbulut, non-soft materials are considered less effective as a TIM because they do not adequately cover all interior openings or gaps, even though the naked eye may not detect this space.

Akbulut explains why optimal contact is not achieved through current technology. "If you look at the very fine scale, [these two pieces] are not smooth. If you look at these with an electron microscope, you see they are like mountains. If you bring these surfaces together, they do not have perfect contact." Thus, the objective of a traditional TIM is not fully met.

Soft materials, including paste, often minimize the gap, said Akbulut. The invention of his new metal-based, soft material leads to high thermal conductive activity and because of its malleable nature, consistent contact is achieved. His research group has recently developed TIMs with thermal conductivities greater than 100 W/m-k and elastic modulus values in the order of 20 GPa, significantly advancing the current state of art for TIMs. As a comparison, this material is ten times softer than steel

and three times more thermally conductive.

Using copper and nanomaterials together, Akbulut believes his new TIM can lead to greater optimization and large-scale implementation in the future.

Provided by Texas A&M University

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