

PROJECT FACTS

UNIVERSITY OF KENTUCKY CENTER FOR APPLIED ENERGY RESEARCH

SPONSORS

US Army AMRDEC
Redstone Arsenal, AL

Materials Sciences Corp.
Horsham, PA

University of KY CAER

CARBON MATERIALS

Multiwall Carbon Nanotube Arrays as Thermal Interface Materials

Multiwall carbon nanotube (MWCNT) arrays possess superior thermal properties, along the direction of the MWCNT axes. Reported values of conductivity for a MWCNT are shown to be as high as 3000 W/mK. At UK CAER, the chemical vapor deposition (CVD) synthesis of MWCNTs on quartz substrates was optimized to produce continuous arrays of uniform thickness and length. When infiltrated with polymers possessing adhesive properties, arrays have the ability to create composite interface materials with required thermal performance of an exceptional thermal interface material (TIM). The MWCNT arrays are harvested from the quartz substrate and are free standing, completely unattached to the substrate.

Advances in technology and further miniaturization of microelectronics have led to serious thermal management issues. Many electronic components are comprised of multilayer systems, creating a need for TIMs for thermal management. Decreasing the interfacial thermal contact resistance can drastically increase the thermal performance of the component.

The thermal diffusivity and interfacial thermal contact resistance of CNT arrays bonded between two aluminum discs were found using a laser flash apparatus (Netzsch LFA 427) to demonstrate the thermal performance of the material under conditions in an actual interface. The thermal interface contact resistance values were as low as 18 mm²K/W, where commonly used commercial thermal adhesives only reached 38.68 mm²K/W. This suggests the epoxy-infiltrated MWCNT array could function as a TIM in many applications, especially where light weight adhesives are preferred.

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