

# CarbAl™ Heat Transfer Material

## *Thermal management for space flight systems*

The increasing use of power electronics, such as high-current semiconductor devices and modules, within space vehicles is driving the need to develop specialty thermal management materials in both the packaging of these discrete devices and the packaging of modules consisting of these device arrays. Developed by Applied Nanotech, Inc. (ANI), CarbAl heat transfer material is uniquely characterized by its low density, high thermal diffusivity, and high thermal conductivity. Its coefficient of thermal expansion (CTE) is similar to most power electronic materials, making it an effective base plate substrate for state-of-the-art silicon carbide (SiC) super junction transistors.

The material currently is being used to optimize hybrid vehicle inverter packaging. Adapting CarbAl-based substrates to space applications was a major focus of the SBIR project work. In Phase I, ANI completed modeling and experimentation to validate its deployment in a space environment. Key parameters related to cryogenic temperature scaling of CTE, thermal conductivity, and mechanical strength. In Phase II, the company concentrated on improving heat sinks and thermally conductive circuit boards for power electronic applications.

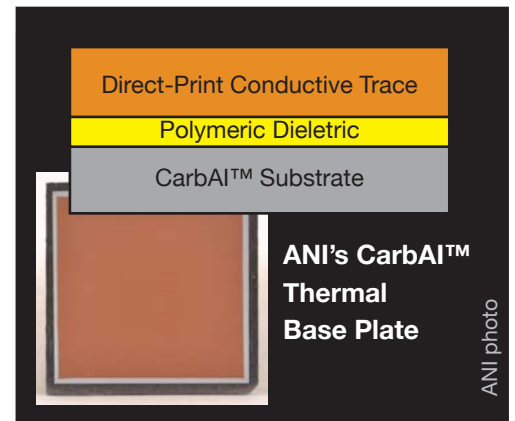
## Applications

### NASA

- ▶ Deep space vehicles
- ▶ Electronic and radioisotope propulsion
- ▶ Ion thruster technologies
- ▶ Lightweight thermal interface materials

### Commercial

- ▶ Tactical quiet generators
- ▶ Hybrid electric vehicle drive systems
- ▶ High-power light-emitting diode (LED) luminaries
- ▶ Wind power converters
- ▶ Electricity transportation and distribution systems
- ▶ Marine vessel propulsion



## Phase II Objectives

- ▶ Refine Phase I thermal model for CarbAl-based thermal packaging that encompasses specific thermal loads of SiC transistors targeted for use in space vehicles
- ▶ Fabricate heat sink system for direct current (DC) power conversion module
- ▶ Demonstrate bench performance temperature reductions of 8 percent from 160 K to 300 K
- ▶ Complete prototype CarbAl heat sink system
- ▶ Target flight deployment testing for 2015

## Benefits

- ▶ Fewer thermal interfaces
- ▶ Lower mass-density ratio
- ▶ Matched CTE
- ▶ Improved thermal resistance

## Firm Contact

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