Thermally Conductive Graphite Foam

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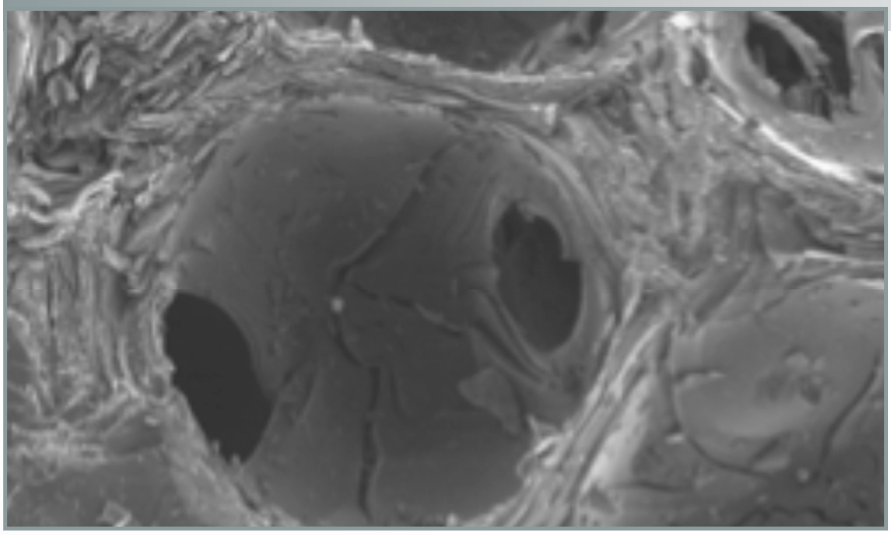

Technology Summary

Researchers at ORNL developed a highly thermally conductive graphite foam material that addresses a variety of needs for numerous industries. These foams are of varying degrees of porosity and density but provide a thermal conductivity equivalent to aluminum alloys at substantially less weight. In addition, researchers developed a method that permits part of a foam article to become thermally conductive while other portions remain insulating.

By heating a specific area with infrared pulses until graphitizing temperatures reach the core, it is possible to make graphite foam with a specific conductivity gradient out of a portion of a foam article. The remainder of the foam article can exhibit relatively low thermal conductivity. A sharp divide can be achieved between the graphite and the carbon portion of the foam. The graphite foam from this method has an open porous structure with more than 100 times greater surface area than typical heat exchangers (>20 m2/g). The cell walls are made of highly oriented graphite planes, similar to high performance carbon fibers, which have been estimated to exhibit a thermal conductivity greater than 1700 W/m·K (copper is 400 W/m·K). The foam also exhibits excellent RF shielding and acoustic management properties.

The technology is currently licensed to two companies to manufacture the foam: Koppers, Inc. (Contact: Tom Golubic, 412-826-3955) and POCO Graphite (Contact: Lee Wiechmann, 940-393-4324). However, ORNL has patent claims not only on the methods of manufacture and the composition of the foam, but also on applications. Therefore, there are a variety of end uses that may still be exploited on an exclusive basis.

Advantages

- Possible to produce distinct graphite and carbon areas in a foam article
- Very high, uniform thermal conductivity
- Low weight
- Easily machinable

Potential Applications

- Power electronics cooling
- Thermoelectric devices
- Radiators
- EMI shielding

Patent

James W. Klett and Christopher Stan Cameron. *Method and Apparatus for Producing a Carbon Based Foam Article Having a Desired Thermal-Conductivity Gradient*, U.S. Patent No. 7,670,682, issued March 2, 2010.

James W. Klett and Timothy D. Burchell. *Pitch-based Carbon Foam Heat Sink with Phase Change Material*, U.S. Patent 6,037,032, issued March 14, 2000; U.S. Patent 6,399,149, issued June 4, 2002; U.S. Patent 6,780,505, issued August 24, 2004; U.S. Patent 7,014,151, issued March 21, 2006; U.S. Patent 7,157,019 issued January 2, 2007; U.S. Patent 7,166,237 issued January 23, 2007.

James W. Klett. *Pitch-based Carbon Foam and Composites*, U.S. Patent 6,261,485, issued July 17, 2001; U.S. Patent 6,387,343, issued May 14, 2002; U.S. Patent 6,656,443, issued December 2, 2003; U.S. Patent 6,663,842, issued December 16, 2003.
James W. Klett. *Process for Making Carbon Foam*, U.S. Patent 6,033,506, issued March 7, 2000.

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