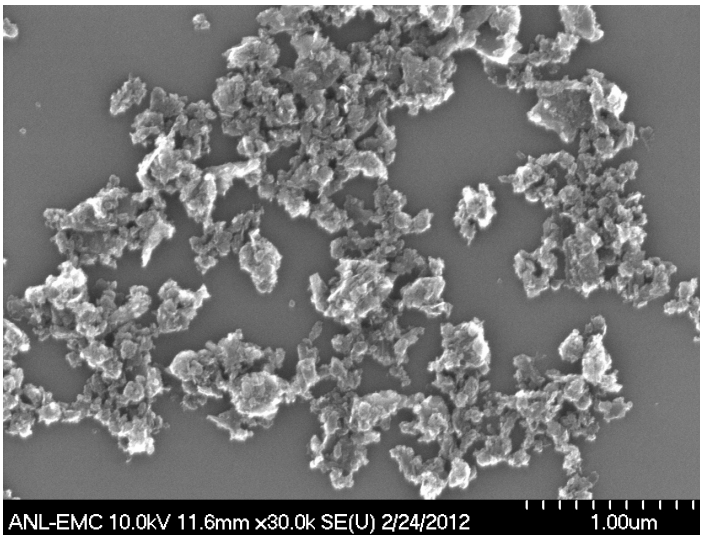
Engineered Nanofluids for Enhanced Heat Transfer

In an age of increasing heat fluxes and power loads in applications as diverse as medical equipment, power electronics, renewable energy and transportation, liquid cooling systems are necessary to enhance heat dissipation, improve energy efficiency and lengthen device lifetime. To satisfy these increasing thermal management needs, the heat transfer efficiency of conventional fluids must be improved.

The Challenge

Heat exchangers and large liquid cooling systems are used in heavy vehicles and hybrid electric vehicles for engine or power electronics thermal management. However, these systems contribute to the size and weight of vehicles. Developing liquid coolants with increased thermo-physical performance can result in smaller cooling systems and lower vehicle weight, which translates to increased fuel efficiency.



Scanning electron micrograph of graphitic nanoparticles used in the nanofluid preparation.

The Solution

Nanofluids are created by stably dispersing nanometer-sized solid particles in conventional heat transfer liquids at low particle volume concentrations in order to enhance thermal conductivity and the heat transfer coefficient.

The Results

By using silicon carbide particles provided by industrial partner Saint Gobain, Argonne researchers have created an ethylene glycol/water nanofluid that carries heat away 15 percent more effectively than conventional fluids. And with partner Valvoline, they've also developed a graphite-based nanofluid that has an enhanced thermal conductivity 50 percent greater than the base fluid, which could, under specific conditions, eliminate the need for a second heat exchanger for cooling power electronics.

***"The result of improved cooling efficiency of nanofluids will be smaller cooling systems, lighter vehicles, less aerodynamic drag, reduced losses in other areas and reduced fuel consumption,"* says materials scientist Dileep Singh.**

For further information, contact Dileep Singh, dsingh@anl.gov

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