

Development, Characterization, Production, and Demonstration of Nanofluids for Industrial Cooling Applications

Argonne National Laboratory is developing water and ethylene glycol/water-based dispersions of nanoparticles—more specifically, silicon carbide (SiC) nanoparticles—for use as the heat transfer fluid (HTF) in liquid cooling systems. The addition of nanoparticles increases the thermal conductivity of liquids, enabling more efficient heat transfer in liquid cooling systems.

Role of Nanotechnology

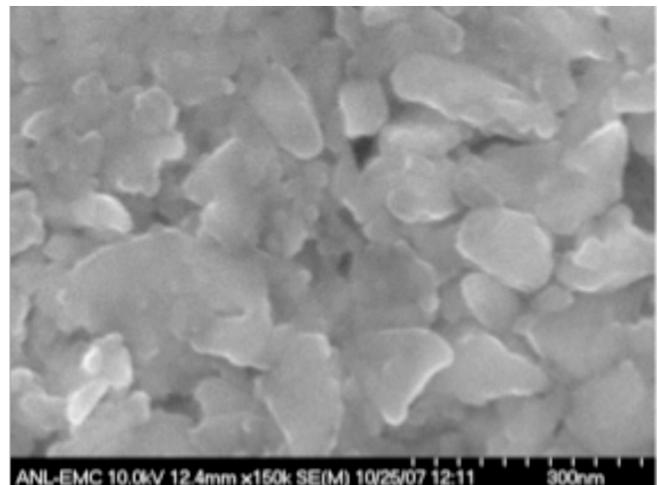
Smaller particle sizes allow solutions to behave more like pure liquids, limiting the changes that need to be made to existing liquid cooling systems so they can accept nanofluid HTFs. Note that optimal particle size (considering thermal conductivity, flow resistance, corrosiveness and erosiveness, stability, etc.) may not necessarily be nanoscale.

Potential Applications

The target application is HTFs in closed-loop liquid cooling systems. These systems are used in a wide array of applications, including chemical/rubber processing, the semiconductor industry, petroleum refineries, electrical systems, computing, power generation, power electronics, production machinery, and combustion engines. Applications may require different solvents and nanoparticles to meet existing needs.

Potential Users

- Michelin
- PACCAR
- Hewlett-Packard
- Intel
- General Motors
- Exxon Mobil
- And others



Scanning electron micrograph image of a dried silicon carbide nanofluid showing 100 nm size nanoparticles

Incumbent Technologies

Nanofluids will compete directly with HTFs used in present-day closed-loop liquid cooling systems, which consist of water and mixtures of water plus ethylene glycol. Other HTFs include 3M's Flouinert, Therminol, and other perfluorinated carbons, oils, and molten salt.

Pathways to Reach the Market

High-volume industrial and power generation markets present the largest opportunity, but will be the toughest to enter. Entry into the market will be greatly expedited, having already secured Saint-Gobain as a large-scale manufacturing partner and an agreement with Michelin for pilot-scale testing. Small-scale systems —like HVAC installations and computers—are significant opportunities as well, and will be addressed early on to acquire operational experience before moving onto larger systems.



Nanofluid test equipment

Funding and Partner

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