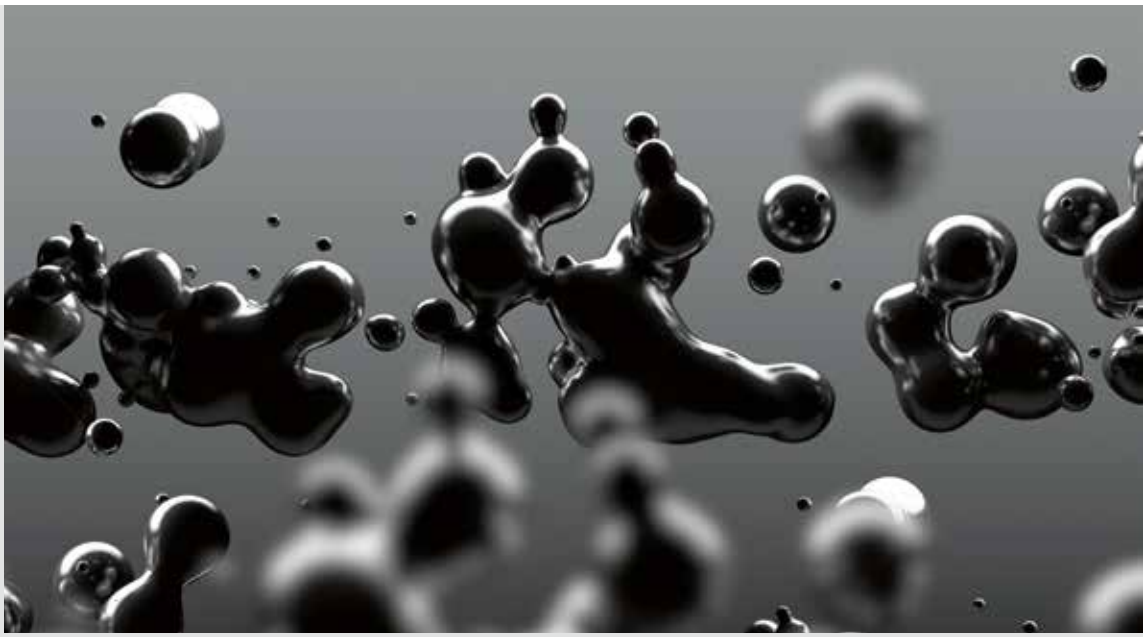


01 External collaborations have become an essential activity for ABB. One such joint enterprise is with FlexeGRAPH, whose innovative nanofluid will change the face of liquid cooling.

01

NANOFLUID COOLING FOR DATA CENTERS

Collaboration with promising startups complements ABB in-house R&D. One such startup is Australia-based FlexeGRAPH, whose innovative nanofluid could lead to entirely new approaches to cooling in data centers.



Peter Löfgren
SynerLeap, ABB Technology Ventures
Västerås, Sweden

peter.Lofgren@se.abb.com



Shannon Notley
FlexeGRAPH
Canberra, Australia

ABB's innovation growth hub, SynerLeap, helps startups to accelerate and expand in a global market. SynerLeap offers unique access to ABB's networks, customers and technology, and provides industrial mentorship to support startups in taking the big leap. Through SynerLeap, ABB has already collaborated on more than 100 startup projects, from industrial proof-of-concept projects to customer business projects. "Collaboration between top industrial startups and ABB unlocks a lot of value in terms of faster innovation, add-ons and new products. In a nutshell, innovation, collaboration and speed are the key pillars and the project outcomes are great too – 95 percent of the fulfilled projects have reached their targets and half of them have already led to increased collaboration," says Peter Löfgren, SynerLeap CEO. One such startup is Australia-based FlexeGRAPH, whose innovative nanofluid could lead to entirely new approaches to cooling in data centers →01.

> FlexeGRAPH has developed a graphene-enhanced nanofluid for advanced cooling applications.

FlexeGRAPH: revolutionary material for enhanced cooling

FlexeGRAPH is a 2015 spin-out from the Australian National University in Canberra, Australia. The company has developed a graphene-enhanced nanofluid for advanced cooling applications. Suspended graphene particles conduct heat 10,000 times better than water does, thus providing a significant improvement in thermal conductivity over standard liquid coolants that has application across many industries. The core focus for development is in two key areas:

- Electric vehicles, and their batteries and charging infrastructure.
- Cooling for electrical systems where heat limits performance – from high-power HVDC systems to 5G and edge computing applications, and liquid-cooled computing for data centers.

Material properties
Graphene is known for its high thermal conductivity, but, previously, its dispersion in fluid had been unsuccessful due to clumping and sedimentation. FlexeGRAPH developed an innovative technique to suspend graphene and bring the high thermal capacity of graphene to cooling fluids.

The graphene coolant is competitive with traditional coolants in corrosion and sedimentation prevention. A traditional coolant for a car engine, for example, has over a dozen ingredients to prevent corrosion, growth of microbes and algae, and degradation due to pressure and temperature changes. FlexeGRAPH's extensive testing ensured its coolant could also prevent these effects – without degrading cooling performance and with a fluid with a much lower environmental impact.

Testing also showed that the product remains stable without clumping or sedimentation. In a static environment, an even particle distribution of 98 percent was observed after five years. Virtually no sedimentation in pumped systems was observed over the same period. This remarkable performance is due in part to the small size of the graphene particles in the FlexeGRAPH fluid. To maximize the benefits of the product, FlexeGRAPH targets applications with operating temperatures at or above 35 °C.

Testbed: the world of motorsports
FlexeGRAPH also partnered with Formula One and Indy race car manufacturers for pilot testing. Because race car manufacturers are challenged to maximize engine performance but are limited by the heat production of high-power engines, the racing car arena provides a perfect testbed for the fluid. In high-performance engines, an increase of a few tenths of a degree in operating temperature can have a measurable positive impact on performance. When the existing cooling fluids were replaced by FlexeGRAPH graphene nanofluid, cooling performance was improved →02. This improvement enables higher

The graphene coolant is competitive with traditional coolants in corrosion and sedimentation prevention.

02



Photo p. 71: GIGA Data Centers

—
02 FlexeGRAPH's nanofluid improves race car performance.

—
03 Graphene's nanofluid is suitable for cooling data centers large and small.



03

engine output or other performance benefits through system redesigns such as lower weight and reduced aerodynamic profile.

Cooling systems for data centers
Data centers provide a perfect application example for FlexeGRAPH. As the data center industry continues to grow, so too does its cooling and energy use. Cooling accounts for over 30 percent of the average data center's energy usage [1] →03. The increased thermal capacity of FlexeGRAPH means that data center owners could cool the same servers using significantly less energy and simpler infrastructure.

—
The FlexeGRAPH nanofluid can deliver high cooling capacity in small-footprint data centers in metropolitan areas.

As in the motorsports example, the increased cooling capacity can also enable system redesigns that deliver other benefits. For example, in cooling systems using rear-door heat exchangers, the server computing density can be increased, which could be an enabler for the high computing power needed for the many new AI applications now appearing. In a similar vein, the ongoing massive expansion of 5G will drive the demand for small, compact data centers in metropolitan areas where real estate is expensive. Here, FlexeGRAPH can deliver high cooling capacity on a small footprint.

Is graphene the future of cooling?
The FlexeGRAPH product could be applied anywhere a bespoke coolant system is used. As FlexeGRAPH expands into new applications, testing and some customization will have to be performed to ensure compatibility, optimization and compliance with geographic- or application-specific regulations or requirements. In the markets in which the FlexeGRAPH product has been tested, this customization and testing were done relatively easily, opening the door to massive savings in cooling costs. •

—
References

[1] Vxchnge, "How to Improve Data Center Power Consumption & Energy Efficiency." Available: https://www.vxchnge.com/blog/power-hungry-the-growing-energy-demands-of-data-centers [Accessed March 23, 2020.]