DANISH GRAPHENE

Electronics in Space

Thermal Management Showcase

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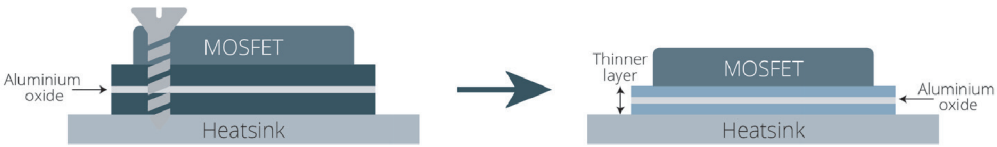
Graphene-Enhanced Thermal Management

In the challenging realm of space technology, effective electronics cooling is paramount, as the majority of satellite malfunctions stem from overheating issues. Traditional solutions involve active or passive cooling methods. However, active cooling often necessitates additional equipment on payloads, while passive cooling options are limited and can pose integration challenges.

At Danish Graphene, we are pioneering graphene-enhanced thermal management solutions designed to revolutionize passive cooling in the space industry. Leveraging graphene's exceptional conductivity, we have engineered user-friendly solutions tailored for space applications. Our innovations seamlessly integrate into existing systems, offering a game-changing approach to temperature regulation in space technology.



Watt&Well set-up enhanced with Danish Graphene's Graphene-Enhanced Thermal Adhesive, read their use case on the next page where they reduce their package temperature by more than 20%.

Our graphene-enhanced thermal management solutions are characterized by their low density, high thermal conductivity, minimal thermal resistance, and a remarkably thin bond line thickness. These products not only address overheating concerns but also open up possibilities for reimagining core systems. Danish Graphene is poised to introduce a new era of thermal management to the space industry.

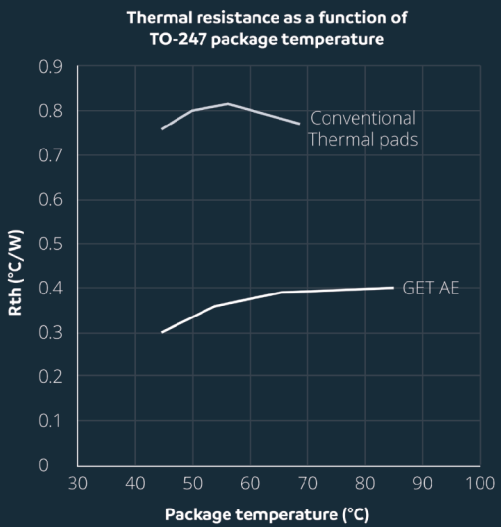
Showcase

The following test results showcase the improvement in thermal resistance when using the graphene-enhanced thermal adhesive epoxy (GET AE) from Danish Graphene, GET AE (100 µm layer), compared to more conventional thermal pads.

Watt&Well is a power electronics equipment provider for severe environments. For their systems in space, they have relied on thermal pads in a two-layer configuration with pads on either side of an alumina piece for isolating purposes. Issues with this configuration however means that most of the heat (upwards of 90%) is not efficiently transported through the thermal pads. The high temperature differential needed to push the heat through the pads result in heat building up in the device leading to component failure.

> "**Danish Graphene's epoxy significantly improves** thermal interface performances, enabling denser and lighter electronics for space applications," Arnaud Bonetti, System Engineer, Watt&Well.

Exchanging the thermal pads for the GET AE from Danish Graphene instantly improved the heat transfer and made for a much lower thermal resistance in the configuration. The graph to the right shows how the thermal resistance changes with temperature, highlighting a noticeable enhancement in performance upon replacing the traditional thermal pad with GET AE. By changing both layers to GET AE the thermal resistance drops to half the original value. This results in a package temperature drop of over 20%!



This performance enhancement means that more power can be applied to the device so it can potentially run with nearly twice the power dissipation without exceeding the temperature limits set for the device. Higher performance means better use of the device and generation of more value from costly launches. With the combination of high strength adhesives and high temperature stability devices can be secured without fasteners and screws which offer new design opportunities of the device itself. Compressing the device design and removing costly weight means less weight and volume on a launch, or more devices in the same payload than was possible before.

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