High Efficiency Heat Exchangers

Aegis Electronics has developed advanced, high-efficiency heat exchangers—such as heat sinks, radiators, and condensers—designed for thermal management of high-power-density electronics. These components use a range of innovative technologies, including aluminum-based composites, graphite foam, heat pipes, micro-jet arrays, network microchannels, phase change materials, and porous media. These systems were developed though collaborations with the U.S. Army, U.S. Department of Energy, and NASA. Commercialization is the next step.

Benefits of Network Microchannel and Microjet Arrays

Network microchannel and microjet arrays provide a 100% improvement over conventional microchannel heatsinks and also allow for more uniform temperature distribution.

Benefits of Graphite Foam

Our graphite foam combines high thermal conductivity with significantly improved mechanical strength. This material enables lightweight, compact heat exchangers with much higher efficiency than traditional metal designs—offering five times than average heat dissipation due to its large surface area and conductivity. By overcoming graphite's typical strength limitations we produce durable, high-performance heat exchangers that maintain excellent thermal performance.

Metal Matrix Composites (MMCs)

Our metal matrix composites (MMCs) boast high thermal conductivity and low coefficient of thermal expansion for thermal management systems. Structurally, MMCs provide several advantages including a high degree of stiffness and strength, while also being lightweight. We have designed both Al-based and Cu-based MMCs.

Metalized Substrates

Propriety metallized substrates (Si_3N_4, Al_2O_3, AlN, BeO) and graphite-based materials, including diamond and C-C composites, are used in applications such as power electronics, RF/microwave devices, amplifiers, laser diode arrays, and photodetectors. Common products include direct bond copper on ceramics for power electronics and direct bond molybdenum for high temperature uses, with customizable metallization options and thicknesses available.

MMC Insulated Substrate

This metal insulated substrate, designed with Al-based metal matrix composite (MMC) as the foundation, integrates both a ceramic with a MMC base plate. Such metal insulated substrates can be scaled to large dimensions and can be used as part of a printed circuit board. In addition, such substrates have high thermal conductivity and low CTE (coefficient of thermal expansion). For example, the thermal conductivity of Al-based MMCs is 120-180 W/mk and has a CTE of 9.0-16.0 x 10-6 /K. These substrates are compatible with Si, GaAs, SiC, and GaN devices. In addition, these substrates are suitable for high heat flux.

Thermoelectric Coolers & Generators

Our propriety thermoelectric coolers and thermoelectric generators designs were made with the goal of high-"ZT" values. These thermoelectric coolers are based on efficient nanocomposite materials. Such coolers are lightweight and high in efficiency. Such thermoelectric coolers can be used for IR sensors, laser diodes, and other electronics. In addition, we adapted high thermal conductivity and low thermal expansion metal insulated substrates for use in thermoelectric cooling. Alongside these goals was the development of lightweight, efficient thermoelectric generators.