

PROCEEDINGS

3D Printed Lightweight Meta-structures for Efficient Liquid Cooling

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ABSTRACT

With the rapid advancement of 5G communication technology, electronic devices are evolving toward intelligence, ultra-thinness, multi-functionality and foldability, giving rise to an urgent challenge of heat dissipation under ultra-high heat flux density. Liquid cooling technologies such as high-performance microchannels and vapor chambers have emerged as critical solutions for high heat flux thermal management. Additive manufacturing opens up new avenues for the optimized design and fabrication of liquid cooling architectures including high-performance microchannels and vapor chambers. Leveraging high-precision micro-nano additive manufacturing technologies, our research group directly printed lightweight meta-structures with optimized capillary pumping performance and convective heat transfer capacity on substrates such as flexible copper, graphene heat sinks and silicon. Combined with advanced packaging processes, we successfully fabricated ultra-thin vapor chambers and silicon-based microchannel cooling devices with exceptional heat dissipation performance. Via ceramic additive manufacturing, integrated ceramic microchannel heat sinks with an ultra-high equivalent heat transfer coefficient were fabricated, offering an innovative thermal management solution for high-power gallium nitride (GaN) and other chips.

KEYWORDS

Lightweight meta-structures; 3D printing; electronic heat dissipation; thermal management

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