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Hotspots-targeted Microjet Cooling with Bistable Programmable Nozzles for Dynamic Power Dissipations

Programmable microjet cooling dynamically targets chip hotspots, boosting reliability and efficiency.

Researchers at Purdue University have developed a microjet cooling system with bistable programmable nozzles that target microchip hotspots for dynamic power dissipation. The ever-increasing demand for high-performance microprocessors with high bandwidth, data rate, and power density has presented unique challenges related to localized hotspots that threaten the reliability and performance of the system. A variety of possible solutions has been proposed, such as heat spreaders, embedded thermoelectric cooling, and microchannel heat sinks, but these suffer from limitations in terms of cooling capacity, efficiency, energy consumption, and compatibility with high-power-density systems. In response to this industry need, these Purdue researchers have created an active flow control microjet cooling method with integrated programmable nozzles. These nozzles can responsively open and close to accommodate the transient changes in power dissipation patterns. The location of the impinging jet nozzles ejecting the coolant onto the chip can be aligned to the hotspot locations by programming the inlet nozzle shape. This new strategy aims to maintain a constant chip temperature while demanding lower cooling power and providing improved energy efficiency.

Technology Validation: Researchers first fabricated the microscale bistable unit cell at a larger stable size and validated its mechanics before moving on to nanoscale prototypes. With this larger system, they tested the integration and assembly of the impingement jet cooling microfluidic system as well as the thermal responsiveness of their proposed materials.

Advantages:

- Low power requirement

- Temperature-responsive materials; no power required to activate

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Category
Semiconductors/Devices & Components
Materials Science & Nanotechnology/Thermal Management Materials & Solutions

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- Increased energy efficiency

- Compatible with high-power-density chip systems

- Responsive to dynamic temperature fluctuations

- Maintains constant chip temperature

- Improves microprocessor reliability and performance

Applications:

- Microprocessor manufacturing

- Chip cooling

- High power computing

TRL: 4

Intellectual Property:

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