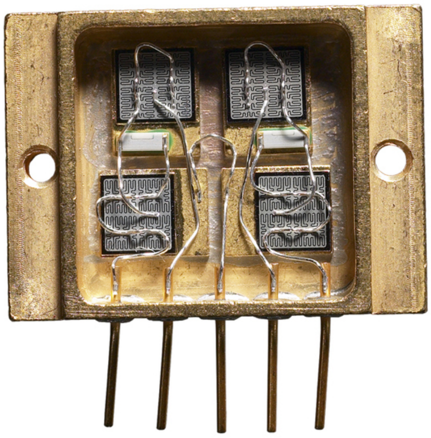
Improved Thermoelectric Module

TECHNOLOGY NUMBER: 6650



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Category
Hardware
Engineering & Physical Sciences
Semiconductors, MEMS, and Electronics

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OVERVIEW

High thermal resistance micro thermoelectric modules for energy harvesting and cooling

- Compact design enhances efficiency using superior thermoelectric properties and thermal resistance
- Electronic cooling, energy harvesting for microelectronics, wearable technology

BACKGROUND

The thermoelectric effect converts thermal gradients into electrical energy and vice versa, enabling thermoelectric generators (TEGs) and coolers (TECs). Historically, small thermoelectric devices have powered applications from CPU cooling to wireless sensor networks. However, low power generation and inefficiency remain challenges. TECs and TEGs depend on high thermal resistance to minimize parasitic heat flow, critical for performance. Attempts to boost thermal resistance by increasing the length of thermoelectric elements often sacrifice the active area, limiting device efficacy. Traditional designs either use suboptimal materials or compromise thermal resistivity, hindering performance. The demand for efficient, compact thermoelectric modules necessitates a design that maximizes thermal resistance while utilizing high-performance materials to improve the coefficient of performance (CoP) and power output.

INNOVATION

Researchers at the University of Michigan have developed a micro-scale thermoelectric module leveraging vertically oriented thermoelectric elements deposited over a mold, optimizing both thermal resistance and active area. The device structure enables the use of superior in-plane thermoelectric properties without sacrificing compactness. By employing materials like bismuth telluride and antimony telluride films, the modules achieve higher efficiency in energy harvesting and cooling applications. The design supports integration across multiple layers with either serial or parallel configurations, drastically enhancing the temperature gradients for cooling or energy output for harvesting. This technology is revolutionary for efficiently managing heat in electronic devices, enabling compact energy solutions for consumer electronics and robust cooling for high-power computing applications.

ADDITIONAL INFORMATION

REFERENCES

"Vertical Self-Defined Thin-Film Thermoelectric Thermocouples by Angled Co-Evaporation for Use in μTEGs"

INTELLECTUAL PROPERTY

US11678578 "Thermoelectric micro-module with high leg density for energy harvesting and cooling applications"