

Heat check on a chip: Nanoscalechip can detect sub-microwatt changes in temperature

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Scientists working in medical research, biology, cellular studies, and in understanding bacteria and other pathogens often need to know about temperature rises and falls in the systems on which they focus. Many

processes involve heat production and tracking those changes can get to the core of understanding a process, diagnosing a disease or perhaps investigating whether a pharmaceutical, such as an antibiotic, will work.

Now, Joohyun Lee and Il Doh of the Korea Research Institute of Standards and Science, in Daejeon, South Korea, have developed a tiny device that measures otherwise undetectable heat changes. They describe their "chip calorimeter" in the *International Journal of Nanotechnology*. The device is based on a thermopile made from bismuth and aluminum and can detect sub-microwatt changes in the [energy levels](#), and thus the heat generated by very small scale systems such as cell samples or bacterial cultures.

The chip calorimeter measures 8 by 10 millimeters and comprises four identical measurement units. A platinum electrode to generate heat in the center and two thermopiles on both sides of the heater and maintains the device at a known temperature within a range of 20 millikelvin, this is technically the furnace and acts as a baseline for the system so that any heat increase from a sample can be detected. The whole device is supported on a membrane of silicon nitride just 1 micrometer thick. "Any heat generation by sample or heater in the area of the inner thermopile connection induces temperature difference between the outer and the inner connections so that it produces voltage signal measurable with a nanovoltmeter," the team explains.

The chip calorimeter could ultimately be employed in measuring metabolic heat of cells for antibiotic research, changes in environmental samples, and temperature changes associated with disease for diagnosis, the team writes.

More information: Joohyun Lee et al. Development of chip calorimeter based on Bi/Al thermopile for biological sample measurement, *International Journal of Nanotechnology* (2020). [DOI:](#)

[10.1504/IJNT.2019.104473](https://phys.org/news/2020-01-chip-nanoscalechip-sub-microwatt-temperature.html)

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