Body heat could electrically power IoT devices, medical monitors using a woven, thermoelectric flexible fabric

April 5 2017

A Purdue University-developed technology that can be woven into a specially designed fabric could help harness human body heat and provide energy to power Internet of things (IoT) devices including heart and respiration monitors and fulfill other uses.

Kazuaki Yazawa, a research associate professor at Discovery Park's Birck Nanotechnology Center at Purdue University, developed the flexible thermoelectric generator technology, which uses semiconductor strings woven into a fabric. The generator takes heat from any type of complex surface it meets and converts it into a small amount of electricity.

Yazawa said the new technology addresses the limitations of conventional thermoelectric generators.

"The human body provides a significantly low-heat flux which requires thicker thermoelectric elements. Optimum size should be larger than one inch in order to generate high power output," he said. "These characteristics limit the technologies use as it is very rigid and cannot effectively fit the three-dimensional form of the body."

Yazawa said the unique woven semiconductor strings used in this novel technology promise to replace conventional thermoelectric generators by making them more flexible and easier to manage.

"The only way to reduce the thickness of the module is by designing the thermoelectric generator using a weaving technique. This allows the technology to be very flexible and dense," Yazawa said. "Lengthening the threads and using a unique combination of insulation makes the generator more flat and manageable, which makes it ideal for use in clothing or any shape that can be wrapped in a flexible fabric that has waste heat such as a chimney or coffee cup.

"Additionally, these semiconductor strings are able to harness the maximum amount of heat from the body or other ambient heat sources, providing reliable power for internet of things devices. This can eliminate the need for batteries."

Yazawa said the technology could greatly benefit tech wearables like those in the medical and healthcare industry.

"Heart monitors, respiration and perspiration monitors are very useful for the elderly or those recovering from a trauma. There also is a huge market for wearables in sports to optimize human performance," he said. "If you have a patient or an athlete who is overheating, real-time information of their vitals could be used by coaches and medical professionals to better monitor and treat their players or patients. These types of devices need energy to be actively charged so they can be used continually."

Yazawa said the technology also could provide a cooling effect.

"Anything that takes heat and converts it to another form of energy is also providing a cooling effect. Therefore, this technology also could provide a continuous cooling treatment," he said. "This could be especially beneficial from a sports or military perspective. The flexible substrate could be applied to undergarments and when athletes are running the technology could help give that little bit of charge."

Provided by Purdue University