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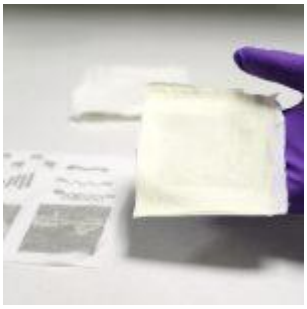
Stretchy fabric converts body's vibrations into electrical energy

Scientists at Nanyang Technological University, Singapore (NTU Singapore) have developed a stretchable and waterproof 'fabric' that turns energy generated from body movements into electrical energy.



A crucial component in the fabric is a polymer that, when pressed or squeezed, converts mechanical stress into electrical energy. It is also made with stretchable spandex as a base layer and integrated with a rubber-like material to keep it strong, flexible, and waterproof.

The NTU Singapore team showed that tapping on a 3cm by 4cm piece of the new fabric generated enough electrical energy to light up 100 LEDs.

Washing, folding, and crumpling the fabric did not cause any performance degradation, and it could maintain stable electrical output for up to five months, demonstrating its potential for use as a smart textile and wearable power source.

"Our prototype continues to function well after washing and crumpling," says researcher Professor Lee Pooi See, "we think it could be woven into t-shirts or integrated into soles of shoes to collect energy from the body's smallest movements, piping electricity to mobile devices."

The fabric turns vibrations produced from the smallest body movements in everyday life into electricity.

The fabric produces electricity in two ways: when it is pressed or squashed (piezoelectricity), and when it comes into contact or is in friction with other materials, such as skin or rubber gloves (triboelectric effect).

To fabricate the prototype, the scientists first made a stretchable electrode by screen-printing an 'ink' comprising silver and styrene-ethylene-butylene-styrene (SEBS), a rubber-like material found in teethers and handlebar grips to make it more stretchable and waterproof.

This stretchable electrode is then attached to a piece of nanofibre fabric that is made up of two main components: poly(vinylidene fluoride)-*co*-hexafluoropropylene (PVDF-HPF), a polymer that

produces an electrical charge when compressed, bent, or stretched; and lead-free perovskites, a promising material in the field of solar cells and LEDs.

“Embedding perovskites in PVDF-HPF increases the prototype’s electrical output,” says researcher Jiang Feng, “in our study, we opted for lead-free perovskites as a more environmentally friendly option. While perovskites are brittle by nature, integrating them into PVDF-HPF gives the perovskites exceptional mechanical durability and flexibility. The PVDF-HPF also acts an extra layer of protection to the perovskites, adding to its mechanical property and stability.”

The result is a prototype fabric that generates 2.34 watts per square metre of electricity – enough to power small electronic devices, such as LEDs and commercial capacitors.

The NTU scientists showed how a hand tapping on a 3cm by 4cm piece of the fabric continuously could light up 100 LEDs.

The fabric continued to produce a continuous stable electrical output up to five months.