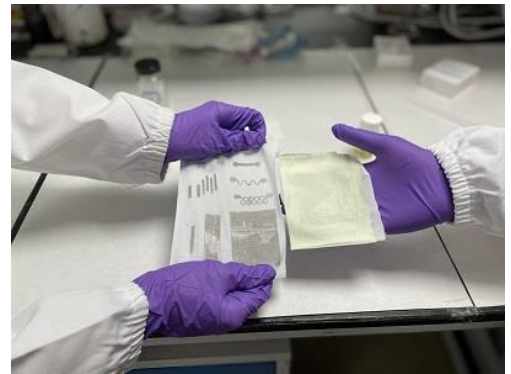


Stretchable fabric generates electricity from body movement

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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. It is made with stretchable spandex as a base layer and integrated with a rubber-like material to keep it strong, flexible and waterproof.

The fabric developed by the NTU team is an energy-harvesting device that turns vibrations produced from the smallest body movements in everyday life into electricity. The prototype 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,” said PhD student Jiang Feng, a member of the research team. “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 W/m² of electricity — enough to power small electronic devices, such as LEDs and commercial capacitors. In a proof-of-concept experiment reported in the journal *Advanced Materials*, the team showed how a hand tapping on a 3 x 4 cm piece of the fabric generated enough electrical energy to light up 100 LEDs or charge various capacitors, which store electrical energy and are found in devices like mobile phones.

The fabric demonstrated good durability and stability — its electrical properties did not deteriorate following washing, folding and crumpling. It also continued to produce a continuous stable electrical

<https://www.electronicsonline.net.au/content/power/article/stretchable-fabric-generates-electricity-from-body-movement-1143235390>

output for up to five months, demonstrating its potential for use as a smart textile and wearable power source.

“There have been many attempts to develop fabric or garments that can harvest energy from movement, but a big challenge has been to develop something that does not degrade in function after being washed, and at the same time retains excellent electrical output,” said study leader Professor Lee Pooi See. “In our study, we demonstrated that our prototype continues to function well after washing and crumpling.”

The scientists showed that the fabric could harness energy from a range of human movements by attaching it to the arm, leg, hand and elbow, as well as to the insoles of shoes, and did so without impacting on the movements. According to Lee, “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.”

Lee continued, “Despite improved battery capacity and reduced power demand, power sources for wearable devices still require frequent battery replacements. Our results show that our energy-harvesting prototype fabric can harness vibration energy from a human to potentially extend the lifetime of a battery or even to build self-powered systems.

“To our knowledge, this is the first hybrid perovskite-based energy device that is stable, stretchable, breathable, waterproof, and at the same time capable of delivering outstanding electrical output performance,” Lee concluded. The team is now looking at how the same fabric could be adapted to harvest different forms of energy.