

POWER FROM THE PEOPLE

'Batteries not included' could be the norm for new electroceuticals

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umans are complex machines, with moving parts that bend, squish, stretch, flow, quiver and beat. Scientists are now plugging into these energy sources to solve a common problem afflicting sensors, wearables and implanted medical devices—the dreaded flat battery.

Devices that are self-powered by design could be the solution, and researchers have discovered that the human body itself can be a handy power source—and just in time to supercharge the exploding market in wearables. “Electroceuticals” are starting to challenge pharmaceuticals in medicine, so more people will depend on devices such as implanted electrostimulators and pacemakers to stay healthy.

“Biobatteries” and energy scavenging could make these devices energy-autonomous, removing the need for invasive surgery to replace dead batteries. As a bonus, this wireless world would avoid implanted charging cables being dislodged or becoming infected—problems that are all too common today.

Scientists have been working on body-powered devices since the early 2000s—until now, the tech has been too energy-hungry for the minute amounts of electricity that can be harvested from humans. But after two decades of advances, today’s devices consume ultra-low amounts of energy, throwing open the gate to myriad ideas and prototypes that draw power from the people.

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A cellular powerhouse

German startup CELTRO uses arrays of microneedles to harvest energy from thousands of body cells. Its first product will be a tiny autonomous pacemaker. “A muscular contraction, like the heart, starts at one point and then propagates through the whole heart muscle,” says CEO and cofounder Gerd Teepe. “Our idea was to harvest energy at multiple points to use this avalanche effect.” celtro.de

Paper fuel-cells

French startup BeFC is building biobatteries with green credentials. Its fuel cell uses layers of carbon, cellulose, and glucose—plus a sprinkling of proprietary enzymes. Adding a drop of fluid, say blood or urine, sets off a reaction that generates electricity. The compostable paper patches could power single-use diagnostic devices and continuously operating sensors, such as glucose-monitoring kits. befc.global

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The human body already generates all the power needed for many medical devices.

Piezo patches

Italian startup PiezoSkin says it has developed an ultra-thin piezoelectric skin patch that can simultaneously measure movements and draw power from them. In one study, it used the patch to monitor neck movements in people with the swallowing issue dysphagia—but the firm's biocompatible film could also harvest power from other body movements. piezoskin.com

Feeling the heat

Humans radiate around 100 Watts a day in thermal energy. Swiss startup Mithras thinks it can harness this heat. Its thermoelectric generators, or TEGs, create electricity by exploiting the temperature difference between the body and the environment. Mithras estimates that with a 5°C difference, a 12 cm² TEG skin patch could power a cochlear implant. mithras.tech



My quivering heart

Paris-based CAIRDAC is designing a pacemaker that's powered by the heart itself. Its leadless pacemaker is packed into a capsule containing a piezoelectric energy harvester—heartbeats oscillations are converted into electricity and stored until the device senses that the heart needs a jolt to reset the rhythm. The startup recently raised €17m in Series-A financing to continue preclinical testing. cairdac.com

Interior illumination

Solar panels could soon be lighting up medtech. Researchers from Monash University in Melbourne have found that a solar panel placed under the skin (between the neck and the shoulder is best, apparently) will still yield up to 10 percent as much electricity as one in direct sunlight—enough to power an ultra-low consumption sensor. A couple of hours in the sun can run an implantable temperature sensor for 24 hours.

The hydroelectric heart

Mini-turbines could turn blood flow into electricity, according to University of Bern researchers. Their torpedo-shaped turbine could be implanted into a heart blood vessel, generating electricity from blood flow, much like a hydroelectric power station. Blood clots forming on the blades of the turbine is still an issue, but in lab simulations, the turbine generated enough energy to power commercially available leadless pacemakers.