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One Day Your Pants May Power Up Your iPod

UC Berkeley researchers are perfecting microscopic fibers that can make electricity from simple body motions. The nanofibers may soon be woven into clothing, creating the ultimate portable generator.

Researchers at UC Berkeley are perfecting microscopic fibers that can produce electricity from simple body motions such as bending, stretching and twisting. The filaments, which resemble tiny fishing lines, may soon be woven into clothing and sold as the ultimate portable generators.

It could take three years or more before it hits the store shelves, but the technology is already being hailed as a breakthrough.

The so-called nanofibers "will have very significant implications," said Mihail Roco, senior advisor for nanotechnology with the National Science Foundation, which recently gave a \$350,000 grant to the project.

In addition to helping reduce electricity demands on local utilities, new industries could spring up to manufacture the tiny personal generators, he said. Researchers are envisioning hikers powering up their digital cameras while trekking up a mountain or a jogger charging up her cellphone in mid-run.

The Pentagon is hot for it too: Soldiers would no longer have to carry heavy batteries to power their gear. Along with the National Science Foundation, the Pentagon's secretive advanced research agency is helping fund the project.

For now, the "smart power suit" is still a lab experiment, said UC Berkeley mechanical engineering professor Liwei Lin, who is overseeing the development of the fibers. Lin and his team, including researchers from Berkeley, Germany and China, recently were able to demonstrate the fibers' capacity to harness the energy from minute body movements.

Working in a small, two-room lab on the Berkeley campus, the researchers were able to convert energy from finger motions into electricity using fibers attached to a surgical glove. At roughly 500 nanometers thick, a strand is barely noticeable to the human eye. It's one-tenth the width of a cloth fiber and one-hundredth the width of a human hair.

It would take about 100,000 fibers to produce enough power for an electrical watch and 1 million fibers to generate enough current to power an iPod. But a bundle of 1 million fibers would be only about the size of a grain of sand.

Lin said the fibers can soak up the untapped energy produced by the human body, a remarkably efficient natural generator. The more vigorous the motion, the more power can be harvested, making knees and elbows and other joints prime spots for the strands.

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The strands take advantage of piezoelectricity, which produces energy through "applied stress," similar to the heat generated when rubbing hands together.

Multiple dips in the washing machine won't hurt — the fibers are flexible and resistant to heat and chemicals. They're also small enough to blend unobtrusively into most garments.

And static shouldn't be a problem, Lin said.

The filaments are made from a cheap, organic plastic called polyvinylidene fluoride. The material, known as PVDF, also comes in fishing lines, insulation for electrical wires and paint on buildings such as the Taipei 101 tower in Taiwan.

Lin's team produces the fibers using a technique it pioneered called near-field electrospinning. A syringe filled with a polymer solution is suspended over a moving, electrically conductive silicon wafer. An electrical field pulls the solution out, forming fine fibers on the wafer in regular patterns. Think of a baker applying very thin lines of frosting on a very small cake.

Generating electricity from tiny components has been a distant dream for scientists for decades, said Roco, who also leads the National Nanotechnology Initiative.

"Up until now, there were too few ways to effectively do this, too far away to really have a discussion," he said. "Now, there's finally a technical solution. Now, people may finally start to think more seriously about it."

Lin's work builds on several years of efforts to mix clothing and electricity.

A team from the Georgia Institute of Technology developed fibers similar to Lin's several years ago using synthetic Kevlar strands coated with zinc oxide rods. The resulting filaments, which look like hair rollers, produce energy when rubbed together.

Led by professor Zhong Lin Wang, the researchers have also produced electrical currents from fingers typing on cellphones, hamsters running on exercise wheels, even vibrating vocal cords. Tiny modules could eventually be implanted in the human body to harvest energy from muscle movement or blood vessels, Wang said.

But the fibers from Lin's team are made with organic matter that can be spun to infinite lengths, while the Georgia strands used inorganic materials and were limited to just a few millimeters in length.

At rival Stanford University, researchers are developing fabric-based batteries, or eTextiles, that could potentially store the energy produced at UC Berkeley.

Ordinary cloth becomes rechargeable batteries and capacitors when immersed in a special ink formula and then oven-dried. A piece weighing about an ounce can retain up to three times the amount of energy that a cellphone battery can, while remaining lightweight and flexible.

Berkeley's Lin said he might seek venture capital funding within three months, though he hasn't decided whether he wants to start his own company with the technology or license it out to other firms.

If the product can be cheaply mass produced, the lack of competition would give nanofibers an easy way to conquer the market, Roco said. "It will be determined by economics — if the nanofibers cost \$10,000, nobody will buy them," he said. "But if they're \$2, everyone will buy. People will use nanotechnology not because it's fancy but because it's economical."

Source: Tiffany Hsu, *Los Angeles Times*, 5/20/10

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- What is your reaction to this article?
- If this technology is perfected, how might it change our world?
- Would you use this technology? Why? Why not?