Spinach power
Vegetable as energy source is MIT dream
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We're talking real 'green' energy

MIT researchers join in project to harness photosynthetic power of spinach in field of electronics

GLOBE FILE PHOTO

By Hiawatha Bray
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Scientists at the Massachusetts Institute of Technology have proved what Popeye already knew — spinach is an excellent energy source. It's so good that in 10 years, our cellphones and portable computers may be coated in a spinach-based material that provides their electrical power.

"The phone is no longer red or blue; it becomes green. So what?" said Shuguang Zhang, associate director of MIT's Center for Biomedical Engineering. In exchange for the color makeover, users would have electrical devices that would recharge themselves from sunlight, using a process similar to the photosynthesis that keeps all green plants alive.

Zhang, assistant computer science professor Marc Baldo, and recent MIT graduate Patrick Kiley helped develop the technology, dubbed Photosystem 1. The MIT team joined forces with scientists at the University of Tennessee and the US Naval Research Laboratory. They isolated a set of spinach proteins that produce energy when exposed to light. The proteins form clusters no more than 20 nanometers in size, meaning that 100,000 would fit on the head of a pin.

Next, they had to solve how to bond this material with electrical circuitry. Zhang figured out how to use broken pieces of proteins, called peptides, to attach the spinach protein to a piece of glass coated with a thin layer of gold.

The resulting experimental chip is dark green, rather than silicon gray. When hit with light from a laser, the chip produced a tiny stream of electrical current — not nearly enough to be useful, but powerful enough to prove the idea works. "There's nothing

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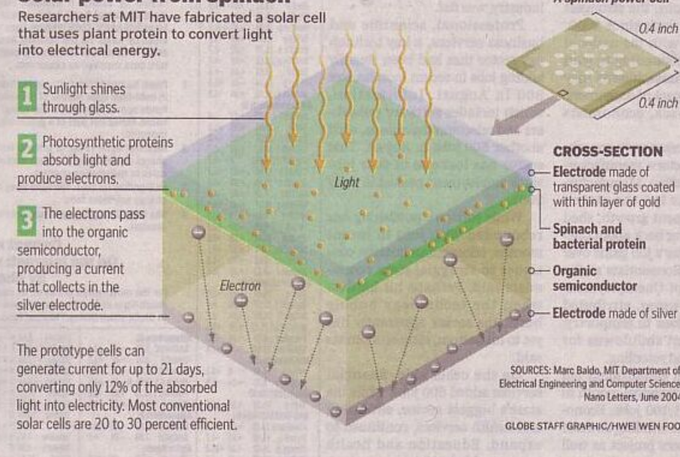
What spinach did for Popeye, researchers hope to replicate for cellphones and PCs.

Solar power from spinach

Researchers at MIT have fabricated a solar cell that uses plant protein to convert light into electrical energy.



The prototype cells can generate current for up to 21 days, converting only 12% of the absorbed light into electricity. Most conventional solar cells are 20 to 30 percent efficient.

SOURCES: Marc Baldo, MIT Department of Electrical Engineering and Computer Science; Nano Letters, June 2004

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wrong with the science," said Zhang. Indeed, the Photosystem 1 experiment has been written up in Nano Letters, a publication of the American Chemical Society.

Zhang said that a spinach-based solar cell should have several advantages over today's technologies. Billions of years of evolution have taught plants to use sunlight efficiently, he said, so a bio-solar device should be capable of higher efficiency than present-day systems. Also, the bio-engineered materials are so thin that thousands of layers of them could be compressed into the width of a human hair. Spinach-based solar cells would use this technique to provide enough juice to run a phone or computer. At the same time, these multilayered cells would still be so thin that they could be built into the outer skin of a device. "It's like a layer of paint," Zhang said. A cellphone's own case, coated in spinach cells, could recharge the battery constantly on sunny days.

How long before our phones turn green? It's just a matter of money to transform the lab experiment into practical products, Zhang said. "If you give me $10,000, it will take me 50 years. Forget about it," he said. "If you give me a million dollars, it will go faster." And with a billion or two to play with, Zhang said our electronics could be running on spinach power in a decade. Some of the money is already on its way; Zhang said that the giant silicon chip-maker Intel Corp. has recently agreed to provide additional research funds.

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