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Bacteria Power: Energy Of The Future?

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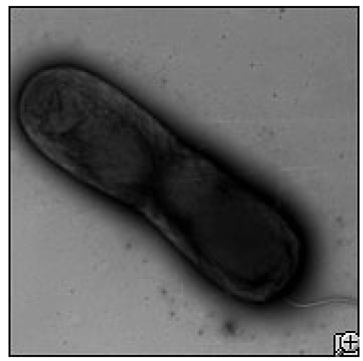

R. ferriducens: "Bacterial Battery"

Sept. 9, 2003 — U.S. scientists said they have invented the world's first efficient "bacterial battery," expanding the potential for cheaper energy alternatives.

In a Pentagon-backed project, University of Massachusetts researchers Swades Chaudhuri and Derek Lovley said the battery's source is an underground bacterium that gobbles up sugar and converts its energy into electricity.

Their prototype device ran flawlessly without refueling for up to 25 days and is cheap and stable.

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"This is a unique organism," Lovley said, as he outlined an array of potential applications.

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The bacterium in question is *Rhodoferax ferriducens*, which was found in airless sediment deep below ground at a terrestrial site at Oyster Bay, Va., and identified as a promising candidate for oxidizing simple sugars.

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The two scientists, whose work is published on Sunday in the specialist journal *Nature Biotechnology*, set up a small two-chambered vessel, with each side containing a graphite electrode and separated by a membrane.

On one side was *R. ferriducens* swimming in a glucose solution, which it broke down into carbon dioxide (CO2) and electrons.

The electrons were transported to the nearby electrode, called the anode, and driven around an external circuit to the other electrode, the cathode: electrical power.

Microbial fuel cells are not new, but until now they have run into big problems of cost and energy efficiency.

Typically, they yield efficiency of "10 percent or less," which makes them big and unwieldy relative to the power they provide, Lovley said.

The best effort has had an efficiency performance of about 50 percent.

But this was only achieved thanks to chemicals called mediators which sneak across the cell's membranes, pick up the free electrons and ferry them to the anode.

The mediators are expensive and have to be replenished frequently, and this makes them unsuitable as a simple, long-term energy source.

The prototype made by Lovley and Chaudhuri cranks out only a tiny amount of current — enough to run a calculator or Christmas tree lights.

But as a proof of concept it is remarkable.

Its energy efficiency is an extraordinary 83 percent, which implies that, if engineering obstacles can be overcome and manufacturing techniques devised, it could one day be as compact as household batteries.

It worked not only with glucose but also with the fruit sugar fructose, with sucrose (found in sugar cane and sugar beet) and even xylose, a sugary byproduct of wood and straw.

In addition, the bacterium is rugged and stable, able to grow at temperatures ranging from four to 30 C (39.2 to 86 F), with 25 C (77 F) the optimum.

All of the fuel is used up. The process does have a pollutant, in the form of CO2, which is a greenhouse gas, but the contribution to global warming would be far less than the equivalent emission using fossil fuel, Lovley said.

"In the short term, I see the usefulness would be for charging up batteries that can be used in a cell phone, something like that," Lovley said.

The technology could also be used in environments where it is difficult or costly to charge the batteries, he said, explaining that the U.S. Department of Defense was interested in it for powering underwater microphones and sonar to spot passing ships and submarines.

And, for people living in poor, remote communities, it should be possible to adapt the electrodes so that they used carbohydrate waste from farm animals or sewage to power batteries for running fridges and stoves.

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Picture(s): University of Massachusetts Amherst |