Microbe powered, An electrifying discovery made by UMass team

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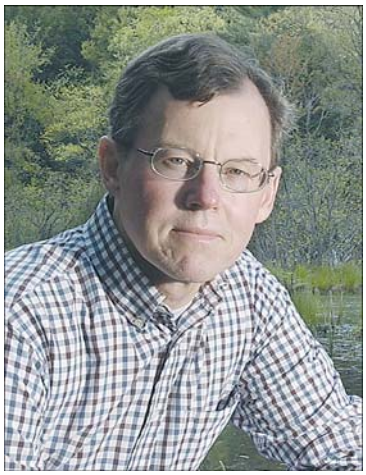

Derek Lovley

Enlarge photo

AMHERST - Microscopic natural electric circuits are living by the billions in the muck beneath rivers, swamps and backyard gardens, raising new possibilities for miniaturized electronic devices and gadgets that might one day live off the land.

A team led by microbiologist Derek Lovley at the University of Massachusetts has discovered that super-fine "nanowires" produced by the microorganism Geobacter are durable and efficient conductors of electricity.

The finding, reported in the current edition of Nature, is the latest in a string of exciting and potentially lucrative discoveries by Lovley, who found Geobacter at the bottom of the Potomac River in 1987 while searching for possible biological tools to clean up environmental pollution.

That muddy find was the research equivalent of gold. Geobacter produces energy by consuming metals the way other life forms use oxygen, seeking out pollutants from benzene to uranium and neutralizing them. The organism was recently shown to have rendered uranium insoluble at a Colorado hazardous waste site, preventing watershed contamination.

''Geobacter will basically eat petroleum products and convert them to carbon dioxide,'' Lovley added.

In the years since Lovley arrived at UMass in 1995 from the U.S. Geological Survey, he has become one of the hottest properties on campus, bringing in some $46 million in research grants. But with this week's discovery, Lovley, 52, may have tapped into a rich new vein of commercial possibilities.

The nanowires, with a width of just three to five nanometers, or 20,000 times finer than a human hair, could provide biological circuitry for a new generation of computers and data storage media, he said. The U.S. Department of Defense sees the potential for undersea bio-warfare monitors that derive power from the seabed via Geobacter. And at least one major auto-maker - he won't say which - is interested in the possibility of producing bio-fuel cells for cars.

Most of those applications are still years away from development, Lovley cautioned.

''These haven't been tested in an electrical device,'' he said. ''Vehicles that live off the land, that's (even) further away.''

But the team is sufficiently convinced of Geobacter's promise that they've already applied for patents on the use of the microbial nanowires in electronic devices, as well as the process for biologically producing them, Lovley said.

The nanowires or "pili," which only grow on one side of the organism, have been observed intertwining with neighboring Geobacter organisms, potentially creating what some have called a mini-power grid. Just how they conduct electricity isn't yet understood, Lovley said, but it's clear they're good at it.

And they're far cheaper to produce than synthetic nanowires from materials like carbon or silica. Billions can be produced in a day with 10 milliliters of water, Lovley said, and genetic engineering holds the possibility of modifying the natural wires for different applications.

It was a discovery that would never have happened without coordination between academic disciplines at UMass, he said. Microbiologist Gemma Ruegera discovered the conductive properties of the pili with help from physicists Mark T. Tuominen and Kevin D. McCarthy, using an atomic force microscope. The team also included microbiologists Teena Mehta and Julie S. Nicoll.

''We joked that maybe these are wires,'' Lovley said, referring to the team's inquiry into the structure behind the organism's unusual electrical properties. ''It was pretty much of a wild guess.''

But it was a guess that has brought national acclaim to the UMass Microbiology

Department.

''I have watched and judged, in peer review, many of Dr. Lovley's remarkable scientific advancements since the discovery of Geobacter in 1987,'' said Cornell University microbiologist Eugene Madsen in a statement. He called the discovery a promising milestone that could usher in a new era in the fields of microbe study and bio-electronics.

Aristides Patrinos of the U.S. Department of Energy, which funded the research beginning in 2002 with a three-year grant for $8.9 million, said the discovery could also lead to better approaches in cleaning up hazardous waste sites.

On the Web: www.geobacter.org