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# Microbial Fuel Cells to Power Future

## New Design Promises Medical Breakthroughs

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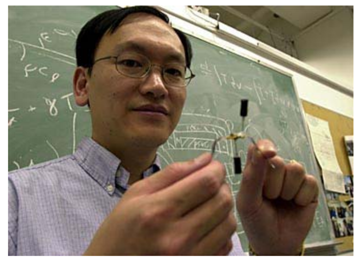

PHOTO/LINA KATZ
Mechanical engineering professor Liwei Lin holds a microbial fuel cell that promises to revolutionize medical treatment by harnessing the body's own energy reserves to power tiny drug delivery devices.

An AIDS patient today may require frequent doses of potent drug cocktails every single day.

Aiming to render such incessant pill-popping obsolete, Berkeley researchers have envisioned a tiny, internal drug delivery system that will power the release of essential medicine from within the body.

This scenario may become a reality thanks to the recent work of UC Berkeley mechanical engineering professor Liwei Lin.

Lin and his graduate students have designed a so-called microbial fuel cell that is just .07 square centimeters in area.

The cell generates as much as 300 microvolts for two hours, an amount sufficient enough to operate tiny devices, including microscopic drug delivery systems.

The microbial fuel cell could conceivably power implantable medical devices and aid individuals who require regular doses of drugs.

A fuel cell is an electrochemical device that converts fuel energy directly into electrical power.

Apart from its small size, the system is unique because it utilizes glucose, a sugar present in the blood stream, as fuel.

"Nothing is more convenient than drawing power from your own system," said Lin.

Using glucose to drive this 'body battery' provides further benefits.

"(The device) is really a very good energy source because it is renewable. You can get glucose from plants and other sources," said Lin.

Lin's microbial system uses Saccharomyces cerevisiae, also known as Baker's Yeast, to ferment glucose and produce protons and electrons from the hydrogen contained within.

The electrons produced supply current to any device attached to the fuel cell.

The byproducts of this process are carbon dioxide and water, substances that the body can naturally filter out.

The use of Baker's Yeast to run the microbial system is another positive characteristic of Lin's work that has sparked interest among the broader scientific community.

"S. cerevisiae is a remarkably benign organism." said Princeton University molecular biology professor Mark Rose. "(It) is one of the safest microorganisms that we commonly come into contact with."

A number of challenges must be overcome before microbial fuel cells can be used to run implantable medical devices.

"These (obstacles) include the means of safely extracting glucose from human fluids and safely exhausting the waste products, carbon dioxide and water, of the fuel cell," said Jacob Brouwer, Associate Director of UC Irvine's National Fuel Cell Research Center.

Lin has already designed two Micro-Electro-Mechanical Systems (MEMS) that could make use of microbial fuel cells, each being comparable to a penny in size.

The first such device is a drug delivery system that would use the fuel cell to pump water into a chamber.

The incompressibility of water would then cause a diaphragm to expand and push a specific amount of drug into the bloodstream of a patient.

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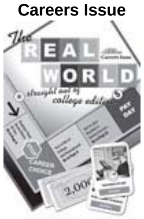


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Lin's second MEMS is a photosynthetic cell that will use carbon dioxide to create glucose, enhancing the body's energy stores.

Graduate student Mu Chiao, the primary author of the team's most recent publication, hopes to apply the microbial fuel cell to the treatment of diabetes.

"(One) can have long term monitoring of the blood glucose level," said Chiao.