

# Photosynthesis: a new source of electrical energy

February 18 2010

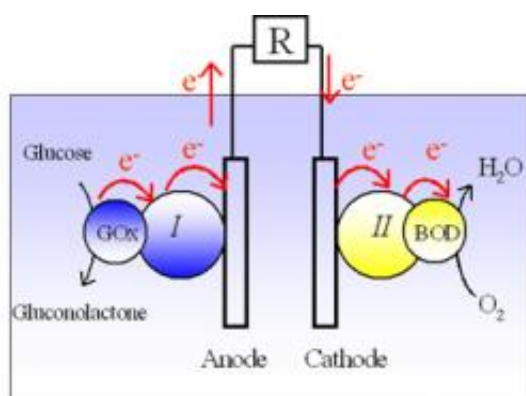


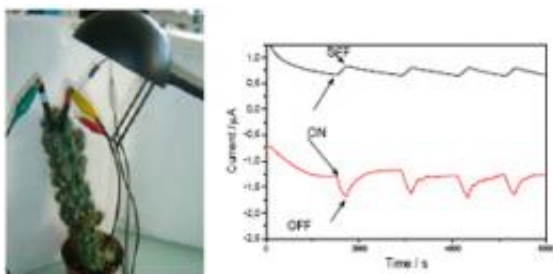
Diagram of the biofuel cell. The two electrodes are modified by their respective bioelectrocatalysts and placed in the same solution. Electrodes at the anode are transferred from glucose to glucose oxidase (GOx), from GOx to polymer I and from polymer I to the electrode. At the cathode, electrons are transferred from the cathode to polymer II, from polymer II to bilirubin oxidase (BOD) and from BOD to O. © Mano et al, JACS, 2003, 125, 6588-6594

French scientists have transformed the chemical energy generated by photosynthesis into electrical energy. They thus propose a new strategy to convert solar energy into electrical energy in an environmentally-friendly and renewable manner. The biofuel cell thus developed could also have medical applications. These findings have just been published in the journal *Analytical Chemistry*.

Photosynthesis is the process by which plants convert solar energy into

[chemical energy](#). In the presence of visible light, [carbon dioxide](#) (CO<sub>2</sub>) and water (H<sub>2</sub>O) are transformed into glucose and O<sub>2</sub> during a complex series of chemical reactions. Researchers at the Centre de Recherche Paul Pascal (CNRS) developed a biofuel cell that functions using the products of photosynthesis (glucose and O<sub>2</sub>) and is made up of two enzyme-modified electrodes.

The cell was then inserted in a living plant, in this case a cactus. Once the electrodes, highly sensitive to O<sub>2</sub> and glucose, had been implanted in the cactus leaf, the scientists succeeded in monitoring the real-time course of photosynthesis in vivo. They were able to observe an increase in electrical current when a desk lamp was switched on, and a reduction when it was switched off. During these experiments, the scientists were also able to make the first ever observation of the real-time course of [glucose levels](#) during photosynthesis. This method could offer a new means of better understanding the mechanisms of photosynthesis.



Biofuel cell inserted in a cactus and graph showing the course of electrical current as a function of illumination of the cactus. (black: glucose, red: O<sub>2</sub>). © Flexer, Mano; Anal Chem, 2010, 82, 1444-1449

Furthermore, the researchers showed that a biofuel cell inserted in a cactus leaf could generate power of 9 W per cm<sup>2</sup>. Because this yield was proportional to light intensity, stronger illumination accelerated the

production of glucose and O<sub>2</sub> (photosynthesis), so more fuel was available to operate the cell. In the future, this system could ultimately form the basis for a new strategy for the environmentally-friendly and renewable transformation of [solar energy](#) into [electrical energy](#).

Alongside these results, the initial objective of this work was to develop a biofuel cell for medical applications. This could then function autonomously under the skin (in vivo), drawing chemical energy from the oxygen-glucose couple that is naturally present in physiological fluids. It could thus provide power for implanted medical devices such as, for example, autonomous subcutaneous sensors to measure glucose levels in diabetic patients.

**More information:** From Dynamic Measurements of Photosynthesis in a Living Plant to Sunlight Transformation into Electricity, Victoria Flexer, Nicolas Mano, *Analytical Chemistry*, 15 February 2010.

Provided by CNRS

Citation: Photosynthesis: a new source of electrical energy (2010, February 18) retrieved 30 January 2023 from <https://phys.org/news/2010-02-photosynthesis-source-electrical-energy.html>

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.