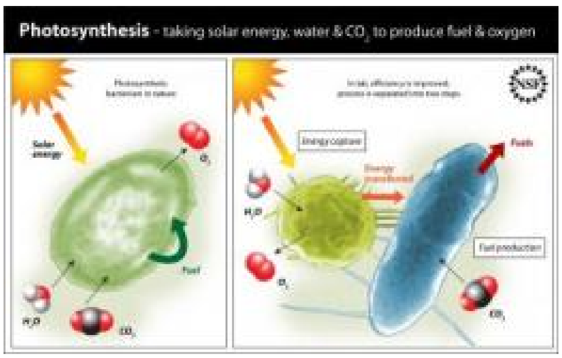
Biological nanowires expedite future fuel production

March 30 2011



Schematic comparison of a natural photosynthetic system and the hypothetical system to be constructed in this project (Biological nanowires expedite future fuel production). Credit: Zina Deretsky NSF

Scientists in the UK and US, including researchers at Arizona State University, have been awarded funding to improve the photosynthetic process as a means of producing renewable fuel.

This award will permit four transatlantic teams, one directed by ASU's Assistant Professor Anne Jones in the department of chemistry and biochemistry, to investigate methods to overcome the limited efficiency of photosynthesis. This will lead to ways of significantly increasing the yield of important crops for food production or sustainable bioenergy. Ensuring a stable energy supply is the central challenge of the 21st century.

The funding has been awarded by the US National Science Foundation (NSF) and the UK Biotechnology and Biological Sciences Research Council (BBSRC) in an unusual program designed to co-opt some of the best minds from the USA and UK to explore this important problem. Although photosynthesis is nature's means for capturing the sun's energy in plants, algae and other organisms, it has intrinsic limitations for major energy production.

"The project represents a radical approach to augment and surpass photosynthetic strategies observed in nature by engineering modular division of labor through electrical connectivity," says Jones who is also from the College of Liberal Arts and Sciences and the Center for Bioenergy and Photosynthesis at ASU.

"A simple analogy is a power plant unconnected to the distribution grid. Unconnected, excess energy goes to waste, and this is what currently happens in photosynthetic organisms when they are overwhelmed with light. However, engineering of transmission lines allows energy to be utilized and stored elsewhere. In this project, we will set up conductive transmission lines between the photosynthetic apparatus in one species and the fuel-producing metabolism of a second species to funnel excess energy directly into fuel production."

The strategy is to create a trans-cellular, plug-and-play platform that allows the team to shunt electrons from photosynthetic source cells to independently engineered fuel production modules along biological nanowires.

"Photosynthesis is essential for life on Earth," says Joann Roskoski, NSF's Acting Assistant Director for Biological Sciences. "By providing food and generating oxygen, it has made our planet hospitable for life. This process is also critical in addressing the food and fuel challenges of the future. For decades, NSF has invested in photosynthesis research projects that range from biophysical studies to ecosystem analyses at a macroscale. The Ideas Lab in photosynthesis was an opportunity to stimulate and support different types of projects than what we have in our portfolio in order to address a critical bottleneck to enhancing the photosynthetic process."

"This is hugely ambitious research, but if the scientists we are supporting can achieve their aims it will be a profound achievement," explains Professor Janet Allen, Director of Research at BBSRC.

Other members of Jones's team in the US are John Golbeck from Penn State University, David Kramer from Michigan State University and Ichiro Matsumura from Emory University School of Medicine. Lee Cronin, from the University of Glasgow, Scotland, will direct the British part of the team including also Travis Bayer at Imperial College London and Thomas Bibby from the University of Southampton.

This project integrates diverse disciplines to address a critical limitation in the efficiency of photosynthesis, and along the way will advance both fundamental and applied knowledge in the areas of synthetic biology, inorganic and biosynthetic chemistry, protein engineering, electron transfer, energy storage, photosynthetic physiology and integration of novel traits into organisms.

Provided by Arizona State University

Citation: Biological nanowires expedite future fuel production (2011, March 30) retrieved 25 April 2024 from
https://phys.org/news/2011-03-biological-nanowires-future-fuel-production.html

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