Scientists develop novel biophotovoltaics system

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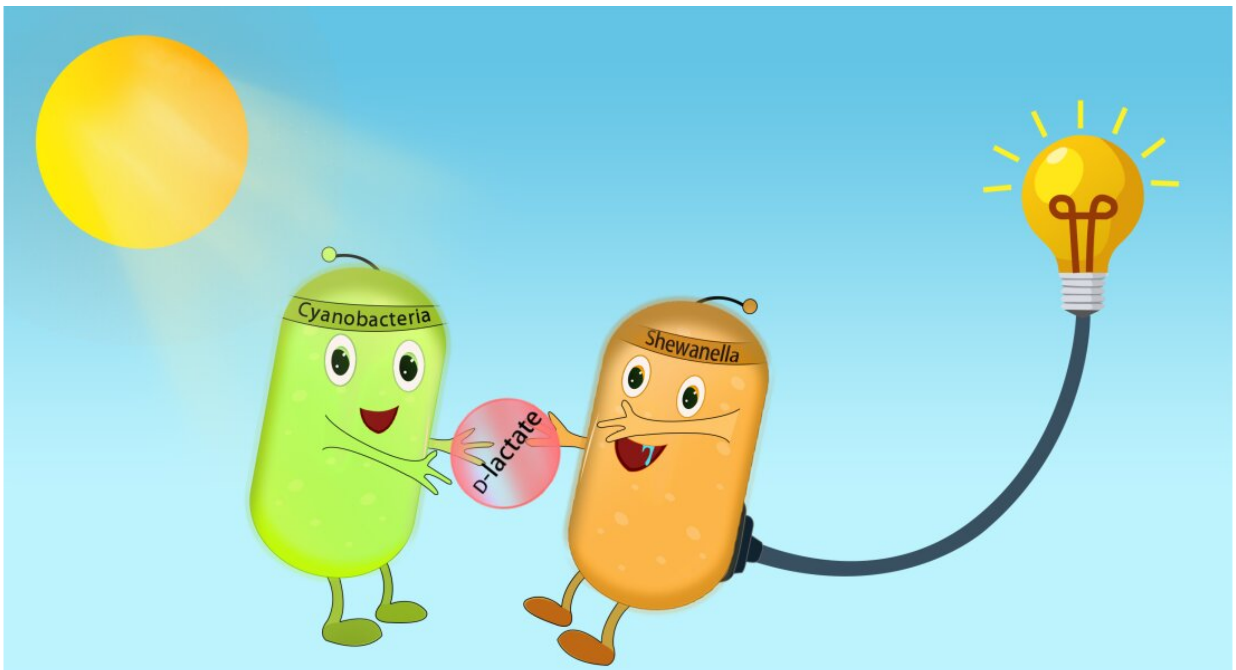

A cartoon diagram of BPV system based on a two-species microbial consortium. Credit: Image from LI Yin's group, Institute of Microbiology, Chinese Academy of Sciences

Researchers from the Institute of Microbiology of the Chinese Academy of Sciences have reported a novel biophotovoltaics (BPV) system based on a synthetic microbial consortium with constrained electron flow. This BPV system can stably operate for more than 40 days, setting a new

BPV longevity milestone, according to a recent article in *Nature Communications*.

BPV is an emerging technology that employs biological photosynthetic materials (mainly living photosynthetic microorganisms) to convert solar energy into electricity. BPV is more environmentally friendly and potentially more cost-effective than semiconductor-based photovoltaics (PV), given the toxicity and hard-to-recycle nature of PV materials.

However, the power densities of BPV systems reported to date have been low, since photosynthetic microorganisms have a weak capacity to transfer electrons outside cells. To circumvent this problem, researchers have created a two-species microbial consortium.

This microbial consortium is composed of photosynthetic cyanobacteria and the exoelectrogenic bacteria Shewanella, with the latter inherently possessing strong exoelectrogenic activity. D-lactate was selected as the energy carrier responsible for directed energy transfer between cyanobacteria and Shewanella (Fig. 1).

In this microbial consortium, cyanobacteria capture solar energy and fix CO_2 to synthesize D-lactate, while Shewanella produce electricity by oxidizing D-lactate, thus creating a constrained electron flow from photons to D-lactate, then to electricity.

Through genetic manipulation, as well as manipulation of the growth medium and device, the two very different microorganisms are able to work together effectively. This BPV system generates a power density of 150 $mW{\cdot}m^{-2}$ in a temporal separation setup, which is approximately one order of magnitude greater than mediator-less BPV devices with conventional configurations.

The researchers further demonstrated that this BPV system can stably operate for more than 40 days at an average power density of 135 $mW{\cdot}m^{-2}$ in a spatial-temporal separation setup with medium replenishment. This represents the greatest longevity and power output per device of any BPV system reported to date.

More information: Huawei Zhu et al, Development of a longevous two-species biophotovoltaics with constrained electron flow, *Nature Communications* (2019). DOI: 10.1038/s41467-019-12190-w

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