Biological photovoltaic devices

What is biological photovoltaics?

Biological photovoltaics,also called biophotovoltaics or BPV,is an energy-generating technologywhich uses oxygenic photoautotrophic organisms,or fractions thereof,to harvest light energy and produce electrical power.

What is a biological photovoltaic device (BPV)?

Similarly, other organisms, such as oxygenic photosynthetic microorganisms, are also able to harvest solar energy, absorbing carbon dioxide and driving oxidation of water. This oxygenic photosynthetic mechanism lays the foundation for development of biological photovoltaic devices (BPVs).

How does a biological photovoltaic system work?

An illustration of how a biological photovoltaic system operates. Like other fuel cells,biological photovoltaic systems are divided into anodic and cathodic half-cells. Oxygenic photosynthetic biological material,such as purified photosystems or whole algal or cyanobacterial cells,are employed in the anodic half-cell.

What are Biophotovoltaic devices?

Provided by the Springer Nature SharedIt content-sharing initiative Biophotovoltaic devices (BPVs),which use photosynthetic organisms as active materials to harvest light,have a range of attractive features relative to synthetic and non-biological photovoltaics,including their environmentally friendly nature and ability to self-repair.

Are Biophotovoltaic devices environmentally friendly?

Nature Energy 3 ,75-81 (2018) Cite this article Biophotovoltaic devices (BPVs),which use photosynthetic organisms as active materials to harvest light,have a range of attractive features relative to synthetic and non-biological photovoltaics,including their environmentally friendly natureand ability to self-repair.

Why are biological photovoltaic systems better than non-biological fuel cells?

Similar to microbial fuel cells,biological photovoltaic systems which employ whole organisms have the advantage over non-biological fuel cells and photovoltaic systems of being able to self-assemble and self-repair(i.e. the photosynthetic organism is able to reproduce itself).

Coupling this approach to existing photovoltaic systems could increase solar-to-food energy conversion efficiency by about fourfold over biological photosynthesis, reducing the solar footprint ...

In particular, this paper focuses on how different biological materials and their separated products enhance and effectively guarantee BPV power generation technology (Section 2). At the end of the review, the future direction of biological materials reinforced photovoltaic system technology is prospected. 2 Biological materials used in BPV

Quantitative analysis of the factors limiting solar power transduction by Synechocystis sp. PCC 6803 in biological photovoltaic devices. Energy Environ. Sci. 4, 4690-4698. doi: 10.1039/C1EE02531G

A review of the progress of BPV development with a focus on biological materials, electrode design and interfacial wiring considerations, and proposed steps for driving the field forward are proposed. Abstract Biophotovoltaic systems (BPVs) resemble microbial fuel cells, but utilise oxygenic photosynthetic microorganisms associated with an anode to generate an ...

Following the practice of photovoltaic technology, the scale-up of BPV should go through from a BPV cell to a BPV module, and eventually to a BPV panel. ... Terminal oxidase mutants of the cyanobacterium Synechocystis sp. PCC 6803 show increased electrogenic activity in biological photo-voltaic systems. Phys. Chem. Chem. Phys., 15 (2013), pp ...

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This led to the development of MFC-inspired photovoltaic (BPV) devices that produce electrical power by harvesting solar energy through biological activities of photosynthetic organisms. We describe the fabrication of a BPV device with multiple microchannels.

The exploitation of renewable energy sources for delivering carbon neutral or carbon negative solutions has become challenging in the current era because conventional fuel sources are of finite origins. Algae are being used in the development of biophotovoltaic (BPV) platforms which are used to harvest solar energy for bioelectricity generation. Fast-growing ...

In the experiment, the device was used to power an Arm Cortex M0+, which is a microprocessor used widely in Internet of Things devices. It operated in a domestic environment and semi-outdoor conditions under natural light and associated temperature fluctuations, and after six months of continuous power production the results were submitted for ...

Biological photovoltaic devices, which are energy conversion technologies, are termed bioelectrochemical fuel cells, microbial fuel cells, or the photo-bioelectrochemical fuel cells used recently. In photovoltaic systems where biological organisms are used, the electrons dissociate from the photolysis of water to oxygen and hydrogen, and are ...

T1 - Quantitative analysis of the factors limiting solar power transduction by Synechocystis sp. PCC 6803 in biological photovoltaic devices. AU - Bombelli, Paolo. AU - Bradley, Robert W. AU - Scott, Amanda M. AU - Philips, Alexander J. AU - McCormick, Alistair J. AU - Cruz, Sonia M. AU - Anderson, Alexander. AU - Yunus, Kamran. AU - Bendall ...

2.1. Cyanobacteria. At present, cyanobacteria is the most commonly used material in the research of BPV. As

a single-celled prokaryote, cyanobacteria have relatively simple cell membrane arrangement, which is conducive to electron output, and contains chlorophyll a, lutein, carotene, phycobilirubicin and other pigments, which has a good light adaptation mechanism ...

Biological photovoltaic devices are a type of biological electrochemical system, or microbial fuel cell, and are sometimes also called photo-microbial fuel cells or "living solar cells". In a biological photovoltaic system, electrons generated by photolysis of water are transferred to an anode. A relatively high-potential reaction takes ...

The devices are of interest for power generation, especially in situations where there is no local power supply, small amounts of power are required, and bringing in batteries or silicon photovoltaic devices is considered undesirable in view of potential environmental impacts.

Quantitative analysis of the factors limiting solar power transduction by Synechocystis sp. PCC 6803 in biological photovoltaic devices+ Paolo Bombelli,?ab Robert W. Bradley,?b Amanda M ...

Development of Bio-Photovoltaic Devices Increased awareness of the environmental effect of using fossil fuels as well as government targets to reduce carbon dioxide emmisions have resulted in an increased interest in methods of harnessing solar energy. ... We have shown that this device can be used with a variety of biological material such as ...

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Biological photovoltaics (BPVs) are emerging systems that concurrently exploit the advantages of photovoltaics and bioelectrochemical cells to generate electricity by harvesting solar energy without relying on any exogenous supply of reducing equivalents . 17 Numerous cyanobacterial 18 and green algal 19 biofilms have been used in BPV systems ...

Quantitative analysis of the factors limiting solar power transduction by Synechocystis sp. PCC 6803 in biological photovoltaic devices. Energy Environ. Sci. (2011) P ... Terminal oxidase mutants of the cyanobacterium Synechocystis sp. PCC 6803 show increased electrogenic activity in biological photo-voltaic systems. Phys. Chem. Chem. Phys ...

Forward thinking: Biophotovoltaic (BPV) systems utilise oxygenic photosynthetic microorganisms associated with an anode to generate an extracellular electrical current, which is stimulated by illumination.The aim of ...

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Biological photovoltaic devices, also called photomicrobial fuel cells or living solar cells, are a kind of biological electrochemical system or microbial fuel cell. In biological photovoltaic systems using of biological organisms, electrons are transferred to the anode (anode) by decomposition of water into oxygen and hydrogen by photolysis. ...

The principle that photosynthetic bacteria can generate and transfer electrons directly or indirectly to an anode has been demonstrated by a number of groups, although the power output obtained from these devices is too low for biological photovoltaic devices to be useful outside the laboratory.