TECH OFFER

Wavelength-Selective Organic Solar Cell for Greenhouse

KEY INFORMATION

TECHNOLOGY CATEGORY:
Chemicals - Organic
Sustainability - Low Carbon Economy
Energy - Solar
Materials - Composites
Green Building - Façade & Envelope

TECHNOLOGY READINESS LEVEL (TRL): TRL4
COUNTRY: JAPAN
ID NUMBER: TO174934

OVERVIEW

The development of next-generation greenhouses in agriculture is driving a growing demand for innovative systems that can address both energy and food challenges simultaneously. Currently, agriculture heavily relies on fossil fuels, particularly heavy oil, as its primary energy source, new technologies must be explored to significantly reduce greenhouse gas emissions, such as carbon dioxide.

Ensuring a stable food supply is crucial for increasing self-sufficiency rates, but the installation of traditional silicon solar cells has presented challenges due to shading effects, leading to reduced crop yields. Consequently, the absence of suitable solar cell technology for greenhouses poses critical problems for both power generation and food supply.

Under this situation, **green-light wavelength-selective organic solar cells (OSCs)** have been developed. In this system, transmitted blue and red light can be effectively used to promote plant growth, while absorbed green light can be effectively utilized as a source of electricity for greenhouses. In addition, **near-infrared wavelength-selective OSCs** have been developed, which can use the near-infrared light to generate electricity while lowering the temperature inside the greenhouses.

This wavelength-selective OSCs can be installed on the entire roof of greenhouses due to the advantages of light weight, flexible, and large area. This technology enables efficient utilization of solar energy for both power generation and agriculture.

TECHNOLOGY FEATURES & SPECIFICATIONS

The active layer of OSCs consists of an intermixed bulk heterojunction structure of a donor and an acceptor. In the green-light wavelength-selective OSCs, the absorption range of both donors and acceptors is specially tuned to be in the green light region at approximately 500–600 nm. For the near-infrared wavelength-selective OSCs, organic semiconductors with the extended pi-conjugation system are used for the absorption in the range of 800-1200 nm. These absorption ranges are complementary to those of chlorophylls a and b, which are essential plant pigments involved in photosynthesis.

The technology owner is seeking collaboration partners from chemical companies, OSC manufacturers, greenhouse manufacturers, and agricultural manufacturers.

POTENTIAL APPLICATIONS

This technology can be developed by the joint implementation of chemical companies, OSC manufactures, greenhouse manufactures, and agricultural manufactures. Due to the advantage of transmitted feature, this technology can be also installed on the windows in buildings.

MARKET TRENDS & OPPORTUNITIES

Based on the Report Ocean Co. Ltd, the global market for agricultural greenhouses is projected to reach US $34925 billion in 2030.

UNIQUE VALUE PROPOSITION

This OSC technology is designed specifically for agrivoltaics in agriculture. It is different from existing agrivoltaic systems and uses green-light wavelength selectivity to maximize crop yields while generating electricity. It has higher transmittance properties compared to traditional silicon solar cells. The **near-infrared wavelength selectivity** can absorb the near-infrared light and lower the temperature inside the greenhouses, which can improve working conditions for farmers.

Unlike traditional silicon solar cells, this lightweight, and cost-effective OSCs are ideal for greenhouse applications, reducing the need for frequent roof replacement. The single layer material is flexible and can be fabricated up to 50 meter-scale modules

This technology includes the green light wavelength selective factor (SG) and the power conversion efficiency, to quantitatively evaluate the performance of OSCs for agrivoltaics.