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FOTOBIOSMART | Photobioreactor smart Illumination system for cultivation of microalgae

ULPGC Universidad de Las Palmas de Gran Canaria | Fundación Parque Científico Tecnológico

OTRI Oficina de Transferencia de Resultados de Investigación

TYPE OF R+D RESULT

- **New technology**
- New product
- New service
- New knowledge or skill

COMMERCIAL MATURITY LEVEL

- Model or conceptual idea
- Proof of concept (design)
- **Validated in a controlled environment**
- Validated in a real environment
- Successfully implanted

PROTECTION LEVEL

- **Non- applicable**
- Patent
- Software
- Know - how
- Utility model

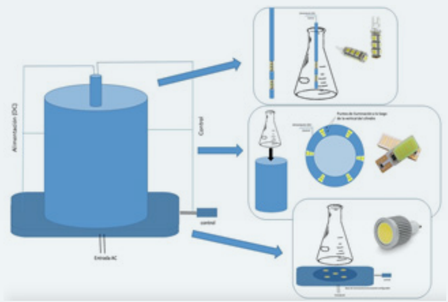
Description of the solution. Problem solved

The cultivation of micro algae is an alternative that allows us to efficiently transform possible contaminant agents present in liquid (N and P) and gaseous media (CO2) into bioremediation processes that are environmentally friendly.

In order to cultivate these microalgae, closed or open photobioreactors are needed. These devices have different sizes and their main objective is to produce microalgal biomass in a sustainable way. Most of these photobioreactors use solar light. On the contrary, the present solution is a photobioreactor prototype based on optical communication technology and LED illumination systems.

Optical communication technology allows to control and modify different parameters of the source of light used in photobioreactor such as intensity, spectral composition or temporal variation of light. This way, light emission is optimised, adapting it to the needs of the cultivations and enhancing its growth.

The prototype designed is based on visible light communication (VLC), particularly those used in underwater wireless optical communications (UWOC). The prototype is intended to provide both configurable illumination and visible light communication, basing on solid-state lightning applied to the cultivation and production of microalgae and photosynthetic cyanobacteria.



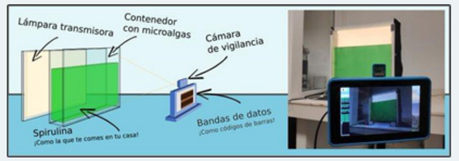
Non-guided optical communication systems, as the ones here used, introduce some control parameters that allow to modify radiation for stimulating and maximise the growth of microalgae. Having well featured cultivations also allows to analyse the UWOC links performance in controlled and well parametrised environments, which is a vital knowledge for the enhancement of this type of systems.

In this way, for example, more reliable and competitive UWOC systems may be obtained to be used in underwater sensors in this type of cultivation, which are used for monitoring growth, production, photosynthetic efficiency and physiological state of the biomass produced.

In fact, one of the most relevant innovations of the proposed system is the use of new technology for monitoring optical sensors. We are referring to optical camera communications (or OCC). Our system is based in the aforementioned technology, and it intends to use a camera for receiving information from bioreactors by sensors with optical transmitters submerged in the cultivation or by the light source feeding the cultivation. This camera can also be used as a data optical transmitter without affecting the photobioreactor performance.

In the image on the right side, data bands transmitted by the photobioreactors lamps can be seen. These bands are imperceptible for human beings, but they can be easily detected by the camera for data extraction.

The next figure shows the basic scheme of these OCC systems:



Fields of commercial application

- Biotechnology industry
- Pharmaceutical industry.
- Cosmetics industry.
- Animal and human food industry and nutraceutical.

Market opportunity

Microalgae cultivations are one of the areas with major potential impact on the development of blue economy; as well as one of the fields to become the main driver of scientific and socioeconomic development of Canary Islands.

The development of efficient methods for cultivation implies using techniques as the solution presented hereby, which is based on systems of intelligent illuminations, as well as the implementation of constant monitoring of the systems in different scales.

In this line, it must be highlighted that Canary Islands satisfy the ideal conditions for developing algae biotechnology and become a reference on this field. In fact, two centres working on the development of the innovative industry of algae biotechnology can be found in this archipelago: the Spanish Bank of Algae (BEA) and the Canary Islands Institute of Technology (ITC).

Competitive advantage

This solution is based on programmable systems, that have flexible control parameters and that can be controlled remotely by electronic systems and software developed by the research staff. In this way, more reliable and competitive UWOC systems may be obtained to be used in underwater sensors in this type of cultivation, which are used for monitoring growth, production, photosynthetic efficiency and physiological state of the biomass produced.

UWOC is a promising technique in the development and implementation of short-reach data networks in submarine environments. Among other advantages, these systems provide improvements in costs, performance and complexity compared to other alternatives such as acoustic communication or radiofrequency networks.

Including OCC techniques allows centralised monitoring of several photobioreactors (up to a whole plant) with a single camera, resulting in costs and installation savings. In the following image, an example of the data captured by the camera and transmitted by the lamps of the different photobioreactors can be seen. As above mentioned, the same camera can collect data from several photobioreactors at the same time.

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