



**Published:****(88) Date of publication of the international search report:**

26 October 2012

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

## INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/US2012/021922****A. CLASSIFICATION OF SUBJECT MATTER****B09B 3/00(2006.01)i, C02F 11/04(2006.01)i, C12M 3/00(2006.01)i, C12P 1/00(2006.01)i, C12R 1/89(2006.01)n**

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

B09B 3/00; C12P 7/16; A01H 13/00; B03C 1/30; B01D 53/84; B01D 53/92; A01G 7/00; C02F 11/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) &amp; Keywords: photo\*, anaerobic\*, algae, algal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|-----------|------------------------------------------------------------------------------------|-----------------------|
| X         | WO 2010-141634 A1 (PROMETHEUS TECHNOLOGIES, LLC et al.) 09 December 2010           | 41,54                 |
| Y         | See abstract, figures 1,5, pages 7-11 and all claims.                              | 1-39                  |
| X         | US 2009-0250401 A1 (KOTELKO, MIKE et al.) 08 October 2009                          | 55-62                 |
| Y         | See abstract, figures 1-7, pages 2-7 and claims 1-23.                              | 1-35                  |
| Y         | US 2009-0162922 A1 (DE MATTIA, JIM et al.) 25 June 2009                            | 4,5,20,21,25-39       |
|           | See abstract, figure 1, pages 2-5 and claim 1.                                     |                       |
| X         | US 2010-0330637 A1 (LEE, JAMES WEIFU) 30 December 2010                             | 40                    |
| Y         | See abstract, figure 1 and page 27                                                 | 5,7,8,21,29,36-39     |
| A         | US 2010-0031561 A1 (HATCHER, PATRICK G. et al.) 11 February 2010                   | 1-41,54-62            |
|           | See abstract, figure 1, pages 1,2 and claim 1.                                     |                       |



Further documents are listed in the continuation of Box C.



See patent family annex.

\* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&amp;" document member of the same patent family

Date of the actual completion of the international search

22 AUGUST 2012 (22.08.2012)

Date of mailing of the international search report

**27 AUGUST 2012 (27.08.2012)**

Name and mailing address of the ISA/KR

Korean Intellectual Property Office  
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan  
City, 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

KIM Dae Young

Telephone No. 82-42-481-8651



# INTERNATIONAL SEARCH REPORT

International application No.

**PCT/US2012/021922**

## Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☒ Claims Nos.: 42-53  
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:  
  
Claim 40 relates to the method of sequestering carbon dioxide, but claims 42-53 dependent on claim 40 relate to the product. As claims 42-53 do not clearly define the matter for which protection is sought, these claims do not meet the requirement of PCT Article 6.
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

SEE EXTRA SHEET.

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
  
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

### Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

< EXTRA SHEET >

This ISA found multiple inventions as follows:

- I. Claims 1-16 are directed to a biorefinery system comprising a photobioreactor system, an anaerobic bioreactor system, and an enclosure.
- II. Claims 17-24 are directed to a method of growing plant life in a greenhouse system including steps of forming an enclosure, disposing a photobioreactor system, and disposing an anaerobic bioreactor system.
- III. Claim 25-34 are directed to a photobioreactor system for growing an algal colony comprising a source of exhaust gas, a raceway system, and a valve system.
- IV. Claim 35 is directed to a method of growing an algal colony comprising steps of providing a photobioreactor, delivering exhaust gas and draining the algal colony.
- V. Claims 36-39 are directed to a biorefinery system for sequestering exhaust gases to produce energy, comprising a biomass pyrolysis device, a photobioreactor system.
- VI. Claims 40,42-53 are directed to a method of sequestering carbon dioxide, comprising steps of obtaining carbon dioxide and directing the carbon dioxide to an algal colony.
- VII. Claim 41 is directed to a soil regeneration product comprising a carbon to nitrogen ratio, and a potassium content.
- VIII. Claim 54 is directed to a soil regeneration product comprising a carbon to nitrogen ratio, a second component selected from the group consisting of a potassium content, a sulfate content and so on.
- IX. Claim 55 is directed to a method of remediating water comprising steps of generating an organic carbon product, and filtering water.
- X. Claims 56-62 are directed to a control system for a biorefinery system comprising a biological process, and a plurality of autonomous agents for controlling components in the biorefinery system.

The inventions listed as Groups I-X do not relate to a single general inventive concept under PCT Rule 13.1, because under PCT Rule 13.2 they lack the same or corresponding special technical features for the following reasons; they are separate inventions with distinct fields of search.

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2012/021922**

| Patent document<br>cited in search report | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|-------------------------------------------|---------------------|----------------------------|---------------------|
| WO 2010-141634 A1                         | 09.12.2010          | US 2011-0003357 A1         | 06.01.2011          |
| US 2009-0250401 A1                        | 08.10.2009          | CA 2710201 A1              | 23.07.2009          |
|                                           |                     | CN 101925542 A             | 22.12.2010          |
|                                           |                     | MX 2010006908 A            | 10.11.2010          |
|                                           |                     | US 2011-0165638 A1         | 07.07.2011          |
|                                           |                     | US 7927491 B2              | 19.04.2011          |
|                                           |                     | WO 2009-090476 A2          | 23.07.2009          |
|                                           |                     | WO 2009-090476 A3          | 03.09.2009          |
|                                           |                     | WO 2009-090476 A8          | 15.07.2010          |
| US 2009-0162922 A1                        | 25.06.2009          | None                       |                     |
| US 2010-0330637 A1                        | 30.12.2010          | AU 2009-217293 A1          | 27.08.2009          |
|                                           |                     | CA 2716364 A1              | 27.08.2009          |
|                                           |                     | CN 102124118 A             | 13.07.2011          |
|                                           |                     | EA 201070990 A1            | 29.04.2011          |
|                                           |                     | EP 2250276 A2              | 17.11.2010          |
|                                           |                     | EP 2250276 A4              | 07.12.2011          |
|                                           |                     | WO 2009-105733 A2          | 27.08.2009          |
|                                           |                     | WO 2009-105733 A9          | 03.12.2009          |
| US 2010-0031561 A1                        | 11.02.2010          | None                       |                     |