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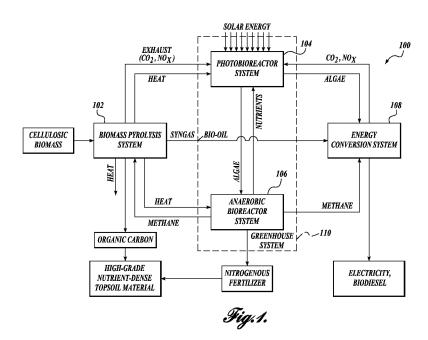
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[Continued on next page]

(54) Title: BIOREFINERY SYSTEM, COMPONENTS THEREFOR, METHODS OF USE, AND PRODUCTS DERIVED THEREFROM



(57) Abstract: Embodiments of the present disclosure provide systems, components, methods directed to generating energy and output products from biomass in a biorefinery system. The systems, components, and methods can be used alone or in combination as part of an integrated biorefinery system.





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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 application No. PCT/US2012/021922

### 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

### 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) & Keywords: photo\*, anaerobic\*, algae, algal

### DOCUMENTS CONSIDERED TO BE RELEVANT

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

i	Further	documents	are listed	in the	continuation	of Box	Ċ.
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See patent family annex.

- Special categories of cited documents:
- document defining the general state of the art which is not considered to be of particular relevance
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- 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)
- document referring to an oral disclosure, use, exhibition or other
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- 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
- "&" document member of the same patent family

Date of the actual completion of the international search

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Date of mailing of the international search report

27 AUGUST 2012 (27.08.2012)

Name and mailing address of the ISA/KR



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# INTERNATIONAL SEARCH REPORT

International application No.

# PCT/US2012/021922

Box N	o. II Observat	tions where certain claims were found unsearchable (Continuation of item 2 of first sheet)
This in	nternational searc	ch 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.		42-53 relate to parts of the international application that do not comply with the prescribed requirements to such an meaningful international search can be carried out, specifically:
		ates to the method of sequestering carbon dioxide, but claims 42-53 dependent on claim 40 relate to the product.  2-53 do not clearly define the matter for which protection is sought, these claims do not meet the requirement of 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 N	o. III Observa	tions where unity of invention is lacking (Continuation of item 3 of first sheet)
	nternational Sear SEE EXTRA SH	ching Authority found multiple inventions in this international application, as follows: IEET.
1.	As all required claims.	d addtional search fees were timely paid by the applicant, this international search report covers all searchable
2.	As all searcha of any addition	ble claims could be searched without effort justifying an additional fee, this Authority did not invite payment nal fee.
3.		of the required additional search fees were timely paid by the applicant, this international search report covers ims for which fees were paid, specifically claims Nos.:
4.		dditional search fees were timely paid by the applicant. Consequently, this international search report is the invention first mentioned in the claims; it is covered by claims Nos.:
Rema	rk 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.

### INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/021922

### <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 cited in search report	Publication date	Patent family member(s)	Publication date
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US 2010-0031561 A1	11.02.2010	None	