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Declarations under Rule 4.17:

— of inventorship (Rule 4.17(iv))

Published:

— with international search report (Art. 21(3))

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

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(54) Title: SYSTEMS AND METHODS FOR DELIVERY OF CARBON DIOXIDE, BIOREACTOR SYSTEMS, AND USES THEREOF

(57) Abstract: Systems and methods for the production of carbon dioxide are provided that can be used directly at a bioreactor site and that can provide release and delivery of carbon dioxide in a cost-efficient manner. The methods and systems can use solar energy for the thermal dehydration or desorption of a carbon dioxide source. Further, methods and bioreactor plants for the production of carbon-based products are provided that can include the methods and systems for the production of carbon dioxide, and can allow reduced carbon-based product cost due to reduced carbon dioxide associated costs and further can allow for energy efficient temperature control of bioreactors.



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/041272

A. CLASSIFICATION OF SUBJECT MATTER
INV. C01B31/20 C12M1/00
ADD.

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)
C01B B01J F24J

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

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

EPO-Internal, WPI Data, INSPEC, COMPENDEX, CHEM ABS Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	NIKULSHINA V ET AL: "CO2 capture from atmospheric air via consecutive CaO-carbonation and CaCO3-calcination cycles in a fluidized-bed solar reactor", CHEMICAL ENGINEERING JOURNAL, ELSEVIER SEQUOIA, LAUSANNE, CH, vol. 146, no. 2, 1 February 2009 (2009-02-01), pages 244-248, XP025809067, ISSN: 1385-8947, DOI: 10.1016/J.CEJ.2008.06.005 [retrieved on 2008-06-13] abstract page 245, left-hand column, paragraph 2 ----- -/-	1-13, 27-40, 52-67



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 another 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

"&" document member of the same patent family

Date of the actual completion of the international search

1 October 2012

Date of mailing of the international search report

23/01/2013

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INTERNATIONAL SEARCH REPORT

International application No

PCT/US2012/041272

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 127 726 A1 (SHELL INT RESEARCH [NL]) 2 December 2009 (2009-12-02) claims 1- 17 paragraphs [0001], [0007], [0008], [0011], [0014], [0018], [0026], [0027], [0047] - [0054], [0063] -----	1,7,8, 10, 27-40, 52-67
X	WO 2008/009049 A1 (COMMW SCIENT IND RES ORG [AU]; WIBBERLEY LOUIS [AU]) 24 January 2008 (2008-01-24) page 2, line 25 - page 7, line 17 -----	1,27,36
X	CN 101 234 281 A (UNIV TSINGHUA [CN]) 6 August 2008 (2008-08-06) abstract -----	1,27,36

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2012/041272

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2127726	A1	02-12-2009	AU 2009259548 A1 23-12-2009
		EP 2127726 A1	02-12-2009
		US 2011077447 A1	31-03-2011
		WO 2009153144 A2	23-12-2009

WO 2008009049	A1	24-01-2008	AU 2007276694 A1 24-01-2008
		CN 101516473 A	26-08-2009
		EP 2043764 A1	08-04-2009
		JP 2009543751 A	10-12-2009
		KR 20090039779 A	22-04-2009
		US 2010005966 A1	14-01-2010
		WO 2008009049 A1	24-01-2008
		ZA 200900391 A	27-01-2010

CN 101234281	A	06-08-2008	NONE

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-13, 27-40, 54-67(completely); 52, 53(partially)

The problem to be solved by the first invention is to provide:

- a method for generating carbon dioxide comprising heating a carbon dioxide source with solar energy provided by concentrated solar radiation to generate carbon dioxide
- a system suitable for carrying out the above-mentioned method.

2. claims: 14-26, 41-50(completely); 52, 53(partially)

The problem to be solved by the second invention is to provide:

- a method for producing a carbon-based product comprising in a first step producing carbon dioxide by thermal decomposition, thermal dehydration, or desorption of a carbon dioxide source.

- a bioreactor plant and a bioreactor system suitable for carrying out the above-mentioned method.

(It is noted that independent claims 14, 41 and 48 do not refer to the use of solar energy)

3. claim: 51

The problem solved by the third invention is to provide a method for obtaining carbon credits, comprising a step of thermally decomposing a carbonate or thermally dehydrating a bicarbonate to produce carbon dioxide.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/041272

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.:
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:
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 additional 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 fees, this Authority did not invite payment of additional fees.
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.:

1-13, 27-40, 54-67(completely); 52, 53(partially)

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.