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12/630,577 3 December 2009 (03.12.2009) US(71) Applicant (for all designated States except US): **BP CORPORATION NORTH AMERICA INC.** [US/US];
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CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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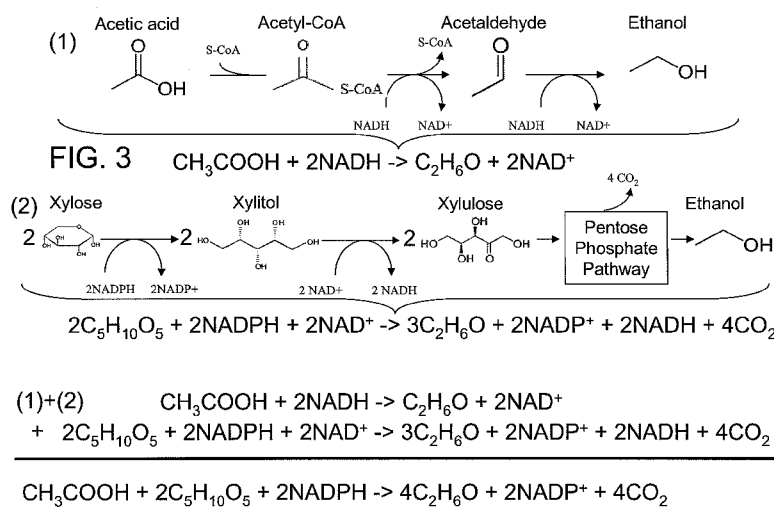
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(54) Title: METHODS AND APPARATUSES FOR PRODUCING RENEWABLE MATERIALS FROM INHIBITING COMPOUNDS



(57) Abstract: Renewable materials made from inhibiting compounds. A method includes the step of consuming a fermentation inhibiting compound with a biological organism, and the step of producing a renewable material with the biological organism from at least a portion of the fermentation inhibiting compound. The methods may include a net balance of cofactor production and consumption.

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2010/057637

A. CLASSIFICATION OF SUBJECT MATTER

INV. C12P7/06

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)

C12N C12P

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 practical, search terms used)

EPO-Internal, EMBASE, BIOSIS, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2008/048513 A2 (ROWAN UNIVERSITY [US]; LEFEBVRE BRIAN GERALD [US]; SAVELSKI MARIANO JA) 24 April 2008 (2008-04-24) page 5, last paragraph - page 6, paragraph 1 page 6, paragraph 3 page 10, paragraph 4 - page 27, paragraph 4 ----- -/--	1,4-6, 13,14, 16-18



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 document 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

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2010/057637

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.:

1-18(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.

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2010/057637

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	LEWIS LIU Z ET AL: "Multiple gene-mediated NAD(P)H-dependent aldehyde reduction is a mechanism of in situ detoxification of furfural and 5-hydroxymethylfurfural by <i>Saccharomyces cerevisiae</i> ", APPLIED MICROBIOLOGY AND BIOTECHNOLOGY, vol. 81, no. 4, December 2008 (2008-12), pages 743-753, XP002634448, ISSN: 0175-7598, DOI: 10.1007/S00253-008-1702-0 abstract page 749, right-hand column, paragraph 2 - page 751, right-hand column, paragraph 1; figure 5	1,4-6, 10-12, 14-18
X	----- ZALDIVAR J ET AL: "Effect of organic acids on the growth and fermentation of ethanologenic <i>Escherichia coli</i> LY01", APPLIED MICROBIOLOGY AND BIOTECHNOLOGY, vol. 66, no. 4, 1999, pages 203-210, XP002634449, ISSN: 0006-3592, DOI: 10.1007/S00253-008-1702-0	1,3-6,9, 12-14,18
Y	abstract page 205, left-hand column, last paragraph - page 209, left-hand column, paragraph 2; figures 1-4; tables I-IV	1-18
Y	----- GONZALEZ RAMON ET AL: "Gene array-based identification of changes that contribute to ethanol tolerance in ethanologenic <i>Escherichia coli</i> : Comparison of K011 (parent) to LY01 (resistant mutant).", BIOTECHNOLOGY PROGRESS, vol. 19, no. 2, March 2003 (2003-03), pages 612-623, XP002634628, ISSN: 8756-7938 abstract page 617, right-hand column, last paragraph - page 618, right-hand column; figure 3; table 3	1-18
X	----- VILLA G P ET AL: "Microbial transformation of furfural to furfuryl alcohol by <i>Saccharomyces cerevisiae</i> ", ACTA BIOTECHNOLOGICA, vol. 12, no. 6, 1992, pages 509-512, XP002634450, ISSN: 0138-4988	1
Y	page 510, paragraph 4 - page 511, paragraph 1; figures 1,2; tables 1,2 ----- -/--	1-18

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2010/057637

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JOACHIMSTHAL EVA ET AL: "A mutant of Zymomonas mobilis ZM4 capable of ethanol production from glucose in the presence of high acetate concentrations", BIOTECHNOLOGY LETTERS, vol. 20, no. 2, 1 February 1998 (1998-02-01), pages 137-142, XP002514186, ISSN: 0141-5492, DOI: :10.1023/A:1005320306410	1
Y	page 137, left-hand column, last paragraph - right-hand column, paragraph 2 page 139, left-hand column, paragraph 3 - page 141, right-hand column, paragraph 3; figure 1; table 4	1-18
X	----- LAWFORD H G ET AL: "The effect of acetic acid on fuel ethanol production by Zymomonas", APPLIED BIOCHEMISTRY AND BIOTECHNOLOGY, vol. 39-40, no. 1, September 1993 (1993-09), pages 687-699, XP008135991, ISSN: 0273-2289	1
Y	abstract page 690, paragraph 4 - page 694, paragraph 1; figures 1-7; table 1 page 695, last paragraph - page 696, paragraph 1 page 696, last paragraph - page 697, last paragraph	1-18
X	----- VEGA J L ET AL: "IMPROVED ETHANOL PRODUCTION BY S. CEREVISIAE WITH ORGANIC ACID ADDITION", BIOTECHNOLOGY AND BIOENGINEERING SYMPOSIUM, NEW YORK, NY, US, no. 17, 1 January 1986 (1986-01-01), pages 401-412, XP008060110, ISSN: 0572-6565	1
Y	page 402, last paragraph - page 403, paragraph 3 page 407, paragraph 2; figures 4,5 page 410, paragraph 2 - page 411, paragraph 1	1-18
A	----- WO 03/054155 A2 (SQUIBB BRISTOL MYERS CO [US]; GOLDBERG STEVEN L [US]; CINO PAUL M [US]) 3 July 2003 (2003-07-03) page 1, lines 5-9 page 28, lines 15-21 page 47, line 6 - page 49, line 11 ----- -/--	1-18

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2010/057637

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	LEE S -E ET AL: "Proteomic examination of <i>Ralstonia eutropha</i> in cellular responses to formic acid", PROTEOMICS, vol. 6, no. 15, August 2006 (2006-08), pages 4259-4268, XP002634453, ISSN: 1615-9853 abstract page 4259, left-hand column, paragraph 1 - page 4260, left-hand column, paragraph 3 page 4261, left-hand column, paragraph 1 page 4261, right-hand column, paragraph 1 - page 4262, right-hand column, paragraph 1 page 4265, right-hand column, paragraph 2-3 page 4267, left-hand column, paragraph 2 -----	1-18
A	KIRKPATRICK C ET AL: "Acetate and formate stress: opposite-responses in the proteome of <i>Escherichia coli</i>", JOURNAL OF BACTERIOLOGY, vol. 183, no. 21, 1 November 2001 (2001-11-01), pages 6466-6477, XP003009622, AMERICAN SOCIETY FOR MICROBIOLOGY, WASHINGTON, DC; US ISSN: 0021-9193, DOI: 10.1128/JB.183.21.6466-6477.2001 abstract page 6466, left-hand column, paragraph 2 - page 6467, left-hand column, paragraph 4; figure 1 page 6470, right-hand column, paragraph 4 - page 6474, right-hand column, paragraph 2 page 6475, left-hand column, paragraph 2-3 -----	1-18
A	ALMEIDA J R M ET AL: "Increased tolerance and conversion of inhibitors in lignocellulosic hydrolysates by <i>Saccharomyces cerevisiae</i>", JOURNAL OF CHEMICAL TECHNOLOGY AND BIOTECHNOLOGY,, vol. 82, no. 4, 1 April 2007 (2007-04-01), pages 340-349, XP002542370, BLACKWELL SCIENTIFIC PUBLICATIONS. OXFORD, GB ISSN: 0268-2575, DOI: 10.1002/JCTB.1676 abstract page 344, left-hand column, last paragraph - page 345, left-hand column, paragraph 1; figure 2; table 1 ----- -/--	1-18

INTERNATIONAL SEARCH REPORT

International application No

PCT/US2010/057637

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	MILLS TIRZAH Y ET AL: "Cellulosic hydrolysate toxicity and tolerance mechanisms in Escherichia coli.", BIOTECHNOLOGY FOR BIOFUELS, vol. 2, 26, October 2009 (2009-10), pages 1-11, XP002634452, ISSN: 1754-6834 page 2, right-hand column, paragraph 2 - page 5, left-hand column, paragraph 2 -----	1-18
X,P	HASUNUMA TOMOHISA ET AL: "Metabolic pathway engineering based on metabolomics confers acetic and formic acid tolerance to a recombinant xylose-fermenting strain of Saccharomyces cerevisiae", MICROBIAL CELL FACTORIES, vol. 10, January 2011 (2011-01), pages 1-13, XP002634455, DOI: 10.1186/1475-2859-10-2 abstract -----	1-18
X,P	WO 2009/154624 A1 (UNIV OHIO STATE [US]; YANG SHANG-TIAN [US]) 23 December 2009 (2009-12-23) the whole document -----	1-18

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2010/057637

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2008048513 A2	24-04-2008	US 2009061501 A1 US 2009053793 A1 US 2008090283 A1	05-03-2009 26-02-2009 17-04-2008
WO 03054155 A2	03-07-2003	AU 2002359721 A1 EP 1463807 A2	09-07-2003 06-10-2004
WO 2009154624 A1	23-12-2009	AU 2008358063 A1 CA 2728262 A1 CN 102099483 A EP 2304042 A1 US 2011151529 A1	23-12-2009 23-12-2009 15-06-2011 06-04-2011 23-06-2011

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-18(partially)

A method of producing renewable materials, the method comprising: consuming a fermentation inhibiting compound which comprises formic acid with a biological organism; and producing a renewable material with the biological organism from a least a portion of the formic acid

2. claims: 1-18(partially)

A method of producing renewable materials, the method comprising: consuming a fermentation inhibiting compound which comprises acetic acid with a biological organism; and producing a renewable material with the biological organism from a least a portion of the acetic acid

3. claims: 1-18(partially)

A method of producing renewable materials, the method comprising: consuming a fermentation inhibiting compound which comprises butyric acid with a biological organism; and producing a renewable material with the biological organism from a least a portion of the butyric acid

4. claims: 1-18(partially)

A method of producing renewable materials, the method comprising: consuming a fermentation inhibiting compound which comprises lactic acid with a biological organism; and producing a renewable material with the biological organism from a least a portion of the lactic acid

5. claims: 1-18(partially)

A method of producing renewable materials, the method comprising: consuming a fermentation inhibiting compound which comprises pyruvic acid, consuming the pyruvic acid with a biological organism; and producing a renewable material with the biological organism from a least a portion of the pyruvic acid

6. claims: 1-18(partially)

A method of producing renewable materials, the method comprising: consuming a fermentation inhibiting compound which comprises propionic acid with a biological organism; and producing a renewable material with the biological

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

organism from a least a portion of the propionic acid

7. claims: 1-18(partially)

A method of producing renewable materials, the method comprising: consuming a fermentation inhibiting compound which comprises furfural with a biological organism; and producing a renewable material with the biological organism from a least a portion of the furfural

8. claims: 1-18(partially)

A method of producing renewable materials, the method comprising: consuming a fermentation inhibiting compound which comprises hydroxymethylfurfural with a biological organism; and producing a renewable material with the biological organism from a least a portion of the hydroxymethylfurfural

9. claims: 1-18(partially)

A method of producing renewable materials, the method comprising: consuming a fermentation inhibiting compound which comprises phenylmethylethers with a biological organism; and producing a renewable material with the biological organism from a least a portion of the phenylmethylethers

10. claims: 19-33

A method of producing renewable materials, the method comprising: consuming two aldose molecules with a biological organism to produce two polyol molecules; consuming the two polyol molecules with the biological organism to produce two ketose molecules and two reduced cofactor molecules; consuming the two ketose molecules with the biological organism to produce a renewable material; consuming an organic acid molecule and one reduced cofactor molecule with the biological organism to produce an aldehyde molecule and an oxidized cofactor molecule; and consuming the aldehyde molecule and one reduced cofactor molecule with the biological organism to produce a same or a different renewable material molecule than formed from the two ketose molecules and an oxidized cofactor molecule.
