

(51) International Patent Classification:
C12P 5/00 (2006.01)(21) International Application Number:
PCT/US2010/058959(22) International Filing Date:
3 December 2010 (03.12.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/266,610 4 December 2009 (04.12.2009) US
61/328,368 27 April 2010 (27.04.2010) US

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21202-1636 (US).(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,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.(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG,
ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ,
TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK,
EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,
LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, ML, MR, NE, SN, TD, TG).

Published:

- 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))

[Continued on next page]

(54) Title: PROCESS FOR PRODUCING FERMENTATION PRODUCTS AND FERMENTATION MEDIUM COMPOSITIONS THEREFOR

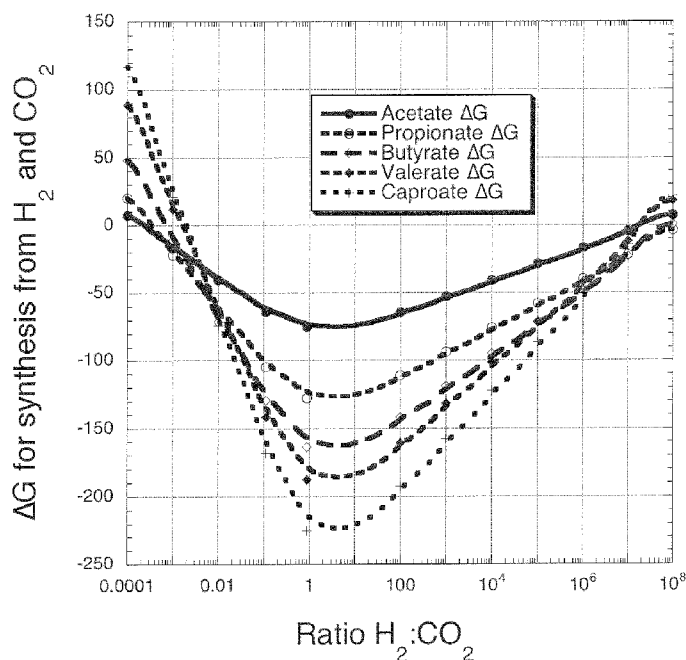


Figure 1

(57) Abstract: Fermentation products (e.g., bio-products such as hydrocarbons and other organic compounds) are produced from biomass or gases through digestion and fermentation under conditions that thermodynamically favor production of the fermentation products.



(88) Date of publication of the international search report:
11 August 2011

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 10/58959

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - C12P 5/00 (2011.01)

USPC - 435/166

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)

IPC(8)- C12P 5/00 (2011.01);

USPC- 435/166

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

USPC- 435/167;

Patents and NPL (classification, keyword; search terms below)

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

PubWest (US Pat, PubMed, EPO, JPO), GoogleScholar, FreePatentsOnline;

search terms: ferment, digest, synthesis, gas, syngas, alkane, biomass, biofuel, carboxylic acid, volatile fatty acid, produce, production, convert, synthesis, ethane, propane, butane, pentane, hexane, heptane, octane

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y --- A	WO 2008/103480-A2 (PETERSON et al.) 28 August 2008 (28.08.2008), pg 3-8, 11	1, 2, 6-10, 14-16 ----- 4, 5, 12, 13, 17-25 ----- 3, 11
Y --- A	WACKETT "Biomass to fuels via microbial transformations." Current Opinion in Chemical Biology [online]; April 2008 [Retrieved on 2011-03-04], Vol. 12, Iss. 2, pp. 187-193, Retrieved from the Internet: <URL: http://www.sciencedirect.com/>, pg 187, 191	17-19, 20 ----- 3, 11
Y	US 2008/0187975 A1 (KOHN) 07 August 2008 (07.08.2008), para [0086], [0103], [0128], [0133], [0141], [0195], [0199]	4, 5, 12, 13, 17, 18, 24, 25 ----- 3, 11
Y	PIND et al. "Dynamics of the anaerobic process: Effects of volatile fatty acids." Biotechnology and Bioengineering [online], 30 June 2003 (30.06.2003) [Retrieved on 2011-03-04], Vol. 82, Iss. 7, pp. 791-801, Retrieved from the Internet: URL: http://onlinelibrary.wiley.com>, especially pg 791, 793	21-23
T	WEIMER "End product yields from the extraruminal fermentation of various polysaccharide, protein and nucleic acid components of biofuels feedstocks." Bioresource Technology [online], February 2011 [Retrieved on 2011-03-08], Vol. 103, Iss. 3, pp. 3254-3259, Retrived from the Internet: <URL: www.sciencedirect.com/>, especially pg 3254-3255	3, 11



Further documents are listed in the continuation of Box C.



* 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

03 March 2011 (03.03.2011)

Date of mailing of the international search report

20 JUN 2011

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450

Facsimile No. 571-273-3201

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PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 10/58959

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 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 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.:

1-25

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/US 10/58959

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/0006280 A1 (DAVID) 01 January 2009 (01.01.2009), para [0032], [0071]	1-25
Y	WO 2007/095215 A2 (BRADIN) 23 August 2007 (23.08.2007), pg 2-3	1-25
Y	CHAN et al. "Conversion of Municipal Solid Wastes to Carboxylic Acids by Thermophilic Fermentation." Applied Biochemistry and Biotechnology [online], 2003 [Retrieved on 2011-03-03], Vol. 111, No. 2, pp. 93-112, Retrieved from the Internet: <URL: http://www.springerlink.com/ >	1-25
Y	HENSTRA et al. "Microbiology of synthesis gas fermentation for biofuel production." Current Opinion in Biotechnology [online], June 2007 [Retrieved on 2011-03-03], Vol. 18, Iss. 3, pp. 200	1-25

Box No. III, Observations where unity of invention is lacking:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, Claims 1-25 directed to a method for producing at least one alkane ranging in length from 2 to 10 carbon atoms.
Group II, Claims 26-32 directed to a method for controlling a fermentation process for the production of a given fermentation product.

The inventions listed as Groups I-II 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.

The special technical feature of each Group are as follows:

Group I: specific, static, reaction conditions, including the ratio of reactant gases and pressure.

Group II: software for maintaining a reaction condition of the fermentation process at a thermodynamically favorable condition by electronically determining values for a Gibbs free energy change (ΔG) under specified reaction conditions and under alternative conditions for a plurality of chemical reactions

Group I describes static reaction conditions. Notably Group I does not require any means, static or dynamic, for determining whether the particular parameters are thermodynamically favorable or for maintaining the reaction in a thermodynamically favorable state. Group I does not require software or reliance on the Gibbs free energy equation.

Group II describes a dynamic means for determining whether a particular reaction is thermodynamically favorable and then using that determination to maintain said conditions. Group II does not require any particular static reaction condition, such as ratio of reactant gases and pressure.

Because the two groups do not share a special technical feature, there can be no unity of invention.