

(19) World Intellectual Property
Organization
International Bureau



(43) International Publication Date
20 November 2003 (20.11.2003)

PCT

(10) International Publication Number
WO 2003/096455 A3

(51) International Patent Classification⁷: **H01M 8/10**,
8/24, 8/02, 4/86, 4/88

(21) International Application Number:
PCT/US2003/014445

(22) International Filing Date: 9 May 2003 (09.05.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/379,524 9 May 2002 (09.05.2002) US
60/408,732 6 September 2002 (06.09.2002) US
60/458,116 26 March 2003 (26.03.2003) US

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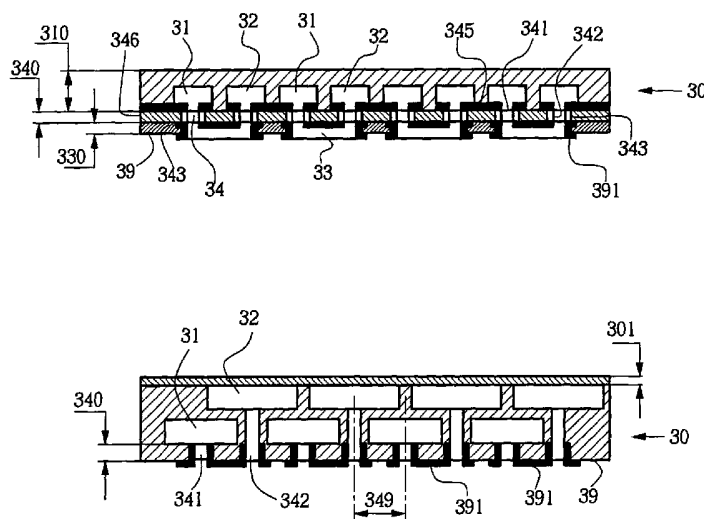
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(81) Designated States (*national*): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZM, ZW.

[Continued on next page]

(54) Title: IMPROVED FUEL CELL



(57) Abstract: A simple, inexpensive and highly efficient fuel cell has boundary structures made of a photo-sensitive material in combination with selective patterning. Printed circuit board (PCB) fabrication techniques combine boundary structures with two and three dimensional electrical flow path. Photo-sensitive material and PCB fabrication techniques are alternately or combined utilized for making micro-channel structures or micro stitch structures for substantially reducing dead zones of the diffusion layer while keeping fluid flow resistance to a minimum. The fuel cell assembly is free of mechanical clamping elements. Adhesives that may be conductively contaminated and/or fiber-reinforced provide mechanical and eventual electrical connections, and sealing within the assembly. Mechanically supporting backing layers are pre-fabricated with a natural bend defined in combination with the backing layers' elasticity to eliminate massive support plates and assist the adhesive bonding. Proton insulation between adjacent and electrically linked in-plane cell elements is provided by structural insulation within the central membrane.



(84) **Designated States (regional):** ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

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

17 November 2005

Published:

— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 03/14445

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H01M8/10 H01M8/24 H01M8/02 H01M4/86 H01M4/88

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 7 H01M

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, PAJ, 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	DE 198 23 880 A1 (MOTOROLA, INC. , SCHAUMBURG, ILL., US) 10 December 1998 (1998-12-10)	1,9
Y	column 3, line 47 - column 5, line 53; figure 4	9,12
X	US 6 051 331 A (SPEAR, JR. ET AL) 18 April 2000 (2000-04-18)	1-3,5,7, 8,16
Y	column 3, lines 12-37	9,11,31
Y	column 4, line 66 - column 8, line 44; figures 3-11	9,12
A	column 15, line 19 - column 18, line 61; figure 15	4,6
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in 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)

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"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

28 June 2005

Date of mailing of the international search report

13.09.05

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 03/14445

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 95/08851 A (BALLARD POWER SYSTEMS INC) 30 March 1995 (1995-03-30) page 13, line 31 - page 15, line 34 page 17, line 11 - page 18, line 27 page 27, line 24 - page 28, line 31; figure 7 -----	9,11,31
X	WO 00/69007 A (SANDIA CORPORATION; KLITSNER, TOM; BARRON, CAROLE, C; SYLWESTER, ALAN,) 16 November 2000 (2000-11-16) page 10, line 6 - page 13, line 2 page 13, line 23 - page 18, line 10; figures 5,6a,6b,8,11,12a,12b,15 -----	1-3,5,7, 8,12,16, 31
X	PATENT ABSTRACTS OF JAPAN vol. 1997, no. 11, 28 November 1997 (1997-11-28) & JP 09 190828 A (TOHO GAS CO LTD), 22 July 1997 (1997-07-22) abstract; figures 1-5 -----	1-3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 03/14445

Box I Observations where certain claims were found unsearchable (Continuation of item 1 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 II Observations where unity of invention is lacking (Continuation of item 2 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 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.:

1-9, 11, 12, 16, 31, 41

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-9,11,12,16,31,41

This invention concerns a fuel cell comprising a selectively patterned shaped layer, in particular on a fluid distributing separator substrate shaped to comprise a duly designed pattern of flow channels for the distribution of fluid reactants to a cell's electrode, in which the special technical feature is related to the formation of the said pattern on a suitable substrate by employing an irradiation cured photo-sensitive material.

2. claim: 10

This invention concerns a fuel cell comprising a selectively patterned shaped layer, in particular on a fluid distributing separator substrate, formed by an irradiation cured photo-sensitive material, wherein the special technical feature resides in the nature of the substrate material selected to be an epoxy material rather than a semi-rigid polyimide falling under the ambit of invention 1.

3. claims: 13-15, 18-20

This invention concerns a fuel cell comprising a selectively patterned shaped layer, in particular on a fluid distributing separator substrate, formed by an irradiation cured photo-sensitive material, wherein the special technical feature resides in the formation of a sort of channel hyper-structure by forming an assembly of micro-channels onto a selectively pre-patterned structure of flow channels, in particular by adhering a layer of a material comprising the said micro-channels, e.g. a perforated metal foil, onto a patterned substrate.

4. claims: 17, 32-35

This invention concerns a fuel cell comprising a diffuser on a selectively patterned shaped layer, in particular on a fluid distributing separator substrate, formed by an irradiation cured photo-sensitive material, wherein the special technical feature resides in bonding the diffuser to the patterned substrate, especially by using a conductive adhesive.

5. claims: 21-30, 38-40, 42-61, 64, 65

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This invention concerns a fuel cell comprising a diffuser on a selectively patterned shaped layer, in particular on a fluid distributing separator substrate, formed by an irradiation cured photo-sensitive material, wherein the special technical feature resides in the design and arrangement of manifolds provided for supplying and removing the fluids to and from the fuel cells.

6. claims: 36, 37

This invention concerns a fuel cell comprising a diffuser on a selectively patterned shaped layer, in particular on a fluid distributing separator substrate, formed by an irradiation cured photo-sensitive material, wherein the special technical feature resides in allowing for a system of holes through an appropriate structure (typically an apertured conductive board) establishing a pattern of fluid communication between the fluid supply channels of the fluid distributor and the diffuser on one hand and the exhaust removal channels of the fluid distributor and the diffuser on other hand such that the respective holes are arranged in an interlaced fashion.

7. claim: 62

This invention concerns a fuel cell comprising a selectively patterned shaped layer, in particular on a fluid distributing separator substrate, formed by an irradiation cured photo-sensitive material, wherein the special technical feature resides in providing a shaped layer in form of a backing layer having a natural curvature, which, as a result of its curved shape is capable of elastically exerting a compressive force, especially onto non adhered areas of a neighbouring cell component, the respective neighbouring parts so remaining into tight mutual contact.

8. claim: 63

This invention concerns a fuel cell comprising a selectively patterned shaped layer, in particular on a fluid distributing separator substrate, formed by an irradiation cured photo-sensitive material, wherein the special technical feature resides in providing a shaped layer having a proton insulation structure in an assembly involving a lateral arrangement of fuel cells as depicted in figures 16 and 17 of the application.

9. claims: 64-68

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This invention concerns a fuel cell comprising a diffuser on a selectively patterned shaped layer, in particular on a fluid distributing separator substrate, formed by an irradiation cured photo-sensitive material, wherein the special technical feature resides in providing a board structure having a via hole with an electrically conductive wall for conducting a fluid across the said board structure, the said board structure not necessarily being a metallic foil, in particular a foil adhered to a patterned substrate as the case may be in invention 3.

10. claims: 69-82

This invention concerns a fuel cell in general, which is not necessarily subject to the limitations imposed in the fuel cells according to inventions 1 to 9, wherein the special technical feature resides in providing two (not further specified) cell components bonded with a fibre-reinforced adhesive which is not any closer defined.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 03/14445

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