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(71) Applicant: **E.I. DU PONT DE NEMOURS AND COMPANY** [US/US]; 1007 Market Street, Wilmington, DE 19898 (US).

(72) Inventor: **DAI, Hongli**; 3705 Haley Court, Wilmington, DE 19808 (US).

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(74) Agent: **HENDRICKSON, John, S.**; E.I. Dupont de Nemours and Company, Legal Patent Records Center, 4417 Lancaster Pike, Wilmington, DE 19805 (US).

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.

(54) Title: ADDITIVE FOR DIRECT METHANOL FUEL CELLS

(57) Abstract: Addition of Lewis bases to the fuel of direct methanol fuel cells reduces methanol and water transport through the fuel cell membrane. The Lewis bases employed have a pKa in their protonated form greater than the pKa of the acid groups of the fuel cell membrane.



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INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/18605

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01M8/10 H01M8/04

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 C08J

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)

EP0-Internal, CHEM ABS Data, PAJ, WPI Data, INSPEC, COMPENDEX

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	PATENT ABSTRACTS OF JAPAN vol. 2002, no. 08, 5 August 2002 (2002-08-05) -& JP 2002 105220 A (TOSHIBA CORP), 10 April 2002 (2002-04-10) abstract	1-5, 23-25, 30-33
P,X	-& US 2002/090541 A1 (HOBSON LOIS ET AL) 11 July 2002 (2002-07-11) page 1, paragraph 8 - paragraph 9 page 2, paragraph 31 - paragraph 33 page 3, paragraph 37 - paragraph 39 page 5, paragraph 61; table 1 ----- -/--	1-5,7,8, 23-25, 30-33

☒ 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)

"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

25 January 2005

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Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Gamez, A

INTERNATIONAL SEARCH REPORT

International Application No

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	SCHECHTER A ET AL: "Imidazole and 1-methyl imidazole in phosphoric acid doped polybenzimidazole, electrolyte for fuel cells" SOLID STATE IONICS, NORTH HOLLAND PUB. COMPANY. AMSTERDAM, NL, vol. 147, no. 1-2, 1 March 2002 (2002-03-01), pages 181-187, XP004342325 ISSN: 0167-2738 the whole document	1,2,5, 23,24, 30-33
X	----- YANG C ET AL: "Approaches and technical challenges to high temperature operation of proton exchange membrane fuel cells" JOURNAL OF POWER SOURCES, ELSEVIER SEQUOIA S.A. LAUSANNE, CH, vol. 103, no. 1, 30 December 2001 (2001-12-30), pages 1-9, XP004323990 ISSN: 0378-7753 page 3, left-hand column, paragraph 3 page 5, left-hand column, paragraph 2 - right-hand column, paragraph 2	1-5, 23-25, 30-33
X	----- SUN J ET AL: "Acid-Organic base swollen polymer membranes" ELECTROCHIMICA ACTA, ELSEVIER SCIENCE PUBLISHERS, BARKING, GB, vol. 46, no. 10-11, 15 March 2001 (2001-03-15), pages 1703-1708, XP004231586 ISSN: 0013-4686 the whole document	1-5, 23-25, 30-33
A	----- IWAKURA, CHIAKI AND AL: "Methanol fuel cell. IX. Inhibition of the anodic oxidation of methanol by nitrogen-containing compounds" DENKI KAGAKU OYOBI KOGYO BUTSURI KAGAKU, vol. 37, no. 1, 1969, pages 58-62, XP008041895 the whole document	1-33
A	----- DATABASE CA [Online] CHEMICAL ABSTRACTS SERVICE, COLUMBUS, OHIO, US; 1968, TAMURA, HIDEO ET AL: "Inhibition effect of pyridine homologs on anodic oxidation of methanol" XP002314978 retrieved from STN Database accession no. 1968:512838 <u>abstract</u>	1-33
	-/-	

INTERNATIONAL SEARCH REPORT

International Application No
PCT/US 03/18605

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	-& KOGYO KAGAKU ZASSHI (1968), 71(8), 1141-3 CODEN: KGKZA7; ISSN: 0368-5462, 1968, XP008041897 ----- ESTEFAN R. M.: "Evaluation of possible methanol fuel additives for reducing engine wear and/or corrosion" SOCIETY OF AUTOMOTIVE ENGINEERS SP-840, 1990, pages 17-39, XP008041894 the whole document -----	1-33

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 03/18605

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:
see FURTHER INFORMATION sheet PCT/ISA/210
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.:

1-33

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: 1-33

A direct methanol fuel cell comprising anode and cathode, a membrane comprising ionomer having acid groups separating said anode and cathode, and a fuel supply for supplying liquid methanol fuel to said anode, said membrane comprising at least one Lewis base selected from the group of claim 5. A direct methanol fuel cell where the fuel supply supplying methanol fuel comprises at least one Lewis base selected from the group of claim 15, is claimed. The process of operating the direct methanol fuel cell is also claimed

2. claims: 34-45

A fuel mixture comprising methanol and at least one Lewis base. Also claimed the container of a fuel mixture comprised of methanol and at least one Lewis base.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box I.2

Claims Nos.: -

Present claims 1 to 4, 7 to 14, 17 to 33 relate to a Lewis base used in a direct methanol fuel cell (DMFC) and the process of operating the DMFC using a Lewis base defined by reference to a desirable characteristic or property, namely the pKa of the protonated form of the Lewis base greater than the pKa of at least some of the acid groups (sulfonic and carboxylic acid groups) of the membrane used in the fuel cell.

The claims cover all Lewis Base used in the DMFC and the process of operating the DMFC comprising the Lewis base having this characteristic or property, whereas the application provides support within the meaning of Article 6 PCT and/or disclosure within the meaning of Article 5 PCT for only a very limited number of such Lewis bas. In the present case, the claims so lack support, and the application so lacks disclosure, that a meaningful search over the whole of the claimed scope is impossible. Independent of the above reasoning, the claims also lack clarity (Article 6 PCT). An attempt is made to define the product/compound/method/apparatus by reference to a result to be achieved. Again, this lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible. Consequently, the search has been carried out for those parts of the claims which appear to be clear, supported and disclosed, namely those parts relating to the Lewis base claimed in claim 5, page 7 in the description and in the examples.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 03/18605

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
JP 2002105220	A	10-04-2002	US	2002090541 A1		11-07-2002

US 2002090541	A1	11-07-2002	JP	2002105220 A		10-04-2002
