

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
25 May 2001 (25.05.2001)

PCT

(10) International Publication Number
WO 01/37357 A3

(51) International Patent Classification⁷: **H01M 8/10**

(21) International Application Number: PCT/US00/31823

(22) International Filing Date:
17 November 2000 (17.11.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/166,372 17 November 1999 (17.11.1999) US
60/189,205 14 March 2000 (14.03.2000) US
60/200,866 2 May 2000 (02.05.2000) US

(71) Applicant (for all designated States except US): **NEAH POWER SYSTEMS, INC.** [US/US]; 343 North 84th Street, Seattle, WA 98103 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **OHLSEN, Leroy, J.** [US/US]; 343 N. 84th Street, Seattle, WA 98103 (US). **COOKE, Aaron, M.** [US/US]; 1617 N 48th Street, Seattle, WA 98103 (US). **MALLARI, Jonathan, C.** [US/US];

1712 S. Dawson Street, Seattle, WA 98108 (US). **CHAN, Chung, M.** [US/US]; #B-102, 16227 Northrup Way, Bellevue, WA 98008 (US). **RICE, Gordon, L.** [CA/US]; #444, 5829 N.E. 75th Street, Seattle, WA 98115 (US). **NELSON, Craig, E.** [US/US]; 2205 E. Howe Street, Seattle, WA 98112 (US).

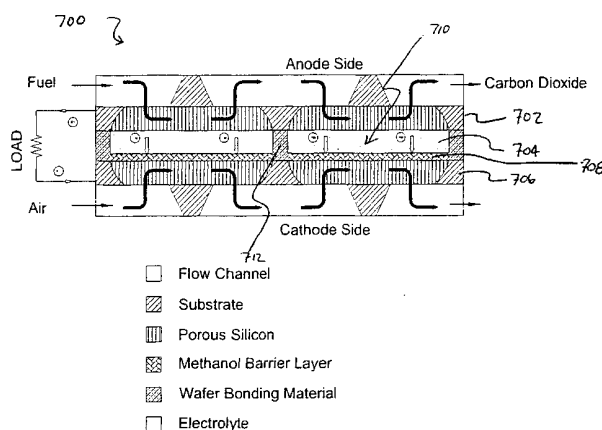
(74) Agents: **LOOP, Thomas, E.** et al.; Seed Intellectual Property Law Group PLLC, Suite 6300, 701 Fifth Avenue, Seattle, WA 98104-7092 (US).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CR, CU, CZ, DE, DK, DM, DZ, 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, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

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

[Continued on next page]

(54) Title: FUEL CELLS HAVING SILICON SUBSTRATES AND/OR SOL-GEL DERIVED SUPPORT STRUCTURES



(57) Abstract: Fuels cells, electrode assemblies, and electrodes that comprise silicon and/or sol-gel derived support structures, as well as to methods relating thereto, are disclosed herein. In one embodiment, the invention is directed to an electrode assembly adapted for use with a fuel cell comprises: an anode derived from a first planar silicon substrate; an electrolyte; a cathode derived from a second planar silicon substrate; wherein the anode and the cathode are parallel to each other and separated by an interstitial region comprising the electrolyte. In another embodiment, the invention is directed to electrode adapted for use with a fuel cell, wherein the electrode comprises a silicon substrate that functions as a current conductor, wherein the silicon substrate has a plurality of pores that define pore surfaces, wherein at least a portion of the pore surfaces have a catalyst thereon, wherein the catalyst is derived from one or more metallic precursors chemisorbed onto at least the pore surfaces. In another embodiment, an electrode comprising a sol-gel derived support structure that functions as a current conductor, wherein the sol-gel derived support structure has a plurality of pores that define pore surfaces, wherein at least a portion of the pore surfaces have a catalyst thereon, wherein the catalyst is derived from one or more metallic precursors chemisorbed onto at least the pore surfaces is disclosed.



Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments

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.

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

20 June 2002

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/31823

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01M8/10

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)

WPI Data, PAJ, EPO-Internal, COMPENDEX, INSPEC, 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.
P,X	WO 00 69007 A (RYBA GAIL N ; SANDIA CORP (US); BARRON CAROLE C (US); HECHT ANDREW) 16 November 2000 (2000-11-16) the whole document ---	1,2,8,9, 16,32, 33,46,65
P,X	WO 00 45457 A (UNIV CALIFORNIA) 3 August 2000 (2000-08-03) the whole document --- -/--	1,32,65

☒ 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

12 April 2002

Date of mailing of the international search report

24/04/2002

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

Riba Vilanova, M

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 00/31823

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	<p>DATABASE SCISEARCH 'Online! 2000:565290, September 2000 (2000-09) XP002196002 abstract & KELLEY S C, DELUGA G A, SMYRL W H: "A minituaire methanol/air polymer electrolyte fuel cell" ELECTROCHEMICAL AND SOLID STATE LETTERS, vol. 3, no. 9, - September 2000 (2000-09) pages 407-409,</p> <p>---</p>	1,32,65
P,X	<p>DATABASE WPI Section EI, Week 200063 Derwent Publications Ltd., London, GB; Class X16, AN 2000-654333 XP002196003 & RU 2 148 878 C (UNIV MOSC ELTRN TECHN TECH), 10 May 2000 (2000-05-10) abstract</p> <p>---</p>	1,32,65
X	<p>US 3 506 561 A (CAESAR PHILIP D) 14 April 1970 (1970-04-14) figures claims</p> <p>---</p>	64
X	<p>DE 197 57 320 A (KERNFORSCHUNGSANLAGE JUELICH) 1 July 1999 (1999-07-01) column 3, line 66 -column 4, line 25 claims</p> <p>---</p>	64
A	<p>US 5 262 021 A (LEHMANN VOLKER ET AL) 16 November 1993 (1993-11-16) column 1, line 6 - line 13 column 1, line 32 - line 54</p> <p>---</p>	1,32,65
A	<p>KENDALL D L: "A NEW THEORY FOR THE ANISOTROPIC ETCHING OF SILICON AND SOME UNDERDEVELOPED CHEMICAL MICROMACHINING CONCEPTS" JOURNAL OF VACUUM SCIENCE AND TECHNOLOGY: PART A, AMERICAN INSTITUTE OF PHYSICS. NEW YORK, US, vol. 8, no. 4, 1 July 1990 (1990-07-01), pages 3598-3605, XP000223116 ISSN: 0734-2101 abstract page 3604, column 1, line 52 -column 2, line 1</p> <p>---</p>	1,32
A	<p>WO 95 13869 A (EXXON RESEARCH ENGINEERING CO) 26 May 1995 (1995-05-26) examples claims</p> <p>-----</p>	64

INTERNATIONAL SEARCH REPORT

information on patent family members

International Application No

PCT/US 00/31823

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 0069007	A	16-11-2000	AU 4993200 A EP 1190460 A1 WO 0069007 A1	21-11-2000 27-03-2002 16-11-2000
WO 0045457	A	03-08-2000	AU 4970300 A WO 0045457 A2	18-08-2000 03-08-2000
RU 2148878	C	10-05-2000	RU 2148878 C1	10-05-2000
US 3506561	A	14-04-1970	US 3377265 A	09-04-1968
DE 19757320	A	01-07-1999	DE 19757320 A1	01-07-1999
US 5262021	A	16-11-1993	DE 4202454 C1 DE 59202728 D1 EP 0553465 A1 JP 3190759 B2 JP 5315316 A	29-07-1993 03-08-1995 04-08-1993 23-07-2001 26-11-1993
WO 9513869	A	26-05-1995	WO 9513869 A1 US 5919725 A US 5866739 A	26-05-1995 06-07-1999 02-02-1999