

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
24 January 2002 (24.01.2002)

PCT

(10) International Publication Number
WO 02/07191 A3

- (51) International Patent Classification⁷: H01L 21/316, C01B 39/00
- (21) International Application Number: PCT/US01/21439
- (22) International Filing Date: 6 July 2001 (06.07.2001)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
60/218,102 13 July 2000 (13.07.2000) US
60/288,626 3 May 2001 (03.05.2001) US
- (71) Applicants (for all designated States except US): THE REGENTS OF THE UNIVERSTY OF CALIFORNIA [US/US]; 1111 Franklin Street, 5th Floor, Oakland, CA 94607 (US). WANG, Huanting [CN/US]; Apartment 12, 160 West Big Springs Road, Riverside, CA 92507 (US).
- (72) Inventors; and
- (75) Inventors/Applicants (for US only): YAN, Yushan [CN/US]; 237 Gracefield Way, Riverside, CA 92506 (US). WANG, Zhengbao [CN/US]; 828 Blaine Street, Riverside, CA 92507 (US).
- (74) Agents: ACKERMAN, Joel, G. et al.; Townsend and Townsend and Crew LLP, Two Embarcadero Center, Eighth Floor, San Francisco, CA 94111 (US).
- (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, 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).
- 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
- (88) Date of publication of the international search report: 18 April 2002
- 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.



WO 02/07191 A3

(54) Title: SILICA ZEOLITE LOW-K DIELECTRIC THIN FILMS

(57) Abstract: Thin films for use as dielectric in semiconductor and other devices are prepared from silica zeolites, preferably pure silica zeolites such as pure-silica MFI. The films have low k values, generally below about 2.7, ranging downwards to k values below 2.2. The films have relatively uniform pore distribution, good mechanical strength and adhesion, are relatively little affected by moisture, and are thermally stable. The films may be produced from a starting zeolite synthesis or precursor composition containing a silica source and an organic zeolite structure-directing agent such as a quaternary ammonium hydroxide. In one process the films are produced from the synthesis composition by in-situ crystallization on a substrate. In another process, the films are produced by spin-coating, either through production of a suspension of zeolite crystals followed by redispersion by in-situ crystallization or by using an excess of the alkanol produced in preparing the synthesis composition. Zeolite films having patterned surfaces may also be produced.

INTERNATIONAL SEARCH REPORT

International Application No

PC1/US 01/21439

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H01L21/316 C01B39/00

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 H01L C01B

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, INSPEC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 99 15280 A (SANDIA CORP) 1 April 1999 (1999-04-01)	1, 2, 9, 11, 12, 14-22
Y	the whole document	6, 8, 28-33
X	---	
X	WO 00 39028 A (BATTELLE MEMORIAL INSTITUTE ; BIRNBAUM JEROME C (US); COYLE CHRISTO) 6 July 2000 (2000-07-06)	1, 2, 14, 16, 18
Y	the whole document	6, 8

	-/--	

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.
- *Z* document member of the same patent family

Date of the actual completion of the international search

30 January 2002

Date of mailing of the international search report

13/02/2002

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

Pusch, C

INTERNATIONAL SEARCH REPORT

International Application No

PC1/US 01/21439

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT		
Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	ZHAO D ET AL: "CONTINUOUS MESOPOROUS SILICA FILMS WITH HIGHLY ORDERED LARGE PORE STRUCTURES" ADVANCED MATERIALS, VCH VERLAGSGESELLSCHAFT, WEINHEIM, DE, vol. 10, no. 16, 10 November 1998 (1998-11-10), pages 1380-1385, XP000785447 ISSN: 0935-9648 cited in the application page 1385, column 1, line 4 - line 11	1,2
Y	---	6,8, 28-33
X	DEN EXTER ET AL.: "Stability of oriented silicalite-1 films in view of zeolite membrane preparation" ZEOLITES, vol. 19, 17 April 1997 (1997-04-17), pages 13-20, XP001026983 New York cited in the application page 13, column 2, line 30 -page 14, column 1, line 30	3,5, 14-17, 19-22
Y	page 19, column 2, line 59 -page 20, column 1, line 12	6,8, 28-33
Y	---	28-33
Y	JANSEN J C ET AL: "ORIENTED GROWTH OF SILICA MOLECULAR SIEVE CRYSTALS AS SUPPORTED FILMS" JOURNAL OF CRYSTAL GROWTH, NORTH-HOLLAND PUBLISHING CO. AMSTERDAM, NL, vol. 128, no. PT 2 1 / 4, 1 March 1993 (1993-03-01), pages 1150-1156, XP000349515 ISSN: 0022-0248 cited in the application page 13 -page 19	28-33
Y	US 5 393 409 A (JAN DENG-YANG ET AL) 28 February 1995 (1995-02-28) column 10, line 16 - line 41; figures 1,2	28-32
X,P	---	6-14,16, 17
	WANG H., WANG Z., YAN Y.: "Colloidal Suspensions of Template-Removed Zeolite Nanocrystals" CHEM. COMMUN, 2000, pages 2333-2334, XP001055158 cited in the application page 2333, column 2, line 5 - line 17	

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 01/21439

Patent document cited in search report	A	Publication date	Patent family member(s)	Publication date
WO 9915280	A	01-04-1999	US 5858457 A	12-01-1999
			AU 9670398 A	12-04-1999
			EP 1028817 A1	23-08-2000
			JP 2001517595 T	09-10-2001
			TW 434186 B	16-05-2001
			WO 9915280 A1	01-04-1999
WO 0039028	A	06-07-2000	US 6329017 B1	11-12-2001
			AU 2379900 A	31-07-2000
			EP 1144310 A1	17-10-2001
			WO 0039028 A1	06-07-2000
US 5393409	A	28-02-1995	NONE	