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13/443,533 10 April 2012 (10.04.2012) US(71) Applicant (for all designated States except US): **BREWER SCIENCE INC.** [US/US]; 2401 Brewer Drive, Rolla, Missouri 65401 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **LIN, Qin** [CN/US]; 2166 Tenbrink Drive, Rolla, Missouri 65401 (US). **WANG, Yubao** [CN/US]; 10215 Summerfield Drive, Rolla, Missouri 65401 (US). **FLAIM, Tony D.** [US/US]; 16710 N. Highway 68, St. James, Missouri 65559 (US).(74) Agent: **BORNMAN, Tracy, L.**; Hovey Williams LLP, 10801 Mastin Blvd. Suite 1000, 84 Corporate Woods, Overland Park, KS 66210 (US).

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2 May 2013

(54) Title: METHOD OF MAKING RADIATION-SENSITIVE SOL-GEL MATERIALS

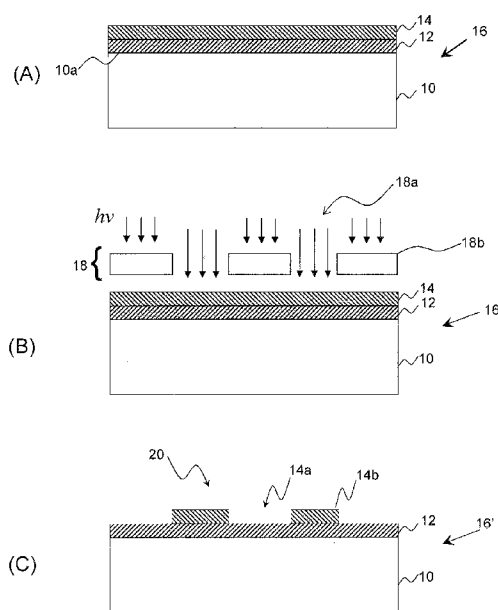


Fig. 1

(57) Abstract: Radiation-sensitive sol-gel compositions are provided, along with methods of forming microelectronic structures and the structures thus formed. The compositions comprise a sol-gel compound and a base generator dispersed or dissolved in a solvent system. The sol-gel compound comprises recurring monomeric units comprising silicon with crosslinkable moieties bonded to the silicon. Upon exposure to radiation, the base generator generates a strong base, which crosslinks the sol-gel compound in the compositions to yield a crosslinked layer that is insoluble in developers or solvents. The unexposed portions of the layer can be removed to yield a patterned sol-gel layer. The invention can be used to form patterns from sol-gel materials comprising features having feature sizes of less than about 1 μ m.

A. CLASSIFICATION OF SUBJECT MATTER***H01L 21/027(2006.01)i***

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)

H01L 21/027; G03F 7/028; G03F 7/004; G02B 5/20; B05D 3/12; H01L 21/31; H01B 3/20

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords:photo-sensitive sol-gel,base generator,exposing,developing,patterning

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	US 2005-0022697 A1 (BENRASHID RAMAZAN et al.) 03 February 2005 See abstract; paragraphs [0066]-[0068]; and figures 1-3	1-7, 10, 13 8-9, 11-12, 14-25
Y A	US 2006-0006541 A1 (TSUCHIYA HAJIME et al.) 12 January 2006 See abstract; paragraphs [0013]-[0028], [0030]-[0059]	1-7, 10, 13 8-9, 11-12, 14-25
A	KR 10-2008-0107128 A (DONGWOO FINE-CHEM CO.) 10 December 2008 See abstract; paragraphs [0009]-[0088]	1-25
A	KR 10-2010-0103987 A (DONGWOO FINE-CHEM CO.) 29 September 2010 See abstract; paragraphs [0023]-[0132]	1-25



Further documents are listed in the continuation of Box C.



See patent family 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 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 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

18 JANUARY 2013 (18.01.2013)

Date of mailing of the international search report

21 JANUARY 2013 (21.01.2013)

Name and mailing address of the ISA/KR

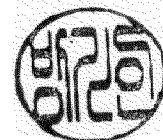
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Telephone No. 82-42-481-8684



INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/033073

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:

Group 1(claims [1-13]) is directed to a method of forming a microelectronic structure, comprising: forming a sol-gel layer on a substrate; exposing the sol-gel layer to radiation; and removing the unexposed portions of the sol-gel layer.

Group 2(claims [14-25]) is directed to a radiation-sensitive sol-gel composition and a microelectronic structure thereof, wherein the sol-gel composition comprises: a sol-gel compound and a base generator, wherein the sol-gel compound comprises silicon and crosslinkable moieties with at least 80% of -OH groups.

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.:

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

Information on patent family members

International application No.

PCT/US2012/033073

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