

(19) World Intellectual Property  
Organization  
International Bureau



(43) International Publication Date  
30 October 2003 (30.10.2003)

PCT

(10) International Publication Number  
**WO 2003/089368 A3**

(51) International Patent Classification<sup>7</sup>: **B81B 7/00**,  
F15C 5/00

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(21) International Application Number:  
PCT/US2003/011848

(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, NI, NO, NZ, OM, PH, PL, PT, RO, RU, SC, SD,  
SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US,  
UZ, VC, VN, YU, ZA, ZM, ZW.

(22) International Filing Date: 17 April 2003 (17.04.2003)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
60/373,426 18 April 2002 (18.04.2002) US

(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).

(63) Related by continuation (CON) or continuation-in-part  
(CIP) to earlier application:  
US 60/373,426 (CON)  
Filed on 18 April 2002 (18.04.2002)

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(US).

**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

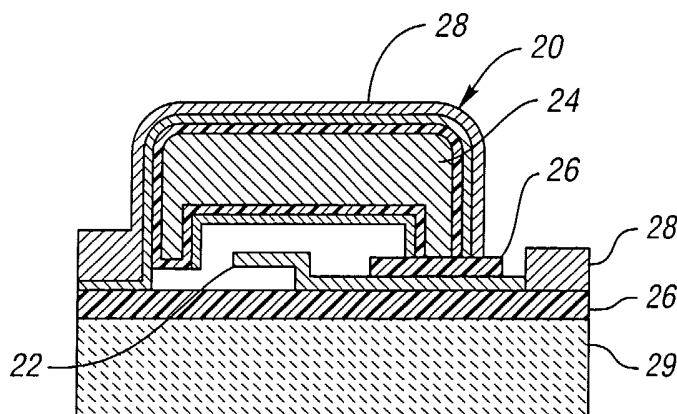
(72) Inventors; and

(88) Date of publication of the international search report:  
13 May 2004

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*For two-letter codes and other abbreviations, refer to the "Guid-  
ance Notes on Codes and Abbreviations" appearing at the begin-  
ning of each regular issue of the PCT Gazette.*

(54) Title: LOW TEMPERATURE METHOD FOR FORMING A MICROCAVITY ON A SUBSTRATE AND ARTICLE HAV-  
ING SAME



(57) Abstract: A low temperature method for forming a microcavity on a substrate and article having same are provided which utilize electroplated films. The method is particularly useful to package microelectromechanical systems (MEMS) in vacuum on the wafer level and provide sealed feedthroughs to the outside world. The method may be performed in a batch process to substantially reduce cost and to form metal diaphragms. Furthermore, the method is performed at near room temperature, which provides more flexibility in the manufacturing process. The method enables substantial cost savings in the production of vacuum-sealed MEMS. Many feedthroughs can be incorporated into the package to transfer signals in and out of the package. One significant advantage of this method is that it does not require bonding of

a second substrate, which reduces the system cost.

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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 03/11848

A. CLASSIFICATION OF SUBJECT MATTER  
 IPC 7 B81B7/00 F15C5/00

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 B81B

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, WPI Data, PAJ

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category ° | Citation of document, with indication, where appropriate, of the relevant passages  | Relevant to claim No. |
|------------|---|-----------------------|
| X          | WO 02 19011 A (CORNING INTELLISENSE CORP)<br>7 March 2002 (2002-03-07)  | 1,3-6,8,<br>14        |
| Y          | page 4, line 14 -page 6, line 15; figures<br>1A-2   | 2,7,9-13              |
| X          | US 5 963 788 A (BARRON CAROLE C ET AL)<br>5 October 1999 (1999-10-05)   | 15-22                 |
| Y          | column 6, line 15 -column 6, line 40<br>column 8, line 37 -column 8, line 45<br>column 9, line 16 -column 9, line 30<br>column 10, line 32 -column 10, line 50;<br>figures 1-13 | 2,7,9-13              |



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

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Date of the actual completion of the international search

24 February 2004

Date of mailing of the international search report

03/03/2004

Name and mailing address of the ISA

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Authorized officer

Seegerberg, T

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 03/11848

| Patent document<br>cited in search report |   | Publication<br>date | Patent family<br>member(s) | Publication<br>date |
|---|---|---------------------|----------------------------|---------------------|
| WO 0219011                                | A | 07-03-2002          | US 6411754 B1              | 25-06-2002          |
|   |   |                     | AU 7800201 A               | 13-03-2002          |
|   |   |                     | WO 0219011 A2              | 07-03-2002          |
|   |   |                     | US 2002102047 A1           | 01-08-2002          |
| <hr/>                                     |   |                     |                            |                     |
| US 5963788                                | A | 05-10-1999          | US 5798283 A               | 25-08-1998          |
|   |   |                     | US 6012336 A               | 11-01-2000          |
|   |   |                     | US 5783340 A               | 21-07-1998          |
| <hr/>                                     |   |                     |                            |                     |