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AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG,
MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM,
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(54) Title: LOCALIZED SEALING OF INTERCONNECT STRUCTURES IN SMALL GAPS

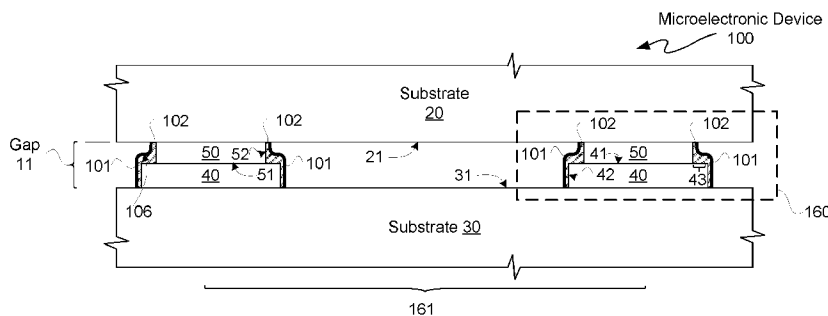


FIG. 2

(57) Abstract: An apparatus relates generally to a microelectronic device. In such an apparatus, a first substrate has a first surface with first interconnects located on the first surface, and a second substrate has a second surface spaced apart from the first surface with a gap between the first surface and the second surface. Second interconnects are located on the second surface. Lower surfaces of the first interconnects and upper surfaces of the second interconnects are coupled to one another for electrical conductivity between the first substrate and the second substrate. A conductive collar is around sidewalls of the first and second interconnects, and a dielectric layer is around the conductive collar.

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/015951

A. CLASSIFICATION OF SUBJECT MATTER
INV. H01L23/485 H01L21/60
ADD. H01L25/065

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

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 practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2007/230153 A1 (TANIDA KAZUMASA [JP] ET AL) 4 October 2007 (2007-10-04) pages 1-10 paragraphs [0041] - [0058]; figures 1,2 paragraphs [0059] - [0064]; figure 3 -----	1,2,5,11
X	US 2008/251280 A1 (SHI HONMO [JP] ET AL) 16 October 2008 (2008-10-16) paragraphs [0018] - [0027]; figure 3 paragraph [0038] -----	1,3-5
X	WO 2009/045371 A2 (TESSERA INC [US]; KWON JINSU [US]) 9 April 2009 (2009-04-09) paragraphs [0003] - [0005] paragraphs [0137] - [0159]; figures 2,2A paragraph [0167]; figure 12 ----- -/--	1,3-5,11

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 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 23 May 2016	Date of mailing of the international search report 01/08/2016
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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, Fax: (+31-70) 340-3016	Authorized officer Corchia, Alessandra
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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	US 2013/256913 A1 (BLACK BRYAN [US] ET AL) 3 October 2013 (2013-10-03) paragraphs [0001] - [0007] paragraphs [0027], [0028]; figure 1 paragraphs [0040], [0041]; figure 6 -----	1,11
X	US 2013/020709 A1 (HUANG CHUN-AN [TW] ET AL) 24 January 2013 (2013-01-24) paragraphs [0007] - [0014] paragraphs [0022] - [0034]; figures 2A-2E -----	1,11
X	US 2007/045869 A1 (HO KWUN-YAO [TW] ET AL) 1 March 2007 (2007-03-01) paragraphs [0005], [0012] paragraphs [0020] - [0024], [0026] - [0029]; figure 2 -----	1,11

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/015951

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:

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 fees, this Authority did not invite payment of additional fees.

- 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.:
1-5, 11

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-5, 11

A device comprising two substrates, each one provided with an interconnect, the interconnects being coupled to each other and comprising around their sidewalls a conductive collar and a dielectric layer, wherein a gap between the surfaces of the substrates falls in specific ranges of values.

1.1. claim: 5

A device comprising two substrates, each one provided with an interconnect, the interconnects being coupled to each other and comprising around their sidewalls a conductive collar and a dielectric layer, wherein the dielectric layer adheres also to the surfaces of the substrates.

1.2. claim: 11

a device comprising two substrates, each one provided with an interconnect, the interconnects being coupled to each other and comprising around their sidewalls a conductive collar and a dielectric layer, wherein the two substrates are a semiconductor die and an interposer or two semiconductor dies.

2. claims: 6, 12-14, 18(completely); 15-17(partially)

A device comprising two substrates, each one provided with an interconnect, the interconnects being coupled to each other and comprising around their sidewalls a conductive collar and a dielectric layer, wherein the interconnects are bonded to each other by diffusion bonding at their interface; a method of manufacturing this device.

3. claims: 7-9, 19, 20(completely); 15(partially)

A device comprising two substrates, each one provided with an interconnect, the interconnects being coupled to each other and comprising around their sidewalls a conductive collar and a dielectric layer, wherein the coupled interconnects comprise an intermetallic compound; a method of manufacturing this device.

4. claims: 10(completely); 16, 17(partially)

A device comprising two substrates, each one provided with an interconnect, the interconnects being coupled to each other and comprising around their sidewalls a conductive

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

collar and a dielectric layer, wherein a diffusion barrier layer is present between the sidewalls of the coupled interconnects and the conductive collar, and a method of manufacturing this device.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No PCT/US2016/015951

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