

(19) World Intellectual Property Organization  
International Bureau



(43) International Publication Date  
22 October 2009 (22.10.2009)

PCT

(10) International Publication Number  
**WO 2009/129334 A3**

- (51) **International Patent Classification:**  
*H01L 23/12* (2006.01)    *H01L 21/336* (2006.01)
- (21) **International Application Number:**  
PCT/US2009/040708
- (22) **International Filing Date:**  
15 April 2009 (15.04.2009)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**  
12/103,701    15 April 2008 (15.04.2008)    US
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- (81) **Designated States (unless otherwise indicated, for every  
kind of national protection available):** AE, AG, AL, AM,

AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, 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, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

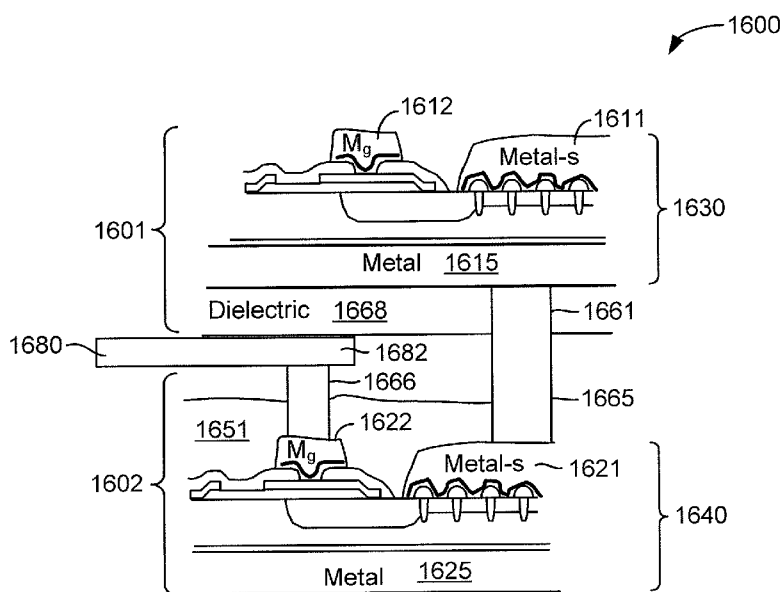
(84) **Designated States (unless otherwise indicated, for every kind of regional protection available):** ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

**Published:**

— with international search report (Art. 21(3))

(88) **Date of publication of the international search report:**  
4 March 2010

(54) **Title:** THREE-DIMENSIONAL SEMICONDUCTOR DEVICE STRUCTURES AND METHODS



**FIG. 16**

(57) **Abstract:** A three-dimensional semiconductor device structure includes a first semiconductor device and a second semiconductor device bonded together using a patterned conductive layer according to an embodiment of the invention. The first semiconductor device includes a first plurality of terminals on its front side, and the second semiconductor device includes a second plurality of terminals on its front side. The patterned conductive layer includes a plurality of conductive regions. Each of the conductive regions is bonded to a conductor coupled to one of the first plurality of terminals and bonded to another conductor coupled to one of the second plurality of terminals, providing electrical coupling between the first semiconductor device and the second semiconductor device. In a specific embodiment, each terminal of the first semiconductor device is bonded to a corresponding terminal of the second semiconductor device, providing a parallel combination of the first and the second semiconductor devices. In another embodiment, a parallel combination of the

first and the second semiconductor devices is provided using one or more terminals on a backside of the first semiconductor device and one or more terminals on a front side of the second semiconductor device.

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## INTERNATIONAL SEARCH REPORT

International application No.  
**PCT/US2009/040708****A. CLASSIFICATION OF SUBJECT MATTER***H01L 23/12(2006.01)i, H01L 21/336(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)

IPC : H01L 29/04, H01L 21/48, H01L 47/00, B44C 1/22

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

Korea Utility Models and applications for Utility Models since 1975

Japanese Utility Models and applications for Utility Models since 1975

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

eKOMPASS (KIPO internal) &amp; keyword : "three-dimensional", "MOSFET", "patterned metal", "conductive structure"

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2006-0226491 A1 (GAUTHIER JR, ROBERT J. et al.) 12 October 2006 See claims 1-20 and Figures 1-3	1-25
A	US 2004-0051170 A1 (KAWAKAMI, SATOKO. et al.) 18 March 2004 See claims 1-21 and Figures 1-34	1-25
A	US 6940085 B2 (FRICKE, PETER. et al.) 06 September 2005 See claims 1-15 and Figures 1-21	1-25
A	US 4612083 A (YASUMOTO, MASSAKI. et al.) 16 September 1986 See claims 1-15 and Figures 1-8	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

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"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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

23 NOVEMBER 2009 (23.11.2009)

Date of mailing of the international search report

**02 DECEMBER 2009 (02.12.2009)**

Name and mailing address of the ISA/KR

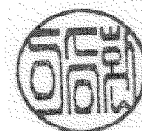
Korean Intellectual Property Office  
Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu,  
Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

LEE, Seung Hwan

Telephone No. 82-42-481-8419



**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/US2009/040708**

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006-0226491 A1	12.10.2006	None	
US 2004-0051170 A1	18.03.2004	CN 1495893 A JP 2004-111656 A KR 20040025631 A KR 10-0899314 B1 TW 222206 B	12.05.2004 08.04.2004 24.03.2004 27.05.2009 11.10.2004
US 6940085 B2	06.09.2005	CN 1449047 A EP 1351305 A2 JP 2004-006715 A KR 10-2003-0079733 A US 2003-0183867 A1	15.10.2003 08.10.2003 08.01.2004 10.10.2003 02.10.2003
US 04612083 A	16.09.1986	EP 0168815 A2 EP 0168815 A3 EP 0168815 B1 JP 61-030059 A	22.01.1986 20.01.1988 07.10.1992 12.02.1986