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- (75) **Inventors/Applicants (for US only):** **TANG, Sanh, D.** [US/US]; 11587 W. Verde Dr., Boise, Idaho 83709 (US). **ZAHURAK, John, K.** [US/US]; 2633 W. Sugarberry Drive, Eagle, Idaho 83616 (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, 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, 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, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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Published:

- with international search report (Art. 21(3))
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- (88) **Date of publication of the international search report:**
21 June 2012

(54) **Title:** THREE DIMENSIONAL MEMORY AND METHODS OF FORMING THE SAME

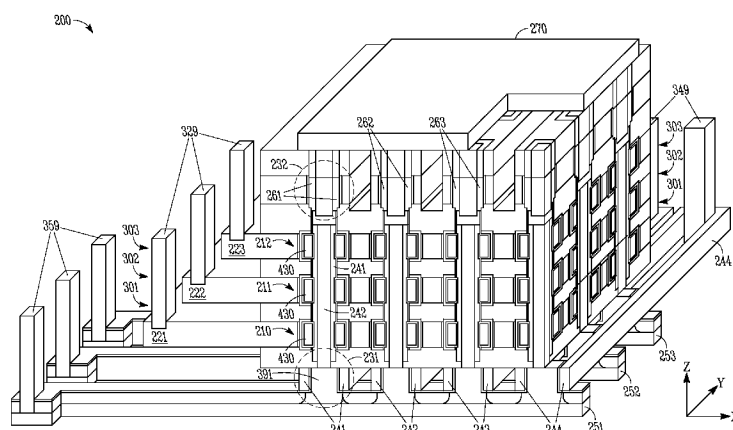


FIG. 3

(57) **Abstract:** Some embodiments include a memory device and methods of forming the memory device. One such memory device includes a first group of memory cells, each of the memory cells of the first group being formed in a cavity of a first control gate located in one device level of the memory device. The memory device also includes a second group of memory cells, each of the memory cells of the second group being formed in a cavity of a second control gate located in another device level of the memory device. Additional apparatus and methods are described.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/041888**A. CLASSIFICATION OF SUBJECT MATTER****H01L 27/115(2006.01)i, H01L 21/8247(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 27/115; H01L 21/336; H01L 29/72; H01L 29/792; H01L 29/76; H01L 21/82; G11C 16/06

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: nonvolatile,memory,stack,3D,flash,control gate,cavity

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 2009-0097321 A1 (KIM SUK-PIL et al.) 16 April 2009 See abstract; figures 1-2, 5-6; paragraphs [0040]-[0065]	9,13-14,22,25-26 1,5-6,27-30
Y	US 2008-0277720 A1 (YOUN SUN-PIL et al.) 13 November 2008 See abstract; figures 9-10; paragraphs [0055]-[0056]	1,5-6,27-30
A	US 2002-0195668 A1 (TETSUO ENDOH et al.) 26 December 2002 See abstract; figures 1-63; paragraphs [0070]-[0137]	1-34
A	US 2007-0272973 A1 (PARK YOON-DONG et al.) 29 November 2007 See abstract; figures 1-2; claim 1	1-34

☐ 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

26 APRIL 2012 (26.04.2012)

Date of mailing of the international search report

01 MAY 2012 (01.05.2012)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2011/041888**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 I, claims [1-8, 15-21, 27-34] are directed to an apparatus and its forming method, the apparatus including a memory element formed in a cavity of a conductive material.

Group II, claims [9-14, 22-26] are directed to an apparatus and its forming method, the apparatus including a ring-shaped non-volatile memory element.

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/US2011/041888

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