

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
17 April 2008 (17.04.2008)

PCT

(10) International Publication Number
WO 2008/045593 A3

(51) International Patent Classification:
H01L 21/8234 (2006.01)

(21) International Application Number:
PCT/US2007/070341

(22) International Filing Date: 4 June 2007 (04.06.2007)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
11/548,231 10 October 2006 (10.10.2006) US
11/749,094 15 May 2007 (15.05.2007) US

(63) Related by continuation (CON) or continuation-in-part (CIP) to earlier application:
US 11/749,094 (CON)
Filed on 15 May 2007 (15.05.2007)

(71) Applicant (for all designated States except US):
SCHILTRON CORPORATION [US/US]; 1638 Cornell Drive, Mountain View, California 94040 (US).

(72) Inventor; and

(75) Inventor/Applicant (for US only): **WALKER, Andrew J.** [US/US]; 1638 Cornell Drive, Mountain View, CA 94040 (US).

(74) Agent: **KWOK, Edward C.**; MacPherson Kwok Chen & Heid LLP, 2033 Gateway Place, Suite 400, San Jose, California 95110 (US).

(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, 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, 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, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, UZ, VC, VN, ZA, ZM, ZW.

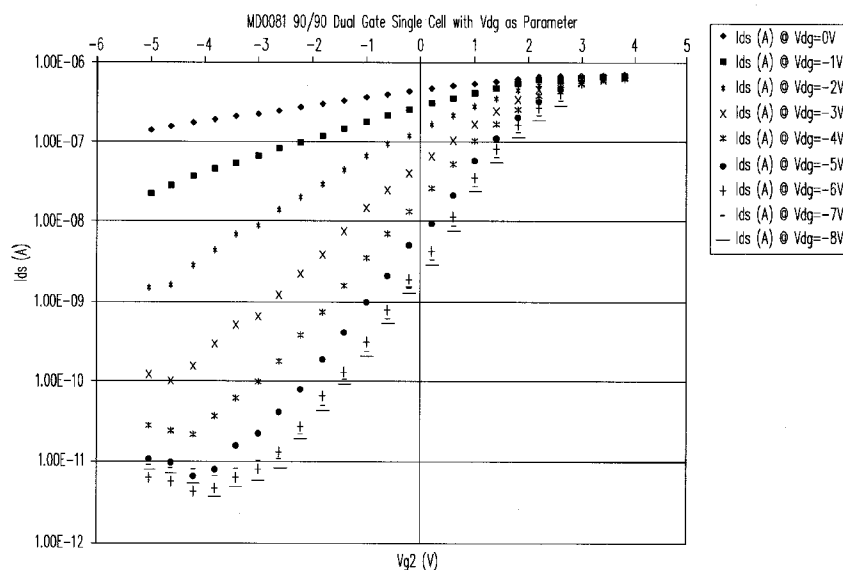
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, 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

(88) Date of publication of the international search report:
10 July 2008

(54) Title: DUAL-GATE MEMORY DEVICE AND OPTIMIZATION OF ELECTRICAL INTERACTION BETWEEN FRONT AND BACK GATES TO ENABLE SCALING



(57) Abstract: A memory circuit having dual-gate memory cells and a method for fabricating such a memory circuit are disclosed. The dual-gate memory cells each include a memory device and an access device sharing a semiconductor layer, with their respective channel regions provided on different surfaces of the semiconductor layer. To achieve good scalability of the dual-gate memory cells, the semiconductor layer between the memory device gate and access device gate can be thinned. This results in a larger sensitivity parameter but this parameter is still small enough to avoid memory charge disturbances. The dual-gate memory cells can be used as building blocks for a non-volatile memory array.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 07/70341

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H01L 21/8234 (2007.10)

USPC - 257/412

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)
USPC - 257/412Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 438/197, §; 257/213,412
Search Terms BelowElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST (USPT, PGPB, EPAB, JPAB); google.com
Search Terms Used: semiconductor, memory device, non-volatile, floating, nano, NAND, access device, polycrystalline, channel

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 6,313,490 B1 (NOBLE) 06 November 2001 (06.11.2001) entire document, especially Abstract; col. 2, ln. 58-67; col. 4, ln. 35-39; col. 5, ln. 9-25; col. 7, ln. 20-65; col. 7, ln. 66 to col. 8, ln. 7	1-45
Y	US 7,075,143 B2 (FUJIWARA et al.) 11 July 2006 (11.07.2006), col 1, ln 15-16; col 16, ln 4-9; col 11, ln 9-21	1-32 and 45
Y	US 2006/0115939 A1 (WALKER et al.) 01 June 2006 (01.06.2006) entire document, especially Abstract; paras [0015]; [0029]; [0035]-[0038]; [0042]; [0043]	33-44
A	US 6,301,155 B1 (FUJIWARA) 09 October 2001 (09.10.2001) entire document, especially Abstract; col. 15, ln. 4-7	1-45
A	US 6,166,407 A (OHTA) 26 December 2000 (26.12.2000) entire document, especially Abstract; col. 1, ln. 57-67; col. 2, ln. 38-53; col. 3, ln. 27-33	1-45
A	US 6,787,832 B2 (SCHMID et al.) 07 September 2004 (07.09.2004) entire document, especially Abstract; col. 1, ln. 50-55; col. 2, ln. 3-5	1-45

☐ Further documents are listed in the continuation of Box C.

* 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

13 March 2008 (13.03.2008)

Date of mailing of the international search report

24 APR 2008

Name and mailing address of the ISA/US

Mail Stop PCT, Attn: ISA/US, Commissioner for Patents
P.O. Box 1450, Alexandria, Virginia 22313-1450
Facsimile No. 571-273-3201

Authorized officer:

Lee W. Young

PCT Helpdesk: 571-272-4300
PCT OSP: 571-272-7774

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 07/70341

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 1-32 and 45;
Group 2: Claims 33-44.

The inventions listed as Groups 1-2 do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Group 1 requires the special technical feature of an access device having a channel region provided on a second surface of the semiconductor layer, not required by Group 2. Group 2 requires the special technical feature of forming a trench in the insulator layer, not required by Group 1.

None of these special technical features are common to the other groups, nor do they correspond to a special technical feature in the other groups. Therefore, unity of invention is lacking under PCT Rule 13.1.

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 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.:

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.