



(51) International Patent Classification:
H01L 29/82 (2006.01)

(21) International Application Number:
PCT/US2011/065573

(22) International Filing Date:
16 December 2011 (16.12.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/424,359 17 December 2010 (17.12.2010) US

(71) Applicant (for all designated States except US): **EVERSPIN TECHNOLOGIES, INC.** [US/US]; 1300 N. Alma School Rd., Chandler, Arizona 85224 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **NAGEL, Kerry** [US/US]; 639 W. Mountain Vista Dr., Phoenix, Arizona 85045 (US). **SMITH, Kenneth** [US/US]; 1331 W. Bartlett Way, Chandler, Arizona 85248 (US). **HOSSAIN, Moazzem** [US/US]; 6861 W. St. Charles, Laveen, Arizona 85339 (US). **AGGARWAL, Sanjeev** [US/US]; 9161 E. Sutton Dr., Scottsdale, Arizona 85260 (US).

(74) Agent: **KOCH, William**; 7010 E. Cochise Rd., Scottsdale, Arizona 85253 (US).

(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, QA, RO, RS, RU, RW, 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.

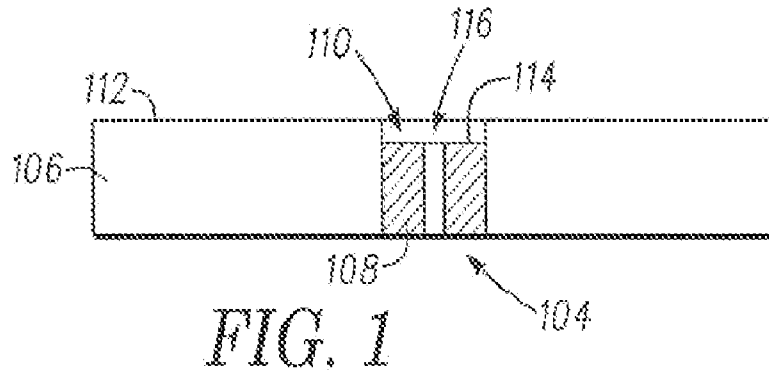
(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, 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:
27 June 2013

(54) Title: MAGNETIC RANDOM ACCESS MEMORY INTEGRATION HAVING IMPROVED SCALING



(57) Abstract: A conductive via for connecting between a digit line and one side of the magnetic device is positioned beneath, and aligned with, each magnetic device. Other contacts may satisfy the same design rules, using the same process step. An electrode formed on the conductive via is polished to eliminate step functions or seams originating at the conductive via from propagating up through the various deposited layers. This integration approach allows for improved scaling of the MRAM devices to at least a 45 nanometer node, a cell packing factor approaching 6F², and a uniform thickness of material between the bit lines and the underlying memory elements.



INTERNATIONAL SEARCH REPORT

International application No.

PCT/US201 1/065573

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - H01 L 29/82 (201 2.01)**USPC - 438/3**

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(8) - H01 L 23/522; H01 L 29/82; H01 L 29/96 (2012.01)

USPC - 257/421 , 797, E43.001 ; 438/3


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)

PatBase, Google Patents, Google.com

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 7,223,612 B2 (SARMA) 29 May 2007 (29.05.2007) entire document	1-23
A	US 2006/0216935 A1 (OSWALD et al) 28 September 2006 (28.09.2006) entire document	7,12,21
A	US 6,365,419 B1 (DURLAM et al) 02 April 2002 (02.04.2002) entire document	1-23
A	US 6,929,957 B2 (MIN et al) 16 August 2005 (16.08.2005) entire document	1-23
A	US 7,399,646 B2 (KANAKASABAPATHY et al) 15 July 2008 (16.07.2008) entire document	1-23
A	US 7,582,941 B2 (CHO et al) 01 September 2009 (01.09.2009) entire document	1-23
A	US 7,706,175 B2 (HOSOTANI et al) 27 April 2010 (27.04.2010) entire document	1-23

 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

02 April 2012

Date of mailing of the international search report

15 MAR 2013

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:

Blaine R. Copenheaver

PCT Helpdesk: 571-272-4300

PCT OSP: 571-272-7774