(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
28 September 2006 (28.09.2006)

PCT

(10) International Publication Number
WO 2006/101695 A1

(51) International Patent Classification:
H01L 21/033 (2006.01) *H01L 21/308* (2006.01)

(21) International Application Number:
PCT/US2006/007739

(22) International Filing Date: 3 March 2006 (03.03.2006)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/662,323 15 March 2005 (15.03.2005) US
11/214,544 29 August 2005 (29.08.2005) US

(71) Applicant *(for all designated States except US)*: **MICRON TECHNOLOGY, INC.** [US/US]; 8000 South Federal Way, P.o. Box 6, Boise, Idaho 83707-0006 (US).

(72) Inventors; and

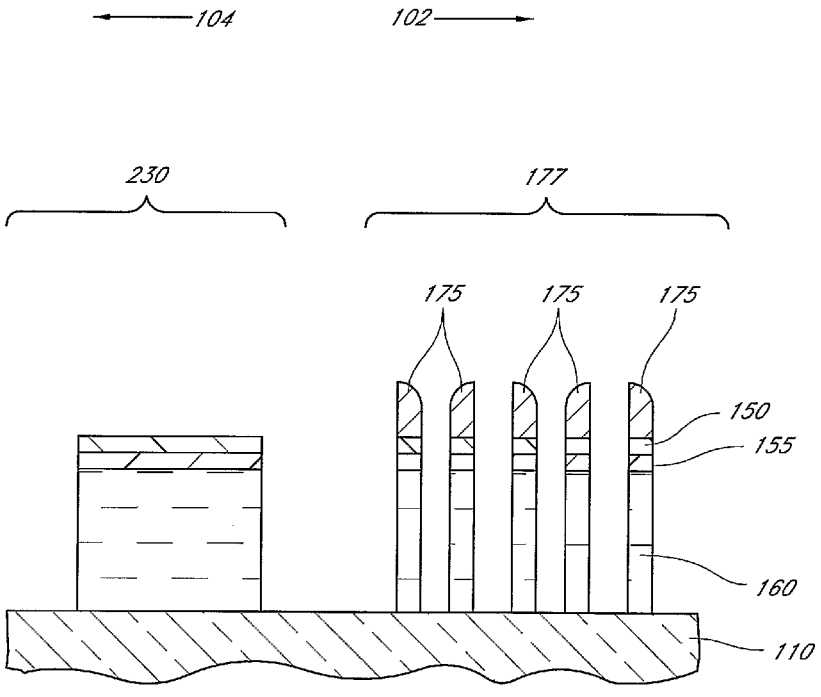
(75) Inventors/Applicants *(for US only)*: **TRAN, Luan** [US/US]; 1125 W. Sandy Court, Meridian, Idaho 83642 (US). **RERICHA, William, T.** [US/US]; 3026 Bogus Basin Road, Boise, Idaho 83702 (US). **LEE, John** [US/US]; 5475 E. Quartersawn Street, Boise, Idaho 83716 (US). **ALAPATI, Ramakanth** [IN/US]; 2401 S. Apple Street, Apt. 5101, Boise, Idaho 83706 (US). **HONARKHAH, Sheron** [CA/US]; 1500 S. Loggers Pond Place, Apt. #12, Boise, Idaho 83706 (US). **MENG, Shuang** [CN/US]; 2808 Cherry Lane, Apt. #j203, Boise, Idaho 83705 (US). **SHARMA, Puneet** [IN/US]; 4324 West Brook Drive #21, Ames, Iowa 50014 (US). **BAI, Jingyi** [CN/US]; 953 Willowleaf Drive, Apt. 1501, San Jose, California 95128 (US). **YIN, Zhiping** [US/US]; 1462 East Regatta Street, Boise, Idaho 83706 (US). **MORGAN, Paul** [US/US]; 12768 S. Cloverdate Road, Kuna, Idaho 83634 (US). **ABATCHEV, Mirzafer, K.** [RU/US]; 6349 S. Mangrove Place, Boise, Idaho 83716 (US). **SANDHU, Gurtej, S.** [GB/US]; 2964 E. Parkriver Drive, Boise, Idaho 83706 (US). **DURCAN, D. Mark** [US/US]; 4850 Boise River Lane, Boise, Idaho 83716 (US).

(74) Agent: **MALLON, Joseph**; KNOBBE, MARTENS, OLSON, AND BEAR LLP, 2040 Main Street, 14th Floor, Irvine, California 92614 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM,

[Continued on next page]

(54) Title: PITCH REDUCED PATTERNS RELATIVE TO PHOTOLITHOGRAPHY FEATURES



(57) Abstract: Differently-sized features of an integrated circuit (100) are formed by etching a substrate (110) using a mask which is formed by combining two separately formed patterns (177) and (230). Pitch multiplication is used to form the relatively small features (175) of the first pattern (177) and conventional photolithography used to form the relatively large features of the second pattern (230). Pitch multiplication is accomplished by patterning a photoresist and then etching that pattern into an amorphous carbon layer. Sidewall spacers (175) are then formed on the sidewalls of the amorphous carbon. The amorphous carbon is removed, leaving behind the sidewall spacers (175), which define the first mask pattern (177). A bottom anti-reflective coating (BARC) is then deposited around the spacers (175) to form a planar surface and a photoresist layer is formed over the BARC. The photoresist is next patterned by conventional photolithography to form the second pattern (230), which is then is transferred to the BARC. The combined pattern (177, 230) made out by the first pattern (177) and the second pattern (230) is transferred to an underlying amorphous silicon layer (150) and the pattern is subjected to a carbon strip to remove BARC and photoresist material. The combined pattern (177, 230) is then transferred to the silicon oxide layer (155) and then to an amorphous carbon mask layer (160). The combined mask pattern (177, 230), having features of difference sizes, is then etched into the underlying substrate (110) through the amorphous carbon hard mask layer (160).

WO 2006/101695 A1

AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK, MN, MW, MX, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RU, SC, SD, SE, SG, SK, SL, SM, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, YU, 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, 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*

— *with amended claims*

Date of publication of the amended claims:

23 November 2006

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.