

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

(19) World Intellectual Property
Organization
International Bureau

(43) International Publication Date
01 October 2020 (01.10.2020)



(10) International Publication Number
WO 2020/198502 A1

(51) International Patent Classification:

H01L 21/311 (2006.01) *H01L 21/02* (2006.01)
H01L 27/11551 (2017.01) *C23C 16/34* (2006.01)
H01L 27/11578 (2017.01) *C23C 16/505* (2006.01)

(21) International Application Number:

PCT/US2020/025004

(22) International Filing Date:

26 March 2020 (26.03.2020)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/825,632 28 March 2019 (28.03.2019) US

(71) Applicant: **LAM RESEARCH CORPORATION**

[US/US]; 4650 Cushing Parkway, Fremont, California 94538 (US).

(72) Inventors: **VAN SCHRAVENDIJK, Bart J.**; 4650 Cushing Parkway, Fremont, California 94538 (US). **HAM-**

MA, Soumana; 4650 Cushing Parkway, Fremont, California 94538 (US). **OU, Kai-Lin**; 4650 Cushing Parkway, Fremont, California 94538 (US). **LI, Ming**; 4650 Cushing Parkway, Fremont, California 94538 (US). **SAMANTARAY, Malay Milan**; 4650 Cushing Parkway, Fremont, California 94538 (US).

(74) Agent: **BERGIN, Denise S.** et al.; Weaver Austin Villeneuve & Sampson LLP, P.O. Box 70250, Oakland, California 94612-0250 (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, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA,

(54) Title: ETCH STOP LAYER

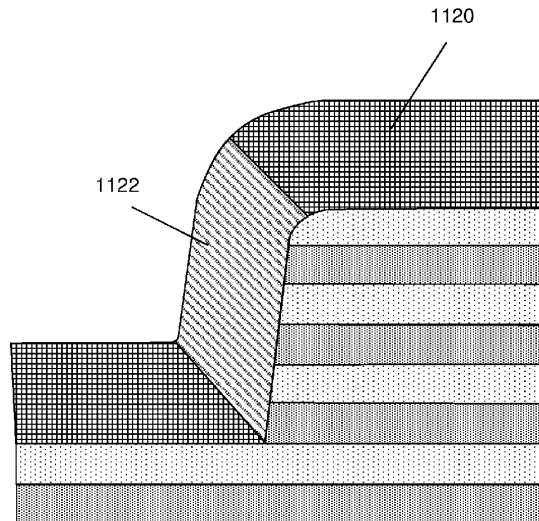


FIG. 12

(57) **Abstract:** Disclosed are methods for the formation of silicon nitride (SiN) on only the horizontal surfaces of structures such as 3D NAND staircase. This allows for thicker landing pads for subsequently formed vias. In some embodiments, the methods involve deposition of a SiN layer over a staircase followed by a treatment to selectively densify the SiN layer on the horizontal surfaces with respect to the sidewall surfaces. A wet etch is then performed to remove SiN from the sidewall surfaces. The selective treatment results in significantly different wet etch rates (WERs) between the horizontal surfaces and the sidewalls.

[Continued on next page]



WO 2020/198502 A1

SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR,
TT, TZ, UA, UG, US, UZ, VC, VN, WS, 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, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, 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, KM, ML, MR, NE, SN, TD, TG).

Published:

- *with international search report (Art. 21(3))*
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*