



(51) International Patent Classification:

H01L 21/311 (2006.01) H01L 21/768 (2006.01)
H01L 21/02 (2006.01)

(21) International Application Number:

PCT/US2024/021069

(22) International Filing Date:

22 March 2024 (22.03.2024)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

63/456,256 31 March 2023 (31.03.2023) US
18/442,681 15 February 2024 (15.02.2024) US

(71) Applicant: **APPLIED MATERIALS, INC.** [US/US];
3050 Bowers Avenue, Santa Clara, California 95054 (US).

(72) Inventors: **JIANG, Ying-Bing**; 3050 Bowers Avenue,
Santa Clara, California 95054 (US). **GELATOS, Avgeri-
nos V.**; 3050 Bowers Avenue, Santa Clara, California
95054 (US). **LEE, Joung Joo**; 3050 Bowers Avenue, San-
ta Clara, California 95054 (US). **MEBARKI, Bencherki**;
3050 Bowers Avenue, Santa Clara, California 95054 (US).
TANG, Xianmin; 3050 Bowers Avenue, Santa Clara, Cal-
ifornia 95054 (US). **HWANG, In Seok**; 3050 Bowers Av-

enue, Santa Clara, California 95054 (US). **CHEN, Zhijun**;
3050 Bowers Avenue, Santa Clara, California 95054 (US).

(74) Agent: **CAMPBELL, Quinten Moore** et al.; 1100
Peachtree Street NE, Suite 2800, Mailstop: IP Docketing -
22, Atlanta, Georgia 30309 (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, CV, CZ, DE, DJ, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG,
KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY,
MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA,
NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO,
RS, RU, RW, SA, 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, CV,
GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, 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, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE,

(54) Title: SYSTEMS AND METHODS FOR NANO HOLE WET CLEANS

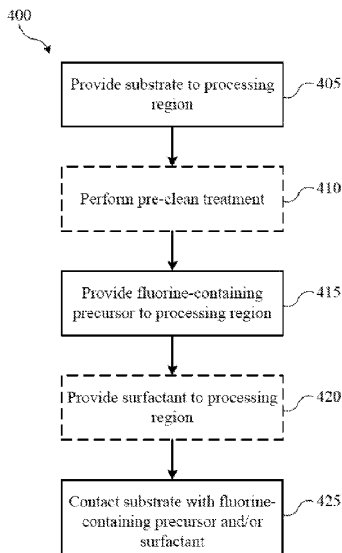


FIG. 4

(57) Abstract: Exemplary semiconductor processing methods may include providing a substrate to a processing region of a semiconductor processing chamber. The substrate may include an alternating stack of materials. A feature may extend through the alternating stack of materials. One material of the alternating stack of materials may include a silicon-containing material. A native oxide material may be disposed on at least a portion of exposed surfaces of the silicon-containing material. The methods may include performing a pre-clean treatment on the substrate. The methods may include providing a fluorine-containing precursor to the processing region. The methods may include contacting the substrate with the fluorine-containing precursor, wherein the contacting removes native oxide from the silicon-containing material.

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))*

(88) Date of publication of the international search report:

12 September 2025 (12.09.2025)