

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

(19) World Intellectual Property
Organization
International Bureau

(43) International Publication Date
10 September 2021 (10.09.2021)



(10) International Publication Number
WO 2021/178123 A1

(51) International Patent Classification:

H01L 21/02 (2006.01) H01L 29/66 (2006.01)
H01L 27/11556 (2017.01) H01J 37/32 (2006.01)
H01L 27/11582 (2017.01)

(21) International Application Number:

PCT/US2021/017807

(22) International Filing Date:

12 February 2021 (12.02.2021)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

62/986,517 06 March 2020 (06.03.2020) US

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

(72) Inventors: **ZHANG, Xinming**; c/o Applied Materials, Inc.,
Law Dept., M/S 1269, 3050 Bowers Avenue, Santa Clara,
California 95054 (US). **MAYUR, Abhilash J.**; c/o Ap-

plied Materials, Inc., Law Dept., M/S 1269, 3050 Bowers
Avenue, Santa Clara, California 95054 (US). **SHARMA,**
Shashank; c/o Applied Materials, Inc., Law Dept., M/S
1269, 3050 Bowers Avenue, Santa Clara, California 95054
(US). **TAM, Norman L.**; c/o Applied Materials, Inc., Law
Dept., M/S 1269, 3050 Bowers Avenue, Santa Clara, Cali-
fornia 95054 (US). **SPULLER, Matthew**; c/o Applied Ma-
terials, Inc., Law Dept., M/S 1269, 3050 Bowers Avenue,
Santa Clara, California 95054 (US).

(74) Agent: **DOUGHERTY, Chad M.** et al.; Patterson + Sheri-
dan LLP, 24 Greenway Plaza, Suite 1600, Houston, Texas
77046 (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, IT, 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,

(54) Title: SYSTEM AND METHOD FOR RADICAL AND THERMAL PROCESSING OF SUBSTRATES

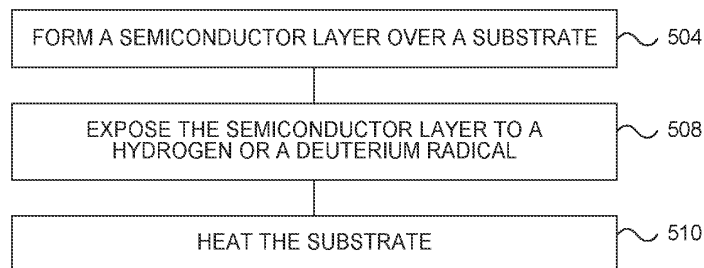


FIG. 5

(57) Abstract: The present disclosure provides systems and methods for processing channel structures of substrates that include positioning the substrate in a first processing chamber having a first processing volume. The substrate includes a channel structure with high aspect ratio features having aspect ratios greater than about 20:1. The method includes forming a silicon-containing layer over the channel structure to a hydrogen-or-deuterium plasma in the first processing volume at a flow rate of about 10 sccm to about 5000 sccm. The substrate is maintained at a temperature of about 100°C to about 1100°C during the exposing, the exposing forming a nucleated substrate. Subsequent to the exposing a thermal anneal operation is performed on the substrate.

[Continued on next page]



WO 2021/178123 A1

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, 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))*