

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

(19) World Intellectual Property  
Organization  
International Bureau

(43) International Publication Date  
26 October 2023 (26.10.2023)



(10) International Publication Number  
**WO 2023/204918 A1**

(51) International Patent Classification:  
**H01L 21/768** (2006.01) **H01L 21/3213** (2006.01)  
**H01L 21/285** (2006.01) **H01L 21/67** (2006.01)

(21) International Application Number:  
PCT/US2023/015640

(22) International Filing Date:  
20 March 2023 (20.03.2023)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:  
63/332,622 19 April 2022 (19.04.2022) US

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

(72) Inventors: **BREIL, Nicolas Louis**; c/o Applied Materials, Inc., Law Dept., M/S 1269, 3050 Bowers Avenue, Santa Clara, California 95054 (US). **PRANATHARTHIHARAN, Balasubramanian**; c/o Applied Materials, Inc., Law Dept., M/S 1269, 3050 Bowers Avenue, Santa Clara, California 95054 (US). **COLOMBEAU, Benjamin**; c/o Applied Materials, Inc., Law Dept., M/S 1269, 3050 Bowers Avenue, Santa Clara, California 95054 (US). **WANG, An-**

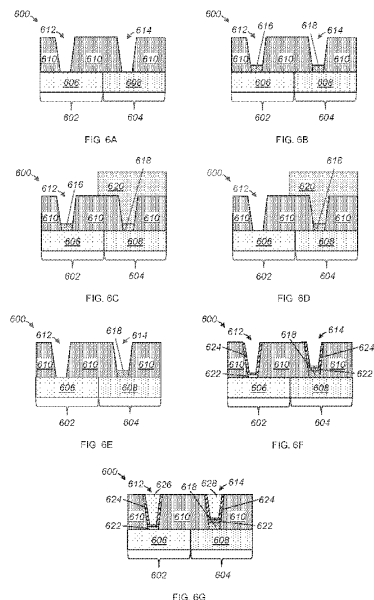
**chuan**; c/o Applied Materials, Inc., Law Dept., M/S 1269, 3050 Bowers Avenue, Santa Clara, California 95054 (US).

(74) Agent: **HAMMACK, Marcus** et al.; PATTERSON + SHERIDAN 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, 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: CONTACT FORMATION PROCESS FOR CMOS DEVICES



(57) Abstract: A method of forming a contact layer in a semiconductor structure includes performing a pre-clean process on exposed surfaces of a plurality of first semiconductor regions and a plurality of second semiconductor regions formed on a substrate, wherein the exposed surfaces of the plurality of first and second semiconductor regions are each disposed within openings formed in a dielectric layer disposed over the substrate, performing a first selective epitaxial deposition process to form a first contact layer on the exposed surfaces of the first semiconductor regions and a second contact layer on the exposed surface of the second semiconductor regions, performing a patterning process to form a patterned stack, wherein the patterned stack comprises a patterned layer that comprises openings formed over the first contact layer disposed within each opening in the dielectric layer and a portion of the patterned layer that is disposed over each second contact layer disposed within each opening in the dielectric layer, and performing a selective removal process to remove the first contact layer selectively to the plurality of first semiconductor regions, the dielectric layer, and the patterned layer.

WO 2023/204918 A1

[Continued on next page]

# WO 2023/204918 A1

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))