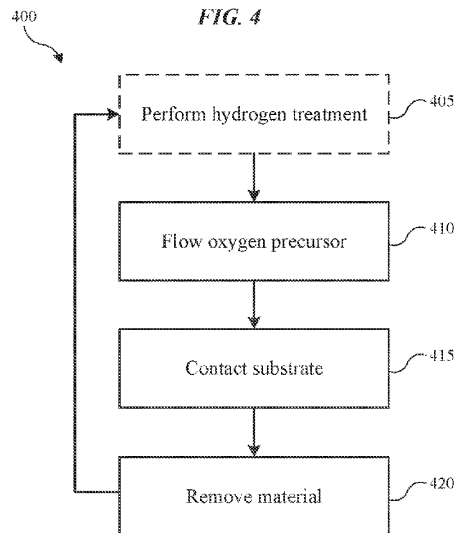




- (51) **International Patent Classification:**
H01L 21/3213 (2006.01) *H01L 21/02* (2006.01)
- (21) **International Application Number:**
PCT/US2022/023776
- (22) **International Filing Date:**
07 April 2022 (07.04.2022)
- (25) **Filing Language:** English
- (26) **Publication Language:** English
- (30) **Priority Data:**
17/240,149 26 April 2021 (26.04.2021) US
- (71) **Applicant:** **APPLIED MATERIALS, INC.** [US/US];
3050 Bowers Avenue, Santa Clara, California 95054 (US).
- (72) **Inventors:** **WANG, Baiwei**; 3050 Bowers Avenue, Santa Clara, California 95054 (US). **CHEN, Xiaolin C.**; 3050 Bowers Avenue, Santa Clara, California 95054 (US). **RED-DY, Rohan Puligoru**; 3050 Bowers Avenue, Santa Clara, California 95054 (US). **JAN, Oliver**; 3050 Bowers Avenue, Santa Clara, California 95054 (US). **CUI, Zhenjiang**; 3050 Bowers Avenue, Santa Clara, California 95054 (US).
- (74) **Agent:** **CAMPBELL, Quinten M.** et al.; 1100 Peachtree Street NE, Suite 2800, Mailstop: IP Docketing - 22, Atlanta, Georgia 95054 (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, JM, 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, 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,

(54) **Title:** SELECTIVE REMOVAL OF RUTHENIUM-CONTAINING MATERIALS



(57) **Abstract:** Exemplary etching methods may include flowing an oxygen-containing precursor into a processing region of a semiconductor processing chamber. The methods may include contacting a substrate housed in the processing region with the oxygen-containing precursor. The substrate may include an exposed region of ruthenium, and the contacting may produce ruthenium tetroxide. The methods may include vaporizing the ruthenium tetroxide from a surface of the exposed region of ruthenium. An amount of oxidized ruthenium may remain. The methods may include contacting the oxidized ruthenium with a hydrogen-containing precursor. The methods may include removing the oxidized ruthenium.

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))