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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
14 August 2025 (14.08.2025)

WIPO | PCT

(10) International Publication Number
WO 2025/170781 A1

(51) International Patent Classification:
H01J 37/32 (2006.01) *C23C 16/505* (2006.01)

(21) International Application Number:
PCT/US2025/013214

(22) International Filing Date:
27 January 2025 (27.01.2025)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
18/433,936 06 February 2024 (06.02.2024) US

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

(72) Inventors: **HWANG, Shinjae**; c/o Applied Materials, Inc., Law Dept., M/S 1269, 3050 Bowers Avenue, Santa Clara, California 95054 (US). **KASHEFI, Kevin**; c/o Applied Materials, Inc., Law Dept., M/S 1269, 3050 Bowers Avenue, Santa Clara, California 95054 (US).

(74) Agent: **STEVENS, Joseph J.** 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, UY, 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, 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))*

(54) Title: BARRIER AND LINER TREATMENT USING DUAL RADIO FREQUENCY CAPACITIVE COUPLE PLASMA FOR METAL INTERCONNECTS

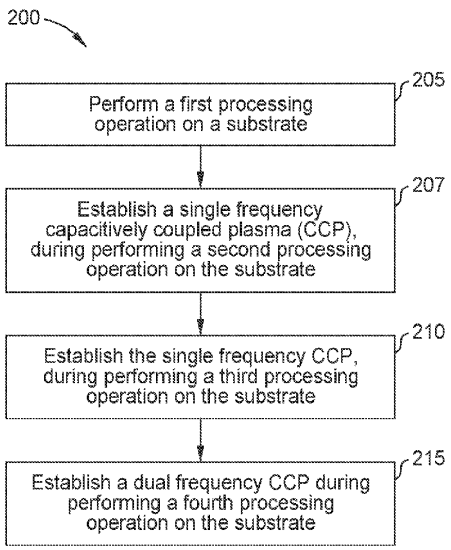

FIG. 2

(57) Abstract: A processing method includes depositing a barrier layer on a field region and sidewalls of a via of an interconnect structure, wherein depositing the barrier layer comprises establishing a single RF frequency capacitively coupled plasma (CCP) using a first radio frequency (RF) generator by delivering a first RF signal from the first radio frequency (RF) generator at a first RF frequency to a first electrode, and treating the barrier layer by establishing a dual RF frequency CCP, wherein the dual RF frequency CCP is formed using the first RF generator and a second RF generator coupled to the first electrode, the dual RF frequency CCP is formed by simultaneously delivering a second RF signal at the first RF frequency to the first electrode and a third RF signal at a second RF frequency to the first electrode, and the first RF frequency is greater than the second RF frequency.

WO 2025/170781 A1