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

CORRECTED VERSION

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
11 September 2025 (11.09.2025)

WIPO | PCT

(10) International Publication Number
WO 2025/188732 A8

(51) International Patent Classification:
H01L 23/00 (2006.01) *H01L 21/02* (2006.01)
H01L 21/304 (2006.01) *H01L 21/768* (2006.01)

(21) International Application Number:
PCT/US2025/018310

(22) International Filing Date:
04 March 2025 (04.03.2025)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
18/599,846 08 March 2024 (08.03.2024) US

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

(72) Inventors: **CHARLES, William Oghandi**; 1 Broadway 14th Floor, Cambridge, Massachusetts 02142 (US). **PRAKASH, Amit**; B52, Applied Materials, 3333 Scott Blvd., Santa Clara, California 95054 (US). **JAIN, Shubhendra Kumar**; Applied Materials, One Broadway, 14th floor, Cambridge, Massachusetts 02142 (US). **GORCHICHKO, Mariia**; 3333 Scott Blvd, Santa Clara, California 95054 (US). **HOLT, Joshua Stuart**; Applied Materials Building 21, 1285 Walsh Ave, Santa Clara, California 95050 (US). **KUMAR, Archana**; Applied Materials Building 81, 974 E Arques Ave., Sunnyvale, California 94085 (US). **QUON, Roger Allan**; 141 Fuller Road, Albany, New York 12203 (US). **BRIGGS, Benjamin D.**; One Broadway, Cambridge, Massachusetts 02142 (US). **WEEKS, Stephen**; Applied Materials B81, 974 E Arques Ave, Sunnyvale, California 94085 (US). **JEON, Yoocharn**; 3333 Scott Blvd., Santa Clara, California 95054 (US). **LEY, Ryan Thomas**; Applied Materials, B52, 3333 Scott Blvd, Santa Clara, California 95054 (US).

(74) Agent: **HALE, Jeffrey D.** et al.; Moser Taboada, 1040 Broad Street, Suite 103, Shrewsbury, New Jersey 07702 (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,

(54) Title: ALUMINUM OXIDE ISOLATION FOR HYBRID BONDING

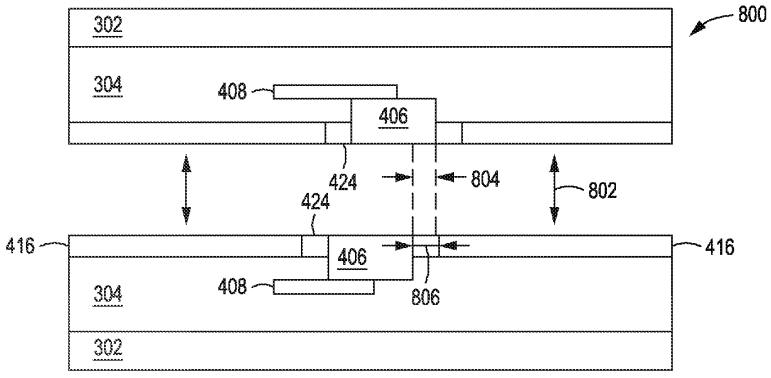

FIG. 8

(57) Abstract: A method for preparing a substrate for hybrid bonding by forming an isolation barrier around metal contacts on the substrate to separate the metal contacts from an aluminum oxide (Al_2O_3) bonding layer prior to performing the hybrid bonding process. A method may include forming an aluminum oxide layer on the substrate as a bonding layer for a hybrid bonding process where the aluminum oxide layer is formed on a dielectric material on the substrate that is different from a material of the aluminum oxide layer, forming a metal contact on the substrate that penetrates through the aluminum oxide layer, and forming an isolation barrier around the metal contact where the isolation barrier prevents adjacent portions of the aluminum oxide layer next to the metal contact from completely covering an uppermost bonding surface of the metal contact during an annealing process of the hybrid bonding process.

WO 2025/188732 A8

[Continued on next page]

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))*

(48) Date of publication of this corrected version:
02 October 2025 (02.10.2025)

(15) Information about Correction:
see Notice of 02 October 2025 (02.10.2025)