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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
06 January 2022 (06.01.2022)

WIPO | PCT

(10) International Publication Number
WO 2022/006010 A1

(51) International Patent Classification:
H01L 21/768 (2006.01) *C23C 16/04* (2006.01)
H01L 21/02 (2006.01)

(21) International Application Number:
PCT/US2021/039444

(22) International Filing Date:
28 June 2021 (28.06.2021)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
62/705,506 30 June 2020 (30.06.2020) US

(71) Applicant: **LAM RESEARCH CORPORATION** [US/US]; 4650 Cushing Parkway, Fremont, California 94538 (US).

(72) Inventors: **ABEL, Joseph R.**; 4650 Cushing Pkwy., Fremont, California 94538 (US). **VAN SCHRAVENDIJK, Bart J.**; 4650 Cushing Pkwy., Fremont, California 94538 (US). **CURTIN, Ian John**; 4650 Cushing Pkwy., Fremont, California 94538 (US). **AGNEW, Douglas Walter**; 4650 Cushing Pkwy., Fremont, California 94538 (US). **AUSTIN, Dustin Zachary**; 4650 Cushing Pkwy., Fremont, California 94538 (US). **GUPTA, Awnish**; 4650 Cushing Pkwy., Fremont, California 94538 (US).

(74) Agent: **BERGIN, Denise S.** et al.; WEAVER AUSTIN VILLENEUVE & SAMPSON LLP, P.O. Box 70250, Oakland, California 94612-0250 (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, 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,

(54) Title: REDUCING INTRALEVEL CAPACITANCE IN SEMICONDUCTOR DEVICES

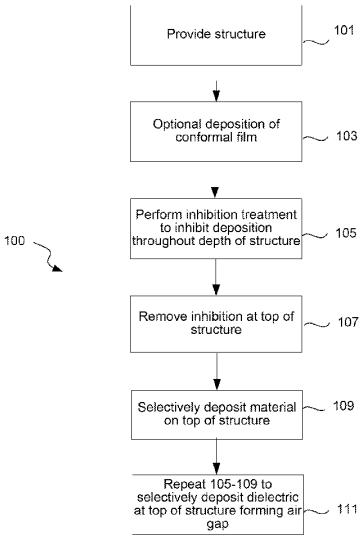

FIG. 1a

(57) Abstract: Methods of forming air gaps in hole and trench structures are disclosed. The methods may be used to form buried voids, i.e., voids for which the top is below the top of the adjacent features. The methods include inhibition of the hole or trench structures and selective deposition at the top of the structure forming an air gap within the structures. In some embodiments, the methods are to reduce intra-level capacitance in semiconductor devices.

WO 2022/006010 A1

[Continued on next page]

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))*