

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

(19) World Intellectual Property
Organization
International Bureau

(43) International Publication Date
15 October 2020 (15.10.2020)



(10) International Publication Number
WO 2020/209971 A1

(51) International Patent Classification:

H01L 29/778 (2006.01) H01L 27/06 (2006.01)
H01L 21/337 (2006.01) H01L 29/10 (2006.01)
H01L 29/207 (2006.01) H01L 29/20 (2006.01)

(21) International Application Number:

PCT/US2020/022228

(22) International Filing Date:

12 March 2020 (12.03.2020)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

16/379,077 09 April 2019 (09.04.2019) US

(71) Applicant: **RAYTHEON COMPANY** [US/US]; 870
Winter Street, Waltham, Massachusetts 02451-1449 (US).

(72) Inventors: **HWANG, Kiuchul**; 63 Seaverns Bridge Road,
Amherst, New Hampshire 03031-2136 (US). **SCHULTZ,
Brian D.**; 30 Fairlawn Lane, Lexington, Massachusetts
02420-2715 (US). **LOGAN, John**; 115 River Pointe

Way, Apt. 6201, Lawrence, Massachusetts 01843 (US).
THOMIDIS, Christos; 279 Lexington Street, Watertown,
Massachusetts 02472 (US).

(74) Agent: **MOFFORD, Donald, F.** et al.; Daly, Crowley,
Mofford & Durkee, LLP, One University Avenue, Suite
201B, Westwood, Massachusetts 02090 (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, 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,

(54) Title: SEMICONDUCTOR STRUCTURE HAVING BOTH ENHANCEMENT MODE GROUP III-N HIGH ELECTRON
MOBILITY TRANSISTORS AND DEPLETION MODE GROUP III-N HIGH ELECTRON MOBILITY TRANSISTORS

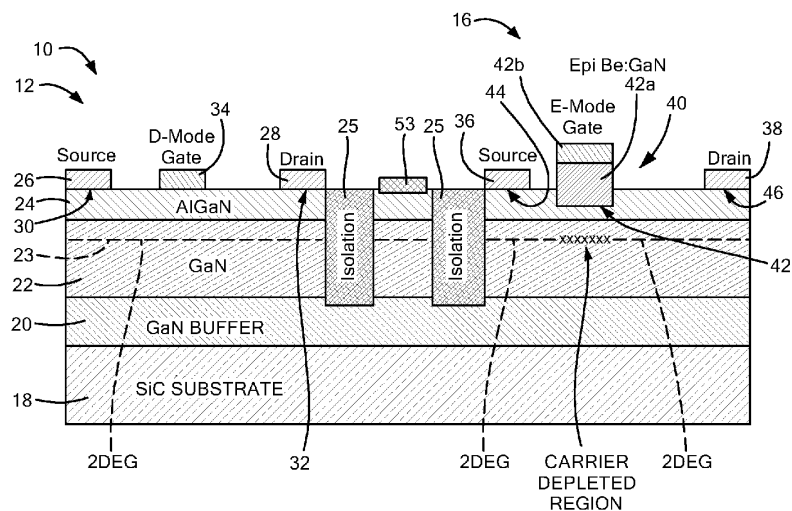


FIG. 1

(57) Abstract: An Enhancement-Mode HEMT (16) having a gate electrode with a doped, Group III-N material (42a) disposed between an electrically conductive gate electrode contact (42b) and a gate region of the Enhancement-Mode HEMT, such doped, Group III-N layer increasing resistivity of the Group III-N material to deplete the 2DEG under the gate at zero bias.

[Continued on next page]

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, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Published:

- *with international search report (Art. 21(3))*