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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
04 July 2024 (04.07.2024)

WIPO | PCT

(10) International Publication Number
WO 2024/145454 A3

(51) International Patent Classification:
C23C 16/455 (2006.01) *C30B 25/10* (2006.01)
C23C 16/52 (2006.01) *C30B 25/16* (2006.01)
C23C 16/46 (2006.01) *H01L 21/67* (2006.01)
C23C 16/458 (2006.01) *H01L 21/687* (2006.01)
C30B 25/12 (2006.01)

(21) International Application Number: PCT/US2023/086200

(22) International Filing Date: 28 December 2023 (28.12.2023)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
63/477,960 30 December 2022 (30.12.2022) US

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(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,

(54) Title: METHODS OF PROCESSING EPITAXIAL SEMICONDUCTOR WAFERS

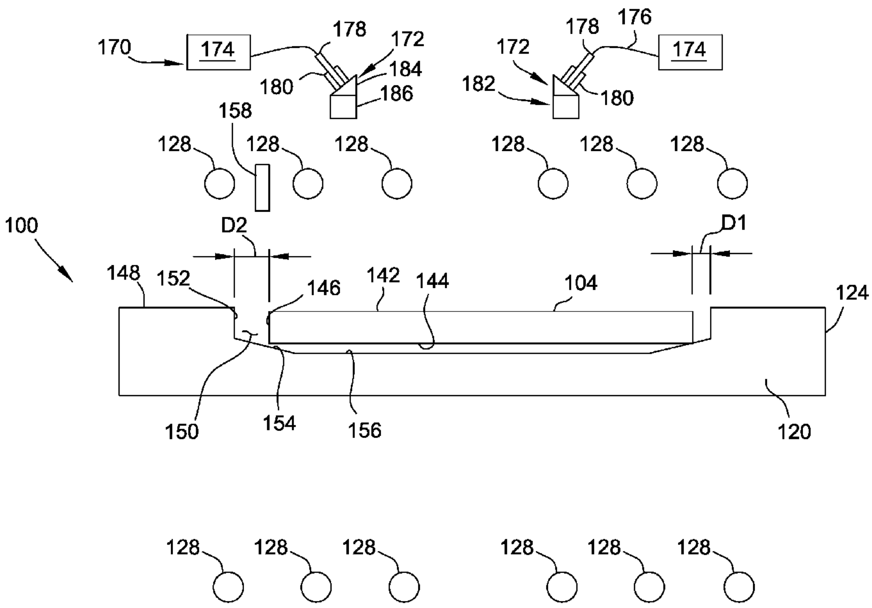

FIG. 2

(57) Abstract: A method of processing semiconductor wafers includes placing a semiconductor wafer in a recess of a susceptor within a heated chamber. The recess is defined in the susceptor by a downwardly depending sidewall. The method also includes determining a distance of a peripheral edge of the wafer from the sidewall. The method also includes supplying a first process gas into the heated chamber at a first gas flow rate and a second process gas into the heated chamber at a second gas flow rate, and supplying heat to the heated chamber. The method also includes modulating the first gas flow rate, the second gas flow rate, and/or the heat supplied to the heated chamber to control a deposition rate of the first and second process gases near the peripheral edge of the wafer based on the determined distance of the peripheral edge of the wafer from the sidewall.

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[Continued on next page]

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, 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))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report: 08 August 2024 (08.08.2024)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2023/086200

A. CLASSIFICATION OF SUBJECT MATTER
INV. C23C16/455 C23C16/52 C23C16/46 C23C16/458 C30B25/12
C30B25/10 C30B25/16 H01L21/67 H01L21/687
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C23C C30B H01L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2016 213242 A (SHINETSU HANDOTAI KK) 15 December 2016 (2016-12-15) paragraphs [0029], [0031], [0032], [0038], [0041] - [0048]; figure 1 -----	1,2,5-16
Y	US 2014/137801 A1 (LAU SHU-KWAN [US] ET AL) 22 May 2014 (2014-05-22) paragraphs [0022], [0042], [0049]; claim 1; figure 2 -----	1,2,5-16
A	US 2019/172739 A1 (NAKAMURA IKUHIRO [JP] ET AL) 6 June 2019 (2019-06-06) pages 95, 96 ----- -/--	1,2,5-16

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search 1 July 2024	Date of mailing of the international search report 12/07/2024
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Schuhmacher, Jörg

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2022/392767 A1 (HUNG CHIH YUNG [TW] ET AL) 8 December 2022 (2022-12-08) paragraphs [0027], [0028], [0049]; figures 1,2,9,10 -----	3,4, 7-12, 17-20
Y	US 2010/216261 A1 (BRENNINGER GEORG [DE] ET AL) 26 August 2010 (2010-08-26) paragraph [0022] -----	3,4, 7-12, 17-20

International application No.
PCT/US2023/086200

INTERNATIONAL SEARCH REPORT

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims;; it is covered by claims Nos.:

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 5, 6, 13-16(completely); 1, 2, 7-12(partially)

   A method of processing semiconductor wafers within a heated chamber as indicated in claims 1 or 13, characterized in that a first gas flow or a second gas flow the gas flows having intersecting directions is modulated based on a distance of the wafer and the susceptor sidewall.

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2. claims: 3, 4, 17-20(completely); 1, 2, 7-12(partially)

   A method of processing semiconductor wafers within a heated chamber as indicated in claims 1 or 17, characterized in that a heat supplied is modulated based on a distance of the wafer and the susceptor sidewall.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2023/086200

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