PTO/AIA/15 (10-17)
Approved for use through 11/30/2020. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

UTILITY PATENT APPLICATION TRANSMITTAL

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.	10018-01-0015-US-CON1
First Named Inventor	Mei Lan GUO
Title	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS
Priority Mail Express® Label No.	

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents.

1. [✔] **Fee Transmittal Form** (PTO/SB/17 or equivalent)
2. [ ] **Applicant asserts small entity status.** See 37 CFR 1.27
3. [ ] **Applicant certifies micro entity status.** See 37 CFR 1.29. Applicant must attach form PTO/SB/15A or B or equivalent.
4. [✔] **Specification** [*Total Pages* 34] Both the claims and abstract must start on a new page. *(See MPEP § 608.01(a) for information on the preferred arrangement)*
5. [✔] **Drawing(s)** (35 U.S.C. 113) [*Total Sheets* 20]
6. **Inventor's Oath or Declaration** [*Total Pages* 3] *(including substitute statements under 37 CFR 1.64 and assignments serving as an oath or declaration under 37 CFR 1.63(e))*
   a. [ ] Newly executed (original or copy)
   b. [✔] A copy from a prior application (37 CFR 1.63(d))
7. [✔] **Application Data Sheet** ** See note below.* See 37 CFR 1.76 (PTO/AIA/14 or equivalent)
8. **CD-ROM or CD-R** in duplicate, large table, or Computer Program (*Appendix*)
   [ ] Landscape Table on CD
9. **Nucleotide and/or Amino Acid Sequence Submission** (*if applicable, items a. – c. are required*)
   a. [ ] Computer Readable Form (CRF)
   b. [ ] Specification Sequence Listing on:
      i. [ ] CD-ROM or CD-R (2 copies); or
      ii. [ ] Paper
   c. [ ] Statements verifying identity of above copies

ADDRESS TO:

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

ACCOMPANYING APPLICATION PAPERS

10. [ ] **Assignment Papers** (cover sheet & document(s)) Name of Assignee Yangtze Memory Technologies Co., Ltd.
11. [ ] **37 CFR 3.73(c) Statement** (*when there is an assignee*) [✔] **Power of Attorney**
12. [ ] **English Translation Document** (*if applicable*)
13. [✔] **Information Disclosure Statement** (PTO/SB/08 or PTO-1449)
    [ ] Copies of citations attached
14. [ ] **Preliminary Amendment**
15. [ ] **Return Receipt Postcard** (*MPEP § 503*) (*Should be specifically itemized*)
16. [ ] **Certified Copy of Priority Document(s)** (*if foreign priority is claimed*)
17. [ ] **Nonpublication Request** Under 35 U.S.C. 122(b)(2)(B)(i). Applicant must attach form PTO/SB/35 or equivalent.
18. [ ] **Other:** _____

***Note**: (1) Benefit claims under 37 CFR 1.78 and foreign priority claims under 1.55 **must** be included in an Application Data Sheet (ADS).
(2) For applications filed under 35 U.S.C. 111, the application must contain an ADS specifying the applicant if the applicant is an assignee, person to whom the inventor is under an obligation to assign, or person who otherwise shows sufficient proprietary interest in the matter. See 37 CFR 1.46(b).

19. CORRESPONDENCE ADDRESS

[✔] The address associated with Customer Number: 153988 **OR** [ ] Correspondence address below

Name					
Address					
City		State		Zip Code	
Country		Telephone		Email	

Signature	/Zhiwei Zou/	Date	1/17/2020
Name (Print/Type)	Zhiwei Zou	Registration No. (Attorney/Agent)	66,041

PTO/SB/17 (01-18)
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Under the Paperwork Reduction Act of 1995 no persons are required to respond to a collection of information unless it displays a valid OMB control number

FEE TRANSMITTAL

Complete if known	
Application Number	
Filing Date	
First Named Inventor	Mei Lan GUO
Examiner Name	To Be Assigned
Art Unit	To Be Assigned
Practitioner Docket No.	10018-01-0015-US-CON1

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29. Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

TOTAL AMOUNT OF PAYMENT ($) 1720

METHOD OF PAYMENT (check all that apply)

☐ Check ■ Credit Card ☐ Money Order ☐ None ☐ Other (please identify): _____

■ Deposit Account Deposit Account Number: 602227 Deposit Account Name: BAYES DEPOSIT ACCOUNT

For the above-identified deposit account, the Director is hereby authorized to (check all that apply):

☐ Charge fee(s) indicated below ☐ Charge fee(s) indicated below, **except for the filing fee**

■ Charge any additional fee(s) or underpayment of fee(s) under 37 CFR 1.16 and 1.17 ☐ Credit any overpayment of fee(s)

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

FEE CALCULATION

1. BASIC FILING, SEARCH, AND EXAMINATION FEES (U = undiscounted fee; S = small entity fee; M = micro entity fee)

	FILING FEES			SEARCH FEES			EXAMINATION FEES			
Application Type	**U ($)**	**S ($)**	**M ($)**	**U ($)**	**S ($)**	**M ($)**	**U ($)**	**S ($)**	**M ($)**	**Fees Paid ($)**
Utility	300	150*	75	660	330	165	760	380	190	1720
Design	200	100	50	160	80	40	600	300	150	
Plant	200	100	50	420	210	105	620	310	155	
Reissue	300	150	75	660	330	165	2,200	1,100	550	
Provisional	280	140	70	0	0	0	0	0	0	

* The $150 small entity status filing fee for a utility application is further reduced to $75 for a small entity status applicant who files the application via EFS-Web.

2. EXCESS CLAIM FEES

Fee Description	**Undiscounted Fee ($)**	**Small Entity Fee ($)**	**Micro Entity Fee ($)**
Each claim over 20 (including Reissues)	100	50	25
Each independent claim over 3 (including Reissues)	460	230	115
Multiple dependent claims	820	410	205

Total Claims		**Extra Claims**		**Fee ($)**		**Fee Paid ($)**
20	-20 or HP =	0	x	0.00	=	

HP = highest number of total claims paid for, if greater than 20.

Indep. Claims		**Extra Claims**		**Fee ($)**		**Fee Paid ($)**
3	-3 or HP =	0	x	0.00	=	

HP = highest number of independent claims paid for, if greater than 3.

Multiple Dependent Claims	**Fee ($)**	**Fee Paid ($)**

3. APPLICATION SIZE FEE

If the specification and drawings exceed 100 sheets of paper (excluding electronically filed sequence or computer listings under 37 CFR 1.52(e)), the application size fee due is $400 ($200 for small entity) ($100 for micro entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).

Total Sheets		**Extra Sheets**		**Number of each additional 50 or fraction thereof**		**Fee ($)**		**Fee Paid ($)**
20	- 100 =		/ 50 =		(round **up** to a whole number) x		=	

4. OTHER FEE(S) **Fees Paid ($)**

Non-English specification, $130 fee (no small or micro entity discount) _____

Non-electronic filing fee under 37 CFR 1.16(t) for a utility application, $400 fee ($200 small or micro entity) _____

Other (e.g., late filing surcharge): _____ _____

SUBMITTED BY

Signature	/Zhiwei Zou/	Registration No. (Attorney/Agent) 66,041	Telephone
Name (Print/Type)	Zhiwei Zou		Date 1/17/2020

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10018-01-0015-US-CON1
	Application Number	
Title of Invention	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Mei Lan		Guo	

Residence Information (Select One) US Residency ● Non US Residency Active US Military Service

City	Wuhan	Country of Residence [i]	CN

Mailing Address of Inventor:

Address 1	18 Gaoxin 4th Road
Address 2	East Lake High-Tech Development Zone

City	Wuhan	State/Province	
Postal Code		Country [i]	CN

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Yushi		Hu	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Wuhan	Country of Residence [i]	CN

Mailing Address of Inventor:

Address 1	18 Gaoxin 4th Road
Address 2	East Lake High-Tech Development Zone

City	Wuhan	State/Province	
Postal Code		Country [i]	CN

Inventor 3 Remove

Legal Name

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	Application Number	
Title of Invention	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME	

Prefix	Given Name	Middle Name	Family Name	Suffix
	Ji		Xia	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Wuhan	Country of Residence [i]	CN

Mailing Address of Inventor:

Address 1	18 Gaoxin 4th Road
Address 2	East Lake High-Tech Development Zone

City	Wuhan	State/Province	
Postal Code		Country [i]	CN

Inventor 4 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Hongbin		Zhu	

Residence Information (Select One) US Residency ◉ Non US Residency Active US Military Service

City	Wuhan	Country of Residence [i]	CN

Mailing Address of Inventor:

Address 1	18 Gaoxin 4th Road
Address 2	East Lake High-Tech Development Zone

City	Wuhan	State/Province	
Postal Code		Country [i]	CN

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	153988		
Email Address	uspto@bayes.law	Add Email	Remove Email

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10018-01-0015-US-CON1
	Application Number	
Title of Invention	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME	

Application Information:

Title of the Invention	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME		
Attorney Docket Number	10018-01-0015-US-CON1	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	20	**Suggested Figure for Publication (if any)**	1

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	153988		

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	Application Number	
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Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	16149103	2018-10-01
Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
16149103	Continuation of	PCT/CN2018/101482	2018-08-21

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

Remove

Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

Additional Foreign Priority Data may be generated within this form by selecting the **Add** button. Add

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10018-01-0015-US-CON1
	Application Number	
Title of Invention	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	10018-01-0015-US-CON1
	Application Number	
Title of Invention	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	YANGTZE MEMORY TECHNOLOGIES CO., LTD.		
Mailing Address Information For Applicant:			
Address 1	18 Gaoxin 4th Road		
Address 2	East Lake High-Tech Development Zone		
City	Wuhan	**State/Province**	
Country	CN	Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Title of Invention	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Zhiwei Zou/			Date (YYYY-MM-DD)	2020-01-17
First Name	Zhiwei	Last Name	Zou	Registration Number	66,041

Additional Signature may be generated within this form by selecting the Add button. Add

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This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1 The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3 A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ABSTRACT

Embodiments of three-dimensional (3D) memory devices having through array contacts (TACs) and methods for forming the same are disclosed. In an example, a method for forming a 3D memory device is disclosed. A dielectric stack including a plurality of dielectric/sacrificial layer pairs is formed on a substrate. A channel structure extending vertically through the dielectric stack is formed. A first opening extending vertically through the dielectric stack is formed. A spacer is formed on a sidewall of the first opening. A TAC extending vertically through the dielectric stack is formed by depositing a conductor layer in contact with the spacer in the first opening. A slit extending vertically through the dielectric stack is formed after forming the TAC. A memory stack including a plurality of conductor/dielectric layer pairs is formed on the substrate by replacing, through the slit, the sacrificial layers in the dielectric/sacrificial layer pairs with a plurality of conductor layers.

WHAT IS CLAIMED IS:

1. A method for forming a three-dimensional (3D) memory device, comprising:

forming a stack comprising a plurality of dielectric/sacrificial layer pairs on a substrate;

forming a channel structure extending vertically through the stack;

forming a first opening extending vertically through the stack;

forming a spacer on a sidewall of the first opening;

forming a through array contact (TAC) extending vertically through the stack by depositing a conductor layer over the spacer in the first opening; and

after forming the TAC, forming a slit extending vertically through the stack.

2. The method of claim 1, further comprising prior to forming the first opening, forming a dummy channel structure extending vertically through the stack.

3. The method of claim 1, wherein forming the first opening comprises simultaneously etching the first opening through the stack and a second opening outside of the stack.

4. The method of claim 3, wherein forming the TAC comprises depositing the conductor layer in the first opening to form the TAC and in the second opening to form a peripheral contact.

5. The method of claim 1, wherein forming the spacer on the sidewall of the first opening comprises:

depositing a dielectric layer on the sidewall and a bottom surface of the first opening; and

removing part of the dielectric layer that is deposited on the bottom surface of the first opening.

6. The method of claim 5, wherein the deposition of the dielectric layer comprises atomic layer deposition (ALD), and the removal of the part of the dielectric layer comprises anisotropic etching on the bottom surface of the first opening.

7. The method of claim 1, wherein forming the spacer on the sidewall of the first opening comprises:

forming a plurality of shallow recesses by removing parts of the sacrificial layers abutting the sidewall of the first opening;

depositing a dielectric layer filling in the shallow recesses and on the sidewall and a bottom surface of the first opening; and

removing part of the dielectric layer that is deposited on the bottom surface of the first opening.

8. The method of claim 7, wherein the removal of the part of the dielectric layer comprises isotropic etching on the sidewall and the bottom surface of the first opening.

9. The method of claim 1, wherein forming the first opening comprises:

simultaneously etching the first opening through the stack, a second opening outside of the stack, and a third opening through the stack,

wherein a lateral dimension of the third opening is smaller than lateral dimensions of the first and second openings.

10. The method of claim 9, wherein forming the spacer on the sidewall of the first opening comprises:

depositing a dielectric layer (i) fully filling in the third opening to form a dummy channel structure and (ii) partially filling in the first opening and the second opening; and

removing parts of the dielectric layer that are deposited on a bottom surface of the first opening and on a bottom surface of the second opening.

11. A method for forming a three-dimensional (3D) memory device, comprising:

forming a stack comprising a plurality of dielectric/sacrificial layer pairs on a substrate;

forming a channel structure extending vertically through the stack;

forming a dummy channel structure extending vertically through the stack;

simultaneously etching a first opening through the stack and a second opening outside of the stack;

simultaneously forming a first spacer on a sidewall of the first opening and a second spacer on a sidewall of the second opening;

depositing a conductor layer (i) filling in the first opening to form a through array contact (TAC) and (ii) filling in the second opening to form a peripheral contact; and

after forming the TAC and peripheral contact, forming a slit extending vertically through the stack.

12. The method of claim 11, wherein forming the first spacer on the sidewall of the first opening comprises:

depositing a dielectric layer on the sidewall and a bottom surface of the first opening; and

removing part of the dielectric layer that is deposited on the bottom surface of the first opening.

13. The method of claim 12, wherein the deposition of the dielectric layer comprises atomic layer deposition (ALD), and the removal of the part of the dielectric layer comprises anisotropic etching on the bottom surface of the first opening.

14. The method of claim 11, wherein forming the first spacer on the sidewall of the first opening comprises:

forming a plurality of shallow recesses by removing parts of the sacrificial layers abutting the sidewall of the first opening;

depositing a dielectric layer filling in the shallow recesses and on the sidewall and a bottom surface of the first opening; and

removing part of the dielectric layer that is deposited on the bottom surface of the first opening.

15. The method of claim 14, wherein the removal of the part of the dielectric layer comprises isotropic etching on the sidewall and the bottom surface of the first opening.

16. The method of claim 11, further comprising forming a slit structure by depositing a conductor layer in the slit.

17. The method of claim 11, wherein the dielectric layers in the dielectric/sacrificial layer pairs comprise silicon oxide, the sacrificial layers in the dielectric/sacrificial layer pairs comprise silicon nitride, and the first and second spacers comprise silicon oxide.

18. A method for forming a three-dimensional (3D) memory device, comprising:

forming a stack comprising a plurality of dielectric/sacrificial layer pairs on a substrate;

forming a channel structure extending vertically through the stack;

simultaneously etching a first opening through the stack, a second opening outside of the stack, and a third opening through the stack, wherein a lateral dimension of the third opening is smaller than lateral dimensions of the first and second openings;

depositing a dielectric layer (i) fully filling in the third opening to form a dummy channel structure and (ii) partially filling in the first opening and the second opening;

removing parts of the dielectric layer that are deposited on a bottom surface of the first opening and on a bottom surface of the second opening;

depositing a conductor layer (i) filling in the first opening to form a through array contact (TAC) and (ii) filling in the second opening to form a peripheral contact; and

after forming the TAC and peripheral contact, forming a slit extending vertically through the stack.

19. The method of claim 18, further comprising forming a slit structure by depositing a conductor layer in the slit.

20. The method of claim 18, further comprising prior to etching the first, second, and third openings, forming a staircase structure at one side of the stack.

THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME

CROSS REFERENCE TO RELATED APPLICATION

[0001] This application is continuation of U.S. Application No. 16/149,103, filed on October 1, 2018, entitled "THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME," which is continuation of International Application No. PCT/CN2018/101482, filed on August 21, 2018, entitled "THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME," both of which are hereby incorporated by reference in their entireties.

BACKGROUND

[0002] Embodiments of the present disclosure relate to three-dimensional (3D) memory devices and fabrication methods thereof.

[0003] Planar memory cells are scaled to smaller sizes by improving process technology, circuit design, programming algorithm, and fabrication process. However, as feature sizes of the memory cells approach a lower limit, planar process and fabrication techniques become challenging and costly. As a result, memory density for planar memory cells approaches an upper limit.

[0004] A 3D memory architecture can address the density limitation in planar memory cells. The 3D memory architecture includes a memory array and peripheral devices for controlling signals to and from the memory array.

SUMMARY

[0005] Embodiments of 3D memory devices and fabrication methods thereof are disclosed herein.

[0006] In one example, a method for forming a 3D memory device is disclosed. A dielectric stack including a plurality of dielectric/sacrificial layer pairs is formed on a substrate. A channel structure extending vertically through the dielectric stack is formed. A first opening extending vertically through the dielectric stack is formed. A spacer is

formed on a sidewall of the first opening. A through array contact (TAC) extending vertically through the dielectric stack is formed by depositing a conductor layer in contact with the spacer in the first opening. A slit extending vertically through the dielectric stack is formed after forming the TAC. A memory stack including a plurality of conductor/dielectric layer pairs is formed on the substrate by replacing, through the slit, the sacrificial layers in the dielectric/sacrificial layer pairs with a plurality of conductor layers.

[0007] In another example, a method for forming a 3D memory device is disclosed. A dielectric stack including a plurality of dielectric/sacrificial layer pairs is formed on a substrate. A channel structure extending vertically through the dielectric stack is formed. A dummy channel structure extending vertically through the dielectric stack is formed. A first opening through the dielectric stack and a second opening outside of the dielectric stack are simultaneously etched. A first spacer on a sidewall of the first opening and a second spacer on a sidewall of the second opening are simultaneously formed. A conductor layer is deposited (i) filling in the first opening to form a TAC and (ii) filling in the second opening to form a peripheral contact. A slit extending vertically through the dielectric stack is formed after forming the TAC and peripheral device. A memory stack including a plurality of conductor/dielectric layer pairs is formed on the substrate by replacing, through the slit, the sacrificial layers in the dielectric/sacrificial layer pairs with a plurality of conductor layers.

[0008] In still another example, a method for forming a 3D memory device is disclosed. A dielectric stack including a plurality of dielectric/sacrificial layer pairs is formed on a substrate. A channel structure extending vertically through the dielectric stack is formed. A first opening through the dielectric stack, a second opening outside of the dielectric stack, and a third opening through the dielectric stack are simultaneously etched. A lateral dimension of the third opening is smaller than lateral dimensions of the first and second openings. A dielectric layer is deposited (i) fully filling in the third opening to form a dummy channel structure and (ii) partially filling in the first opening and the second opening. Parts of the dielectric layer that are deposited on a bottom surface of the first opening and on a bottom surface of the second opening are removed. A conductor layer is deposited (i) filling in the first opening to form a TAC and (ii) filling in the second opening to form a peripheral contact. A slit extending vertically through the

dielectric stack is formed after forming the TAC and peripheral device. A memory stack including a plurality of conductor/dielectric layer pairs is formed on the substrate by replacing, through the slit, the sacrificial layers in the dielectric/sacrificial layer pairs with a plurality of conductor layers.

[0009] In a different example, a 3D memory device includes a substrate, a memory stack on the substrate including a plurality of conductor/dielectric layer pairs, a channel structure extending vertically through the conductor/dielectric layer pairs in the memory stack, a TAC extending vertically through the conductor/dielectric layer pairs in the memory stack, and a dummy channel structure fully filled with a dielectric layer and extending vertically through the conductor/dielectric layer pairs in the memory stack.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The accompanying drawings, which are incorporated herein and form a part of the specification, illustrate embodiments of the present disclosure and, together with the description, further serve to explain the principles of the present disclosure and to enable a person skilled in the pertinent art to make and use the present disclosure.

[0011] FIG. 1 illustrates a cross-section of an exemplary 3D memory device, according to some embodiments of the present disclosure.

[0012] FIGs. 2A–2E illustrate an exemplary fabrication process for forming channel structures of a 3D memory device, according to some embodiments of the present disclosure.

[0013] FIGs. 3A–3F illustrate exemplary fabrication processes for forming TACs, peripheral contacts, and dummy channel structures of a 3D memory device, according to various embodiments of the present disclosure.

[0014] FIGs. 4A–4C illustrate another exemplary fabrication process for forming TACs, peripheral contacts, and dummy channel structures of a 3D memory device, according to some embodiments of the present disclosure.

[0015] FIGs. 5A–5B illustrate an exemplary fabrication process for forming a slit structure and word line contacts of a 3D memory device, according to some embodiments of the present disclosure.

[0016] FIG. 6 is a flowchart of an exemplary method for forming a 3D memory device, according to some embodiments.

[0017] FIG. 7A is a flowchart of an exemplary method for forming a spacer on a sidewall of an opening, according to some embodiments of the present disclosure.

[0018] FIG. 7B is a flowchart of another exemplary method for forming a spacer on a sidewall of an opening, according to some embodiments of the present disclosure.

[0019] FIG. 8 is a flowchart of another exemplary method for forming a 3D memory device, according to some embodiments of the present disclosure.

[0020] Embodiments of the present disclosure will be described with reference to the accompanying drawings.

DETAILED DESCRIPTION

[0021] Although specific configurations and arrangements are discussed, it should be understood that this is done for illustrative purposes only. A person skilled in the pertinent art will recognize that other configurations and arrangements can be used without departing from the spirit and scope of the present disclosure. It will be apparent to a person skilled in the pertinent art that the present disclosure can also be employed in a variety of other applications.

[0022] It is noted that references in the specification to "one embodiment," "an embodiment," "an example embodiment," "some embodiments," etc., indicate that the embodiment described may include a particular feature, structure, or characteristic, but every embodiment may not necessarily include the particular feature, structure, or characteristic. Moreover, such phrases do not necessarily refer to the same embodiment. Further, when a particular feature, structure or characteristic is described in connection with an embodiment, it would be within the knowledge of a person skilled in the pertinent art to effect such feature, structure or characteristic in connection with other embodiments whether or not explicitly described.

[0023] In general, terminology may be understood at least in part from usage in context. For example, the term "one or more" as used herein, depending at least in part upon context, may be used to describe any feature, structure, or characteristic in a singular sense or may be used to describe combinations of features, structures or characteristics in a plural sense. Similarly, terms, such as "a," "an," or "the," again, may be understood to convey a singular usage or to convey a plural usage, depending at least in part upon context. In addition, the term "based on" may be understood as not necessarily intended

to convey an exclusive set of factors and may, instead, allow for existence of additional factors not necessarily expressly described, again, depending at least in part on context.

[0024] It should be readily understood that the meaning of "on," "above," and "over" in the present disclosure should be interpreted in the broadest manner such that "on" not only means "directly on" something but also includes the meaning of "on" something with an intermediate feature or a layer therebetween, and that "above" or "over" not only means the meaning of "above" or "over" something but can also include the meaning it is "above" or "over" something with no intermediate feature or layer therebetween (i.e., directly on something).

[0025] Further, spatially relative terms, such as "beneath," "below," "lower," "above," "upper," and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. The spatially relative terms are intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. The apparatus may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein may likewise be interpreted accordingly.

[0026] As used herein, the term "substrate" refers to a material onto which subsequent material layers are added. The substrate itself can be patterned. Materials added on top of the substrate can be patterned or can remain unpatterned. Furthermore, the substrate can include a wide array of semiconductor materials, such as silicon, germanium, gallium arsenide, indium phosphide, etc. Alternatively, the substrate can be made from an electrically non-conductive material, such as a glass, a plastic, or a sapphire wafer.

[0027] As used herein, the term "layer" refers to a material portion including a region with a thickness. A layer can extend over the entirety of an underlying or overlying structure or may have an extent less than the extent of an underlying or overlying structure. Further, a layer can be a region of a homogeneous or inhomogeneous continuous structure that has a thickness less than the thickness of the continuous structure. For example, a layer can be located between any pair of horizontal planes between, or at, a top surface and a bottom surface of the continuous structure. A layer can extend laterally, vertically, and/or along a tapered surface. A substrate can be a layer, can include one or more layers therein, and/or can have one or more layer thereupon, thereabove, and/or therebelow. A layer can include multiple layers. For example, an

interconnect layer can include one or more conductor and contact layers (in which interconnect lines and/or via contacts are formed) and one or more dielectric layers.

[0028] As used herein, the term "nominal/nominally" refers to a desired, or target, value of a characteristic or parameter for a component or a process operation, set during the design phase of a product or a process, together with a range of values above and/or below the desired value. The range of values can be due to slight variations in manufacturing processes or tolerances. As used herein, the term "about" indicates the value of a given quantity that can vary based on a particular technology node associated with the subject semiconductor device. Based on the particular technology node, the term "about" can indicate a value of a given quantity that varies within, for example, 10–30% of the value (e.g., ±10%, ±20%, or ±30% of the value).

[0029] As used herein, the term "3D memory device" refers to a semiconductor device with vertically oriented strings of memory cell transistors (referred to herein as "memory strings," such as NAND memory strings) on a laterally-oriented substrate so that the memory strings extend in the vertical direction with respect to the substrate. As used herein, the term "vertical/vertically" means nominally perpendicular to the lateral surface of a substrate.

[0030] In some 3D memory devices, interconnects can include through array contacts (TACs) for providing vertical interconnects between the stacked memory array device and peripheral device (e.g., for power bus and metal routing), thereby reducing metal levels and shrinking die size. TACs can be formed within barrier structures, which preserves a dielectric stack region within a memory stack for ease of etching the openings of the TACs. However, the regions enclosed by the barrier structures take up large area in the core array region where memory strings can be formed and also have a negative impact on the resistance of word lines. Moreover, the existing fabrication processes for forming the barrier structures become more challenging for the next-generation 3D memory devices (e.g., having 128 levels or more), which have less process margin.

[0031] Various embodiments in accordance with the present disclosure provide a 3D memory device having TACs not enclosed by barrier structures, which resolves the above-noted issues associated with the barrier structures. For example, by removing the barrier structures, the areas for TACs can be reduced while keeping their functions, thereby increasing memory cell density and decreasing process cost. More process

margin can also be obtained due to the elimination of etching and alignment steps for making the barrier structures, which enables high process extendibility for both current and future generations of 3D memory devices. Moreover, various embodiments of methods for forming the 3D memory device disclosed herein can allow TACs to be formed in the same fabrication process(es) for making other structures (e.g., peripheral contacts and/or dummy channel structures) and thus, further simplify the fabrication flow and reduce process cost.

[0032] FIG. 1 illustrates a cross-section of an exemplary 3D memory device 100, according to some embodiments of the present disclosure. 3D memory device 100 can include a substrate 102, which can include silicon (e.g., single crystalline silicon), silicon germanium (SiGe), gallium arsenide (GaAs), germanium (Ge), silicon on insulator (SOI), or any other suitable materials. In some embodiments, substrate 102 is a thinned substrate (e.g., a semiconductor layer), which was thinned from a normal thickness by grinding, wet/dry etching, chemical mechanical polishing (CMP), or any combination thereof.

[0033] 3D memory device 100 can include a memory stack 104 above substrate 102. Memory stack 104 can be a stacked storage structure through which memory strings (e.g., NAND memory strings 106) are formed. In some embodiments, memory stack 104 includes a plurality of conductor/dielectric layer pairs stacked vertically above substrate 102. Each conductor/dielectric layer pair can include a conductor layer 110 and a dielectric layer 112. That is, memory stack 104 can include interleaved conductor layers 110 and dielectric layers 112 stacked vertically. As shown in FIG. 1, each NAND memory string 106 extends vertically through interleaved conductor layers 110 and dielectric layers 112 in memory stack 104. In some embodiments, 3D memory device 100 is a NAND Flash memory device in which memory cells are provided at intersections of NAND memory strings 106 and conductor layers 110 (functioning as word lines) of 3D memory device 100. The number of conductor/dielectric layer pairs in memory stack 104 (e.g., 32, 64, 96, or 128) can set the number of memory cells in 3D memory device 100.

[0034] Conductor layers 110 can each have the same thickness or have different thicknesses. Similarly, dielectric layers 112 can each have the same thickness or have different thicknesses. Conductor layers 110 can include conductive materials including,

but not limited to, tungsten (W), cobalt (Co), copper (Cu), aluminum (Al), polycrystalline silicon (polysilicon), doped silicon, silicides, or any combination thereof. Dielectric layers 112 can include dielectric materials including, but not limited to, silicon oxide, silicon nitride, silicon oxynitride, or any combination thereof. In some embodiments, conductor layers 110 include metals, such as W, and dielectric layers 112 include silicon oxide. It is understood that a silicon oxide film (not shown), such as an in-situ steam generation (ISSG) silicon oxide, is formed between substrate 102 (e.g., a silicon substrate) and memory stack 104, according to some embodiments.

[0035] It is noted that *x*, *y*, and z axes are added to FIG. 1 to further illustrate the spatial relationship of the components in 3D memory device 100. The *x*-, *y*-, and *z*-directions are perpendicular to one another. Substrate 102 includes two lateral surfaces (e.g., a top surface and a bottom surface) extending laterally in the *x*-direction and *y*-direction (the lateral direction) in the *x*-*y* plane. As used herein, whether one component (e.g., a layer or a device) is "on," "above," or "below" another component (e.g., a layer or a device) of a semiconductor device (e.g., 3D memory device 100) is determined relative to the substrate (e.g., substrate 102) of the semiconductor device in the *z*-direction (the vertical direction) when the substrate is positioned in the lowest plane of the semiconductor device in the *z*-direction. The same notion for describing spatial relationship is applied throughout the present disclosure.

[0036] In some embodiments, 3D memory device 100 is part of a monolithic 3D memory device, in which the components of the monolithic 3D memory device (e.g., memory cells and peripheral devices) are formed on a single substrate (e.g., substrate 102). Peripheral devices 111, such as any suitable digital, analog, and/or mixed-signal peripheral circuits used for facilitating the operation of 3D memory device 100, can be formed on substrate 102 as well, outside of memory stack 104. Peripheral device 111 can be formed "on" substrate 102, where the entirety or part of peripheral device 111 is formed in substrate 102 (e.g., below the top surface of substrate 102) and/or directly on substrate 102. Peripheral device 111 can include one or more of a page buffer, a decoder (e.g., a row decoder and a column decoder), a sense amplifier, a driver, a charge pump, a current or voltage reference, or any active or passive components of the circuits (e.g., transistors, diodes, resistors, or capacitors). Isolation regions (e.g., shallow trench

isolations (STIs)) and doped regions (e.g., source regions and drain regions of the transistors) can be formed in substrate 102 as well, outside of memory stack 104.

[0037] As shown in FIG. 1, memory stack 104 can include an inner region 116 (also known as a "core array region") and an outer region 118 (also known as a "staircase region"). In some embodiments, inner region 116 is the center region of memory stack 104 where an array of NAND memory strings 106 are formed through the conductor/dielectric layer pairs, and outer region 118 is the remaining region of memory stack 104 surrounding inner region 116 (including the sides and edges) without NAND memory strings 106.

[0038] As shown in FIG. 1, each NAND memory string 106 can include a channel structure 108 extending vertically through the conductor/dielectric layer pairs in inner region 116 of memory stack 104. Channel structure 108 can include a channel hole filled with semiconductor materials (e.g., forming a semiconductor channel) and dielectric materials (e.g., forming a memory film). In some embodiments, the semiconductor channel includes silicon, such as amorphous silicon, polysilicon, or single crystalline silicon. In some embodiments, the memory film is a composite layer including a tunneling layer, a storage layer (also known as a "charge trap/storage layer"), and a blocking layer. Each NAND memory string 106 can have a cylinder shape (e.g., a pillar shape). The semiconductor channel, tunneling layer, storage layer, and blocking layer are arranged along a direction from the center toward the outer surface of the pillar in this order, according to some embodiments. The tunneling layer can include silicon oxide, silicon oxynitride, or any combination thereof. The storage layer can include silicon nitride, silicon oxynitride, silicon, or any combination thereof. The blocking layer can include silicon oxide, silicon oxynitride, high dielectric constant (high-k) dielectrics, or any combination thereof.

[0039] In some embodiments, NAND memory strings 106 include a plurality of control gates (each being part of a word line/conductor layer 110) for NAND memory strings 106. Conductor layer 110 in each conductor/dielectric layer pair can function as a control gate for memory cells of NAND memory string 106. Conductor layer 110 can include multiple control gates for multiple NAND memory strings 106 and can extend laterally as a word line ending in outer region 118 of memory stack 104.

[0040] In some embodiments, NAND memory string 106 includes two plugs 117 and 119 at a respective end in the vertical direction. Each plug 117 or 119 can be in contact with a respective end of channel structure 108. Plug 117 can include a semiconductor material, such as silicon, that is epitaxially grown from substrate 102. Plug 117 can function as the channel controlled by a source select gate of NAND memory string 106. Plug 117 can be at the lower end of NAND memory string 106 and in contact with channel structure 108 (e.g., on the upper end of channel structure 108). As used herein, the "upper end" of a component (e.g., NAND memory string 106) is the end father away from substrate 102 in the *z*-direction, and the "lower end" of the component (e.g., NAND memory string 106) is the end closer to substrate 102 in the *z*-direction when substrate 102 is positioned in the lowest plane of 3D memory device 100.

[0041] Plug 119 can include semiconductor materials (e.g., polysilicon) or conductor materials (e.g., metals). In some embodiments, plug 119 includes an opening filled with titanium/titanium nitride (Ti/TiN as a barrier layer) and tungsten (as a conductor). By covering the upper end of channel structure 108 during the fabrication of 3D memory device 100, plug 119 can function as an etch stop layer to prevent etching of dielectrics filled in channel structure 108, such as silicon oxide and silicon nitride. In some embodiments, plug 119 functions as the drain of NAND memory string 106.

[0042] In some embodiments, memory stack 104 includes a lower memory deck 120 disposed on substrate 102 and an upper memory deck 122 disposed above lower memory deck 120. A joint layer 124 can be disposed vertically between and electrically isolate lower memory deck 120 and upper memory deck 122. Each of lower and upper memory deck 120 and 122 can have the same or different number of conductor/dielectric layer pairs. Joint layer 124 can include dielectrics, such as silicon oxide. By separating memory stack 104 into lower and upper memory decks 120 and 122, or even more memory decks in some embodiments, channel structure 108 of NAND memory string 106 can be jointed by multiple channel structures, each of which is separately formed through a respective memory deck, to increase process yield. As shown in FIG. 1, channel structure 108 of NAND memory sting 106 includes a lower channel structure 126 extending vertically through lower memory deck 120 and an upper channel structure 128 extending vertically through upper memory deck. In some embodiments, an inter-deck plug 130 is disposed vertically between and in contact with lower channel structure 126

and upper channel structure 128. Inter-deck plug 130 can include semiconductor materials, such as polysilicon, and joint (e.g., electrically connect) lower and upper channel structures 126 and 128 to form channel structure 108. That is, NAND memory string 106 can include plug 117, lower channel structure 126, inter-deck plug 130, upper channel structure 128, and plug 119 from bottom to top in this order.

[0043] In some embodiments, 3D memory device 100 further includes slit structures 132. Each slit structure 132 can extend vertically through the conductor/dielectric layer pairs in memory stack 104. Slit structure 132 can also extend laterally (e.g., in the *y*-direction) to separate memory stack 104 into multiple blocks. Slit structure 132 can include an opening (slit) filled with conductive materials including, but not limited to, tungsten (W), cobalt (Co), copper (Cu), aluminum (Al), silicides, or any combination thereof. Slit structure 132 can further include a spacer having dielectric materials, such as silicon oxide, laterally between the filled conductive materials and memory stack 104 to electrically insulate the filled conductive materials from surrounding conductor layers 110 in memory stack 104. As a result, slit structures 132 can separate 3D memory device 100 into multiple memory blocks and/or memory fingers.

[0044] In some embodiments, slit structure 132 functions as the source contact for NAND memory strings 106 in the same memory block or the same memory finger that share the same array common source. Slit structure 132 can thus be referred to as a "common source contact" of multiple NAND memory strings 106. In some embodiments, substrate 102 includes a doped region 134 (including p-type or n-type dopants at a desired doping level), and the lower end of slit structure 132 is in contact with doped region 134 of substrate 102. Slit structure 132 thus can electrically connect to NAND memory strings 106 by doped region 134.

[0045] As shown in FIG. 1, 3D memory device 100 further includes TACs 136 each extending vertically through the conductor/dielectric layer pairs in memory stack 104. Each TAC 136 can extend vertically through interleaved conductor layers 110 and dielectric layers 112. In some embodiments, TAC 136 can extend through the entire thickness of memory stack 104, (e.g., all the conductor/dielectric layer pairs in the vertical direction). In some embodiments, TAC 136 further extends through at least part of substrate 102. TAC 136 can carry electrical signals from and/or to 3D memory device 100, such as part of the power bus, with shorten interconnect routing. In some

embodiments, TAC 136 can provide electrical connections between 3D memory device 100 and peripheral device 111 and/or between back-end-of-line (BEOL) interconnects (not shown) and peripheral device 111. TAC 136 can also provide mechanical support to memory stack 104.

[0046] TAC 136 can include a vertical opening through memory stack 104 and that is filled with filling materials. In some embodiments, TAC 136 includes a spacer 138 on a sidewall of the opening and a conductor layer 140 in contact with spacer 138 in the opening. Conductor layer 140 can include conductive materials, including, but not limited to, W, Co, Cu, Al, doped silicon, silicides, or any combination thereof. Spacer 138 can electrically insulate conductor layer 140 of TAC 136 from surrounding conductor layers 110 in memory stack 104. In some embodiments, TAC 136 has a substantially circular shape in the plan view, and conductor layer 140 and spacer 138 are disposed radially from the center of TAC 136 in this order. Spacer 138 of TAC 136 can include dielectric materials including, but not limited to, silicon oxide, silicon nitride, silicon oxynitride, or any combination thereof.

[0047] As shown in FIG. 1, at least on one side in the lateral direction (e.g., in the *y*-direction), outer region 118 of memory stack 104 can include a staircase structure 142. In some embodiments, another staircase structure (not shown) is disposed on the opposite side of memory stack 104 in the *y*-direction. Each "level" of staircase structure 142 can include one or more conductor/dielectric layer pairs, each including conductor layer 110 and dielectric layer 112. The top layer in each level of staircase structure 142 can be conductor layer 110 for interconnection in the vertical direction. In some embodiments, each two adjacent levels of staircase structure 142 are offset by a nominally same distance in the vertical direction and a nominally same distance in the lateral direction. For each two adjacent levels of staircase structure 142, the first level (and conductor layer and dielectric layer therein) that is closer to substrate 102 can extend laterally further than the second level (and conductor layer and dielectric layer therein), thereby forming a "landing area" on the first level for interconnection in the vertical direction.

[0048] Staircase structure 142 can be used for landing word line contacts 144 and/or for balancing load in certain processes during fabrication (e.g., etching and chemical mechanical polishing (CMP)) by dummy channel structures 146 therethrough. The lower end of each word line contact 144 can be in contact with top conductor layer 110 (word

line) in a respective level of staircase structure 142 to individually address a corresponding word line of 3D memory device 100. Word line contact 144 can include an opening (e.g., a via hole or a trench) extending vertical through one or more dielectric layers and filled with conductive materials including, but not limited to, W, Co, Cu, Al, silicides, or any combination thereof.

[0049] Dummy channel structure 146 can extend vertically through memory stack 104 and have a vertical opening filled with the same materials as those in channel structure 108. Different from channel structures 108, a contact is not formed on dummy channel structure 146 to provide electrical connections with other components of 3D memory device 100, according to some embodiments. In some embodiments, dummy channel structure 146 is fully filled with dielectric materials including, but not limited to, silicon oxide, silicon nitride, silicon oxynitride, or any combination thereof. Thus, dummy channel structures 146 cannot be used for forming memory cells in 3D memory device 100. Instead, dummy channel structures 146 can provide mechanical support to the memory array structures, e.g., memory stack 104. Although dummy channel structures 146 are disposed in outer region 118 of memory stack 104 as shown in FIG. 1, it is understood that dummy channel structures 146 can be formed in inner region 116 of memory stack 104 as well. In some embodiments, dummy channel structure 146 is fully filled with a dielectric layer, such as a silicon oxide layer, and extends vertically through the conductor/dielectric layer pairs in memory stack 104, either in inner region 116 or in outer region 118.

[0050] As shown in FIG. 1, 3D memory device 100 can further include peripheral contacts 148 extending vertically through one or more dielectric layers and in contact with peripheral devices 111 outside of memory stack 104. Peripheral contact 148 can provide electrical connections with peripheral devices 111. Peripheral contact 148 can include a vertical opening filled with filling materials. In some embodiments, similar to TAC 136, peripheral contact 148 includes a spacer 150 on a sidewall of the opening and a conductor layer 152 in contact with spacer 150 in the opening. Conductor layer 152 can include conductive materials, including, but not limited to, W, Co, Cu, Al, doped silicon, silicides, or any combination thereof. In some embodiments, peripheral contact 148 has a substantially circular shape in the plan view, and conductor layer 152 and spacer 150 are disposed radially from the center of peripheral contact 148 in this order. Spacer 150 of

peripheral contact 148 can include dielectric materials including, but not limited to, silicon oxide, silicon nitride, silicon oxynitride, or any combination thereof. In some embodiments, spacer 150 of peripheral contact 148 and spacer 138 of TAC 136 have nominally the same thickness in the lateral direction (e.g., radial direction). In some embodiments, both spacer 150 of peripheral contact 148 and spacer 138 of TAC 136 include silicon oxide.

[0051] It is understood that 3D memory device 100 can include additional components and structures not shown in FIG. 1 including, but not limited to, other local contacts and interconnects in one or more BEOL interconnect layers above memory stack 104 and/or below substrate 102.

[0052] FIGs. 2A–2E illustrate an exemplary fabrication process for forming channel structures of a 3D memory device, according to some embodiments of the present disclosure. FIGs. 3A–3F illustrate exemplary fabrication processes for forming TACs, peripheral contacts, and dummy channel structures of a 3D memory device, according to various embodiments of the present disclosure. FIGs. 4A–4C illustrate another exemplary fabrication process for forming TACs, peripheral contacts, and dummy channel structures of a 3D memory device, according to some embodiments of the present disclosure. FIGs. 5A–5B illustrate an exemplary fabrication process for forming a slit structure and word line contacts of a 3D memory device, according to some embodiments of the present disclosure. FIG. 6 is a flowchart of an exemplary method 600 for forming a 3D memory device, according to some embodiments. FIG. 8 is a flowchart of another exemplary method 800 for forming a 3D memory device, according to some embodiments of the present disclosure. Examples of the 3D memory device depicted in FIGs. 2-6 and 8 include 3D memory device 100 depicted in FIG. 1. FIGs. 2-6 and 8 will be described together. It is understood that the operations shown in methods 600 and 800 are not exhaustive and that other operations can be performed as well before, after, or between any of the illustrated operations. Further, some of the operations may be performed simultaneously, or in a different order than shown in FIGs. 6 and 8.

[0053] Referring to FIG. 6, method 600 starts at operation 602, in which a dielectric stack including a plurality of dielectric/sacrificial layer pairs is formed on a substrate. The substrate can be a silicon substrate. In some embodiments, a lower dielectric deck is formed first, followed by the formation of a joint layer. An upper dielectric deck can then

be formed on the joint layer to form the dielectric stack. Method 600 proceeds to operation 604, as illustrated in FIG. 6, in which a channel structure extending vertically through the dielectric stack is formed. In some embodiments, a lower channel structure extending vertically through the lower dielectric deck is formed. An inter-deck plug can then be formed on the lower channel structure in the joint layer. Once the upper dielectric deck is formed, an upper channel structure extending vertically through the upper dielectric deck can be formed and jointed with the lower channel structure by the inter-deck plug, thereby forming the channel structure. In some embodiments, a staircase structure is formed at one side of the dielectric stack.

[0054] As illustrated in FIG. 2A, a lower dielectric deck 204 including a plurality of dielectric/sacrificial layer pairs is formed on a silicon substrate 202. In some embodiments, sacrificial layers 206 and dielectric layers 208 are alternatingly deposited by one or more thin film deposition processes including, but not limited to, physical vapor deposition (PVD), chemical vapor deposition (CVD), atomic layer deposition (ALD), or any combination thereof. In some embodiments, sacrificial layers 206 include silicon nitride, and dielectric layers 208 include silicon oxide. It is understood that the sequence of depositing sacrificial layers 206 and dielectric layers 208 is not limited. The deposition can start with sacrificial layer 206 or dielectric layer 208 and can end with sacrificial layer 206 or dielectric layer 208.

[0055] As illustrated in FIG. 2B, an array of lower channel structures 210 are formed, each of which extends vertically through interleaved sacrificial layers 206 and dielectric layers 208 in lower dielectric deck 204. In some embodiments, fabrication processes to form lower channel structure 210 include forming a channel hole through interleaved sacrificial layers 206 and dielectric layers 208 in lower dielectric deck 204 using dry etching/and or wet etching, such as deep reactive-ion etching (DRIE), followed by filling the channel hole with a plurality of layers, such as a dielectric layer and a semiconductor layer, using thin film deposition processes. In some embodiments, the dielectric layer is a composite dielectric layer, such as a combination of multiple dielectric layers including, but not limited to, a tunneling layer, a storage layer, and a blocking layer. The tunneling layer can include dielectric materials including, but not limited to, silicon oxide, silicon nitride, silicon oxynitride, or any combination thereof. The storage layer can include materials for storing charge for memory operation. The storage layer materials can

include, but not limited to, silicon nitride, silicon oxynitride, a combination of silicon oxide and silicon nitride, or any combination thereof. The blocking layer can include dielectric materials including, but not limited to, silicon oxide or a combination of silicon oxide/silicon oxynitride/silicon oxide (ONO). The blocking layer can further include a high-k dielectric layer, such as an aluminum oxide (Al_2O_3) layer. The semiconductor layer can include polysilicon, serving as a semiconductor channel. The semiconductor layer and dielectric layer can be formed by processes such as ALD, CVD, PVD, or any combination thereof.

[0056] As illustrated in FIG. 2B, a joint layer 212 is formed on lower dielectric deck 204 by depositing a dielectric layer, such as a silicon oxide layer, using thin film deposition processes, such as ALD, CVD, PVD, or any combination thereof. An array of inter-deck plugs 214 are formed in joint layer 212 and in contact with array of lower channel structures 210, respectively. Inter-deck plugs 214 can be formed by patterning and etching openings through joint layer 212, followed by deposition of semiconductor materials, such as polysilicon, using thin film deposition processes, such as ALD, CVD, PVD, or any combination thereof.

[0057] As illustrated in FIG. 2C, an upper dielectric deck 216 is formed on joint layer 212 and above lower dielectric deck 204. A dielectric stack 218 including lower dielectric deck 204 and upper dielectric deck 216 can thus be formed. The same fabrication processes for forming lower dielectric deck 204 can be used for forming upper dielectric deck 216 and thus, are not repeated again.

[0058] As illustrated in FIG. 2D, an array of upper channel structures 220 each extending vertically through upper dielectric deck 216 are formed and in contact with array of inter-deck plugs 214, respectively. An array of channel structures 222 each including lower channel structure 210 and upper channel structure 220 that are electrically connected by inter-deck plug 214 are thus formed. The same fabrication processes for forming lower channel structures 210 can be used for forming upper channel structures 220 and thus, are not repeated.

[0059] As illustrated in FIG. 2E, staircase structures 224 are formed on the sides of dielectric stack 218. Staircase structure 224 can be formed by the so-called "trim-etch" processes, which, in each cycle, trim (e.g., etching incrementally and inwardly, often from all directions) a patterned photoresist layer, followed by etching the exposed

portions of the dielectric/sacrificial layer pair using the trimmed photoresist layer as an etch mask to form one step of staircase structure 224.

[0060] Method 600 proceeds to operation 606, as illustrated in FIG 6, in which a dummy channel structure extending vertically through the dielectric stack is formed. As illustrated in FIG. 3A, an array of dummy channel structures 302 are formed through dielectric layer 218. Dummy channel structure 302 can be formed by first etching an opening through dielectric stack 218 and/or one or more dielectric layers using wet etching and/or dry etching, such as DRIE. In some embodiments, the opening is then fully filled with a dielectric layer, such as a silicon oxide layer, using one or more thin film deposition processes, such as ALD, CVD, PVD, or any combination thereof. In some embodiments, dummy channel structures 302 are formed simultaneously with channel structures 222 in the same fabrication steps, such that the opening of each dummy channel structure 302 is filled with at least some of the materials filling in channel structures 222.

[0061] Method 600 proceeds to operation 608, as illustrated in FIG 6, in which a first opening through the dielectric stack and a second opening outside of the dielectric stack are simultaneously etched. As illustrated in FIG. 3B, first openings (TAC holes) 304 each extending vertically through the dielectric/sacrificial layer pairs in dielectric stack 218 are formed by wet etching and/or drying etching of interleaved dielectric layers 208 and sacrificial layers 206 (e.g., silicon nitride and silicon oxide). In some embodiments, TAC holes 304 are etched using DRIE. Second openings (peripheral contact holes) 306 can be simultaneously formed by the same wet etching and/or drying etching process, such as DRIE, to etch through one or more dielectric layers (e.g., silicon oxide and/or silicon nitride) outside of dielectric stack 218. The depths of TAC hole 304 and peripheral contact hole 306 in the vertical direction can be nominally the same. The lateral dimensions of TAC hole 304 and peripheral contact hole 306, such as the diameters, can be nominally the same or different in various embodiments. For example, the diameter of TAC hole 304 is greater than the diameter of peripheral contact hole 306, according to some embodiments.

[0062] As shown in FIG. 3B, TAC hole 304 and peripheral contact hole 306 can reach to silicon substrate 202, and the lower end of peripheral contact hole 306 can be in contact with a peripheral device 307 formed on silicon substrate 202. In some embodiments,

peripheral device 307 includes transistors, which can be formed by a plurality of processes including, but not limited to, photolithography, dry/wet etch, thin film deposition, thermal growth, implantation, CMP, and any other suitable processes. In some embodiments, doped regions are formed in silicon substrate 202 by ion implantation and/or thermal diffusion, which function, for example, as source regions and/or drain regions of the transistors. In some embodiments, isolation regions (e.g., STIs) are also formed in silicon substrate 202 by wet etching and/or dry etching and thin film deposition processes. The fabrication process for forming peripheral device 307 can occur at any fabrication stage prior to the etching of peripheral contact hole 306.

[0063] Method 600 proceeds to operation 610, as illustrated in FIG 6, in which a first spacer and a second spacer are simultaneously formed on sidewalls of the first opening and the second opening, respectively. FIG. 7A is a flowchart of an exemplary method for forming a spacer on a sidewall of an opening, according to some embodiments. Referring to FIG. 7A, at operation 702, to form the first spacer, a dielectric layer is deposited on the sidewall and bottom surface of the first opening. At operation 704, part of the dielectric layer that is deposited on the bottom surface of the first opening is removed. The deposition of the dielectric layer can include ALD, and the removal of the part of the dielectric layer can include anisotropic etching on the bottom surface of the first opening.

[0064] As illustrated in FIG. 3C, a first spacer 308 is formed on the sidewall, but not the bottom surface, of TAC hole 304. A dielectric layer can be first deposited into TAC hole 304 using one or more thin film deposition processes, such as ALD, CVD, PVD, or any combination thereof, which covers the sidewall and bottom surface of TAC hole 304. The part of the dielectric layer deposited on the bottom surface, but not on the sidewall, of TAC hole 304 can then be etched through using "bottom punch" processes. In some embodiments, a silicon oxide layer can be deposited on the sidewall and bottom surface of TAC hole 304 using ALD, and the part of the silicon oxide layer deposited on the bottom surface of TAC hole 304 can be removed using any suitable anisotropic etching directed to the bottom surface of TAC hole 304. In one example, a bias with a sufficient voltage level may be added to DRIE to etch through the silicon oxide layer on the bottom surface, but not through the sidewall, of TAC hole 304. Second spacer 310 can be simultaneously formed on the sidewall, but not the bottom surface, of peripheral contact hole 306, using the same deposition and bottom punch processes. In some embodiments,

the thicknesses of first spacer 308 and second spacer 310 are nominally the same in the lateral direction (e.g., radial direction).

[0065] FIG. 7B is a flowchart of another exemplary method for forming a spacer on a sidewall of an opening, according to some embodiments. Referring to FIG. 7B, at operation 706, to form the first spacer on the sidewall of the first opening, a plurality of shallow recesses are first formed by removing parts of the sacrificial layers abutting the sidewall of the first opening. At operation 708, a dielectric layer is deposited filling in the shallow recesses and on the sidewall and a bottom surface of the first opening. At operation 710, part of the dielectric layer that is deposited on the bottom surface of the first opening is removed. The removal of the part of the dielectric layer includes isotropic etching on the sidewall and the bottom surface of the first opening, according to some embodiments.

[0066] Different from the example illustrated in FIG. 3C in which first spacer 308 is formed by ALD deposition and bottom punch processes, FIGs. 3D-3E illustrate another example in which a first spacer 314 is formed by any deposition process, followed by an etch-back process. As illustrated in FIG. 3D, parts of sacrificial layers 206 in dielectric stack 218 that abut the sidewall of TAC hole 304 are removed by wet etching and/or dry etching, such as using a wet etchant for silicon nitride. A plurality of shallow recesses 312 can then be formed along the sidewall of TAC hole 304. The degree of the etching, i.e., the lateral dimension of shallow recess, can be controlled by the etching rate and/or etching time. The sacrificial layer partial removal process can provide space for a thicker dielectric layer deposition in the next step.

[0067] As illustrated in FIG. 3E, a first spacer 314 is formed on the sidewall, but not the bottom surface, of TAC hole 304. A dielectric layer can be first deposited into TAC hole 304 using one or more thin film deposition processes, such as ALD, CVD, PVD, or any combination thereof, which fills in shallow recesses 312 (as shown in FIG. 3D) and covers the sidewall and bottom surface of TAC hole 304. The part of the dielectric layer deposited on the bottom surface of TAC hole 304 can be then removed using etch-back processes. In some embodiments, isotropic etching can be applied to etch the dielectric layer deposited on both the sidewall and the bottom surface of TAC hole 304. Because the dielectric layer is substantially thicker along the sidewall (filling in shallow recesses 312) than on the bottom surface, when the part of the dielectric layer on the bottom

surface has been etched through, the part of the dielectric layer on the sidewall can be partially etched, leaving first spacer 314 covering only the sidewall of TAC hole 304. In other words, the thickened dielectric layer along the sidewall is etched-back, leaving a thinner dielectric layer as first spacer 314, according to some embodiments. The etching rate and/or etching time of any suitable isotropic etching process can be controlled to fully etch through the dielectric layer on the bottom surface of TAC hole 304, but partially etch back the dielectric layer on the sidewall of TAC hole 304.

[0068] Method 600 proceeds to operation 612, as illustrated in FIG 6, in which a conductor layer is deposited in the first opening to form a TAC and in the second opening to form a peripheral contact. In some embodiments, the conductor layer is a composite layer including an adhesion/barrier layer and a conductor. As illustrated in FIG. 3F, a conductor layer 316 is deposited in TAC hole 304 (as shown in FIGs. 3C-3E) to fill the remaining space of TAC hole 304, thereby forming a TAC 318 extending vertically through dielectric stack 218. In some embodiments, an adhesion/barrier layer is first formed along first spacer 308/314 by depositing titanium/titanium nitride (Ti/TiN) or titanium/tantalum nitride (Ta/TaN) using one or more thin film deposition processes, such as ALD, CVD, PVD, electrochemical depositions, or any combination thereof. A conductor can then be formed in the remaining space of TAC hole 304 by depositing metals, such as tungsten, using one or more thin film deposition processes, such as ALD, CVD, PVD, electrochemical depositions, or any combination thereof. A conductor layer 320 can be simultaneously formed in peripheral contact hole 306 (as shown in FIGs. 3C-3E) to form a peripheral contact 322 in contact with peripheral device 307, using the same deposition processes. The excess conductor layer after deposition can be removed by CMP.

[0069] Method 600 proceeds to operation 614, as illustrated in FIG 6, in which a slit extending vertically through the dielectric stack is formed after the formation of the TAC. Method 600 proceeds to operation 616, as illustrated in FIG 6, in which a memory stack including a plurality of conductor/dielectric layer pairs is formed on the substrate by replacing, through the slit, the sacrificial layers in the dielectric/sacrificial layer pairs with a plurality of conductor layers. In some embodiments, a slit structure is formed by depositing a conductor layer in the slit after the formation of the memory stack. In some embodiments, a plurality of word line contacts each in contact with a respective one of

the conductor layers of the conductor/dielectric layer pairs in the staircase structure are formed.

[0070] As illustrated in FIG. 5A, an opening (slit) can be etched through the dielectric/sacrificial layer pairs in dielectric stack 218 (as shown in FIGs. 3-4). The slit can be formed by wet etching and/or dry etching of dielectrics (e.g., silicon oxide and silicon nitride). The opening can be used as the pathway for gate replacement processes that replace sacrificial layers 206 in dielectric stack 218 with conductor layers 502 to form a plurality of conductor/dielectric layer pairs. The replacement of sacrificial layers 206 with conductor layers 502 can be performed by wet etching sacrificial layers 206 (e.g., silicon nitride) selective to dielectric layers 208 (e.g., silicon oxide) and filling the structure with conductor layers 502 (e.g., W). Conductor layers 502 can be deposited by PVD, CVD, ALD, electrochemical depositions, or any combination thereof. Conductor layers 502 can include conductive materials including, but not limited to, W, Co, Cu, Al, polysilicon, silicides, or any combination thereof. As a result, after the gate replacement processes, dielectric stack 218 in FIGs. 3-4 becomes memory stack 504 including the conductor/dielectric layer pairs, i.e., interleaved conductor layers 502 and dielectric layers 208, on silicon substrate 202.

[0071] As illustrated in FIG. 5A, a slit structure 506 is formed by filling (e.g., depositing) conductive materials into the slit by PVD, CVD, ALD, electrochemical depositions, or any combination thereof. Slit structure 506 can include conductive materials including, but not limited to, W, Co, Cu, Al, polysilicon, silicides, or any combination thereof. In some embodiments, a dielectric layer (e.g., a silicon oxide layer) is formed first between the conductive materials of slit structure 506 and conductor layers 502 surrounding slit structure 506 as a spacer. The lower end of slit structure 506 can be in contact with a doped region 507, which can be formed in silicon substrate 202 using ion implantation and/or thermal diffusion.

[0072] As illustrated in FIG. 5B, each word line contact 508 is in contact with a respective one of conductor layers 502 of the conductor/dielectric layer pairs in staircase structure 224. Word line contacts 508 are formed through one or more dielectric layers by first etching vertical openings (e.g., by wet etching and/or dry etching), followed by filling the openings with conductive materials using ALD, CVD, PVD, electrochemical depositions, or any combination thereof. In some embodiments, other conductive

materials are filled in the openings to function as an adhesion/barrier layer. Etching of dielectric layers to form the openings of word line contacts 508 can be controlled by etch stop at a different material. For example, etching of dielectric layers can be stopped when reaching to conductor layers 502 in staircase structure 224.

[0073] FIG. 8 is a flowchart of another exemplary method 800 for forming a 3D memory device, according to some embodiments of the present disclosure. Operations 802, 804, 814, and 816 are similar to operations 602, 604, 614, and 616, respectively, and thus are not repeated. Method 800 proceeds to operation 806, as illustrated in FIG 8, in which a first opening through the dielectric stack, a second opening outside of the dielectric stack, and a third opening through the dielectric stack are simultaneously etched. In some embodiments, the lateral dimension (e.g., diameter) of the third opening is smaller than lateral dimensions of the first and second openings. Each of the first, second, and third openings has a nominally circular shape in the plan view, according to some embodiments.

[0074] As illustrated in FIG. 4A, a first opening (TAC hole) 402, a second opening (peripheral contact hole) 404, and a third opening (dummy channel hole) 406 are simultaneously formed, each of which reaches to silicon substrate 202. The lower end of peripheral contact hole 404 can be in contact with a peripheral device 405 formed on silicon substrate 202. TAC hole 402 and dummy channel hole 406 can be etched through interleaved sacrificial layers 206 and dielectric layers 208 (e.g., silicon nitride and silicon oxide) in dielectric stack 218 using wet etching and/or dry etching, and peripheral contact hole 404 can be simultaneously etched through one or more dielectric layers (e.g., silicon oxide) using the same wet etching and/or dry etching process. In some embodiments, TAC hole 402, peripheral contact hole 404, and dummy channel hole 406 are etched using DRIE at the same time. The depths of TAC hole 402, peripheral contact hole 404, and dummy channel hole 406 in the vertical direction can be nominally the same. In some embodiments, each of TAC hole 402, peripheral contact hole 404, and dummy channel hole 406 has a substantially circular shape in the plan view. The lateral dimensions (e.g., diameters) of TAC hole 402, peripheral contact hole 404, and dummy channel hole 406 can be controlled by patterning process and/or etching parameters, such as etching rate and etching time. In some embodiments, in the plan view, the diameter of dummy channel hole 406 is smaller than the diameter of TAC hole 402 and the diameter

of peripheral contact hole 404. In some embodiments, the diameter of peripheral contact hole 404 is smaller than the diameter of TAC hole 402 in the plan view.

[0075] Method 800 proceeds to operation 808, as illustrated in FIG 8, in which a dielectric layer is deposited (i) fully filling in the third opening to form a dummy channel structure and (ii) partially filling in the first opening and the second opening. Method 800 proceeds to operation 810, as illustrated in FIG 8, in which parts of the dielectric layer deposited on the bottom surfaces of the first and second openings are removed.

[0076] As illustrated in FIG. 4B, a dielectric layer (e.g., silicon oxide) is deposited into TAC hole 402, peripheral contact hole 404, and dummy channel hole 406 using one or more thin film deposition processes, such as ALD, CVD, PVD, electrochemical depositions, or any combination thereof. Due to the different lateral dimensions of TAC hole 402, peripheral contact hole 404, and dummy channel hole 406, by controlling the deposition parameters, such as the deposition rate and/or deposition time, the deposited dielectric layer can fully fill in dummy channel hole 406 to form a dummy channel structure 408, but only partially fill in TAC hole 402 and peripheral contact hole 404 to form a first spacer 410 and a second spacer 412, respectively, on the sidewalls of TAC hole 402 and peripheral contact hole 404. Dummy channel structure 408 is thus formed extending vertically through dielectric stack 218. As described above, parts of the dielectric layer deposited on the bottom surfaces of TAC hole 402 and peripheral contact hole 404 can be removed (i.e., etched through) using the bottom punch process, such as high bias DRIE. As a result, first and second spacers 410 and 412 are formed on the sidewalls, but not the bottom surfaces, of TAC hole 402 and peripheral contact hole 404, respectively. In some embodiments, the simultaneously formed first and second spacers 410 and 412 have nominally the same thickness in the radial direction in the plan view.

[0077] Method 800 proceeds to operation 812, as illustrated in FIG 8, in which a conductor layer is deposited (i) filling in the first opening to form a TAC and (ii) filling in the second opening to form a peripheral contact. As illustrated in FIG. 4C, a conductor layer 414 is deposited in TAC hole 402 (as shown in FIG. 4B) to fill the remaining space of TAC hole 402, thereby forming a TAC 416 extending vertically through dielectric stack 218. In some embodiments, an adhesion/barrier layer is first formed along first spacer 410 by depositing Ti/TiN or Ta/TaN using one or more thin film deposition processes, such as ALD, CVD, PVD, electrochemical depositions, or any combination

thereof. A conductor can then be formed in the remaining space of TAC hole 402 by depositing metals, such as tungsten, using one or more thin film deposition processes, such as ALD, CVD, PVD, electrochemical depositions, or any combination thereof. A conductor layer 418 can be simultaneously formed in peripheral contact hole 404 (as shown in FIG. 4B) to form a peripheral contact 420 in contact with peripheral device 405, using the same deposition processes. The excess conductor layer after deposition can be removed by CMP.

[0078] According to one aspect of the present disclosure, a method for forming a 3D memory device is disclosed. A dielectric stack including a plurality of dielectric/sacrificial layer pairs is formed on a substrate. A channel structure extending vertically through the dielectric stack is formed. A first opening extending vertically through the dielectric stack is formed. A spacer is formed on a sidewall of the first opening. A TAC extending vertically through the dielectric stack is formed by depositing a conductor layer in contact with the spacer in the first opening. A slit extending vertically through the dielectric stack is formed after forming the TAC. A memory stack including a plurality of conductor/dielectric layer pairs is formed on the substrate by replacing, through the slit, the sacrificial layers in the dielectric/sacrificial layer pairs with a plurality of conductor layers.

[0079] In some embodiments, a staircase structure is formed at one edge of the dielectric stack prior to forming the first opening. A plurality of word line contacts each in contact with a respective one of the conductor layers of the conductor/dielectric layer pairs in the staircase structure are formed, according to some embodiments.

[0080] In some embodiments, a slit structure is formed by depositing a conductor layer in the slit.

[0081] In some embodiments, a dummy channel structure extending vertically through the dielectric stack is formed prior to forming the first opening.

[0082] In some embodiments, to form the first opening, the first opening through the dielectric stack and a second opening outside of the dielectric stack are simultaneously etched. In some embodiments, to form the TAC, the conductor layer is deposited in the first opening to form the TAC and in the second opening to form a peripheral contact.

[0083] In some embodiments, to form the spacer on the sidewall of first opening, a dielectric layer is deposited on the sidewall and a bottom surface of the first opening, and

part of the dielectric layer that is deposited on the bottom surface of the first opening is removed. The deposition of the dielectric layer includes ALD, and the removal of the part of the dielectric layer includes anisotropic etching on the bottom surface of the first opening, according to some embodiments.

[0084] In some embodiments, to form the spacer on the sidewall of first opening, a plurality of shallow recesses are formed by removing parts of the sacrificial layers abut the sidewall of the first opening, a dielectric layer is deposited filling in the shallow recesses and on the sidewall and a bottom surface of the first opening, and part of the dielectric layer that is deposited on the bottom surface of the first opening is removed. The removal of the part of the dielectric layer includes isotropic etching on the sidewall and the bottom surface of the first opening, according to some embodiments.

[0085] In some embodiments, to form the first opening, the first opening through the dielectric stack, a second opening outside of the dielectric stack, and a third opening through the dielectric stack are simultaneously etched. A lateral dimension of the third opening can be smaller than lateral dimensions of the first and second openings.

[0086] In some embodiments, to form the spacer on the sidewall of the first opening, a dielectric layer is deposited (i) fully filling in the third opening to form a dummy channel structure and (2) partially filling in the first opening and the second opening, and parts of the dielectric layer that are deposited on a bottom surface of the first opening and on a bottom surface of the second opening are removed. Each of the first, second, and third openings can have a nominally circular shape in the plan view.

[0087] In some embodiments, the dielectric layers in the dielectric/sacrificial layer pairs include silicon oxide, the sacrificial layers in the dielectric/sacrificial layer pairs include silicon nitride, and the spacer includes silicon oxide.

[0088] According to another aspect of the present disclosure, a method for forming a 3D memory device is disclosed. A dielectric stack including a plurality of dielectric/sacrificial layer pairs is formed on a substrate. A channel structure extending vertically through the dielectric stack is formed. A dummy channel structure extending vertically through the dielectric stack is formed. A first opening through the dielectric stack and a second opening outside of the dielectric stack are simultaneously etched. A first spacer on a sidewall of the first opening and a second spacer on a sidewall of the second opening are simultaneously formed. A conductor layer is deposited (i) filling in

the first opening to form a TAC and (ii) filling in the second opening to form a peripheral contact. A slit extending vertically through the dielectric stack is formed after forming the TAC and peripheral device. A memory stack including a plurality of conductor/dielectric layer pairs is formed on the substrate by replacing, through the slit, the sacrificial layers in the dielectric/sacrificial layer pairs with a plurality of conductor layers.

[0089] In some embodiments, a staircase structure is formed at one edge of the dielectric stack prior to forming the dummy channel structure. A plurality of word line contacts each in contact with a respective one of the conductor layers of the conductor/dielectric layer pairs in the staircase structure are formed, according to some embodiments.

[0090] In some embodiments, a slit structure is formed by depositing a conductor layer in the slit.

[0091] In some embodiments, to form the first spacer on the sidewall of the first opening, a dielectric layer is deposited on the sidewall and a bottom surface of the first opening, and part of the dielectric layer that is deposited on the bottom surface of the first opening is removed. The deposition of the dielectric layer includes ALD, and the removal of the part of the dielectric layer includes anisotropic etching on the bottom surface of the first opening, according to some embodiments.

[0092] In some embodiments, to form the spacer on the sidewall of first opening, a plurality of shallow recesses are formed by removing parts of the sacrificial layers abutting the sidewall of the first opening, a dielectric layer is deposited filling in the shallow recesses and on the sidewall and a bottom surface of the first opening, and part of the dielectric layer that is deposited on the bottom surface of the first opening is removed. The removal of the part of the dielectric layer includes isotropic etching on the sidewall and the bottom surface of the first opening, according to some embodiments.

[0093] In some embodiments, the dielectric layers in the dielectric/sacrificial layer pairs include silicon oxide, the sacrificial layers in the dielectric/sacrificial layer pairs include silicon nitride, and the first and second spacers include silicon oxide.

[0094] According to still another aspect of the present disclosure, a method for forming a 3D memory device is disclosed. A dielectric stack including a plurality of dielectric/sacrificial layer pairs is formed on a substrate. A channel structure extending vertically through the dielectric stack is formed. A first opening through the dielectric

stack, a second opening outside of the dielectric stack, and a third opening through the dielectric stack are simultaneously etched. A lateral dimension of the third opening is smaller than lateral dimensions of the first and second openings. A dielectric layer is deposited (i) fully filling in the third opening to form a dummy channel structure and (ii) partially filling in the first opening and the second opening. Parts of the dielectric layer that are deposited on a bottom surface of the first opening and on a bottom surface of the second opening are removed. A conductor layer is deposited (i) filling in the first opening to form a TAC and (ii) filling in the second opening to form a peripheral contact. A slit extending vertically through the dielectric stack is formed after forming the TAC and peripheral device. A memory stack including a plurality of conductor/dielectric layer pairs is formed on the substrate by replacing, through the slit, the sacrificial layers in the dielectric/sacrificial layer pairs with a plurality of conductor layers.

[0095] In some embodiments, a staircase structure is formed at one edge of the dielectric stack prior to etching the first, second, and third openings. A plurality of word line contacts each in contact with a respective one of the conductor layers of the conductor/dielectric layer pairs in the staircase structure are formed, according to some embodiments.

[0096] In some embodiments, a slit structure is formed by depositing a conductor layer in the slit.

[0097] In some embodiments, each of the first, second, and third openings has a nominally circular shape in the plan view.

[0098] In some embodiments, the dielectric layers in the dielectric/sacrificial layer pairs includes silicon oxide, the sacrificial layers in the dielectric/sacrificial layer pairs includes silicon nitride, and the dielectric layer filling the first, second, and third openings include silicon oxide.

[0099] According to yet another aspect of the present disclosure, a 3D memory device includes a substrate, a memory stack on the substrate including a plurality of conductor/dielectric layer pairs, a channel structure extending vertically through the conductor/dielectric layer pairs in the memory stack, a TAC extending vertically through the conductor/dielectric layer pairs in the memory stack, and a dummy channel structure fully filled with a dielectric layer and extending vertically through the conductor/dielectric layer pairs in the memory stack.

[0100] In some embodiments, the 3D memory device further includes a peripheral device on the substrate, and a peripheral contact outside of the memory stack and in contact with the peripheral device.

[0101] In some embodiments, each of the TAC and peripheral contact includes a spacer with a nominally same thickness. The dielectric layer in the dummy channel structure and the spacers in the TAC and peripheral contact include silicon oxide, according to some embodiments.

[0102] In some embodiments, the 3D memory device further includes a lower memory deck on the substrate and an upper memory deck above the lower memory stack. In some embodiments, the channel structure includes a lower channel structure extending vertically through the lower memory deck, an upper channel structure extending vertically through the upper memory deck, and an inter-deck plug disposed vertically between and in contact with the lower channel structure and the upper channel structure.

[0103] In some embodiments, the 3D memory device further includes a staircase structure at one edge of the memory stack, and a plurality of word line contacts each in contact with a respective one of the conductor layers of the conductor/dielectric layer pairs in the staircase structure.

[0104] The foregoing description of the specific embodiments will so reveal the general nature of the present disclosure that others can, by applying knowledge within the skill of the art, readily modify and/or adapt for various applications such specific embodiments, without undue experimentation, without departing from the general concept of the present disclosure. Therefore, such adaptations and modifications are intended to be within the meaning and range of equivalents of the disclosed embodiments, based on the teaching and guidance presented herein. It is to be understood that the phraseology or terminology herein is for the purpose of description and not of limitation, such that the terminology or phraseology of the present specification is to be interpreted by the skilled artisan in light of the teachings and guidance.

[0105] Embodiments of the present disclosure have been described above with the aid of functional building blocks illustrating the implementation of specified functions and relationships thereof. The boundaries of these functional building blocks have been arbitrarily defined herein for the convenience of the description. Alternate boundaries

can be defined so long as the specified functions and relationships thereof are appropriately performed.

[0106] The Summary and Abstract sections may set forth one or more but not all exemplary embodiments of the present disclosure as contemplated by the inventor(s), and thus, are not intended to limit the present disclosure and the appended claims in any way.

[0107] The breadth and scope of the present disclosure should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with the following claims and their equivalents.

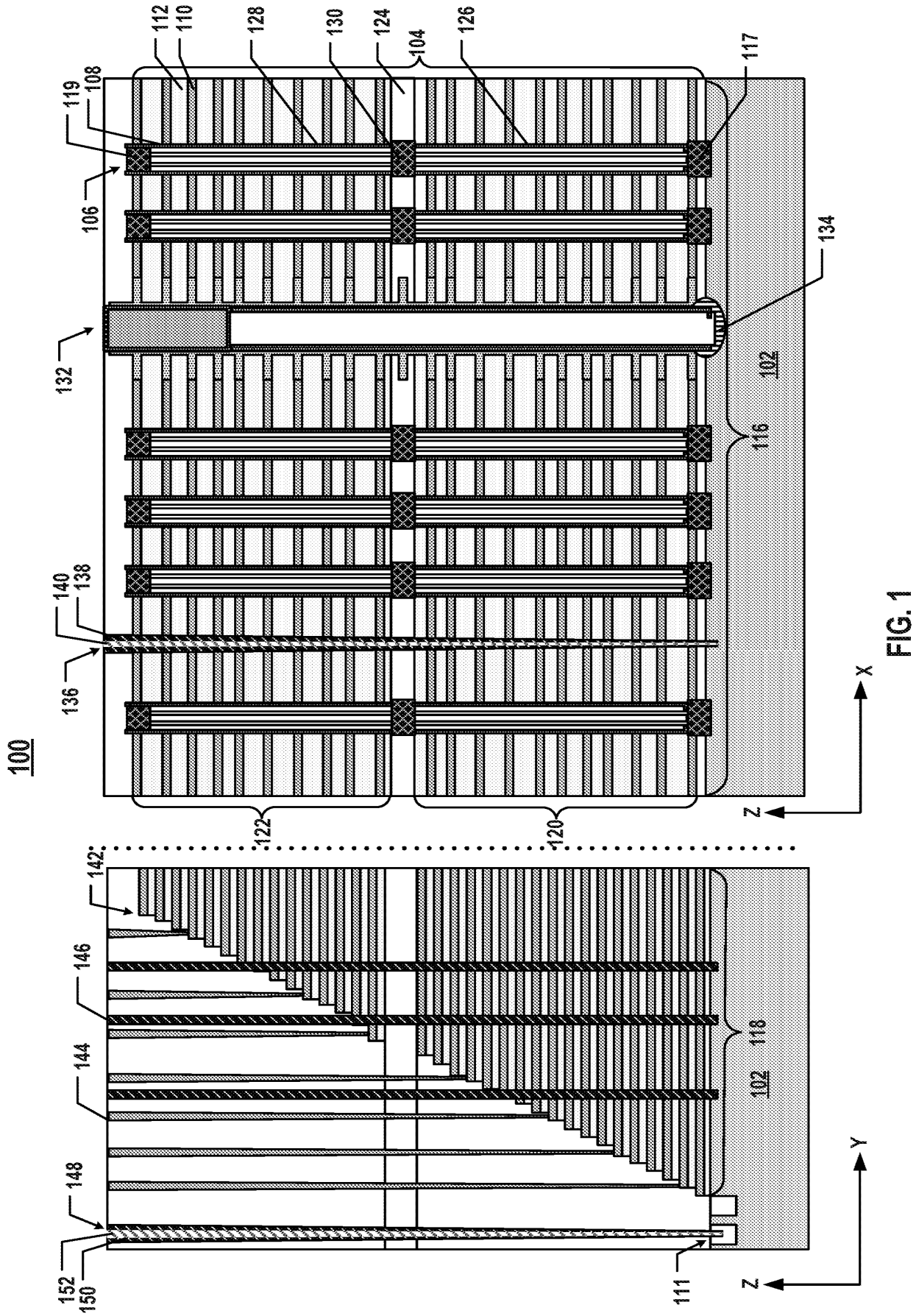
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FIG. 1

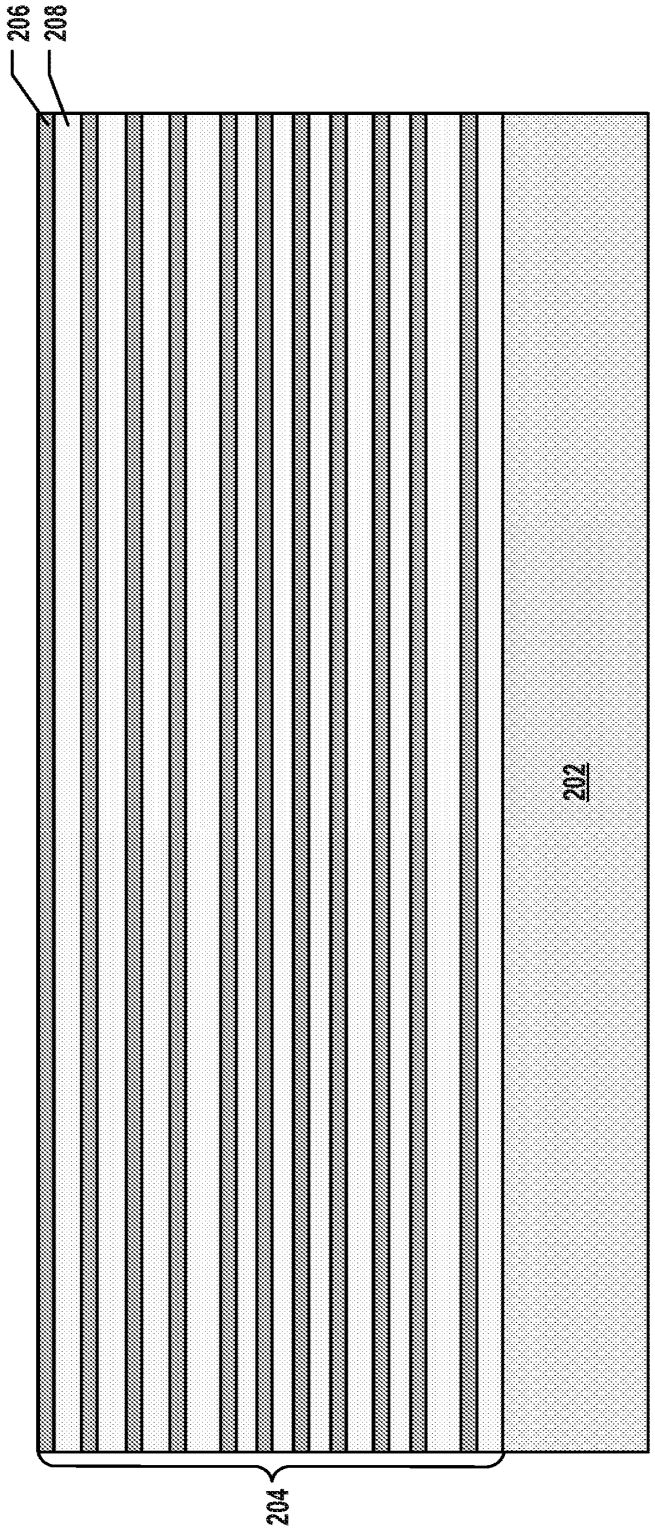

FIG. 2A

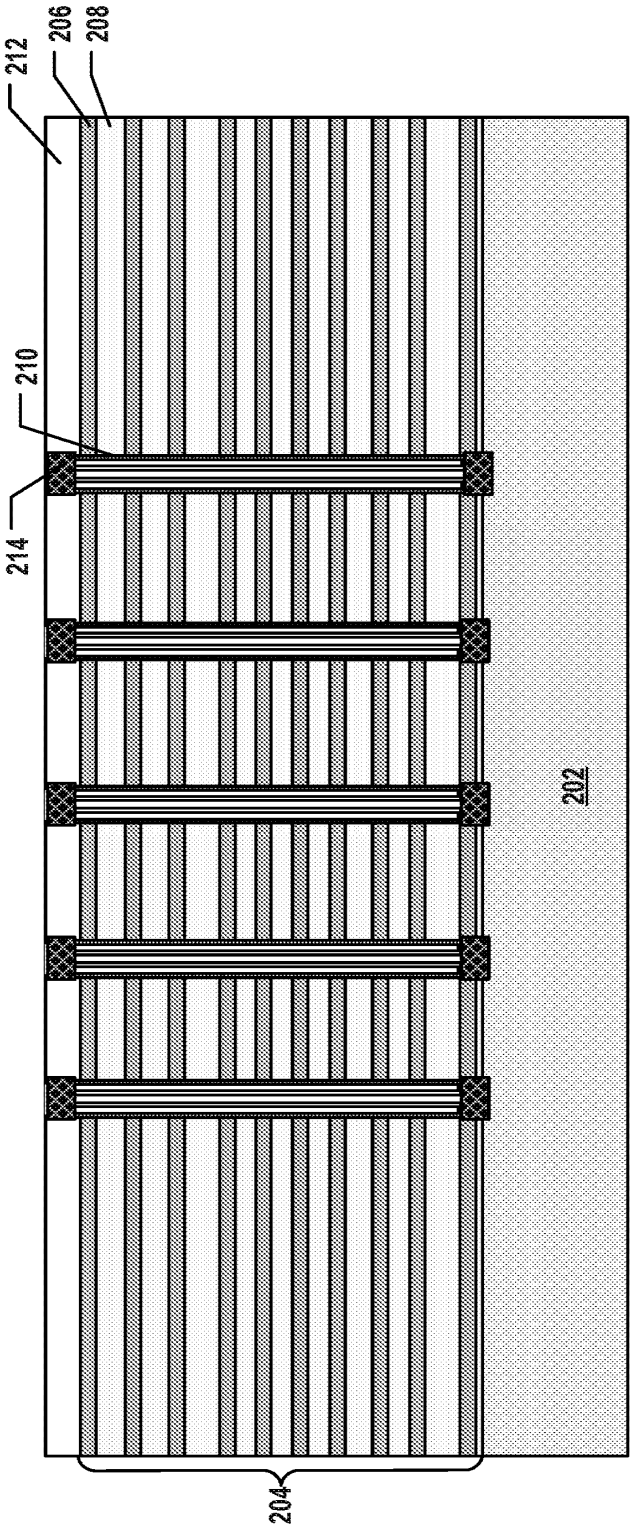

FIG. 2B

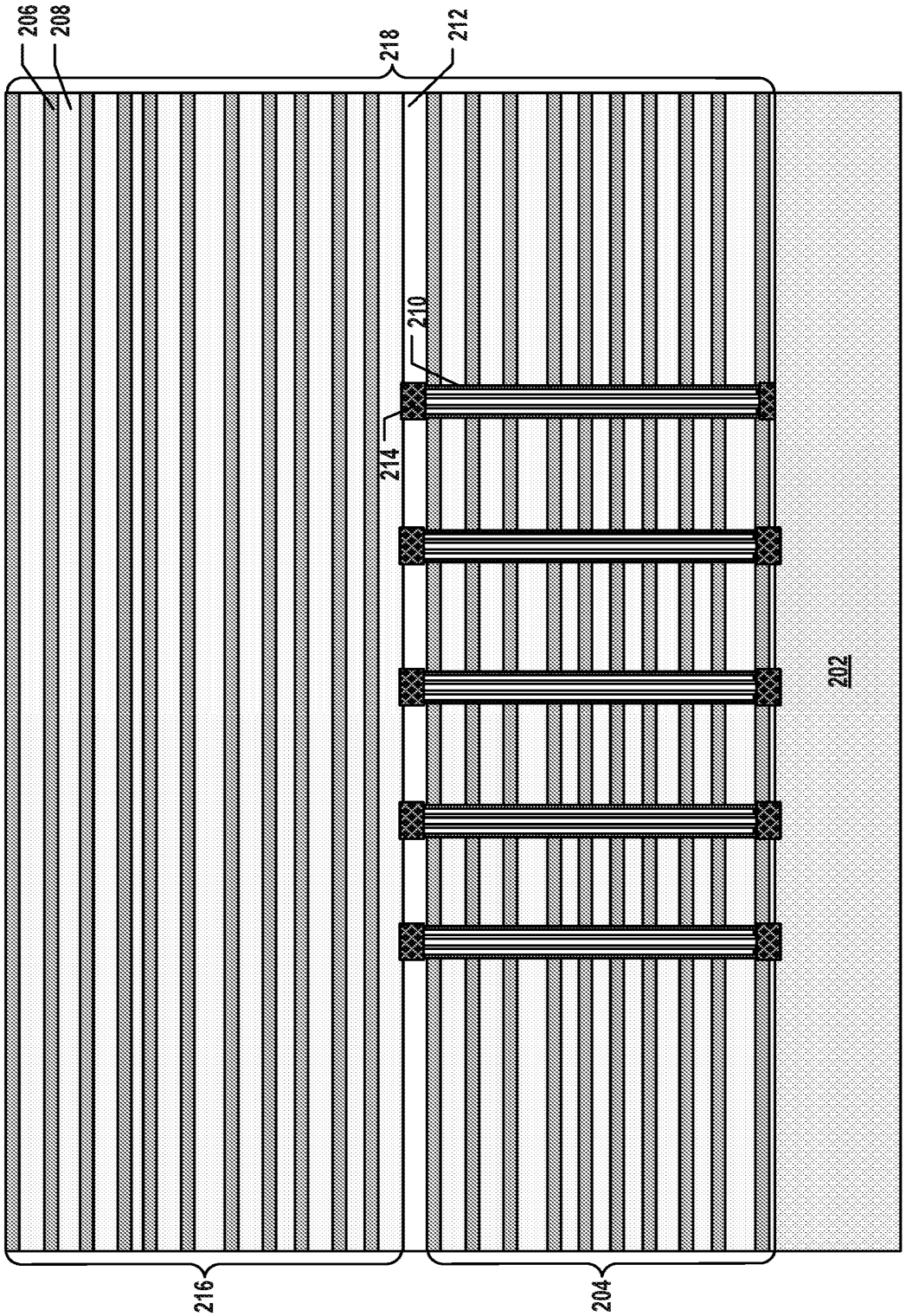

FIG.2C

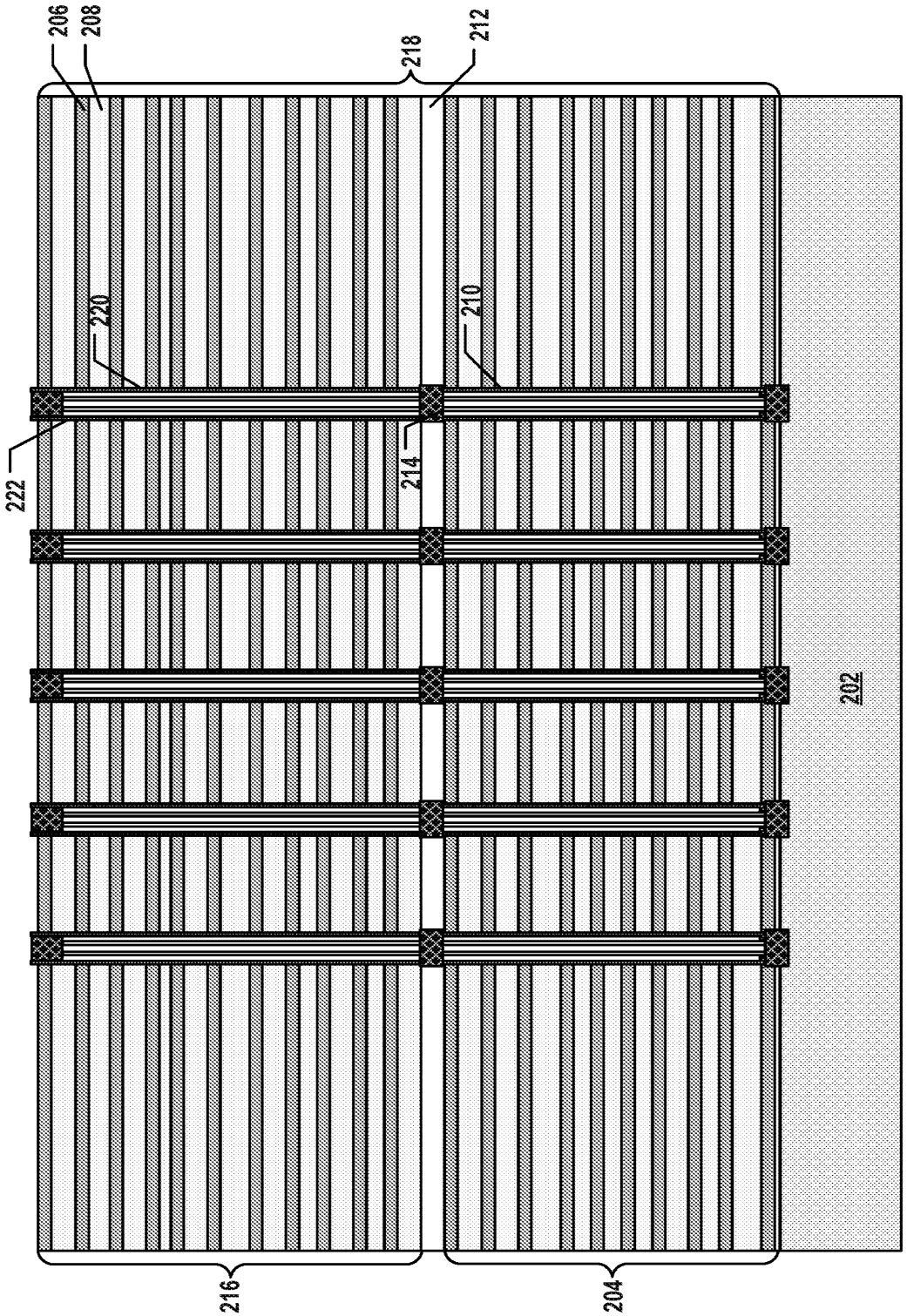

FIG. 2D

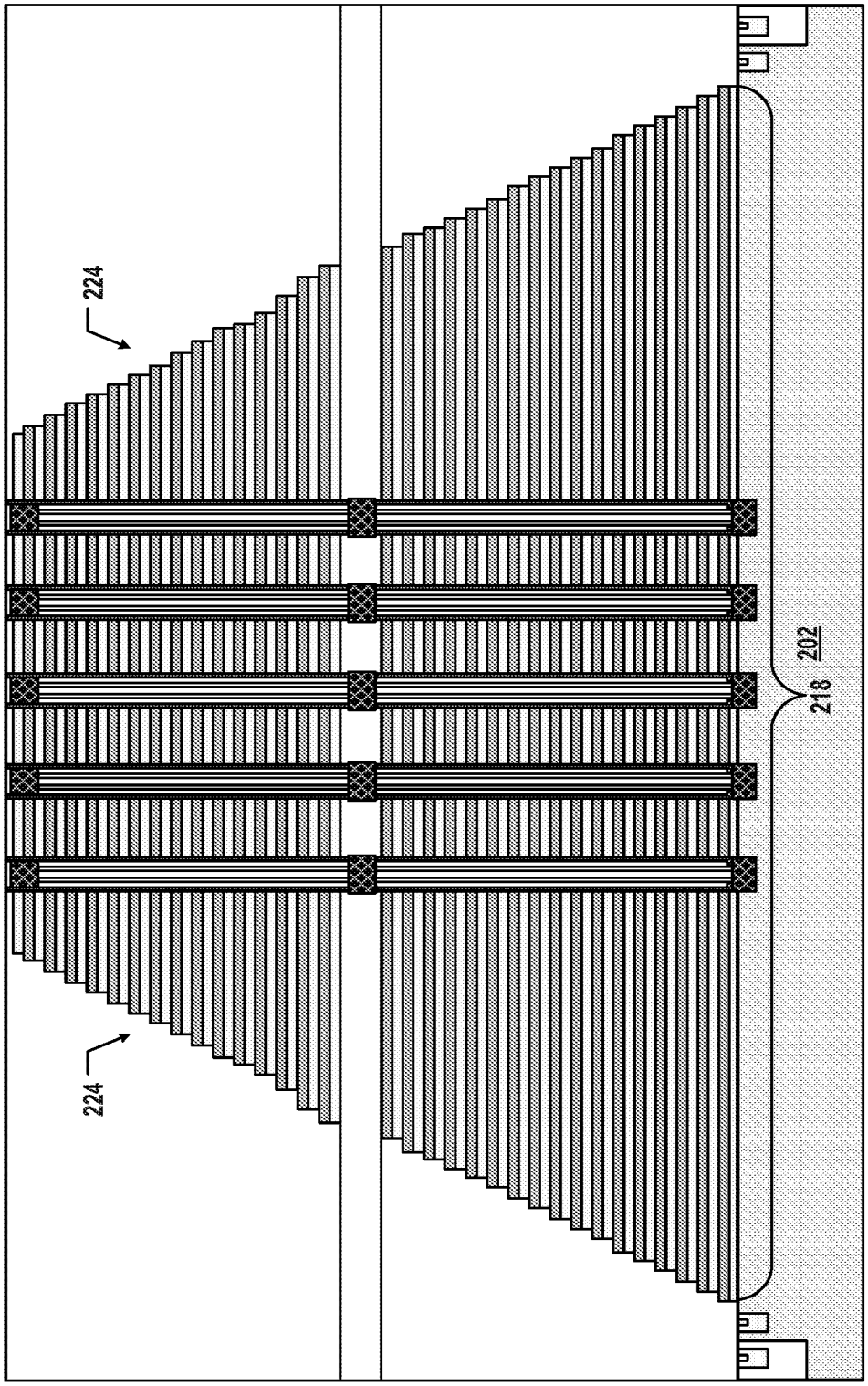

FIG. 2E

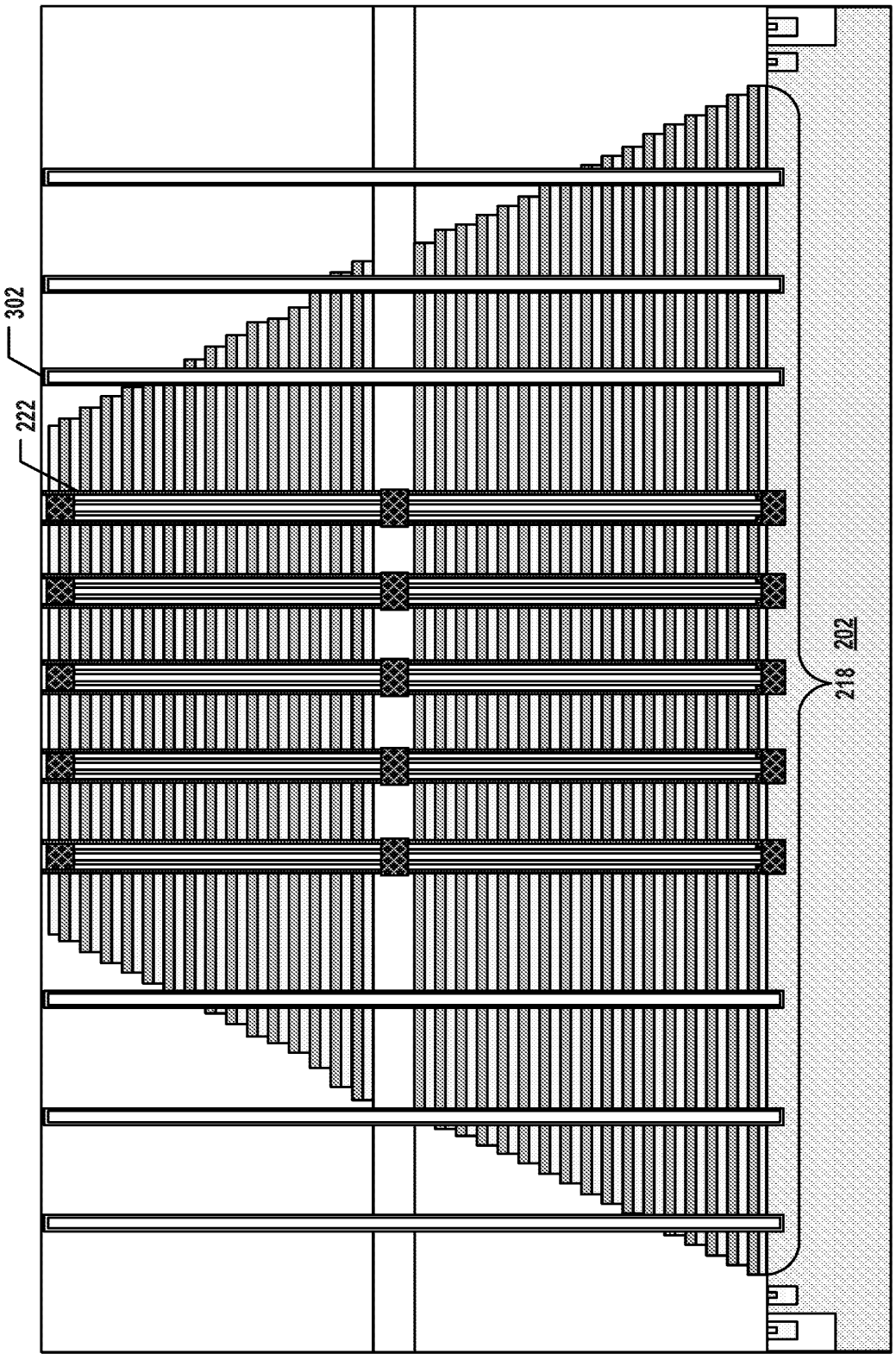

FIG. 3A

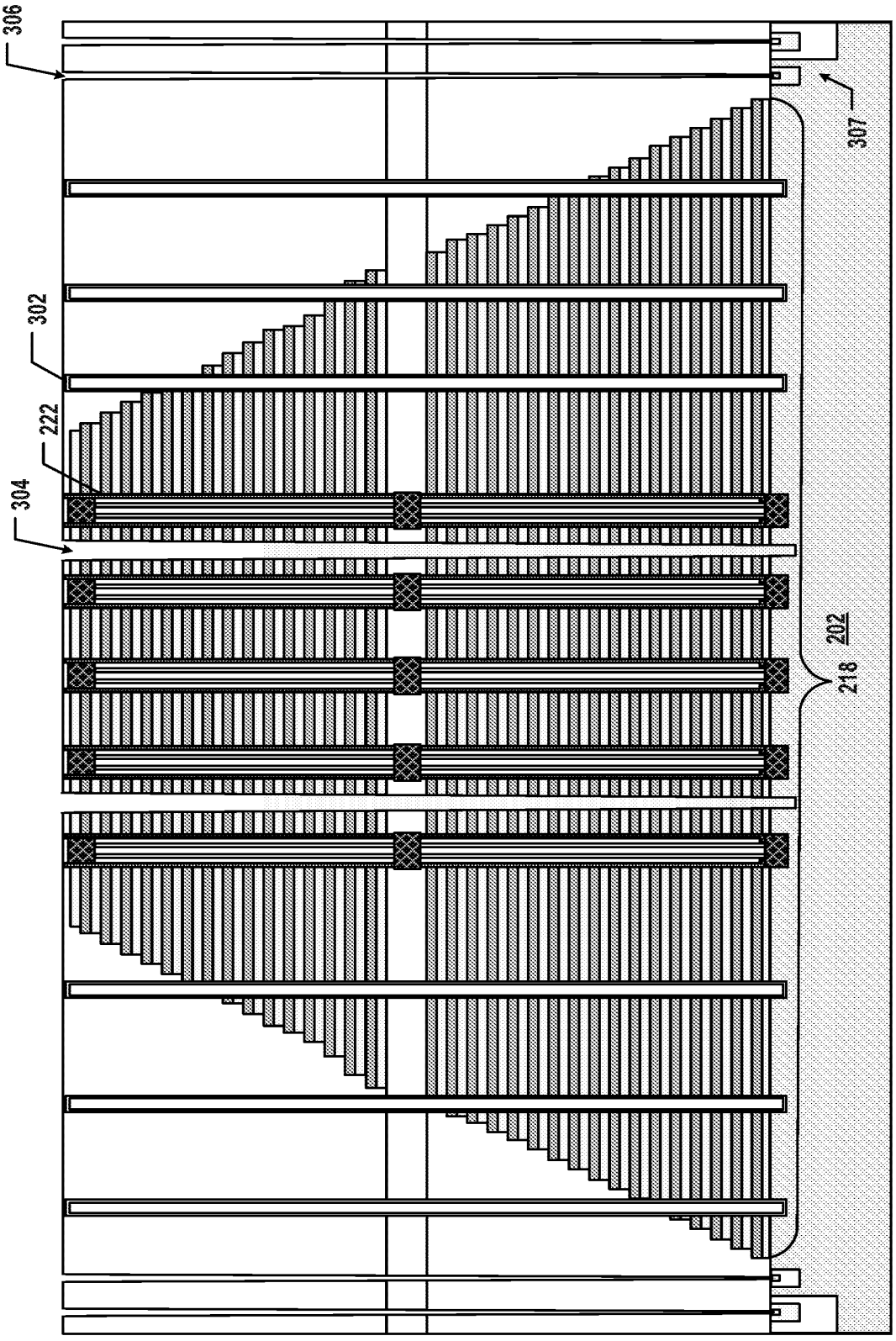

FIG. 3B

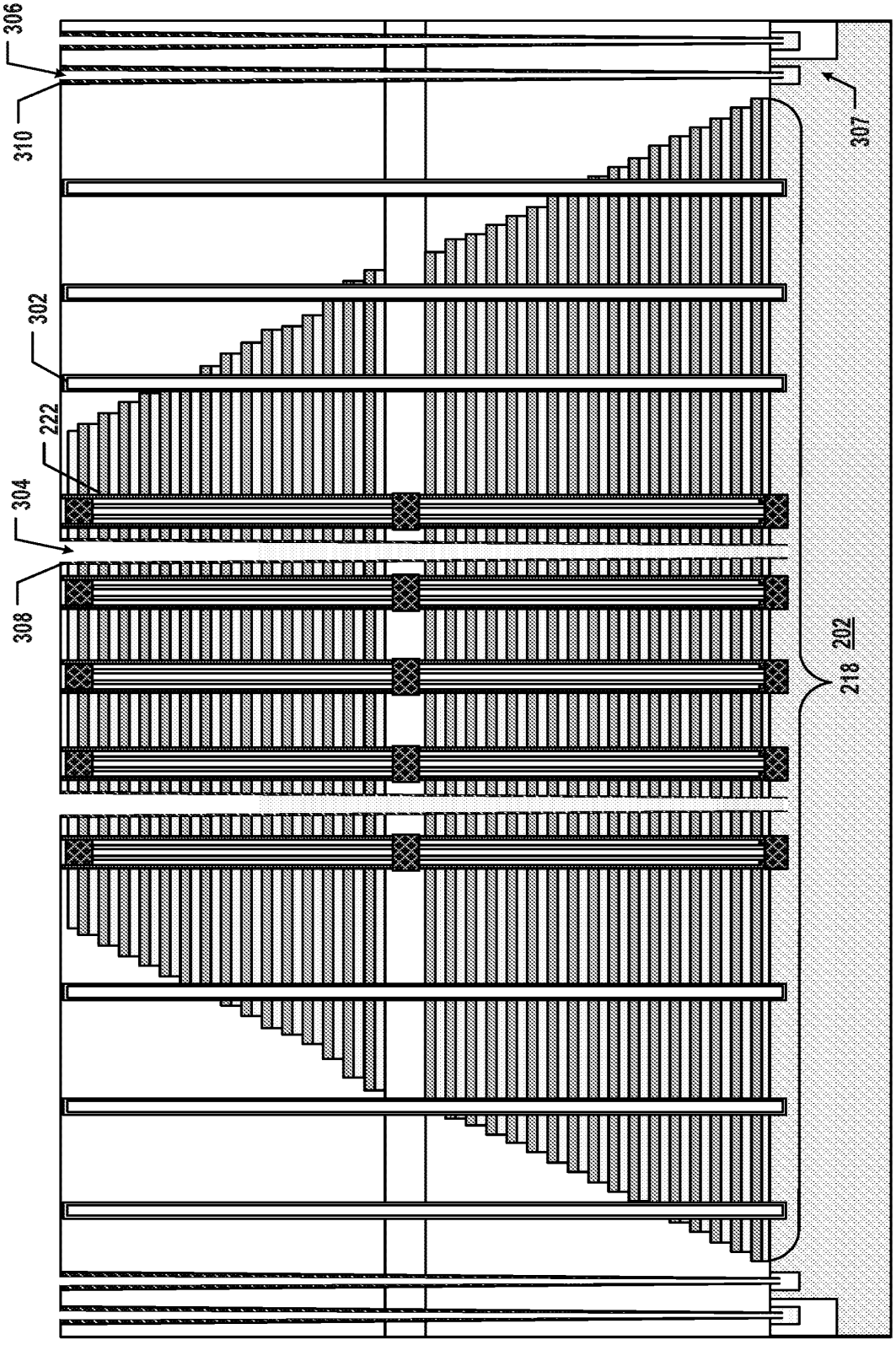

FIG. 3C

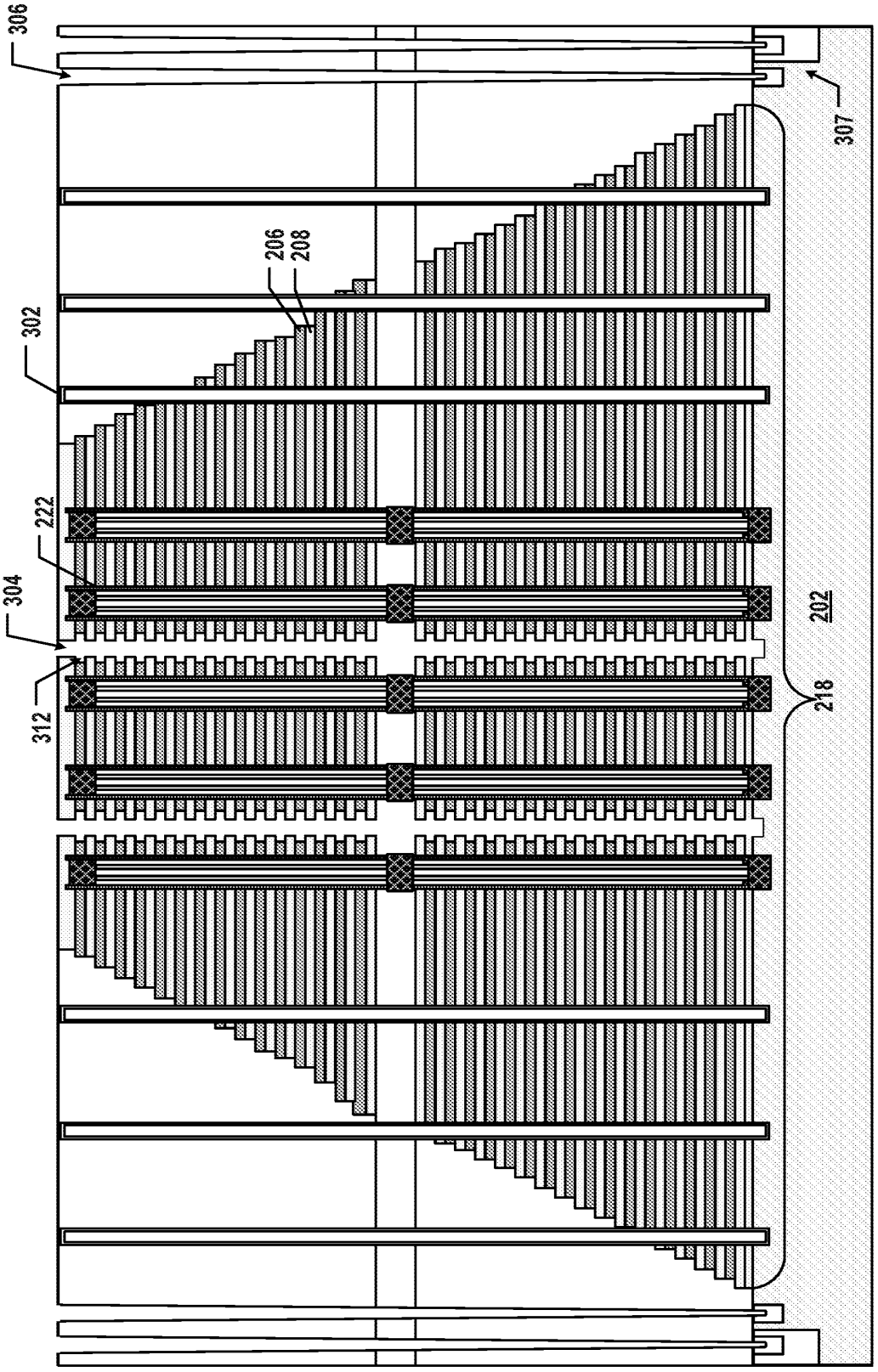

FIG. 3D

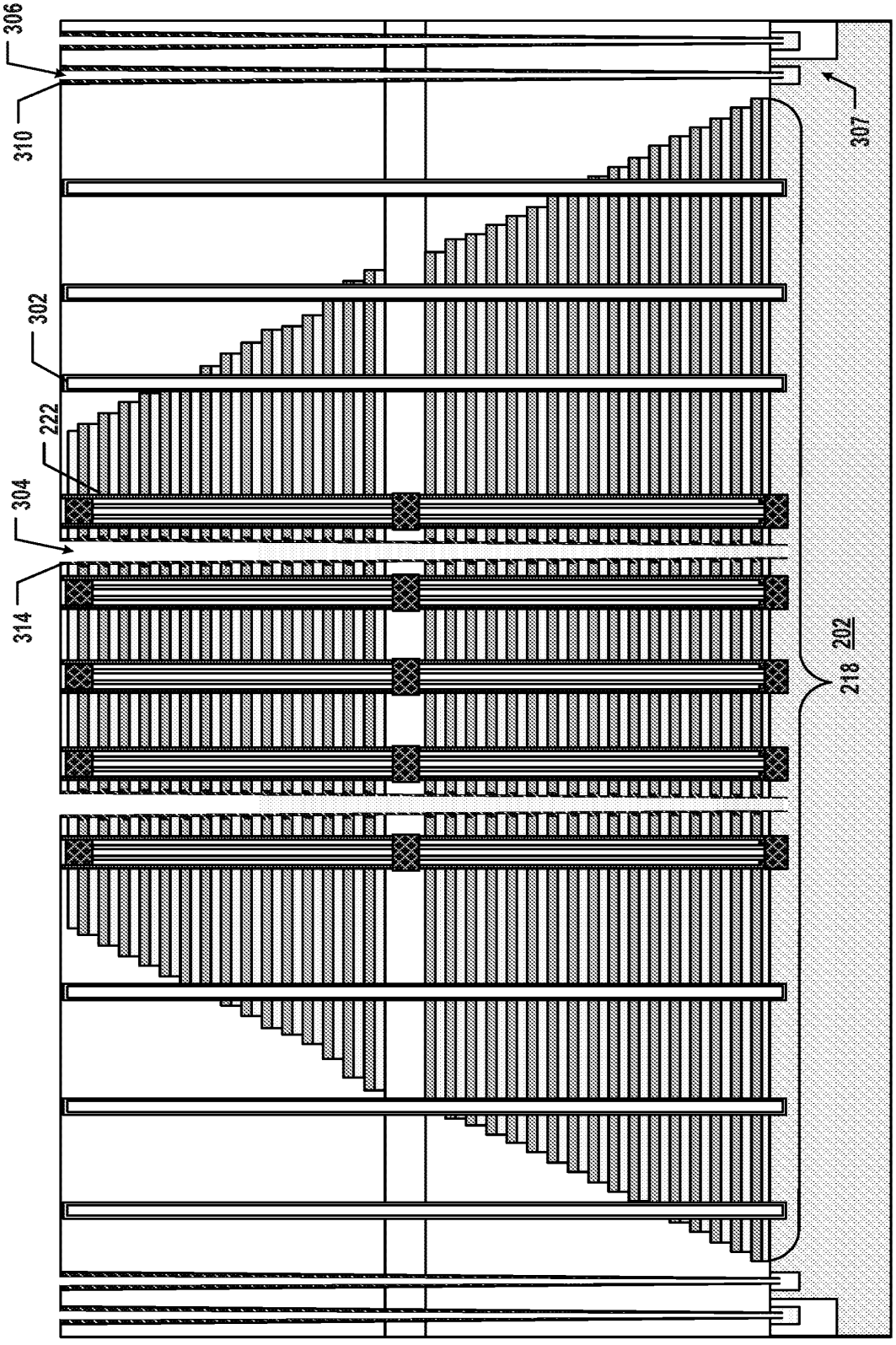

FIG. 3E

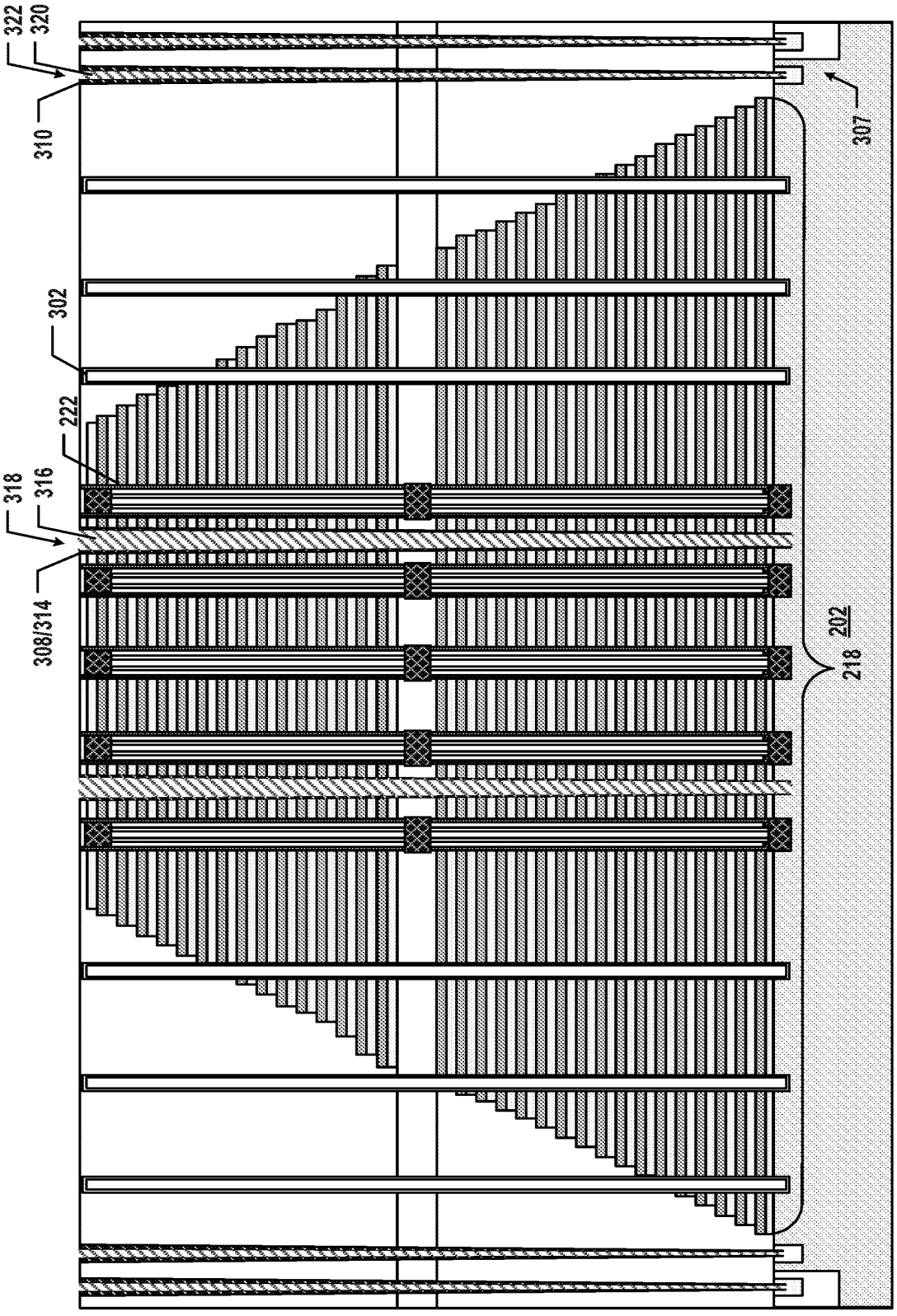

FIG. 3F

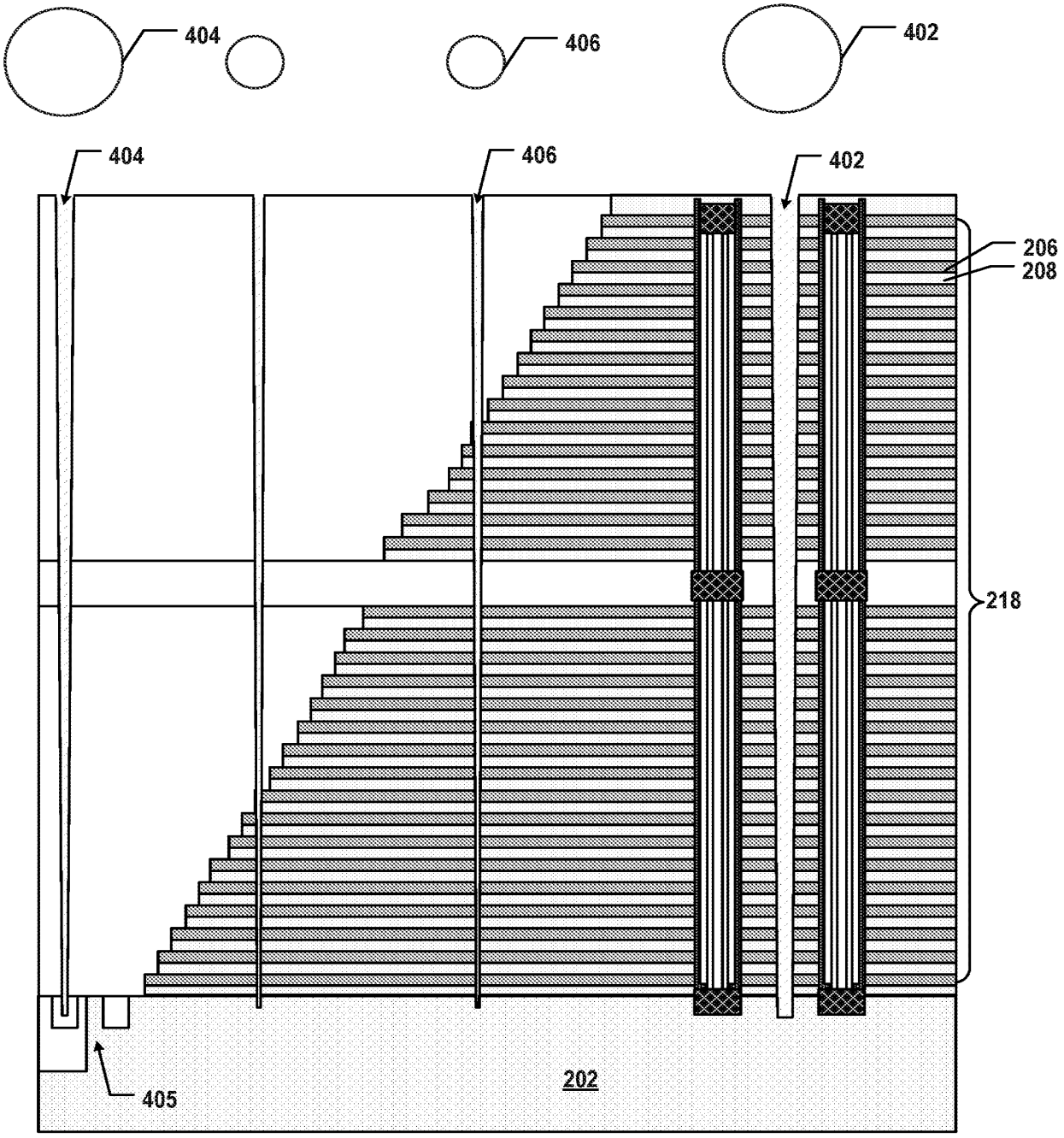

FIG. 4A

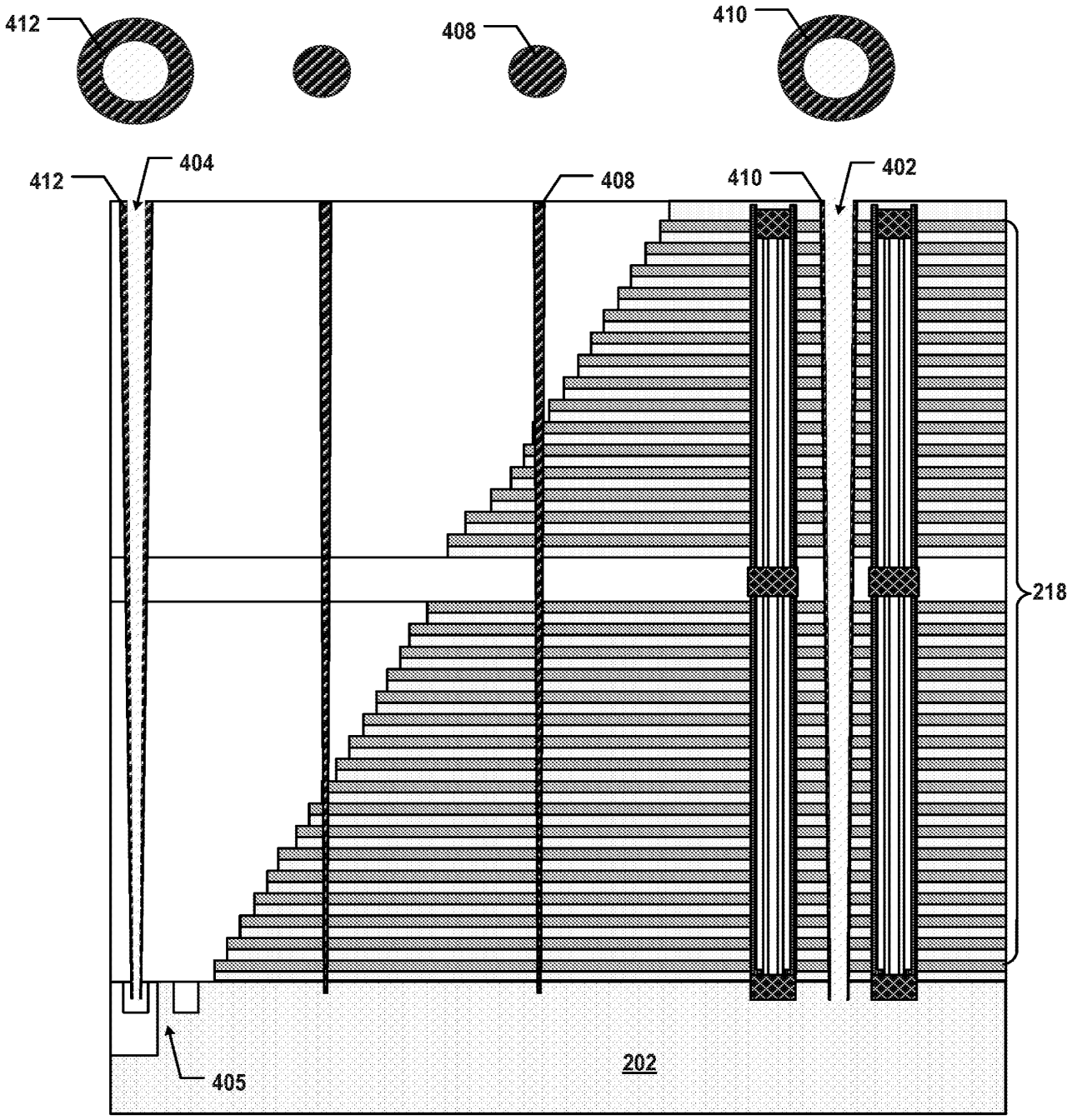

FIG. 4B

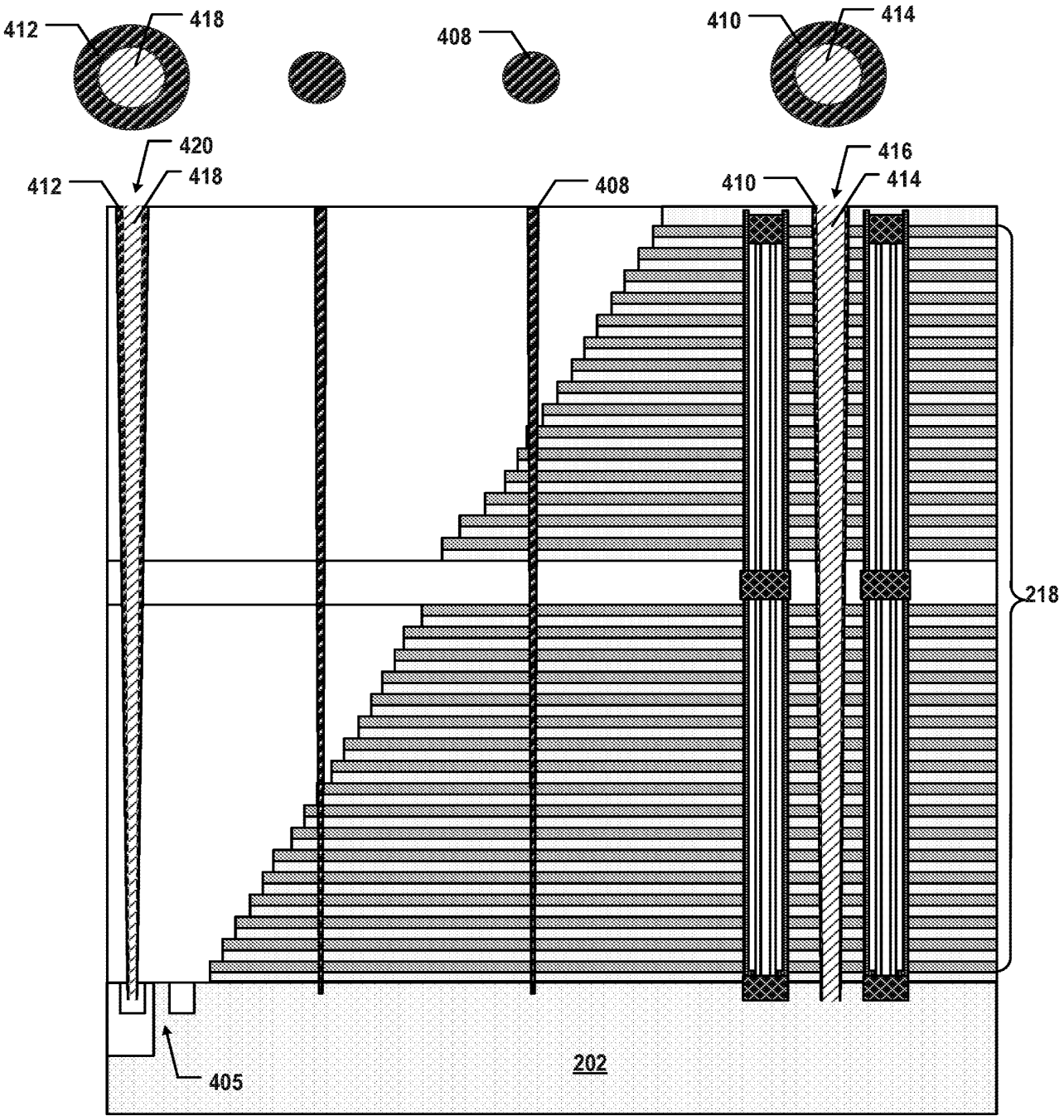

FIG. 4C

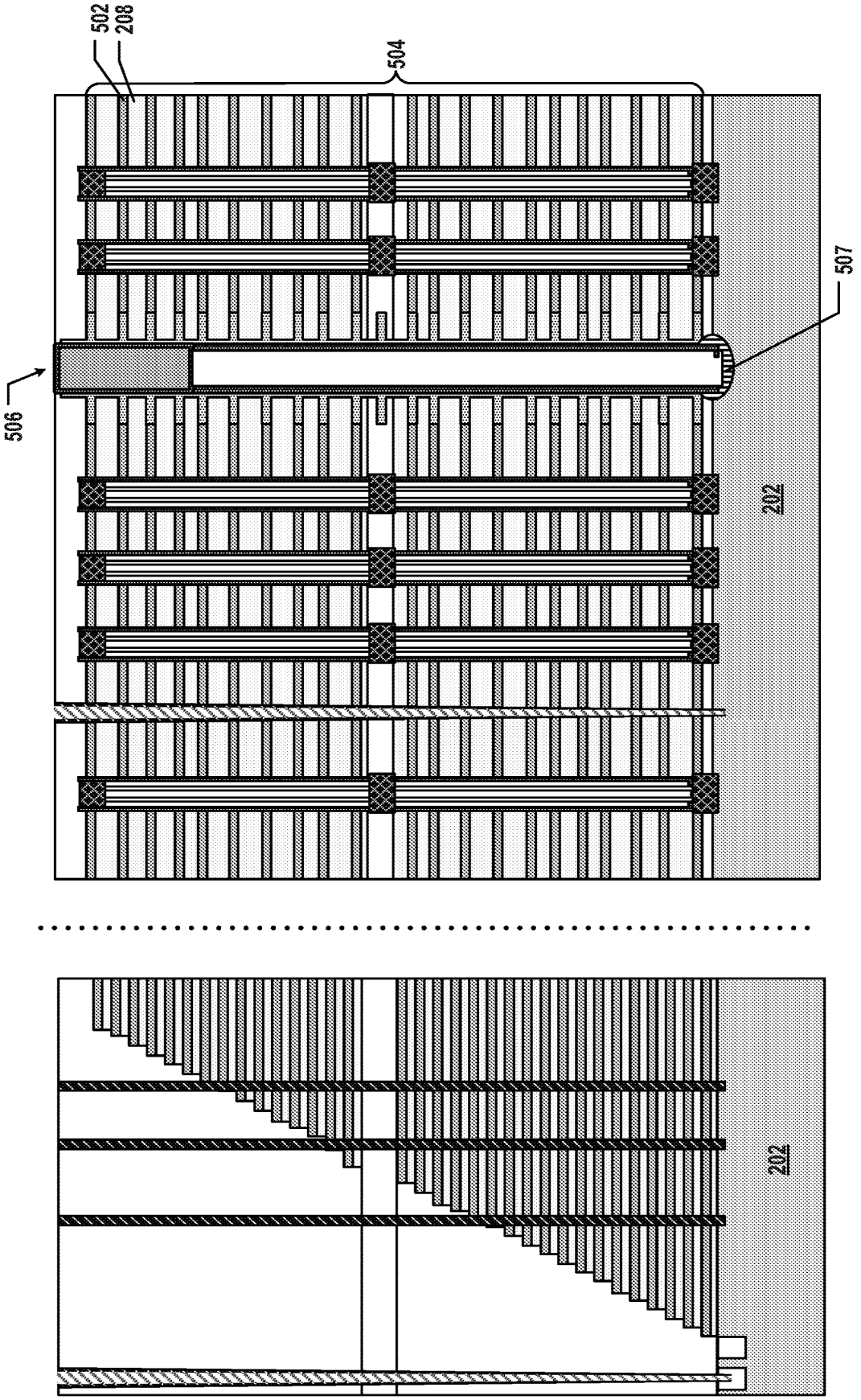

FIG. 5A

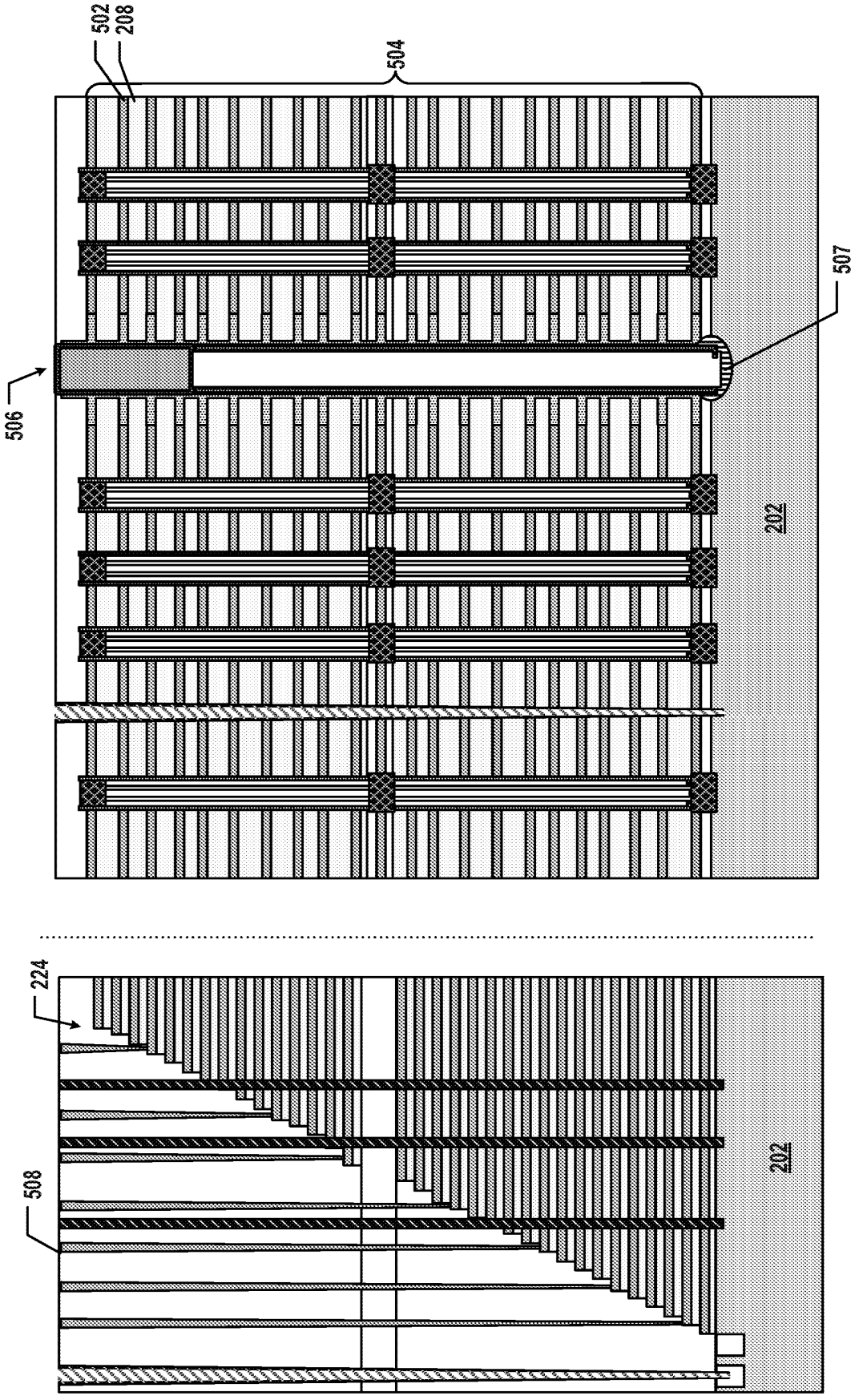

FIG. 5B

600

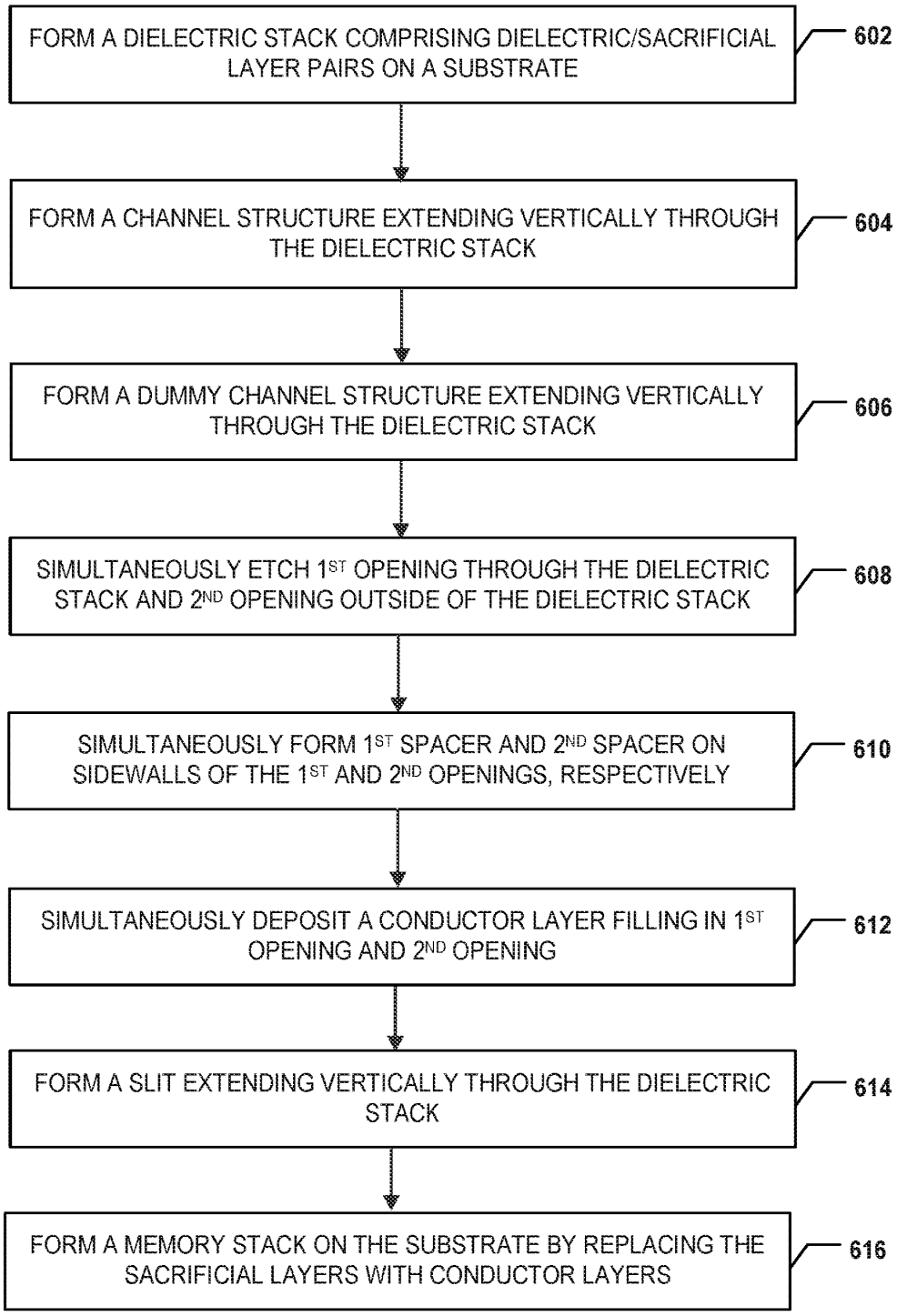
FORM A DIELECTRIC STACK COMPRISING DIELECTRIC/SACRIFICIAL LAYER PAIRS ON A SUBSTRATE
602
FORM A CHANNEL STRUCTURE EXTENDING VERTICALLY THROUGH THE DIELECTRIC STACK
604
FORM A DUMMY CHANNEL STRUCTURE EXTENDING VERTICALLY THROUGH THE DIELECTRIC STACK
606
SIMULTANEOUSLY ETCH 1ST OPENING THROUGH THE DIELECTRIC STACK AND 2ND OPENING OUTSIDE OF THE DIELECTRIC STACK
608
SIMULTANEOUSLY FORM 1ST SPACER AND 2ND SPACER ON SIDEWALLS OF THE 1ST AND 2ND OPENINGS, RESPECTIVELY
610
SIMULTANEOUSLY DEPOSIT A CONDUCTOR LAYER FILLING IN 1ST OPENING AND 2ND OPENING
612
FORM A SLIT EXTENDING VERTICALLY THROUGH THE DIELECTRIC STACK
614
FORM A MEMORY STACK ON THE SUBSTRATE BY REPLACING THE SACRIFICIAL LAYERS WITH CONDUCTOR LAYERS
616

FIG. 6

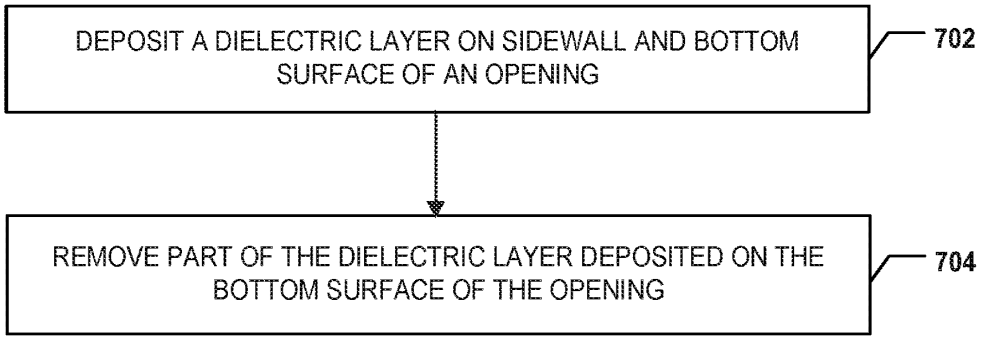
DEPOSIT A DIELECTRIC LAYER ON SIDEWALL AND BOTTOM SURFACE OF AN OPENING
702
REMOVE PART OF THE DIELECTRIC LAYER DEPOSITED ON THE BOTTOM SURFACE OF THE OPENING
704

FIG. 7A

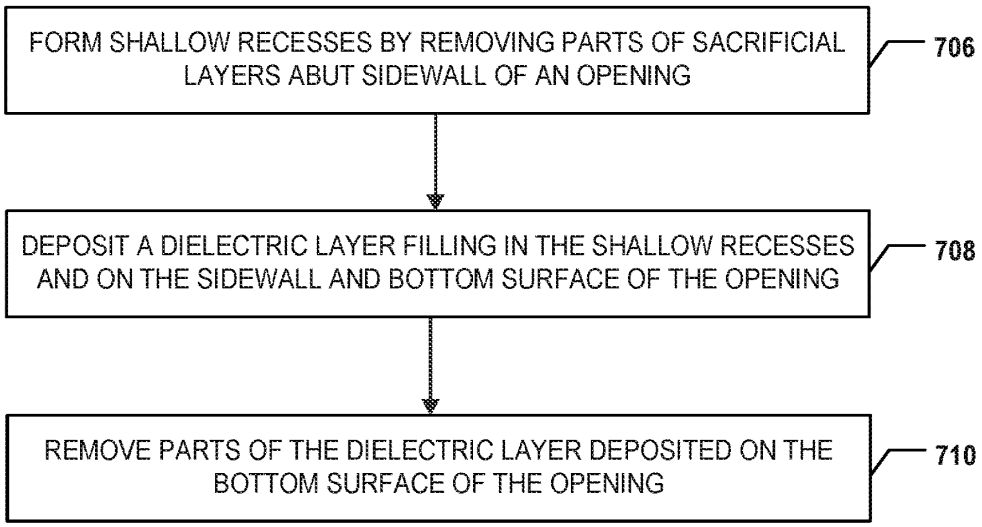
FORM SHALLOW RECESSES BY REMOVING PARTS OF SACRIFICIAL LAYERS ABUT SIDEWALL OF AN OPENING
706
DEPOSIT A DIELECTRIC LAYER FILLING IN THE SHALLOW RECESSES AND ON THE SIDEWALL AND BOTTOM SURFACE OF THE OPENING
708
REMOVE PARTS OF THE DIELECTRIC LAYER DEPOSITED ON THE BOTTOM SURFACE OF THE OPENING
710

FIG. 7B

800

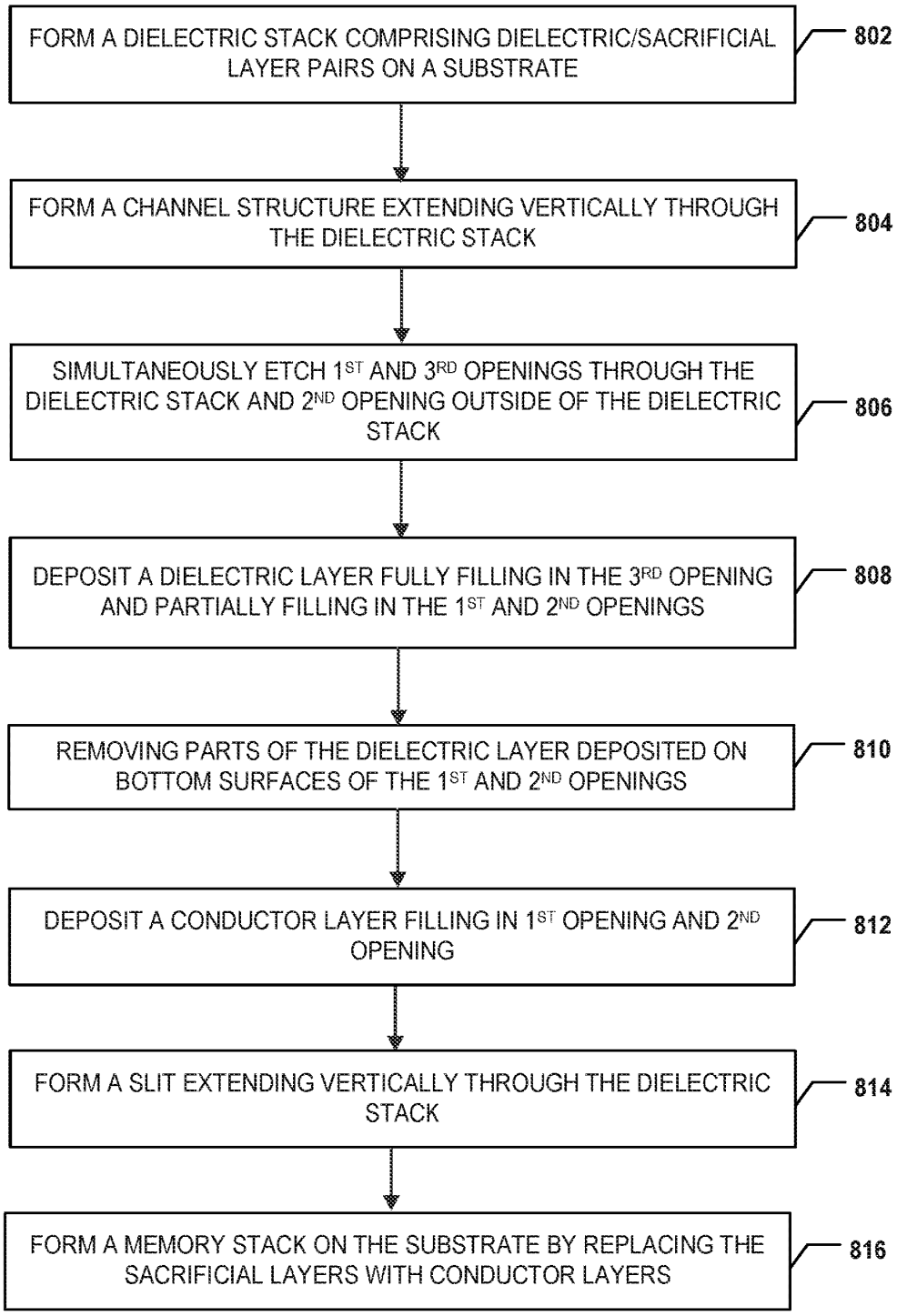
FORM A DIELECTRIC STACK COMPRISING DIELECTRIC/SACRIFICIAL LAYER PAIRS ON A SUBSTRATE
802
FORM A CHANNEL STRUCTURE EXTENDING VERTICALLY THROUGH THE DIELECTRIC STACK
804
SIMULTANEOUSLY ETCH 1ST AND 3RD OPENINGS THROUGH THE DIELECTRIC STACK AND 2ND OPENING OUTSIDE OF THE DIELECTRIC STACK
806
DEPOSIT A DIELECTRIC LAYER FULLY FILLING IN THE 3RD OPENING AND PARTIALLY FILLING IN THE 1ST AND 2ND OPENINGS
808
REMOVING PARTS OF THE DIELECTRIC LAYER DEPOSITED ON BOTTOM SURFACES OF THE 1ST AND 2ND OPENINGS
810
DEPOSIT A CONDUCTOR LAYER FILLING IN 1ST OPENING AND 2ND OPENING
812
FORM A SLIT EXTENDING VERTICALLY THROUGH THE DIELECTRIC STACK
814
FORM A MEMORY STACK ON THE SUBSTRATE BY REPLACING THE SACRIFICIAL LAYERS WITH CONDUCTOR LAYERS
816

FIG. 8

COMBINED DECLARATION AND ASSIGNMENT

DECLARATION

As the below named inventors, I hereby declare that:

This declaration is directed to:

☒ The attached application, or

☐ United States application or PCT international application number _____

filed on _____

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. § 1001 by fine or imprisonment of not more than five (5) years, or both.

ASSIGNMENT

In consideration of the sum of One Dollar ($1.00) or equivalent and other good and valuable consideration paid to each of the below named inventors, each of the below named inventors, hereby sell and assign to **Yangtze Memory Technologies Co., Ltd.**, a corporation formed under the laws of China, whose mailing address is 18 Gaoxin 4th Road, East Lake High-Tech Development Zone, Wuhan, Hubei, China (hereafter referred to as the Assignee), his/her entire right, title and interest, including the right to sue for past infringement and to collect for all past, present and future damages, for the United States of America (as defined in 35 U.S.C. § 100) and throughout the world,

(a) in the invention(s) known as **THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME** for which application(s) for patent in the United States of America is identified above, in any and all applications thereon, in any and all Letters Patent(s) therefor, and

(b) in any and all applications that claim the benefit of the patent application identified above in part (a), including non-provisional applications, continuing (continuation, divisional, or continuation-in-part) applications, reissues, extensions, renewals and reexaminations of the patent application or Letters Patent therefor listed above in part (a), to the full extent of the term or terms for which Letters Patents issue, and

(c) in any and all inventions described in the patent application identified above in part (a), and in any and all forms of intellectual and industrial property protection derivable from such patent application, and that are derivable from any and all continuing applications, reissues, extensions, renewals and reexaminations of such patent application, including, without limitation, patents, applications, utility models, inventor's certificates, and designs together with the right to file applications therefor; and including the right to claim the same priority rights from any previously filed applications under the International Agreement for the Protection of Industrial Property, or any other international agreement, or the domestic laws of the country in which any such application is filed, as may be applicable;

all such rights, title and interest to be held and enjoyed by the above-named Assignee, its successors, legal representatives and assigns to the same extent as all such rights, title and interest would have been held and enjoyed by the Assignor had this assignment and sale not been made.

The below named inventors agree to execute all papers necessary in connection with the application(s) and any non-provisional, continuing (continuation, divisional, or continuation-in-part), reissue, reexamination or corresponding application(s) thereof and also to execute separate assignments in connection with such application(s) as the Assignee may deem necessary or expedient.

The below named inventors agree to execute all papers necessary in connection with any patent enforcement action (judicial or otherwise) related to the application(s) or any non-provisional, continuing (continuation, divisional, or continuation-in-part), reissue or reexamination application(s) thereof and to cooperate with the Assignee in every way possible in obtaining evidence and going forward with such patent enforcement action.

The below named inventors hereby represent that he/she has full right to convey the entire interest herein assigned, and that he/she has not executed, and will not execute, any agreement in conflict therewith.

The below named inventors hereby represent that he/she understands that the patent practitioners associated with **CUSTOMER NUMBER 153988** are the legal representatives of, and attorneys for, the assignee, and are NOT the legal representatives of, and attorneys for, the inventors.

IN WITNESS WHEREOF, executed by the below named inventors on the date opposite his/her name.

LEGAL NAME OF INVENTOR

Inventor: Mei Lan Guo Date: 2018.9.5

Signature of Inventor: [signature]

Inventor: Yushi Hu Date: 2018.08.22

Signature of Inventor: [signature]

Inventor: Ji Xia Date: 2018/8/22

Signature of Inventor: Ji Xia

Inventor: Hongbin Zhu Date: 2018/8/29

Signature of Inventor: [signature]

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	
First Named Inventor	Mei Lan GUO
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	10018-01-0015-US-CON1

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	1	20170125430	A1	2017-05-04	NISHIKAWA et al.	
	2	20140175532	A1	2014-06-26	Chen	
	3	20160099255	A1	2016-04-07	Lai	

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	1	108377660	CN	A	2018-08-07	SANDISK TECHNOLOGIES LLC		

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	Application Number	
	Filing Date	
	First Named Inventor	Mei Lan GUO
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	10018-01-0015-US-CON1

	2	108140644	CN	A	2018-06-08	SANDISK TECHNOLOGIES LLC			
	3	106920794	CN	A	2017-07-04	YANGTZE MEMORY TECH CO LTD			
	4	106910746	CN	A	2017-06-30	YANGTZE MEMORY TECH CO LTD			
	5	106920796	CN	A	2017-07-04	YANGTZE MEMORY TECH CO LTD			
	6	106256005	CN	A	2016-12-21	SANDISK TECHNOLOGIES INC			
	7	107771356	CN	A	2018-03-06	SANDISK TECHNOLOGIES INC			

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	1	International Search Report issued in corresponding International Application No. PCT/CN2018/101482, mailed May 5, 2019, 5 pages	
	2	Written Opinion of the International Searching Authority issued in corresponding International Application No. PCT/CN2018/101482, mailed May 5, 2019, 4 pages	

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	Filing Date	
	First Named Inventor	Mei Lan GUO
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	10018-01-0015-US-CON1

EXAMINER SIGNATURE			
Examiner Signature		Date Considered	

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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	Application Number	
	Filing Date	
	First Named Inventor	Mei Lan GUO
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	10018-01-0015-US-CON1

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Zhiwei Zou/	Date (YYYY-MM-DD)	2020-01-17
Name/Print	Zhiwei Zou	Registration Number	66,041

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME
First Named Inventor/Applicant Name:	Mei Lan GUO
Filer:	Zhiwei Zou/Anna O'Connor
Attorney Docket Number:	10018-01-0015-US-CON1

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1720**

Electronic Acknowledgement Receipt

EFS ID:	38322661
Application Number:	16745343
International Application Number:	
Confirmation Number:	7456
Title of Invention:	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME
First Named Inventor/Applicant Name:	Mei Lan GUO
Customer Number:	153988
Filer:	Zhiwei Zou/Anna O'Connor
Filer Authorized By:	Zhiwei Zou
Attorney Docket Number:	10018-01-0015-US-CON1
Receipt Date:	17-JAN-2020
Filing Date:	
Time Stamp:	00:55:44
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1720
RAM confirmation Number	E20201G156071945
Deposit Account	602227
Authorized User	Anna O'Connor
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal of New Application	10018-01-0015-US-CON1_UtilityPatentAppTransmittal.pdf	379161 72a0569fa389e51ce7a3ac71621dff4a2a63020d	no	2
Warnings:					
Information:					
2	Application Data Sheet	10018-01-0015-US-CON1_ADS.pdf	1829275 2c74b08a43f34433a50321325bef41c0153ab2f4	no	9
Warnings:					
Information:					
3		10018-01-0015-US-CON1_FINALApplication.pdf	192518 f4ffbe05ef683ccf9efab3bbd6154c1efe91628d	yes	34

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Abstract	34	34
Claims	30	33
Specification	1	29

Warnings:					
Information:					
4	Drawings-only black and white line drawings	10018-01-0015-US-CON1_FINALDrawings.pdf	148793 d42f2a763c1bcb97596109f820cd5d041b5e374d	no	20
Warnings:					
Information:					
5	Oath or Declaration filed	10018-01-0015-US_SignedFormalPapers.pdf	4566449 b2556008c56fba9052ebebb08081adacacb941bb	no	3

Warnings:					
Information:					
6	Power of Attorney	10018-01-0015-US-CON1_GenPOA.pdf	338936 5561e925c5f0449fc1d9d52c0d5bb024031e220f	no	2
Warnings:					
Information:					
7	Information Disclosure Statement (IDS) Form (SB08)	10018-01-0015-US-CON1_IDS-SB08.pdf	612604 d509e7dd098f3b36f142e3a5a12225c493a72cc8	no	5
Warnings:					
Information:					
8	Fee Worksheet (SB06)	fee-info.pdf	34833 8435c6342784b88a4aaaec86b00e598f5303081f	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	8102569		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

<u>New Applications Under 35 U.S.C. 111</u>
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
<u>National Stage of an International Application under 35 U.S.C. 371</u>
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
<u>New International Application Filed with the USPTO as a Receiving Office</u>
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PATENT ASSIGNMENT COVER SHEET

Electronic Version v1.1
Stylesheet Version v1.2

EPAS ID: PAT5916142

SUBMISSION TYPE:	NEW ASSIGNMENT
NATURE OF CONVEYANCE:	ASSIGNMENT

CONVEYING PARTY DATA

Name	Execution Date
MEI LAN GUO	09/05/2018
YUSHI HU	08/22/2018
JI XIA	08/22/2018
HONGBIN ZHU	08/29/2018

RECEIVING PARTY DATA

Name:	YANGTZE MEMORY TECHNOLOGIES CO., LTD.
Street Address:	18 GAOXIN 4TH ROAD
Internal Address:	EAST LAKE HIGH-TECH DEVELOPMENT ZONE
City:	WUHAN, HUBEI
State/Country:	CHINA

PROPERTY NUMBERS Total: 1

Property Type	Number
Application Number:	16745343

CORRESPONDENCE DATA

Fax Number: (703)821-8128

Correspondence will be sent to the e-mail address first; if that is unsuccessful, it will be sent using a fax number, if provided; if that is unsuccessful, it will be sent via US Mail.

Phone: 703-995-9887
Email: uspto@bayes.law
Correspondent Name: BAYES PLLC
Address Line 1: 1765 GREENSBORO STATION PLACE
Address Line 2: SUITE 900
Address Line 4: MCLEAN, VIRGINIA 22102

ATTORNEY DOCKET NUMBER:	10018-01-0015-US-CON1
NAME OF SUBMITTER:	ZHIWEI ZOU
SIGNATURE:	/Zhiwei Zou/
DATE SIGNED:	01/17/2020
	This document serves as an Oath/Declaration (37 CFR 1.63).

Total Attachments: 3

source=10018-01-0015-US_SignedFormalPapers#page1.tif
source=10018-01-0015-US_SignedFormalPapers#page2.tif
source=10018-01-0015-US_SignedFormalPapers#page3.tif

COMBINED DECLARATION AND ASSIGNMENT

DECLARATION

As the below named inventors, I hereby declare that:

This declaration is directed to:

☒ The attached application, or

☐ United States application or PCT international application number _____

filed on _____

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. § 1001 by fine or imprisonment of not more than five (5) years, or both.

ASSIGNMENT

In consideration of the sum of One Dollar ($1.00) or equivalent and other good and valuable consideration paid to each of the below named inventors, each of the below named inventors, hereby sell and assign to **Yangtze Memory Technologies Co., Ltd.**, a corporation formed under the laws of China, whose mailing address is 18 Gaoxin 4th Road, East Lake High-Tech Development Zone, Wuhan, Hubei, China (hereafter referred to as the Assignee), his/her entire right, title and interest, including the right to sue for past infringement and to collect for all past, present and future damages, for the United States of America (as defined in 35 U.S.C. § 100) and throughout the world,

(a) in the invention(s) known as **THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME** for which application(s) for patent in the United States of America is identified above, in any and all applications thereon, in any and all Letters Patent(s) therefor, and

(b) in any and all applications that claim the benefit of the patent application identified above in part (a), including non-provisional applications, continuing (continuation, divisional, or continuation-in-part) applications, reissues, extensions, renewals and reexaminations of the patent application or Letters Patent therefor listed above in part (a), to the full extent of the term or terms for which Letters Patents issue, and

(c) in any and all inventions described in the patent application identified above in part (a), and in any and all forms of intellectual and industrial property protection derivable from such patent application, and that are derivable from any and all continuing applications, reissues, extensions, renewals and reexaminations of such patent application, including, without limitation, patents, applications, utility models, inventor's certificates, and designs together with the right to file applications therefor; and including the right to claim the same priority rights from any previously filed applications under the International Agreement for the Protection of Industrial Property, or any other international agreement, or the domestic laws of the country in which any such application is filed, as may be applicable;

all such rights, title and interest to be held and enjoyed by the above-named Assignee, its successors, legal representatives and assigns to the same extent as all such rights, title and interest would have been held and enjoyed by the Assignor had this assignment and sale not been made.

The below named inventors agree to execute all papers necessary in connection with the application(s) and any non-provisional, continuing (continuation, divisional, or continuation-in-part), reissue, reexamination or corresponding application(s) thereof and also to execute separate assignments in connection with such application(s) as the Assignee may deem necessary or expedient.

The below named inventors agree to execute all papers necessary in connection with any patent enforcement action (judicial or otherwise) related to the application(s) or any non-provisional, continuing (continuation, divisional, or continuation-in-part), reissue or reexamination application(s) thereof and to cooperate with the Assignee in every way possible in obtaining evidence and going forward with such patent enforcement action.

The below named inventors hereby represent that he/she has full right to convey the entire interest herein assigned, and that he/she has not executed, and will not execute, any agreement in conflict therewith.

The below named inventors hereby represent that he/she understands that the patent practitioners associated with **CUSTOMER NUMBER 153988** are the legal representatives of, and attorneys for, the assignee, and are NOT the legal representatives of, and attorneys for, the inventors.

IN WITNESS WHEREOF, executed by the below named inventors on the date opposite his/her name.

LEGAL NAME OF INVENTOR

Inventor: Mei Lan Guo Date: 2018.9.5

Signature of Inventor: [signature]

Inventor: Yushi Hu Date: 2018.08.22

Signature of Inventor: [signature]

Inventor: Ji Xia Date: 2018/8/22

Signature of Inventor: Ji Xia

Inventor: Hongbin Zhu Date: 2018/8/29

Signature of Inventor: [signature]

DocCode – SCORE

SCORE Placeholder Sheet for IFW Content

Application Number: 16745343 Document Date: 01/17/2020

The presence of this form in the IFW record indicates that the following document type was received in electronic format on the date identified above. This content is stored in the SCORE database.

Since this was an electronic submission, there is no physical artifact folder, no artifact folder is recorded in PALM, and no paper documents or physical media exist. The TIFF images in the IFW record were created from the original documents that are stored in SCORE.

- Drawing

At the time of document entry (noted above):

- USPTO employees may access SCORE content via DAV or via the SCORE web page.
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Form Revision Date: March 1, 2019

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82A (07-13)
Approved for use through 01/31/2018. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	
Filing Date	
First Named Inventor	Mei Lan GUO
Title	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME
Art Unit	To Be Assigned
Examiner Name	To Be Assigned
Attorney Docket Number	10018-01-0015-US-CON1

SIGNATURE of Applicant or Patent Practitioner

Signature	/Zhiwei Zou/	Date (Optional)	1/17/2020
Name	Zhiwei Zou	Registration Number	66,041
Title (if Applicant is a juristic entity)	Attorney for Applicant		
Applicant Name (if Applicant is a juristic entity)	Yangtze Memory Technologies Co., Ltd.		

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 01/31/2016. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number

POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 153988

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

Yangtze Memory Technologies Co., Ltd.

☐ Inventor or Joint Inventor (title not required below)
☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)
☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)
☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	Simon	Date (Optional)	
Name	SIMON SHI-NING YANG		
Title	CEO		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ Total of One forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/745,343	01/17/2020	2812	1720	10018-01-0015-US-CON1	20	3

CONFIRMATION NO. 7456

153988
Bayes PLLC
1765 Greensboro Station Place
Suite 900
McLean, VA 22102

FILING RECEIPT

OC000000114633378

Date Mailed: 02/13/2020

Receipt is acknowledged of this non-provisional utility patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF FIRST INVENTOR, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection.

Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please submit a written request for a corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections provided that the request is grantable.

Inventor(s)

Mei Lan Guo, Wuhan, CHINA;
Yushi Hu, Wuhan, CHINA;
Ji Xia, Wuhan, CHINA;
Hongbin Zhu, Wuhan, CHINA;

Applicant(s)

YANGTZE MEMORY TECHNOLOGIES CO., LTD., Wuhan, CHINA;

Power of Attorney: The patent practitioners associated with Customer Number 153988

Domestic Priority data as claimed by applicant

This application is a CON of 16/149,103 10/01/2018 PAT 10566336
which is a CON of PCT/CN2018/101482 08/21/2018

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

If Required, Foreign Filing License Granted: 02/11/2020

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/745,343**

Projected Publication Date: 05/21/2020

Non-Publication Request: No

Early Publication Request: No

Title

THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME

Preliminary Class

438

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific

countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

The applicant has been granted a license under 35 U.S.C. 184, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" followed by a date appears on this form. Such licenses are issued in all applications where the conditions for issuance of a license have been met, regardless of whether or not a license may be required as set forth in 37 CFR 5.15. The scope and limitations of this license are set forth in 37 CFR 5.15(a) unless an earlier license has been issued under 37 CFR 5.15(b). The license is subject to revocation upon written notification. The date indicated is the effective date of the license, unless an earlier license of similar scope has been granted under 37 CFR 5.13 or 5.14.

This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/745,343

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	660
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760
TOTAL CLAIMS (37 CFR 1.16(i))	20 minus 20 =	*			OR	x 100 =	0.00
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*				x 460 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	1720

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".
The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/745,343	01/17/2020	Mei Lan Guo	10018-01-0015-US-CON1

CONFIRMATION NO. 7456

153988
Bayes PLLC
1765 Greensboro Station Place
Suite 900
McLean, VA 22102

PUBLICATION NOTICE

OC000000117168448

Title:THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME

Publication No.US-2020-0161322-A1
Publication Date:05/21/2020

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently https://portal.uspto.gov/pair/PublicPair. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

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www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/745,343	01/17/2020	Mei Lan Guo	10018-01-0015-US-CON1	7456

153988 7590 09/25/2020

Bayes PLLC
1765 Greensboro Station Place
Suite 900
McLean, VA 22102

EXAMINER	
TRAN, DZUNG	

ART UNIT	PAPER NUMBER
2829	

NOTIFICATION DATE	DELIVERY MODE
09/25/2020	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

USPTO@dockettrak.com
eofficeaction@appcoll.com
uspto@bayes.law

Office Action Summary	Application No. 16/745,343	Applicant(s) Guo et al.	
	Examiner DZUNG T TRAN	Art Unit 2829	AIA (FITF) Status Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 01/17/2020.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-20 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-20 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 01/17/2020 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☑ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☑ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

DETAILED ACTION

Status of the Claims

1. Claims 1-20 are pending.

Action on merits of claims 1-20 as follows.

Priority

2. Receipt is acknowledged of certified copies of papers submitted under 35 U.S.C. 119(a)-(d), which papers have been placed of record in the file.

Information Disclosure Statement

3. The information disclosure statement (IDS) submitted on January 17th, 2020 has been considered by the examiner.

Drawings

4. The drawings filed on 01/17/2020 are acceptable.

Specification

5. The specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Double Patenting

6. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

7. Claims 1-20 are rejected on the ground of nonstatutory obviousness-type double patenting as being unpatentable over claims 1-16 of U.S. Patent No. US 10,566,336 hereinafter as PAT '336. Although the conflicting claims are not identical, they are not patentably distinct from each other because both claim a same structure and the examined claims are similar to that of the patent's claims. To be more specific below is a table with the respective claims of the instant application and the copending claims.

Instant Claims (16/745343)	US 10,566,336
1	1
2	5
3	6
4	7
5	8
6	9
7	10
8	9
9	10
10	13
11	16
12	16
13	9
14	10
15	11
16	4
17	15
18	16
19	4
20	2 and 16

Conclusion

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The following patents are cited to further show the state of the art with respect to semiconductor devices:

Oh et al. (US 2015/0206895 A1)

Yada et al. (US 2015/0179660 A1)

Alsmeier et al. (US 2013/0264631 A1)

Lee et al. (US 2012/0280304 A1)

Park et al. (US 2012/0119287 A1)

9. For applicant's benefit portions of the cited reference(s) have been cited to aid in the review of the rejection(s). While every attempt has been made to be thorough and consistent within the rejection it is noted that the *PRIOR ART MUST BE CONSIDERED IN ITS ENTIRETY, INCLUDING DISCLOSURES THAT TEACH AWAY FROM THE CLAIMS.* See MPEP 2141.02 VI.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to DZUNG T TRAN whose telephone number is (571) 270-3911. The examiner can normally be reached on M-F 8 AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Sue Purvis can be reached on (571) 272-1236. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/DZUNG TRAN/
Primary Examiner, Art Unit 2829

Notice of References Cited	Application/Control No. 16/745,343	Applicant(s)/Patent Under Reexamination Guo et al.	
	Examiner DZUNG T TRAN	Art Unit 2829	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20150206895-A1	07-2015	OH; Sung Lae	H01L29/7926	257/324
*	B	US-20150179660-A1	06-2015	Yada; Shinsuke	H01L21/02164	257/321
*	C	US-20130264631-A1	10-2013	Alsmeier; Johann	H01L29/512	257/324
*	D	US-20120280304-A1	11-2012	LEE; SANG-HOON	H01L29/7889	257/316
*	E	US-20120119287-A1	05-2012	PARK; Sang-Yong	H01L27/11519	257/329
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/745,343	Guo et al.
	Examiner	Art Unit
	DZUNG T TRAN	2829

CPC - Searched*		
Symbol	Date	Examiner
H01L 27/11531; 21/76816; 21/76877; 23/5226; 23/5283; 27/11524	09/22/2020	DT

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
257	314	09/22/2020	DT

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Conducted inventor name searching	09/22/2020	DT
Text searching	09/22/2020	DT

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/745,343	Guo et al.
	Examiner	Art Unit
	DZUNG T TRAN	2829

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	09/22/2020								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
	11	✓								
	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	✓								
	17	✓								
	18	✓								
	19	✓								
	20	✓								

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S40	1,324	(257/314).CCLS.	US-PGPUB	OR	OFF	2019/11/20 06:10
S41	142	((("GUO") near3 ("Mei") near3 ("Lan")) OR (("HU") near3 ("Yushi")) OR (("XIA") near3 ("Ji")) OR (("ZHU") near3 ("Hongbin"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2019/11/20 06:10
S42	2,770	H01L21/76816.CPC.	US-PGPUB	OR	OFF	2019/11/20 06:19
S43	2,391	S42 and @pd<"20180821"	US-PGPUB; USPAT; USOCR	OR	OFF	2019/11/20 06:19
S44	4,923	H01L21/76877.CPC.	US-PGPUB	OR	OFF	2019/11/20 07:00
S45	4,252	S44 and @pd<"20180821"	US-PGPUB; USPAT; USOCR	OR	OFF	2019/11/20 07:00
S46	1,826	S45 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2019/11/20 07:00
S47	5,604	H01L23/5226.CPC.	US-PGPUB	OR	OFF	2019/11/20 07:49
S48	4,538	S47 and @pd<"20180821"	US-PGPUB; USPAT; USOCR	OR	OFF	2019/11/20 07:49
S49	2,126	S48 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2019/11/20 07:49
S50	1,937	H01L23/5283.CPC.	US-PGPUB	OR	OFF	2019/11/20 07:49
S51	3	("20140175532" | "20160099255" | "20170125430").PN.	US-PGPUB; USPAT	OR	OFF	2019/11/20 08:10
S52	2,775	H01L27/11524.CPC.	US-PGPUB	OR	OFF	2019/12/18 10:42
S53	2,477	S52 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2019/12/18 10:42
S54	2,464	S53 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2019/12/18 10:42

S55	2,358	S54 and (bit line)	US-PGPUB; USPAT; USOCR	OR	OFF	2019/12/18 11:00
S56	925	H01L27/11529.CPC.	US-PGPUB	OR	OFF	2019/12/18 11:01
S57	1,715	H01L27/11529.CPC.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/12/18 11:02
S58	4,129	H01L27/11556.CPC.	US-PGPUB; USPAT; USOCR	OR	OFF	2019/12/18 12:06
S59	2,225	H01L27/11556.CPC.	US-PGPUB	OR	OFF	2019/12/18 12:06
S60	2,407	H01L27/1157.CPC.	US-PGPUB	OR	OFF	2019/12/18 12:06
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S66	2	"14832579"	US-PGPUB; USPAT; USOCR	OR	OFF	2019/12/18 17:55
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		"20150179660" | "5915167" | "7005350" | "7023739" | "7177191" | "7221588" | "7233522" | "7514321" | "7575973" | "7696559" | "7745265" | "7808038" | "7848145" | "7851851" | "8008710" | "8053829" | "8187936" | "8394716" | "9023719" | "9305934").PN. OR ("9449987").URPN.				
S70	1	("9449987").PN.	USPAT; USOCR	OR	OFF	2019/12/18 18:13
S71	179	((("GUO") near3 ("Mei") near3 ("Lan")) OR (("HU") near3 ("Yushi")) OR (("XIA") near3 ("Ji")) OR (("ZHU") near3 ("Hongbin"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2020/06/18 08:41
S72	1,326	(257/314).CCLS.	US-PGPUB	OR	OFF	2020/06/18 08:43
S73	2,120	H01L27/11531.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/06/18 08:47
S74	3,081	H01L21/76816.CPC.	US-PGPUB	OR	OFF	2020/06/18 09:16
S75	2,449	S74 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 09:16
S76	753,089	"55" and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 09:16
S77	1,242	S75 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 09:16
S78	1,033	S75 and (bit data)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 09:18
S79	1,421	S77 S78	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 09:18
S80	5,390	H01L21/76877.CPC.	US-PGPUB	OR	OFF	2020/06/18 09:58
S81	4,301	S80 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 09:59

S82	1,852	S81 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 09:59
S83	6,379	H01L23/5226.CPC.	US-PGPUB	OR	OFF	2020/06/18 09:59
S84	4,603	S83 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 10:00
S85	2,159	S84 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 10:00
S86	2,210	H01L23/5283.CPC.	US-PGPUB	OR	OFF	2020/06/18 10:51
S87	2,984	H01L27/11524.CPC.	US-PGPUB	OR	OFF	2020/06/18 10:52
S88	2,481	S87 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 10:53
S89	2,468	S88 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 10:53
S90	2,270	S89 and (bit data)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 10:53
S91	990	H01L27/11529.CPC.	US-PGPUB	OR	OFF	2020/06/18 12:01
S92	1,832	H01L27/11529.CPC.	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 12:01
S93	4,636	H01L27/11556.CPC.	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 12:01
S94	2,504	H01L27/11556.CPC.	US-PGPUB	OR	OFF	2020/06/18 12:02
S95	1,755	S94 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 12:02
S96	0	H01L27/11557.CPC.	US-PGPUB	OR	OFF	2020/06/18 12:53
S97	2,710	H01L27/1157.CPC.	US-PGPUB	OR	OFF	2020/06/18 12:53
S98	1,803	S97 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/06/18 12:53

S99	2,006	H01L27/11573.CPC.	US-PGPUB	OR	OFF	2020/06/18 12:54
S100	5,136	H01L27/11582.CPC.	US-PGPUB	OR	OFF	2020/09/22 06:28
S101	3,325	S100 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 06:28
S102	3,285	S101 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 06:28
S103	3,067	S102 and stack$3	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 06:29
S104	2,215	S103 and (bit near line)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 06:29
S105	3	("20140175532" | "20160099255" | "20170125430").PN.	US-PGPUB; USPAT	OR	OFF	2020/09/22 08:07
S106	193	((("GUO") near3 ("Mei") near3 ("Lan")) OR (("HU") near3 ("Yushi")) OR (("XIA") near3 ("Ji")) OR (("ZHU") near3 ("Hongbin"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2020/09/22 08:24
S107	3,495	(257/314).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:25
S108	3,490	S107 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:25
S109	3,341	S108 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:25
S110	1,801	S109 and (bit near line)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:25
S111	996	H01L27/11531.CPC.	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:29
S112	3,165	H01L21/76816.CPC.	US-PGPUB	OR	OFF	2020/09/22 08:55
S113	2,454	S112 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:55
S114	1,244	S113 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:55

S115	562	S112 and (bit near line)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:56
S116	1,389	S114 S115	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:56
S117	5,531	H01L21/76877.CPC.	US-PGPUB	OR	OFF	2020/09/22 09:43
S118	4,301	S117 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 09:43
S119	1,852	S118 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 09:43
S120	6,627	H01L23/5226.CPC.	US-PGPUB	OR	OFF	2020/09/22 09:43
S121	4,604	S120 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 09:44
S122	2,160	S121 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 09:45
S123	5	"10566336"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 10:20
S124	2,317	H01L23/5283.CPC.	US-PGPUB	OR	OFF	2020/09/22 10:27
S125	1,620	S124 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 10:27
S126	3,094	H01L27/11524.CPC.	US-PGPUB	OR	OFF	2020/09/22 10:27
S127	2,481	S126 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 10:27
S128	2,468	S127 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 10:28
S129	1,775	S128 and (bit near line)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 10:28
S130	1	(14/925224).APP.	USPAT; USOCR	OR	OFF	2020/09/22 10:57
S131	63	("20070210338" | "20070252201" | "20090230449" | "20090242967" | "20100044778" | "20100112769" |	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 10:58

		"20100120214" | "20100155810" | "20100155818" | "20100181610" | "20100207195" | "20100320528" | "20110076819" | "20110133606" | "20110266606" | "20120001247" | "20120001249" | "20120001250" | "20120012920" | "20120119287" | "20120280304" | "20130264631" | "20150076584" | "20150076586" | "20150179660" | "20150206895" | "5915167" | "7005350" | "7023739" | "7177191" | "7221588" | "7233522" | "7514321" | "7575973" | "7696559" | "7745265" | "7808038" | "7848145" | "7851851" | "8008710" | "8053829" | "8187936" | "8394716" | "8643142" | "8878278" | "9023719").PN. OR ("9620512").URPN.				
S132	1	(14/925224).APP.	US-PGPUB; USOCR	OR	OFF	2020/09/22 10:58

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S63	1	(form$3 near2 spacer near3 sidewall near3 first near open$3) and (form$3 near3 array ear contact near2 extend$3 near vertically tnear3 dielectric near stack near3 conductor near layer near4 spacer near3 first near open$3) and (after near form$3 TAC near2 form$3 near2 slit near extend$3 near vertically near3 dielectric near stack).clm.	USPAT	OR	OFF	2019/12/18 15:52

9/22/2020 11:30:41 AM
H:\East search\16_745343_memory string.wsp

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	
First Named Inventor	Mei Lan GUO
Art Unit	TBD
Examiner Name	TBD
Attorney Docket Number	10018-01-0015-US-CON1

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20170125430	A1	2017-05-04	NISHIKAWA et al.	
	2	20140175532	A1	2014-06-26	Chen	
	3	20160099255	A1	2016-04-07	Lai	

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FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1	108377660	CN	A	2018-08-07	SANDISK TECHNOLOGIES LLC		

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.T/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Mei Lan GUO
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	10018-01-0015-US-CON1

	2	108140644	CN	A	2018-06-08	SANDISK TECHNOLOGIES LLC			
	3	106920794	CN	A	2017-07-04	YANGTZE MEMORY TECH CO LTD			
	4	106910746	CN	A	2017-06-30	YANGTZE MEMORY TECH CO LTD			
	5	106920796	CN	A	2017-07-04	YANGTZE MEMORY TECH CO LTD			
	6	106256005	CN	A	2016-12-21	SANDISK TECHNOLOGIES INC			
	7	107771356	CN	A	2018-03-06	SANDISK TECHNOLOGIES INC			

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NON-PATENT LITERATURE DOCUMENTS Remove

Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1	International Search Report issued in corresponding International Application No. PCT/CN2018/101482, mailed May 5, 2019, 5 pages	
	2	Written Opinion of the International Searching Authority issued in corresponding International Application No. PCT/CN2018/101482, mailed May 5, 2019, 4 pages	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Mei Lan GUO
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	10018-01-0015-US-CON1

EXAMINER SIGNATURE			
Examiner Signature	/DZUNG TRAN/	Date Considered	09/22/2020

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.T/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Mei Lan GUO
	Art Unit	TBD
	Examiner Name	TBD
	Attorney Docket Number	10018-01-0015-US-CON1

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Zhiwei Zou/	Date (YYYY-MM-DD)	2020-01-17
Name/Print	Zhiwei Zou	Registration Number	66,041

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.T/

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The information provided by you in this form will be subject to the following routine uses:

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6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /D.T/

Bibliographic Data

Application No: 16/745,343

Foreign Priority claimed: (•) Yes ( ) No

35 USC 119 (a-d) conditions met: [✓] Yes [ ] No [ ] Met After Allowance

Verified and Acknowledged: /DZUNG TRAN/ Examiner's Signature [ ] Initials

Title: THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
01/17/2020	257	2829	10018-01-0015-US-CON1
RULE			

APPLICANTS

YANGTZE MEMORY TECHNOLOGIES CO., LTD., Wuhan, CHINA

INVENTORS

Mei Lan Guo, Wuhan, CHINA

Yushi Hu, Wuhan, CHINA

Ji Xia, Wuhan, CHINA

Hongbin Zhu, Wuhan, CHINA

CONTINUING DATA

This application is a CON of 16149103 10/01/2018 PAT 10566336

16149103 is a CON of PCT/CN2018/101482 08/21/2018

FOREIGN APPLICATIONS

IF REQUIRED, FOREIGN LICENSE GRANTED**

02/11/2020

STATE OR COUNTRY

CHINA

ADDRESS

Bayes PLLC

1765 Greensboro Station Place

Suite 900

McLean, VA 22102

UNITED STATES

FILING FEE RECEIVED

$1,720

Doc Code: DIST.E.FILE **Document Description: Electronic Terminal Disclaimer - Filed**	PTO/SB/26 U.S. Patent and Trademark Office Department of Commerce

Electronic Petition Request	**TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT**
Application Number	16745343
Filing Date	17-Jan-2020
First Named Inventor	Mei Lan Guo
Attorney Docket Number	10018-01-0015-US-CON1
Title of Invention	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME

☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action

☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.

Owner	Percent Interest
YANGTZE MEMORY TECHNOLOGIES CO., LTD.	100%

The owner(s) with percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of prior patent number(s)

10566336

as the term of said prior patent is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the prior patent, "as the term of said prior patent is presently shortened by any terminal disclaimer," in the event that said prior patent later:
- expires for failure to pay a maintenance fee;
- is held unenforceable;
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- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

◉ Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request.

○ I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.	
Applicant claims the following fee status: ○ Small Entity ○ Micro Entity ◉ Regular Undiscounted I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.	
THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES I certify, in accordance with 37 CFR 1.4(d)(4) that I am: ◉ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application Registration Number 66041 ○ A sole inventor ○ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application ○ A joint inventor; all of whom are signing this request	
Signature	/Zhiwei Zou/
Name	Zhiwei Zou

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Electronic Patent Application Fee Transmittal

Application Number:	16745343
Filing Date:	17-Jan-2020
Title of Invention:	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME
First Named Inventor/Applicant Name:	Mei Lan Guo
Filer:	Zhiwei Zou/Anna O'Connor
Attorney Docket Number:	10018-01-0015-US-CON1

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
STATUTORY OR TERMINAL DISCLAIMER	1814	1	170	170
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**170**

Doc Code: DISQ.E.FILE
Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 16745343

Filing Date: 17-Jan-2020

Applicant/Patent under Reexamination: Guo

Electronic Terminal Disclaimer filed on October 12, 2020

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Electronic Acknowledgement Receipt

EFS ID:	40815677
Application Number:	16745343
International Application Number:	
Confirmation Number:	7456
Title of Invention:	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME
First Named Inventor/Applicant Name:	Mei Lan Guo
Customer Number:	153988
Filer:	Zhiwei Zou/Anna O'Connor
Filer Authorized By:	Zhiwei Zou
Attorney Docket Number:	10018-01-0015-US-CON1
Receipt Date:	12-OCT-2020
Filing Date:	17-JAN-2020
Time Stamp:	15:21:35
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$170
RAM confirmation Number	E20200BF21317204
Deposit Account	602227
Authorized User	Anna O'Connor
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Terminal Disclaimer-Filed (Electronic)	eTerminal-Disclaimer.pdf	33513 6acdf4b41de7cb96f5ae8269744110c428d55c1f	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30237 d8eba02d0f99edd8283983f943e8c2d7bbbc8d04	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	63750		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Inventor(s): Mei Lan Guo	Confirmation No.: 7456
Applicant: YANGTZE MEMORY TECHNOLOGIES CO. LTD.	Art Unit: 2829
Application No.: 16/745,343	Examiner: Dzung Tran
Filing Date: September 25, 2020	Atty. Docket: 10018-01-0015-US-CON1

Title: **THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME**

Amendment and Reply Under 37 C.F.R. § 1.111

Mail Stop Amendment

Commissioner for Patents
PO Box 1450
Alexandria, VA 22313-1450

Commissioner:

In reply to the Office Action dated September 25, 2020, Applicant submits the following Amendments and Remarks.

Remarks begin on page 2 of this paper.

It is not believed that extensions of time are required beyond those that may otherwise be provided for in documents accompanying this paper. However, if additional extensions of time are necessary to prevent abandonment of this application, then such extensions of time are hereby petitioned under 37 C.F.R. § 1.136(a), and any additional fees required to continue prosecution or appeal of this application (including issue fee, fees for net addition of claims or forwarding to appeal) are hereby authorized to be charged to our Deposit Account No. 60-2227.

Electronic Acknowledgement Receipt

EFS ID:	40815694
Application Number:	16745343
International Application Number:	
Confirmation Number:	7456
Title of Invention:	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME
First Named Inventor/Applicant Name:	Mei Lan Guo
Customer Number:	153988
Filer:	Zhiwei Zou/Anna O'Connor
Filer Authorized By:	Zhiwei Zou
Attorney Docket Number:	10018-01-0015-US-CON1
Receipt Date:	12-OCT-2020
Filing Date:	17-JAN-2020
Time Stamp:	15:22:22
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		10018-01-0015-US-CON1_ResponseNFOA_09-25-20.pdf	28716 1a5099d4ed80ad5cf47234b0e80d8dd84a3174d9	yes	3

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Applicant Arguments/Remarks Made in an Amendment	2	3
	Amendment/Req. Reconsideration-After Non-Final Reject	1	1
Warnings:			
Information:			
	Total Files Size (in bytes):	28716	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Remarks

Reconsideration of this Application is respectfully requested.

Upon entry of the foregoing amendments, claims 1-20 are pending in the application, with claims 1, 11, and 18 being independent claims. No amendment has been made.

Throughout the arguments, Applicant reminds the Examiner that the claims are given their broadest reasonable meaning in view of the specification, and any paraphrasing of the claim features is not to be interpreted as reading any features into, or characterizing of, the claims.

Based on the above amendments and the following remarks, Applicant respectfully requests that the Examiner reconsider and withdraw all outstanding rejections.

Double-Patenting Rejection

Claims 1-20 were rejected for obviousness-type double patenting over the claims 1-16 of U.S. Patent No. 10,566,336 (hereinafter "'336 patent"). Without acquiescing to propriety of the rejection and to expedite the prosecution, a terminal disclaimer is being filed as an electronic Terminal Disclaimer (eTD) herewith. Withdrawal of the rejection on the basis of the eTD is respectfully requested.

Conclusion

All of the stated grounds of rejection have been properly traversed, accommodated, or rendered moot. Applicant therefore respectfully requests that the Examiner reconsider the presently outstanding rejections and that they be withdrawn. Applicant believes that a full and complete reply has been made to the outstanding Office Action and, as such, the present application is in condition for allowance. If the Examiner believes, for any reason, that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at the number provided.

Prompt and favorable consideration of this Amendment and Reply is respectfully requested.

Respectfully submitted,

BAYES PLLC

/Zhiwei Zou/

Zhiwei Zou
Attorney for Applicant
Registration No. 66,041

Date: October 12, 2020

1765 Greensboro Station Place, Suite 900
McLean, VA 22102
(703) 995-9887

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

153988 7590 10/26/2020

Bayes PLLC
1765 Greensboro Station Place
Suite 900
McLean, VA 22102

EXAMINER
TRAN, DZUNG

ART UNIT	PAPER NUMBER
2829	

DATE MAILED: 10/26/2020

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/745,343	01/17/2020	Mei Lan Guo	10018-01-0015-US-CON1	7456

TITLE OF INVENTION: THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	01/26/2021

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PTOL-85 (Rev. 02/11)

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

153988 7590 10/26/2020

Bayes PLLC
1765 Greensboro Station Place
Suite 900
McLean, VA 22102

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/745,343	01/17/2020	Mei Lan Guo	10018-01-0015-US-CON1	7456

TITLE OF INVENTION: THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	01/26/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
TRAN, DZUNG	2829	257-314000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

PTOL-85 Part B (08-18) Approved for use through 01/31/2020 OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/745,343	01/17/2020	Mei Lan Guo	10018-01-0015-US-CON1	7456

153988 7590 10/26/2020

Bayes PLLC
1765 Greensboro Station Place
Suite 900
McLean, VA 22102

EXAMINER	
TRAN, DZUNG	

ART UNIT	PAPER NUMBER
2829	

DATE MAILED: 10/26/2020

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

PTOL-85 (Rev. 02/11)

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	**Application No.** 16/745,343	**Applicant(s)** Guo et al.	
	Examiner DZUNG T TRAN	**Art Unit** 2829	**AIA (FITF) Status** Yes

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 10/12/2020.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 1-20 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☑ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☑ All b) ☐ Some *c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☑ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/DZUNG TRAN/
Primary Examiner, Art Unit 2829

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Terminal Disclaimer

The terminal disclaimer filed on October 12th, 2020 disclaiming the terminal portion of any patent granted on this application which would extend beyond the expiration date of the US Patent Number 10,566,336 has been reviewed and is accepted. The terminal disclaimer has been recorded on October 12th, 2020.

DETAILED ACTION

Response to Amendment

1. This office action is in response to Amendment filed on 10/12/2020. Claims 1-20 are pending.

Allowable Subject Matter

2. Claims 1-20 are allowed.

Applicant's arguments, with regards to claims 1-20, filed on 10/12/2020 have been fully considered and they are persuasive due to the Terminal Disclaimer filed on 10/12/2020 has been approved on 10/12/2020. Claim 1, 11 and 18 include allowable subject matter since the prior art made of record and considered pertinent to the applicants' disclosure, taken individually or in combination, does not teach or suggest the claimed invention having: "forming a spacer on a sidewall of the first opening; forming a through array contact (TAC) extending vertically through the stack by depositing a conductor layer over the spacer in the first opening; and after forming

the TAC, forming a slit extending vertically through the stack" and combination of other steps of independent claims 1, 11 and 18. Furthermore, claims 2-10, 12-17 and 19-20 are also allowed as they depend from an allowed base claims. In addition, the invention is allowable after it was rejected as Obvious Double patenting in the previous office action. However, the applicants filed a terminal disclaimer in a timely manner in compliance with 37 CFR 1.32(c). It may be used to overcome an actual patent shown as commonly owned with this application. Therefore, the Examiner made decision to allow these limitations over the Terminal Disclaimer and prior art of record.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Conclusion

3. Any inquiry concerning this communication or earlier communications from the examiner should be directed to DZUNG T TRAN whose telephone number is (571) 270-3911. The examiner can normally be reached on M-F 8 AM-5PM.

4. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Sue Purvis can be reached on 571-272-1236. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

5. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/DZUNG TRAN/
Primary Examiner, Art Unit 2829

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/745,343	Guo et al.
	Examiner	Art Unit
	DZUNG T TRAN	2829

CPC - Searched*		
Symbol	**Date**	**Examiner**
H01L 27/11531; 21/76816; 21/76877; 23/5226; 23/5283; 27/11524	09/22/2020 (Updated on 10/19/2020)	DT
H01L 27/11524; 27/11529; 27/11556; 27/1157; 27/11573; 27/11582	10/19/2020	DT

CPC Combination Sets - Searched*		
Symbol	**Date**	**Examiner**

US Classification - Searched*			
Class	**Subclass**	**Date**	**Examiner**
257	314	09/22/2020	DT

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	**Date**	**Examiner**
Conducted inventor name searching	09/22/2020	DT
Text searching	09/22/2020	DT
Text searching	10/19/2020	DT

Interference Search			
US Class/CPC Symbol	**US Subclass/CPC Group**	**Date**	**Examiner**
	Conducted interference key words searching (see East search print out)	10/19/2020	DT

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/745,343	Guo et al.
	Examiner	**Art Unit**
	DZUNG T TRAN	2829

CPC						
Symbol					**Type**	**Version**
H01L	/	27	/	11531	F	2013-01-01
H01L	/	21	/	76816	I	2013-01-01
H01L	/	21	/	76877	I	2013-01-01
H01L	/	23	/	5226	I	2013-01-01
H01L	/	23	/	5283	I	2013-01-01
H01L	/	27	/	11524	I	2013-01-01
H01L	/	27	/	11529	I	2013-01-01
H01L	/	27	/	11556	I	2013-01-01
H01L	/	27	/	1157	I	2013-01-01
H01L	/	27	/	11573	I	2013-01-01
H01L	/	27	/	11582	I	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/DZUNG TRAN/ Primary Examiner, Art Unit 2829	19 October 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20201019

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/745,343	Guo et al.
	Examiner	**Art Unit**
	DZUNG T TRAN	2829

INTERNATIONAL CLASSIFICATION					
CLAIMED					
H01L	/	27	/	11531	

NON-CLAIMED					
	/		/		

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
257	314

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner) (Date)		**Total Claims Allowed:** 20	
/DZUNG TRAN/ Primary Examiner, Art Unit 2829 (Primary Examiner)	19 October 2020 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 1

U.S. Patent and Trademark Office Part of Paper No.: 20201019

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/745,343	Guo et al.
	Examiner	Art Unit
	DZUNG T TRAN	2829

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		10		19										
	2		11		20										
	3		12												
	4		13												
	5		14												
	6		15												
	7		16												
	8		17												
	9		18												

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/DZUNG TRAN/ Primary Examiner, Art Unit 2829	19 October 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	1

U.S. Patent and Trademark Office — Part of Paper No.: 20201019

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/745,343	Guo et al.
	Examiner	Art Unit
	DZUNG T TRAN	2829

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	09/22/2020	10/19/2020							
	1	✓	=							
	2	✓	=							
	3	✓	=							
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	18	✓	=							
	19	✓	=							
	20	✓	=							

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S100	5,136	H01L27/11582.CPC.	US-PGPUB	OR	OFF	2020/09/22 06:28
S101	3,325	S100 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 06:28
S102	3,285	S101 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 06:28
S103	3,067	S102 and stack$3	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 06:29
S104	2,215	S103 and (bit near line)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 06:29
S105	3	("20140175532" | "20160099255" | "20170125430").PN.	US-PGPUB; USPAT	OR	OFF	2020/09/22 08:07
S106	193	((("GUO") near3 ("Mei") near3 ("Lan")) OR (("HU") near3 ("Yushi")) OR (("XIA") near3 ("Ji")) OR (("ZHU") near3 ("Hongbin"))).INV.	US-PGPUB; USPAT; USOCR; EPO; JPO; DERWENT	OR	OFF	2020/09/22 08:24
S107	3,495	(257/314).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:25
S108	3,490	S107 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:25
S109	3,341	S108 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:25
S110	1,801	S109 and (bit near line)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:25
S111	996	H01L27/11531.CPC.	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:29
S112	3,165	H01L21/76816.CPC.	US-PGPUB	OR	OFF	2020/09/22 08:55

S113	2,454	S112 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:55
S114	1,244	S113 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:55
S115	562	S112 and (bit near line)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:56
S116	1,389	S114 S115	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 08:56
S117	5,531	H01L21/76877.CPC.	US-PGPUB	OR	OFF	2020/09/22 09:43
S118	4,301	S117 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 09:43
S119	1,852	S118 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 09:43
S120	6,627	H01L23/5226.CPC.	US-PGPUB	OR	OFF	2020/09/22 09:43
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S125	1,620	S124 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 10:27
S126	3,094	H01L27/11524.CPC.	US-PGPUB	OR	OFF	2020/09/22 10:27
S127	2,481	S126 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 10:27
S128	2,468	S127 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 10:28

S129	1,775	S128 and (bit near line)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 10:28
S130	1	(14/925224).APP.	USPAT; USOCR	OR	OFF	2020/09/22 10:57
S131	63	("20070210338" | "20070252201" | "20090230449" | "20090242967" | "20100044778" | "20100112769" | "20100120214" | "20100155810" | "20100155818" | "20100181610" | "20100207195" | "20100320528" | "20110076819" | "20110133606" | "20110266606" | "20120001247" | "20120001249" | "20120001250" | "20120012920" | "20120119287" | "20120280304" | "20130264631" | "20150076584" | "20150076586" | "20150179660" | "20150206895" | "5915167" | "7005350" | "7023739" | "7177191" | "7221588" | "7233522" | "7514321" | "7575973" | "7696559" | "7745265" | "7808038" | "7848145" | "7851851" | "8008710" | "8053829" | "8187936" | "8394716" | "8643142" | "8878278" | "9023719").PN. OR ("9620512").URPN.	US-PGPUB; USPAT; USOCR	OR	OFF	2020/09/22 10:58
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S134	3,120	H01L27/11524.CPC.	US-PGPUB	OR	OFF	2020/10/19 06:12
S135	2,481	S134 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/10/19 06:12
S136	1,043	H01L27/11529.CPC.	US-PGPUB	OR	OFF	2020/10/19 06:12
S137	1,927	H01L27/11529.CPC.	US-PGPUB; USPAT; USOCR	OR	OFF	2020/10/19 06:13
S138	5,101	H01L27/11556.CPC.	US-PGPUB; USPAT; USOCR	OR	OFF	2020/10/19 07:50
S139	2,783	H01L27/11556.CPC.	US-PGPUB	OR	OFF	2020/10/19 07:51
S140	1,758	S139 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/10/19 07:51

S141	5,244	H01L27/11582.CPC.	US-PGPUB	OR	OFF	2020/10/19 07:51
S142	3,325	S141 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/10/19 07:51
S143	3,285	S142 and (memory string)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/10/19 07:52
S144	989	S143 and (memory near stack$3)	US-PGPUB; USPAT; USOCR	OR	ON	2020/10/19 07:52
S145	3,153	S143 and (bit data)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/10/19 07:52
S146	2,346	S145 and (bit near line)	US-PGPUB; USPAT; USOCR	OR	OFF	2020/10/19 07:52
S147	1,778,054	"10" and stack$3	US-PGPUB; USPAT; USOCR	OR	ON	2020/10/19 07:53
S148	2,215	S146 and stack$3	US-PGPUB; USPAT; USOCR	OR	ON	2020/10/19 07:53
S149	2,922	H01L27/1157.CPC.	US-PGPUB	OR	OFF	2020/10/19 08:42
S150	1,803	S149 and @pd<"20180914"	US-PGPUB; USPAT; USOCR	OR	OFF	2020/10/19 08:42
S151	2,166	H01L27/11573.CPC.	US-PGPUB	OR	OFF	2020/10/19 08:51

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S152	1	(form$3 near2 spacer near3 sidewall near3 first near open$3) and (form$3 near3 array near contact near2 extend$3 near vertica$4 near3 stack$3 near deposit$3 near2 conduct$3 near layer near3 spacer near3 first near open$3) and (after near form$3 near2 TAC near form$3 near2 slit near extend$3 near vertic$4 near3 stack$3).clm.	USPAT	OR	OFF	2020/10/19 09:40

10/19/2020 9:55:58 AM
H:\East search\16_745343_memory string.wsp

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

153988 7590 10/26/2020

Bayes PLLC
1765 Greensboro Station Place
Suite 900
McLean, VA 22102

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

Anna J. O'Connor	(Typed or printed name)
/Anna J.O'Connor/	(Signature)
November 23, 2020 E-FILED	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/745,343	01/17/2020	Mei Lan Guo	10018-01-0015-US-CON1	7456

TITLE OF INVENTION: THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	01/26/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
TRAN, DZUNG	2829	257-314000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

☐ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

☐ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 BAYES PLLC
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: YANGTZE MEMORY TECHNOLOGIES CO., LTD.

(B) RESIDENCE: (CITY and STATE OR COUNTRY): WUHAN, CHINA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ☐ Individual ☒ Corporation or other private group entity ☐ Government

4a. Fees submitted: ☒ Issue Fee ☐ Publication Fee (if required) ☐ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ☐ Enclosed check ☐ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 60-2227

5. **Change in Entity Status** (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29

☐ Applicant asserting small entity status. See 37 CFR 1.27

☐ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date 11/23/2020

Typed or printed name Zhiwei Zou Registration No. 66,041

PTOL-85 Part B (08-18) Approved for use through 01/31/2020 OMB 0651-0033 U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE

Electronic Patent Application Fee Transmittal

Application Number:	16745343
Filing Date:	17-Jan-2020
Title of Invention:	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME
First Named Inventor/Applicant Name:	Mei Lan Guo
Filer:	Zhiwei Zou/Anna O'Connor
Attorney Docket Number:	10018-01-0015-US-CON1

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1200	1200

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**1200**

Electronic Acknowledgement Receipt

EFS ID:	41206982
Application Number:	16745343
International Application Number:	
Confirmation Number:	7456
Title of Invention:	THREE-DIMENSIONAL MEMORY DEVICES HAVING THROUGH ARRAY CONTACTS AND METHODS FOR FORMING THE SAME
First Named Inventor/Applicant Name:	Mei Lan Guo
Customer Number:	153988
Filer:	Zhiwei Zou/Anna O'Connor
Filer Authorized By:	Zhiwei Zou
Attorney Docket Number:	10018-01-0015-US-CON1
Receipt Date:	23-NOV-2020
Filing Date:	17-JAN-2020
Time Stamp:	22:39:24
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1200
RAM confirmation Number	E2020AMM39479557
Deposit Account	602227
Authorized User	Anna O'Connor
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	10018-01-0015-US-CON1_IFTransmittal.pdf	287550 dd898190367296f26d3e7d17163409b2a7456503	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30353 bff3f88da495b7e6139c9f8ea2d9b97a37394bec	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	317903		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111
If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.
National Stage of an International Application under 35 U.S.C. 371
If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.
New International Application Filed with the USPTO as a Receiving Office
If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/745,343	12/29/2020	10879254	10018-01-0015-US-CON1	7456

153988 7590 12/09/2020

Bayes PLLC
1765 Greensboro Station Place
Suite 900
McLean, VA 22102

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

Mei Lan Guo, Wuhan, CHINA;
YANGTZE MEMORY TECHNOLOGIES CO., LTD., Wuhan, CHINA;
Yushi Hu, Wuhan, CHINA;
Ji Xia, Wuhan, CHINA;
Hongbin Zhu, Wuhan, CHINA;