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(71) Applicant: CORNELL UNIVERSITY [US/US]; 395 Pine Tree Road, Suite 310, Ithaca, New York 14850 (US).

(72) Inventors: JAYANT, Krishna; 2250 North Triphammer Road, Apt. 7B, Ithaca, New York 14850 (US). KAN, Edwin C.; 107 Briarwood Drive, #1, Ithaca, New York 14850 (US).

(74) Agents: GREENER, William et al.; Bond, Schoeneck & King, PLLC, 10 Brown Road, Suite 102, Ithaca, New York 14850 (US).

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[Continued on next page]

(54) Title: FLOATING GATE BASED SENSOR APPARATUS AND APPLICATIONS

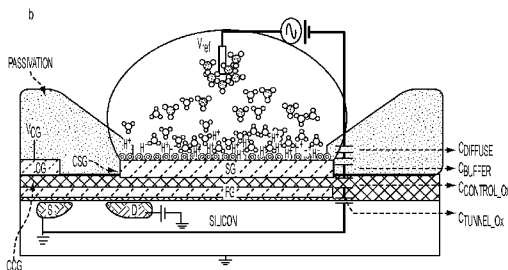
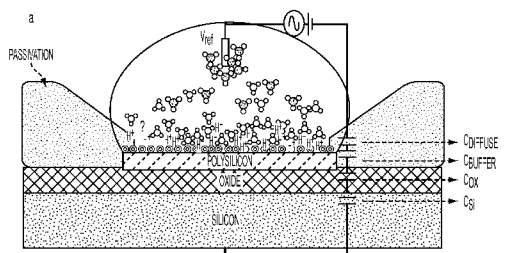


FIG. 1

(57) Abstract: A floating gate based sensor apparatus includes at least two separate electrical bias components with respect to a floating gate based sensor surface within the floating gate based sensor apparatus. By including the at least two electrical bias components, the floating gate based sensor apparatus provides enhanced capabilities for biomaterial and non-biomaterial detection and manipulation while using the floating gate based sensor apparatus.

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

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US14/41507

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G01N 27/06, 27/22; H01L 29/788 (2014.01)
CPC - G01N 27/22, 27/266; H01L 29/788
 According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) Classification(s): G01N 27/00, 27/02, 27/04, 27/06, 27/22, 27/414; H01L 29/788, 29/792, 29/76 (2014.01)
CPC: G01N 27/00, 27/02, 27/04, 27/06, 27/07, 27/22, 27/266, 27/414, 27/414; H01L 29/788, 29/7883, 29/7885, 29/66825

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
 MicroPatent (US Granted, US Applications, EP-A, EP-B, WO, JP, DE-G, DE-A, DE-T, DE-U, GB-A, FR-A); ProQuest (Derwent, INSPEC, NTIS, PASCAL, Current Contents Search, Dissertation Abstracts Online, Inside Conferences); IP.com; Google Scholar; **KEYWORDS**: sens*, floating*, gate*, liquid*, fluid*, chamber*, dielectric*, control*, electro*, tunnel*, planar*, finFET

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2008/0094074 A1 (KIM, M et al.) April 24, 2008; abstract; figures 1-4; paragraphs [0014, 0018-0021]	1-9, 12, 16, 19, 20 --- 10, 11, 13-15, 17, 18, 21
Y	US 2004/0266076 A1 (DORIS, B et al.) December 30, 2004; abstract; figures 1 and 8; paragraphs [0037 and 0052]	10, 11, 17, 18
Y	US 2006/0038222 A1 (KAN, E et al.) February 23, 2006; figures 1-3; paragraphs [0021, 0024, 0027, 0043]	13-15, 21

Further documents are listed in the continuation of Box C.

* Special categories of cited documents:
 "A" document defining the general state of the art which is not considered to be of particular relevance
 "E" earlier application or patent but published on or after the international filing date
 "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
 "O" document referring to an oral disclosure, use, exhibition or other means
 "P" document published prior to the international filing date but later than the priority date claimed
 "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
 "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
 "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
 "&" document member of the same patent family

Date of the actual completion of the international search 19 November 2014 (19.11.2014)	Date of mailing of the international search report 09 DEC 2014
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Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US14/41507

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

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

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

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

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

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

This International Searching Authority found multiple inventions in this international application, as follows:
See supplemental sheet.

- 1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
- 2. As all searchable claims could be searched without effort justifying additional fees; this Authority did not invite payment of additional fees.
- 3. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
- 4. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-21

- Remark on Protest**
- The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
 - The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
 - No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US14/41507

-***-Continued from Box III -***-

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fee must be paid.

Group I: Claims 1-21 are directed toward a sensor, floating gate sensor surface, liquid sample chamber, substrate, electrical bias, two electrical bias components, introducing a liquid sample containing at least one analyte, measuring parameters as a function of electrical bias.

Group II: Claims 1-19 and 22-26 are directed toward a sensor, floating gate sensor surface, liquid sample chamber, substrate, electrical bias, two electrical bias components, a receptor coating, measuring change in floating potential, and a biomolecule target.

Group III: Claim 1-19 and 27-29 are directed toward a sensor, floating gate sensor surface, liquid sample chamber, substrate, electrical bias, two electrical bias components, providing nucleic acid oligonucleotide, nucleic acid oligonucleotide is complementary to target nucleic acid, incubating nucleic acid oligonucleotide with sample, annealing nucleic acid oligonucleotide to target nucleic acid, double-stranded nucleic acid molecule, poly-1-lysine coating.

Group IV: Claims 1-19 and 30-35 are directed toward a sensor, floating gate sensor surface, liquid sample chamber, substrate, electrical bias, two electrical bias components, plurality of cells, monitoring change in surface potential of plurality of cells, and a change indicating release of biomolecules.

The inventions listed as Groups I-IV do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features. Group I has at least introducing a liquid sample containing at least one analyte and measuring parameters of the analyte as a function of electric bias that groups II-IV do not have. Group II has at least a receptor coating, measuring change in floating potential, and a biomolecule target that groups I, III, and IV do not have. Group III has at least a nucleic acid oligonucleotide, wherein the nucleic acid oligonucleotide is complementary to target nucleic acid, incubating nucleic acid oligonucleotide with the sample, annealing nucleic acid oligonucleotide to target nucleic acid, forming a double-stranded nucleic acid molecule, and a poly-1-lysine coating that groups I, II, and IV do not have. Group IV has at least a plurality of cells, monitoring change in surface potential of plurality of cells, and wherein a change indicating release of biomolecules that groups I-III do not have.

The common technical features of Groups I-IV are at least a sensor, floating gate sensor surface, liquid sample chamber, substrate, electrical bias, and two electrical bias components. These common features are disclosed by US 2008/0094074 A1 to Kim et al. (hereinafter "Kim"). Kim discloses a sensor (A sensor includes a field effect transistor having a source, drain, a control gate and floating gate; abstract; figures 1-4; paragraph [0014]), floating gate sensor surface (floating gate is coated with different dielectric layers; figures 1-3; paragraph [0021]), liquid sample chamber (a portion of oxide may be removed to form a microfluid channel (liquid sample chamber) to deliver fluid containing chemicals to be sensed; figure 4; paragraph [0028]), substrate (floating gate is formed over substrate 105; figure 1; paragraph [0018]), electrical bias and two electrical bias components (floating gate is connected with many input nodes (biased via at least two biasing components) through dielectric layers for create a floating gate potential VFG; figures 1-3; paragraph [0021]).

Since the common technical features are previously disclosed by the Kim reference, these common features are not special and so Groups I-IV lack unity.