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[Continued on next page]

(54) Title: NANOSCALE WIRES, NANOSCALE WIRE FET DEVICES, AND NANOTUBE-ELECTRONIC HYBRID DEVICES FOR SENSING AND OTHER APPLICATIONS

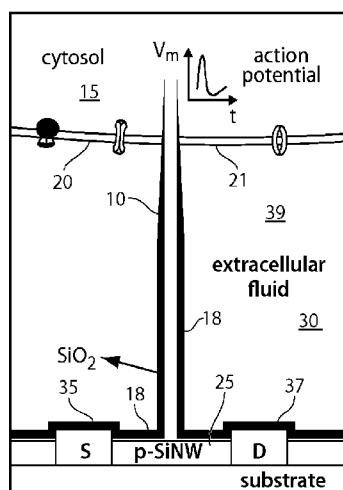


Fig. 1A

(57) Abstract: The present invention generally relates to nanotechnology, including field effect transistors and other devices used as sensors (for example, for electrophysiological studies), nanotube structures, and applications. Certain aspects of the present invention are generally directed to transistors such as field effect transistors, and other similar devices. In one set of embodiments, a field effect transistor is used where a nanoscale wire, for example, a silicon nanowire, acts as a transistor channel connecting a source electrode to a drain electrode. In some cases, a portion of the transistor channel is exposed to an environment that is to be determined, for example, the interior or cytosol of a cell. A nanotube or other suitable fluidic channel may be extended from the transistor channel into a suitable environment, such as a contained environment within a cell, so that the environment is in electrical communication with the transistor channel via the fluidic channel. In some embodiments, the rest of the transistor channel may be coated, e.g., so that the electrical properties of the transistor channel reflect the electrical behavior of the environment that the fluidic channel is in communication with. Other aspects of the invention are generally directed to methods of making such sensors, methods of using such sensors, kits involving such sensors, or the like.



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

— *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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A. CLASSIFICATION OF SUBJECT MATTER***H01L 29/78(2006.01)i, H01L 21/336(2006.01)i***

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)

H01L 29/78; H01L 23/52; H01L 21/20; H01L 29/06; H01L 29/66; G01N 33/44; H01L 21/44

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: Nanowire, branch, cell, detect, sensor, growth, transistor

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2011-0042641 A1 (LIEBER, CHARLES M. et al.) 24 February 2011 See abstract; paragraphs[0064],[0065],[0128]; figures 1A,1J	1,36,37,44-46 ,62-65
Y		2,3,38-40,56-61
Y	Tzahi Cohen-Karni et al. Graphene and Nanowire Transistors for Cellular Interfaces and Electrical Recording, Nano Letters, 2010, Vol. 10, pp.1098-1102. See abstract, figures 1,3	2,3,38-40,56-61
A	US 2010-0022012 A1 (LIEBER, CHARLES M. et al.) 28 January 2010 See abstract; paragraphs[0122]-[0146]; figures 2B,4A	1-3,36-40,44-46 ,56-65
A	US 2007-0111493 A1 (LEE, EUN KYUNG et al.) 17 May 2007 See abstract; paragraphs[0016]-[0059]; figure 1	1-3,36-40,44-46 ,56-65



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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

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

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of 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

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Name and mailing address of the ISA/KR

Korean Intellectual Property Office
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US2012/041253**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.: 31,33,49,54
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:

Claims 31,33,49,54 were unsearchable because they are worded in reference to multiple dependant claims which do not comply with PCT Rule 6.4(a).
3. ☒ Claims Nos.: 4-30,32,34,35,41-43,47,48,50-53,55
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:

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

Remark on Protest

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

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2012/041253

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Information on patent family members

International application No.

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