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Declarations under Rule 4.17:

— as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

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(54) Title: NANOWIRE FIELD-EFFECT TRANSISTOR BIOSENSOR WITH IMPROVED SENSITIVITY

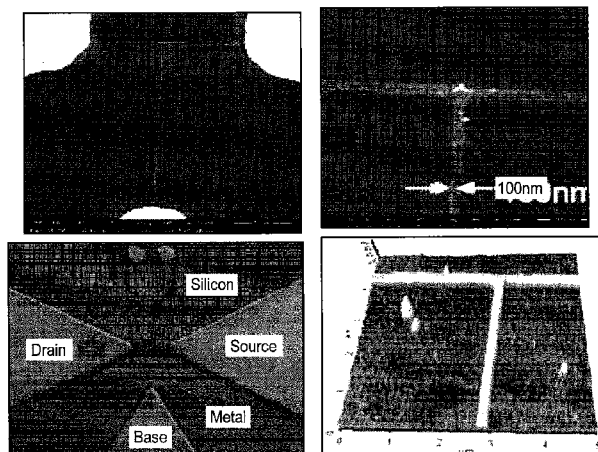


FIG. 10

(57) Abstract: The present invention is directed to a multiwire nanowire field effect transistor (nwFET) device for the measurement. The device includes a sensing nanowire having a first end and a second end and a nanowire FET having a first end and a second end, wherein the first end of the sensing nanowire is connected to the nanowire FET to form a node. Additionally, the first end of the nanowire FET is connected to a source electrode, the second end of the nanowire FET is connected to a drain electrode, and the second end of the sensing nanowire is connected to a base electrode. The sensing nanowire is derivatized with a plurality of immobilized capture probes that are specific for a target(s) of interest. The device is used to detect biomolecules or to detect the change in the ionic environment of a sample. In a further embodiment, the sensing nanowire is derivatized with amino, carboxyl or hydroxyl groups. Upon a change in ionic environment, or binding of a molecule to the sensing nanowire, the sensing nanowire current (I_B) fluctuates. This fluctuation is amplified and readout as the nanowire FET drain current (I_D). Accordingly, the present invention provides for label-free detection of biomolecules and may find use as a point-of-care diagnostic device.



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A. CLASSIFICATION OF SUBJECT MATTER**G01N 27/414(2006.01)i, G01N 33/483(2006.01)i, C12Q 1/68(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)

G01N 27/414; G01N 7/00; C07H 21/02; H01L 21/336; C12M 1/34

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)

eKOMPASS(KIPO internal) & Keywords: nanowire field effect transistor, pH sensor, node, channel, sensing gate, and drain current.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	KYEONG-SIK SHIN et al. 'Novel T-Channel Nanowire FET with Built-in Signal Amplification for pH Sensing.' , Electron Devices Meeting (IEDM), 2009 IEEE International Meeting, 2009 December, pp. 1-4.	1-15,22-34
A	See abstract; device design and operation; device fabrication; pH sensing measurement; Figs. 3, 5, 11.	16-21,35,36
A	US 6482639 B2 (SNOW; ERIC S. et al.) 19 November 2002 See the whole document.	1-36
A	US 2010-0050745 A1 (LIU; WEI-LONG et al.) 04 March 2010 See the whole document.	1-36
A	US 2004-0173815 A1 (YEO; YEE-CHIA et al.) 09 September 2004 See the whole document.	1-36



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

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"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

Information on patent family members

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6482639 B2	19.11.2002	US 2002-012937 A1	31.01.2002
US 2010-0050745 A1	04.03.2010	US 7963148 B2	21.06.2011
US 2004-0173815 A1	09.09.2004	CN 100345280 C0	24.10.2007
		CN 1527379 A0	08.09.2004
		SG 115550 A1	28.10.2005
		TW 223449 A	01.11.2004
		TW 223449 B	01.11.2004
		US 2005-0170594 A1	04.08.2005
		US 6921913 B2	26.07.2005
		US 8062946 B2	22.11.2011