

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter I of the Patent Cooperation Treaty)

(PCT Rule 44bis)

Applicant's or agent's file reference F2605P-WO	FOR FURTHER ACTION		See item 4 below
International application No. PCT/JP2016/069267	International filing date (<i>day/month/year</i>) 29 June 2016 (29.06.2016)	Priority date (<i>day/month/year</i>) 30 June 2015 (30.06.2015)	
International Patent Classification (8th edition unless older edition indicated) See relevant information in Form PCT/ISA/237			
Applicant FUJITSU LIMITED			

<p>1. This international preliminary report on patentability (Chapter I) is issued by the International Bureau on behalf of the International Searching Authority under Rule 44 bis.1(a).</p> <p>2. This REPORT consists of a total of 8 sheets, including this cover sheet.</p> <p>In the attached sheets, any reference to the written opinion of the International Searching Authority should be read as a reference to the international preliminary report on patentability (Chapter I) instead.</p>																								
<p>3. This report contains indications relating to the following items:</p> <table border="0"> <tr> <td><input checked="" type="checkbox"/></td> <td>Box No. I</td> <td>Basis of the report</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. II</td> <td>Priority</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. III</td> <td>Non-establishment of opinion with regard to novelty, inventive step and industrial applicability</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. IV</td> <td>Lack of unity of invention</td> </tr> <tr> <td><input checked="" type="checkbox"/></td> <td>Box No. V</td> <td>Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. VI</td> <td>Certain documents cited</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. VII</td> <td>Certain defects in the international application</td> </tr> <tr> <td><input type="checkbox"/></td> <td>Box No. VIII</td> <td>Certain observations on the international application</td> </tr> </table> <p>4. The International Bureau will communicate this report to designated Offices in accordance with Rules 44bis.3(c) and 93bis.1 but not, except where the applicant makes an express request under Article 23(2), before the expiration of 30 months from the priority date (Rule 44bis .2).</p>	<input checked="" type="checkbox"/>	Box No. I	Basis of the report	<input type="checkbox"/>	Box No. II	Priority	<input type="checkbox"/>	Box No. III	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability	<input type="checkbox"/>	Box No. IV	Lack of unity of invention	<input checked="" type="checkbox"/>	Box No. V	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement	<input type="checkbox"/>	Box No. VI	Certain documents cited	<input type="checkbox"/>	Box No. VII	Certain defects in the international application	<input type="checkbox"/>	Box No. VIII	Certain observations on the international application
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	Date of issuance of this report 02 January 2018 (02.01.2018)
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PATENT COOPERATION TREATY

TRANSLATION

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

To:

Date of mailing (day/month/year)	20.09.2016
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Applicant's or agent's file reference F2605P-WO

FOR FURTHER ACTION See paragraph 2 below
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International application No. PCT/JP2016/069267	International filing date (day/month/year) 29.06.2016	Priority date (day/month/year) 30.06.2015
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International Patent Classification (IPC) or both national classification and IPC G01N27/00 (2006.01) i

Applicant FUJITSU LIMITED

1. This opinion contains indications relating to the following items:

- Box No. I Basis of the opinion
- Box No. II Priority
- Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- Box No. IV Lack of unity of invention
- Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- Box No. VI Certain documents cited
- Box No. VII Certain defects in the international application
- Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA/JP	Date of completion of this opinion	Authorized officer
Facsimile No.		Telephone No.

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

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Box No. I Basis of this opinion

1. With regard to the **language**, this opinion has been established on the basis of:
 - the international application in the language in which it was filed
 - a translation of the international application into _____, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).
2. This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43bis.1(a))
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:
 - a. forming part of the international application as filed:
 - in the form of an Annex C/ST.25 text file.
 - on paper or in the form of an image file.
 - b. furnished together with the international application under PCT Rule 13ter.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.
 - c. furnished subsequent to the international filing date for the purposes of international search only:
 - in the form of an Annex C/ST.25 text file (Rule 13ter.1(a)).
 - on paper or in the form of an image file (Rule 13ter.1(b) and Administrative Instructions, Section 713).
4. In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
5. Additional comments:

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Box No. V	Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
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1. Statement			
Novelty (N)	Claims	3, 5-6, 11	YES
	Claims	1-2, 4, 7-10, 12	NO
Inventive step (IS)	Claims	_____	YES
	Claims	1-12	NO
Industrial applicability (IA)	Claims	1-12	YES
	Claims	_____	NO

2. Citations and explanations:	
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Document 1: WO 2015/007947 A1 (NOKIA CORP.) 22 January 2015, page 7, line 15 to page 9, line 30, page 11, lines 4-18, fig. 5 & US 2016/0153882 A & GB 2516247 A & EP 3022552 A & CN 105531585 A

Document 2: JP 2012-247189 A (HITACHI, LTD.) 13 December 2012, paragraphs [0020]-[0031], [0035]-[0037], [0043], fig. 1, 3 (Family: none)

Document 3: US 2010/0025660 A1 (UNIVERSITY OF CONNECTICUT) 04 February 2010, paragraphs [0008], [0030]-[0050], fig. 4 (Family: none)

Document 4: JP 2012-202864 A (ROHM CO., LTD.) 22 October 2012, paragraphs [0084]-[0089], fig. 19 (Family: none)

Document 5: WO 2012/150884 A1 (SENSIC AB) 08 November 2012, page 13, lines 17-19, fig. 2 & US 9157888 B2 & EP 2705357 A & CN 103649739 A

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Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

The invention as in claims 1, 2, 4, 9-10, and 12 is disclosed in document 1 (page 7, line 15 to page 9, line 30, page 11, lines 4-18, and fig. 5) cited in the ISR, and thus lacks novelty and does not involve an inventive step.

Herein, the "supporting substrate 515" and "third layer 514" in the invention disclosed in document 1 correspond, respectively, to the "semiconductor layer" and "barrier film" in the invention as in claims 1, 2, 4, 9-10, and 12. Furthermore, the "second layer 513" of "graphene oxide" in the invention disclosed in document 1 corresponds to the "graphene film" in the invention as in claims 1, 2, 4, 9-10, and 12.

The invention as in claims 1, 2, 4, and 7-10 is disclosed in document 2 (paragraphs [0020]-[0031], [0035]-[0037], and [0043], and fig. 1 and 3) cited in the ISR, and thus lacks novelty and does not involve an inventive step.

Herein, the "silicon single crystal substrate 101", "graphene film 104", and "aluminum oxide film 103" in the invention disclosed in document 2 correspond, respectively, to the "semiconductor layer", "graphene film" and "barrier film" in the invention as in claims 1, 2, 4, and 7-10.

The invention as in claim 1 does not involve an inventive step in light of document 1 and document 3 cited in the ISR.

Document 3 discloses a sensor that has a semiconductor layer (wafer 101), a graphene film (gate layer 117) that is provided above the semiconductor

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Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

layer, and a barrier film (first gate insulator layer 115) between the semiconductor layer and the graphene film, wherein the graphene film is modified and is used to detect a chemical substance.

If the invention as in claim 1 and the invention disclosed in document 3 are compared, the inventions differ in that the invention as in claim 1 is a gas sensor, whereas the invention disclosed in document 3 is a sensor but it is unclear whether said sensor is a gas sensor. However, in the technical field of FET sensors, the feature of detecting a gas by modifying a sensing material with a substance that reacts with the gas is well known as illustrated by document 1 (page 8, lines 20-22), and a person skilled in the art could, as appropriate, have used the sensor disclosed in document 3 as a gas sensor.

The invention as in claim 2 does not involve an inventive step in light of documents 1 and 3. Document 3 discloses the feature of having two electrodes that are provided on the surface of the semiconductor layer so as to sandwich a lower portion of the barrier film.

The invention as in claim 3 does not involve an inventive step in light of document 1 and document 4 cited in the ISR, or documents 3 and 4. In the technical field of FET sensors, the feature of providing a sensing film on an interlayer insulation film is well known as illustrated by document 4, for example.

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Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

The invention as in claim 4 does not involve an inventive step in light of documents 1 and 3. Document 3 indicates that the graphene film makes direct contact with the barrier film.

The invention as in claim 5 does not involve an inventive step in light of documents 1 and 3. Document 3 discloses the feature of having an electrode (gate metal 121) that makes contact with the graphene film and an electrode (source and drain interconnects 123) that makes contact with the semiconductor layer.

The invention as in claim 6 does not involve an inventive step in light of document 1 and document 5 cited in the ISR, documents 2 and 5, or documents 3 and 5. Document 5 discloses the feature of having nanoparticles on a graphene film.

The invention as in claims 7-8 does not involve an inventive step in light of documents 1 and 2 or documents 2 and 3. Document 2 discloses the feature of forming a plurality of pores in the graphene film and chemically modifying the edges of the pores, and a person skilled in the art could easily have conceived of applying this feature to the inventions disclosed in documents 1 and 3.

The invention as in claims 9-10 does not involve an inventive step in light of documents 1 and 3. Refer to document 3 (paragraphs [0030] and [0034]).

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Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

The invention as in claim 11 does not involve an inventive step in light of document 1, document 2, or documents 1 and 3. The inventions disclosed in documents 1-3 are all provided with an insulating barrier film, but a person skilled in the art could, as appropriate in accordance with the desired insulation properties and ease of production, have used a semiconductor having a large band gap as a barrier film.

The invention as in claim 12 does not involve an inventive step in light of documents 1 and 3. The invention disclosed in document 3 is considered to detect a physical quantity corresponding to the amount of change in the work function of the graphene film.