

**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 <b>P89503PCT</b>	<b>FOR FURTHER ACTION</b>	See item 4 below
International application No. <b>PCT/US2015/000373</b>	International filing date ( <i>day/month/year</i> ) <b>26 December 2015 (26.12.2015)</b>	Priority date ( <i>day/month/year</i> )
International Patent Classification (8th edition unless older edition indicated) <b>See relevant information in Form PCT/ISA/237</b>		
Applicant <b>INTEL CORPORATION</b>		

<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 6 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> <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 <b>26 June 2018 (26.06.2018)</b>
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## PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

# PCT

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

To: RICHARDS, E.E.  TROP, PRUNER & HU, P.C. 1616 S. VOSS RD., STE. 750 HOUSTON TX 77057-2631 USA
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Date of mailing (day/month/year) <b>24 August 2016 (24.08.2016)</b>
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Applicant's or agent's file reference P89503PCT	<b>FOR FURTHER ACTION</b> See paragraph 2 below
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International application No. <b>PCT/US2015/000373</b>	International filing date (day/month/year) <b>26 December 2015 (26.12.2015)</b>	Priority date(day/month/year)
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International Patent Classification (IPC) or both national classification and IPC <b>H01L 29/78(2006.01)i, H01L 21/336(2006.01)i</b>
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Applicant <b>INTEL CORPORATION</b>
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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 and 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/KR International Application Division Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea Facsimile No. +82-42-481-8578	Date of completion of this opinion  24 August 2016 (24.08.2016)	Authorized officer  CHO, KI YUN  Telephone No. +82-42-481-5655
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**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

**PCT/US2015/000373**

**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 43*bis*.I(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 13*ter*.I(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 13*ter*.I(a)).
    - on paper or in the form of an image file (Rule 13*ter*.I(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:

**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

**PCT/US2015/000373**

**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**

1. Statement

Novelty (N)	Claims	<u>1-23</u>	YES
	Claims	<u>NONE</u>	NO
Inventive step (IS)	Claims	<u>5-23</u>	YES
	Claims	<u>1-4</u>	NO
Industrial applicability (IA)	Claims	<u>1-23</u>	YES
	Claims	<u>NONE</u>	NO

2. Citations and explanations :

Reference is made to the following documents:

- D1: US 2012-0012935 A1 (AKIO KANEKO et al.) 19 January 2012
- D2: US 2014-0203376 A1 (GLOBALFOUNDRIES INC.) 24 July 2014
- D3: US 2015-0179770 A1 (UNITED MICROELECTRONICS CORP.) 25 June 2015
- D4: US 2012-0205742 A1 (SUBRAMANIAN S. IYER et al.) 16 August 2012
- D5: US 8981481 B2 (WALID M. HAFEZ et al.) 17 March 2015

1. Novelty and Inventive Step

1.1 Claims 1-4

1.1.1 Independent Claim 1

D1, which is considered to be the closest prior art to the subject matter of claim 1, discloses a system comprising: a first gate electrode (31) and a drain both on first fins (11) (see paragraphs [0048],[0054] and figure 5 in D1); and a second gate electrode (32) and a drain both on second fins (12) (see paragraphs [0048],[0054] and figure 5 in D1). Claim 1 differs from D1 in an interlayer dielectric (ILD) portion between first and second contacts, wherein (a) first and second gates are aligned along a first axis that is substantially orthogonal to first and second fins, (b) the first and second contacts and an ILD portion are aligned along a second axis substantially parallel to the first axis; and (c) the ILD portion includes a recess that comprises a cap layer including at least one of an oxide and a nitride. However, D2 discloses a shallow trench isolation (STI) (84) between source and drain contacts (102) (see paragraph [0025] and figure 15 in D2); and a gate stack aligned along Z-Z' axis that is orthogonal to the fins (see paragraphs [0006],[0023] and figure 15 in D2); the source and drain contacts and the STI aligned X-X' axis parallel to the Z-Z' axis (see paragraph [0025] and figures 12,15 in D2), and the STI including a trench (78) that comprises a liner formed of silicon nitride (see

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**Supplemental Box**

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Continuation of : Box No. V

paragraph [0021] and figure 15 in D2). Accordingly, claim 1 would have been obvious over a combination of D1 and D2. Therefore, claim 1 lacks an inventive step under PCT Article 33(3).

1.1.2 Dependent Claims 2-4

The additional feature of claim 2 is merely a variation of the disclosure of D2 such as oxide of the STI (84) (see paragraph [0024] in D2). Accordingly, claim 2 would have been obvious over a combination of D1 and D2. Therefore, claim 2 lacks an inventive step under PCT Article 33(3).

The additional feature of claim 3 is merely a variation of the disclosure of D2 that a trench (78) is etched to a surface (83) of a semiconductor substrate (52) (see paragraph [0021] and figure 15 in D2). Accordingly, claim 3 would have been obvious over a combination of D1 and D2. Therefore, claim 3 lacks an inventive step under PCT Article 33(3).

The additional feature of claim 4 is merely a variation of the disclosure of D2 such as the fins (58) disposed on an active region (85) and an active region (87), and a gate stack (88) intersecting with the STI (84) (see paragraphs [0021]-[0025] and figures 12,15 in D2). Accordingly, claim 4 would have been obvious over a combination of D1 and D2. Therefore, claim 4 lacks an inventive step under PCT Article 33(3).

1.2 Claims 5-9

The subject matter of claim 5 differs from these prior art documents in a method comprising: forming first, second and third replacement gate columns over a semiconductor fin; forming a first interlayer dielectric (ILD) between the first and second columns and a second ILD between the second and third columns; recessing a first portion of the first ILD to form a first recess between the first and second columns and recessing a second portion of the second ILD to form a second recess between the second and third columns; forming a first oxide within the first recess and a second oxide within the second recess, the first and second oxides directly contacting each other; planarizing the first and second oxides while the first and second oxides are within the first and second recesses, the planarized first and second oxides not directly contacting each other; removing a portion of at least one of the first, second and third replacement gate columns, while the planarized first and second oxides are within the first and second recesses, to form a void; and forming a gate within the void. And they are not obvious

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**Supplemental Box**

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Continuation of : Previous Page

to a person skilled in the art by the documents, taken alone or in combination. Therefore, claim 5 meets the requirements of PCT Article 33(2) and (3) with respect to novelty and inventive step.

Claims 6-9 are dependent on claim 5 and therefore meet the requirements of PCT Article 33(2) and (3).

**1.3 Claims 10-23**

The subject matter of claim 10 differs from these prior art documents in a system comprising: a first interlayer dielectric (ILD) portion collinear with and between the first and second source contact columns and a second ILD portion collinear with and between the first and second drain contact columns, wherein (a) a first gate column is collinear with the second gate column, the first source contact column is collinear with the second source contact column, and the first drain contact column is collinear with the second drain contact column; (b) the first ILD portion includes a first recess and the second ILD portion includes a second recess; and (c) the first recess includes a first oxide cap layer and the second recess includes a second oxide cap layer. And they are not obvious to a person skilled in the art by the documents, taken alone or in combination. Therefore, claim 10 meets the requirements of PCT Article 33(2) and (3) with respect to novelty and inventive step.

Claims 11-23 are dependent on claim 10 and therefore meet the requirements of PCT Article 33(2) and (3).

**2. Industrial Applicability**

Claims 1-23 are industrially applicable under PCT Article 33(4).