

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

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| To: MCANDREWS, Kevin KLA Corporation Legal Department One Technology Drive Milpitas, California 95035 USA | | Date of mailing (day/month/year) 25 March 2020 (25.03.2020) | |
| Applicant's or agent's file reference P5424-PCT | | FOR FURTHER ACTION See paragraph 2 below | |
| International application No. PCT/US2019/064805 | International filing date (day/month/year) 06 December 2019 (06.12.2019) | Priority date(day/month/year) 06 December 2018 (06.12.2018) | |
| International Patent Classification (IPC) or both national classification and IPC G01N 21/59(2006.01)i, H01L 21/66(2006.01)i, G01B 11/02(2006.01)i | | | |
| Applicant KLA CORPORATION | | | |

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.

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| 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 25 March 2020 (25.03.2020) | Authorized officer LEE, Hun Gil Telephone No. +82-42-481-8525 |
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WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

International application No.

PCT/US2019/064805

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*.1(b))
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*.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 13*ter*.1(a)).
 - on paper or in the form of an image file (Rule 13*ter*.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:

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2019/064805

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>1-33</u> | YES |
| | Claims | <u>NONE</u> | NO |
| Inventive step (IS) | Claims | <u>5-12,24-31</u> | YES |
| | Claims | <u>1-4,13-23,32-33</u> | NO |
| Industrial applicability (IA) | Claims | <u>1-33</u> | YES |
| | Claims | <u>NONE</u> | NO |

2. Citations and explanations :

Reference is made to the following documents:

D1: US 2015-0032398 A1 (KLA-TENCOR CORPORATION) 29 January 2015

D2: US 2017-0205342 A1 (KLA-TENCOR CORPORATION) 20 July 2017

D3: US 2016-0223476 A1 (ASML NETHERLANDS B.V.) 04 August 2016

D4: US 2012-0275568 A1 (MAZOR et al.) 01 November 2012

D5: US 7478019 B2 (ZANGOOIE et al.) 13 January 2009

I. Novelty and Inventive Step (PCT Article 33(2) and (3))

1. Claims 1, 19-20

D1, which is considered to be the closest prior art to the subject matter of claim 1, discloses a system comprising: an X-ray metrology system; an optical metrology system; and a computing system (130) comprising one or more processors, wherein the processor is configured to generate a geometric model (152) of a measured structure of a specimen (see paragraphs [0030], [0032], [0083], [0087] and figure 2).

Claim 1 differs from D1 in that a processor is configured to: generate a material model for determining one or more material parameters of a test HAR structure from metrology data from an optical metrology tool; form a composite model from a geometric model and the material model for determining a profile of a test HAR structure based on metrology data from the optical metrology tool (different feature 1); measure at least one additional test HAR structure with the optical metrology tool (different feature 2); and determine a profile of the at least one additional test structure based on the composite model and metrology data from the optical metrology tool associated with the at least one test HAR structure (different feature 3).

Different feature 1 would be easily derived from the disclosure of D1 (see paragraphs

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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

PCT/US2019/064805

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

Claims 3, 22 are worded in reference to "the one or more reference samples" of claims 1, 20, respectively. However, the term "one or more reference samples" has not been worded in claims 1, 20. Therefore, claims 3, 22 do not meet the requirements of PCT Article 6.

(*Note: The international search report and the written opinion have been established on the assumption that claim 3 referst to claim 2 and claim 22 refers to claim 21.)

Claim 20 relates to a metrology method, but claim 23, dependent on claim 20, relates to a metrology system, thereby rendering the definition of the subject matter of claim 23 unclear. Therefore, claim 23 does not meet the requirements of PCT Article 6.

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of : Box No. V

[0035]-[0036]: an x-ray response function building module (153) generates an x-ray response function model (155) based at least in part on the geometric model (152), wherein the x-ray response function model (155) is based on a fundamental parameters model that relates a measured signal associated with each material element to the sum of contributions from all materials that include the element). Different feature 2 would be easily derived from the disclosure of D1 (see paragraph [0046]: optical measurement data associated with measurements of the specimen by the optical metrology system is received by a fitting analysis module (157)). And different feature 3 would be easily derived from the disclosure of D1 (see paragraph [0047]: the fitting analysis module (157) compares modeled x-ray and optical scattering with the corresponding measured data to determine geometric as well as material properties of the specimen).

Claims 19 and 20 relates to a metrology system and a metrology method, and have substantially the same technical features as claim 1. Thus, the same reasoning as in claim 1 applies to claims 19 and 20.

Accordingly, these claims would have been obvious over D1. Therefore, claims 1, 19-20 do not involve an inventive step.

1.2. Claims 4, 14, 16-18, 23, 33

The additional feature of claim 4 is merely one of several straightforward possibilities from which a skilled person would select, in accordance with circumstances, without the exercise of inventive skill, in order to solve the problem posed.

The additional features of claims 14, 33 are identical to the disclosure of D1 (see paragraph [0083] and figure 2: the metrology tool (100) includes the x-ray metrology system).

The additional features of claims 16-18 would be easily derived from the disclosure of D1 (see paragraph [0067]: calibration of scaling factors and offset values may be performed with the aid of transmission electron microscopy (TEM) or atomic force microscopy (AFM)).

The additional feature of claim 23 is the same as that of claim 4.

Accordingly, these claims would have been obvious over D1. Therefore, claims 4, 14, 16-18, 23, 33 do not involve an inventive step.

1.3. Claims 2-3, 13, 15, 21-22, 32

The additional features of claims 2-3, 13 would be easily derived from the disclosure of D2

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Supplemental Box

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Continuation of : Previous Page

(see paragraph [0032]: a system enables optical critical dimension (CD), film, and composition metrology for semiconductor devices with HAR structures).

The additional feature of claim 15 would be easily derived from the disclosure of D2 (see paragraph [0006]: small angle X-ray scatterometry (CD-SAXS) is a measurement solution for the high aspect ratio structures).

The additional features of claims 21-22, 32 are the same as those of claims 2-3, 13, respectively.

Accordingly, these claims would have been obvious over D1 in view of D2. Therefore, claims 2-3, 13, 15, 21-22, 32 do not involve an inventive step.

1.4. Claims 5-12, 24-31

The additional feature of claim 5 is not disclosed in any of the documents D1-D5, nor is it obvious to a person skilled in the art over the documents taken individually or in combination.

Claims 6-12 are directly or indirectly dependent on claim 5.

The additional features of claims 24-31 are the same as those of claims 5-12, respectively.

Therefore, claims 5-12, 24-31 are novel and involve an inventive step.

II. Industrial Applicability (PCT Article 33(4))

Claims 1-33 are industrially applicable.