

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

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Date of mailing (day/month/year) 11 October 2018 (11.10.2018)

Applicant's or agent's file reference 024766WO01	FOR FURTHER ACTION See paragraph 2 below	
International application No. PCT/US2018/038327	International filing date (day/month/year) 19 June 2018 (19.06.2018)	Priority date(day/month/year) 26 June 2017 (26.06.2017)
International Patent Classification (IPC) or both national classification and IPC G03F 7/20(2006.01)i, G03F 9/00(2006.01)i, H01L 21/027(2006.01)i		
Applicant APPLIED MATERIALS, INC.		



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.

 <p>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</p>	<p>Date of completion of this opinion 11 October 2018 (11.10.2018)</p>	<p>Authorized officer LEE, Ki Cheul Telephone No. +82-42-481-3353</p> 
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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

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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 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:

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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

1. Statement

Novelty (N)	Claims	<u>1-10,12-15</u>	YES
	Claims	<u>NONE</u>	NO
Inventive step (IS)	Claims	<u>NONE</u>	YES
	Claims	<u>1-10,12-15</u>	NO
Industrial applicability (IA)	Claims	<u>1-10,12-15</u>	YES
	Claims	<u>NONE</u>	NO

2. Citations and explanations :

Reference is made to the following documents:

D1: WO 2016-107798 A1 (VISITECH AS) 07 July 2016

D2: WO 2004-001508 A2 (UNIVERSITY OF SOUTH FLORIDA) 31 December 2003

D3: JP 2013-197334 A (HITACHI HIGH-TECHNOLOGIES CORP.) 30 September 2013

D4: US 2007-0222088 A1 (SMITH, N. P. et al.) 27 September 2007

1. Novelty and Inventive Step

1.1 Claims 1-7

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 method, comprising: creating a projected light beam (102) onto UV sensitive media (107) placed on a table (108) as a projected light pattern (103) (see page 4, lines 1-3 in D1).

Claim 1 differs from D1 in that a method comprises opening a camera shutter in a maskless lithography system; capturing and accumulating an image of a first substrate layer on a camera; closing the camera shutter; repeating directing and the capturing using different configurations of non-adjacent mirrors to cover an entire field-of-view (FOV) of the camera on the first substrate layer; and storing the accumulated image in memory. However, these differences are merely variations of the disclosures of D1 and D2 such as: capturing, by an electronic camera device (104) with a light source (105), fiducial objects (109) from a reflected light beam (106) (see page 4, lines 3,4 in D1); a means for controlling the position of each micromirror of an array of micromirrors individually such that each micromirror is individually positioned to either

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Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

- Claims of this application are not numbered consecutively in Arabic numbers, since claim 11 is found missing (PCT Rule 6.1(b)).

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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 12 and 13 depend on claim 11 which is missing in this application. Therefore, claims 12 and 13 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 claims 12 and 13 refer to claim 10).

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reflect the light incident on the each micromirror so as to be incident on a substrate mounted in an alignment fixture or reflect the light (see claim 1 in D2); and connecting a CCD camera to a PC through a standard interface (Ethernet, USB or similar) for further image processing (see page 4, lines 39-42 in D1). D1 and D2 are concerned with mutually related technical fields and there is no need for fundamental changes in the key features or for a new technical idea in combining the subject matters of D1 and 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 2-7

The additional features of claims 2 and 3 are merely variations of the disclosure of D2 such as a means for controlling the position of each micromirror of said array of micromirrors individually such that each micromirror is individually positioned to either reflect the light incident on the each micromirror so as to be incident on the substrate mounted in the alignment fixture or reflect the light (see claim 1 in D2). Accordingly, claims 2 and 3 would have been obvious over a combination of D1 and D2. Therefore, claims 2 and 3 lack an inventive step under PCT Article 33(3).

The additional feature of claim 4 is not disclosed in D1 or D2. However, it is merely a variation of the disclosure of D3 that an alignment mark for detecting the position on a sample is detected by optical means, and the position of the alignment mark is determined, and a reference mark used as a template is stored in advance as an initial mark, and a simulation mark is generated by deforming the initial mark on the basis of predetermined parameters, and an actual image mark and the simulation mark are compared and collated, and when a determination is made that the result is equal to or smaller than a threshold (correlation is low), parameters for generating a simulation mark are controlled to be optimized (see claim 1 in D3). D1, D2 and D3 are concerned with mutually related technical fields and there is no need for fundamental changes in the key features or for a new technical idea in combining the subject matters of D1, D2 and D3. Accordingly, claim 4 would have been obvious over a combination of D1-D3. Therefore, claim 4 lacks an inventive step under PCT Article 33(3).

The additional feature of claim 5 is not disclosed in D1 or D2. However, it is merely a variation of the disclosure of D4 such as an overlay metrology mark for determining the

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relative position between two or more layers of an integrated circuit structure comprising a first mark portion associated with a first layer and a second mark portion associated with a second layer (see claim 1 in D4). D1, D2 and D4 are concerned with mutually related technical fields and there is no need for fundamental changes in the key features or for a new technical idea in combining the subject matters of D1, D2 and D4. Accordingly, claim 5 would have been obvious over a combination of D1, D2 and D4. Therefore, claim 5 lacks an inventive step under PCT Article 33(3).

The additional feature of claim 6 is not disclosed in D1, D2 or D3. However, it is merely a variation of the disclosure of D3 that an alignment mark for detecting the position on a sample is detected by optical means, and the position of the alignment mark is determined, and a reference mark used as a template is stored in advance as an initial mark, and a simulation mark is generated by deforming the initial mark on the basis of predetermined parameters, and an actual image mark and the simulation mark are compared and collated, and when a determination is made that the result is equal to or smaller than a threshold (correlation is low), parameters for generating a simulation mark are controlled to be optimized (see claim 1 in D3). D1-D4 are concerned with mutually related technical fields and there is no need for fundamental changes in the key features or for a new technical idea in combining the subject matters of D1-D4. Accordingly, claim 6 would have been obvious over a combination of D1-D4. Therefore, claim 6 lacks an inventive step under PCT Article 33(3).

The additional feature of claim 7 is merely a variation of the disclosure of D4 such as: determining the relative position between two or more layers of an integrated circuit structure; laying down a first mark portion in association with a first layer, and laying down a second mark portion in association with a second layer, the first and second mark portions being so structured as to together constitute at least one pair of test zones as hereinabove described; optically imaging the two test zones in the first and second directions; collecting and digitizing the image; and numerically analyzing the digitized data to obtain a quantified measurement of the misalignment of the first and second mark portions (see claim 22 in D4). Accordingly, claim 7 would have been obvious over a combination of D1, D2 and D4. Therefore, claim 7 lacks an inventive step under PCT Article 33(3).

1.2 Claims 8-10, 12, 13

※ This written opinion has been established on the assumption that claims 12 and 13 refer to

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claim 10.

1.2.1 Independent claim 8

D1, which is considered to be the closest prior art to the subject matter of claim 8, discloses a method, comprising: creating a projected light beam (102) onto UV sensitive media (107) placed on a table (108) as a projected light pattern (103) (see page 4, lines 1-3 in D1).

Claim 8 differs from D1 in that a method comprises moving a substrate; opening a camera shutter in a maskless lithography system; capturing and accumulating, continuously, images in a camera to cover an entire camera field-of-view (FOV) on a first substrate layer on the moving substrate; closing the camera shutter; and storing the accumulated image in memory. However, these differences are merely variations of the disclosures of D1 and D3 such as: providing a stage controller (119) for controlling the movement of a sample stage (120) (see paragraph [0018] in D3); capturing, by an electronic camera device (104) with a light source (105), fiducial objects (109) from a reflected light beam (106) (see page 4, lines 3,4 in D1); and connecting a CCD camera to a PC through a standard interface (Ethernet, USB or similar) for further image processing (see page 4, lines 39-42 in D1). D1 and D3 are concerned with mutually related technical fields and there is no need for fundamental changes in the key features or for a new technical idea in combining the subject matters of D1 and D3. Accordingly, claim 8 would have been obvious over a combination of D1 and D3. Therefore, claim 8 lacks an inventive step under PCT Article 33(3).

1.2.2 Dependent claims 9, 10, 12, 13

The additional feature of claim 9 is merely a variation of the disclosure of D3 that an alignment mark for detecting the position on a sample is detected by optical means, and the position of the alignment mark is determined, and a reference mark used as a template is stored in advance as an initial mark, and a simulation mark is generated by deforming the initial mark on the basis of predetermined parameters, and an actual image mark and the simulation mark are compared and collated, and when a determination is made that the result is equal to or smaller than a threshold (correlation is low), parameters for generating a simulation mark are controlled to be optimized (see claim 1 in D3). Accordingly, claim 9 would have been obvious over a combination of D1 and D3. Therefore, claim 9 lacks an inventive step under PCT Article 33(3).

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The additional feature of claim 10 is not disclosed in D1 or D3. However, it is merely a variation of the disclosure of D4 such as an overlay metrology mark for determining the relative position between two or more layers of an integrated circuit structure comprising a first mark portion associated with a first layer and a second mark portion associated with a second layer (see claim 1 in D4). D1, D3 and D4 are concerned with mutually related technical fields and there is no need for fundamental changes in the key features or for a new technical idea in combining the subject matters of D1, D3 and D4. Accordingly, claim 10 would have been obvious over a combination of D1, D3 and D4. Therefore, claim 10 lacks an inventive step under PCT Article 33(3).

The additional feature of claim 12 is merely a variation of the disclosure of D3 that an alignment mark for detecting the position on a sample is detected by optical means, and the position of the alignment mark is determined, and a reference mark used as a template is stored in advance as an initial mark, and a simulation mark is generated by deforming the initial mark on the basis of predetermined parameters, and an actual image mark and the simulation mark are compared and collated, and when a determination is made that the result is equal to or smaller than a threshold (correlation is low), parameters for generating a simulation mark are controlled to be optimized (see claim 1 in D3). Accordingly, claim 12 would have been obvious over a combination of D1, D3 and D4. Therefore, claim 12 lacks an inventive step under PCT Article 33(3).

The additional feature of claim 13 is merely a variation of the disclosure of D4 such as: determining the relative position between two or more layers of an integrated circuit structure; laying down a first mark portion in association with a first layer, and laying down a second mark portion in association with a second layer, the first and second mark portions being so structured as to together constitute at least one pair of test zones as hereinabove described; optically imaging the two test zones in the first and second directions; collecting and digitizing the image; and numerically analyzing the digitized data to obtain a quantified measurement of the misalignment of the first and second mark portions (see claim 22 in D4). Accordingly, claim 13 would have been obvious over a combination of D1, D3 and D4. Therefore, claim 13 lacks an inventive step under PCT Article 33(3).

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1.3 Claims 14 and 15

1.3.1 Independent claim 14

D1, which is considered to be the closest prior art to the subject matter of claim 14, discloses a maskless exposure apparatus comprising: a light source (302) (see claim 1 in D1); a dichroic beam splitter prism (303) (see page 4, line 31; and figure 3 in D1); and an electronic light projector with a built-in registration camera module (309), as a part of a measurement system (see page 4, lines 27-29; and figure 3 in D1).

Claim 14 differs from D1 in that a mirror array is adapted to have a configuration of non-adjacent mirrors, to receive light from a light source and is adapted to reflect light towards a substrate layer; and a processor is coupled to the light source and the mirror array to select the configuration of non-adjacent mirrors, the beam splitter, and a camera. However, these differences are merely variations of the disclosures of D1 and D2 such as: an array of micromirrors; a means for directing light onto the array of micromirrors, wherein light incident on each micromirror of the array of micromirrors can be reflected by the each micromirror so as to be incident on a substrate mounted in an alignment fixture when the each micromirror is at or near a first position and can be reflected by the each micromirror so as to not be incident on the substrate mounted in the alignment fixture when the each micromirror is not at or near the first position (see claim 1; and figure 1A in D2); a CCD camera connected to a PC through a standard interface (Ethernet, USB or similar) for further image processing (see page 4, lines 39-42 in D1); and such movement and/or rotation of micromirror array (14) which can be accomplished by an interconnected computer system (16) with a means to accomplish the movement and/or rotation (see paragraph [0043]; and figure 1A in D2). D1 and D2 are concerned with mutually related technical fields and there is no need for fundamental changes in the key features or for a new technical idea in combining the subject matters of D1 and D2. Accordingly, claim 14 would have been obvious over a combination of D1 and D2. Therefore, claim 14 lacks an inventive step under PCT Article 33(3).

1.3.2 Dependent claim 15

The additional feature of claim 15 is merely a variation of the disclosure of D2 that alignment is controlled through the use of a coarse alignment stage provided by a mechanically movable substrate mounting alignment fixture, combined with a fine, electronic alignment stage,

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and this fine alignment stage is computer controlled and aligns the mask pattern reflected from the micromirror instead of moving the alignment fixture, thereby offering exceptional accuracy and repeatability (see paragraph [0057] in D2). Accordingly, claim 15 would have been obvious over a combination of D1 and D2. Therefore, claim 15 lacks an inventive step under PCT Article 33(3).

2. Industrial Applicability

Claims 1-10 and 12-15 are industrially applicable under PCT Article 33(4).