PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To: MICHAEL A. HOOD
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PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing *(day/month/year)* 27 FEB 2020

Applicant's or agent's file reference	FOR FURTHER ACTION
SP18-406	See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/US2019/060815	12 November 2019	26 November 2018

International Patent Classification (IPC) or both national classification and IPC
IPC(8) - G02B 26/00; H01L 21/027; H01L 21/00; H01L 27/00 (2020.01)
CPC - G02B 26/005; G02B 26/00; G09G 3/348; H01L 21/00; H01L 21/027; H01L 27/00 (2020.02)

Applicant CORNING INCORPORATED

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

- [x] 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
- [x] Box No. IV Lack of unity of invention
- [x] Box No. V Reasoned statement under Rule 43*bis*.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 66.1*bis*(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/US	Date of completion of this opinion	Authorized officer
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450, Alexandria, VA 22313-1450 Facsimile No. 571-273-8300	12 February 2020	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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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*.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 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:

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Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has, within the applicable time limit:
   - ☐ paid additional fees.
   - ☐ paid additional fees under protest and, where applicable, the protest fee.
   - ☐ paid additional fees under protest but the applicable protest fee was not paid.
   - ☒ not paid additional fees.
2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.
3. This Authority considers that the requirement of unity of invention in accordance with Rule 13.1, 13.2 and 13.3 is
   - ☐ complied with.
   - ☒ not complied with for the following reasons:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claims 1-22, are drawn to a method for forming a patterned insulating layer on a conductive layer, the method comprising: removing an annular region of an insulating layer overlying a perimeter of an opening in a mask by laser ablation.

Group II, claims 23-29, are drawn to an electrowetting device comprising: a first window, a second window, and a cavity disposed between the first window and the second window.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons: the special technical feature of the Group I invention: removing an annular region of an insulating layer overlying a perimeter of an opening in a mask by laser ablation, an inner portion of the annular region of the insulating layer disposed on a central region of the conductive layer corresponding to the opening in the mask, and an outer portion of the annular region of the insulating layer disposed on the mask, whereby an annular portion of the central region of the conductive layer is uncovered by each of the mask and the insulating layer; and removing the mask from the conductive layer to remove an excess portion of the insulating layer disposed on the mask, whereby a remaining portion of the insulating layer defines the patterned insulating layer disposed on the central region of the conductive layer, and a surrounding region of the conductive layer surrounding the central region of the conductive layer is uncovered by the patterned insulating layer as claimed therein is not present in the invention of Group II. The special technical feature of the Group II invention: a first window, a second window, and a cavity disposed between the first window and the second window; a first liquid and a second liquid disposed within the cavity, the first liquid and the second liquid substantially immiscible with each other, whereby a liquid interface is formed between the first liquid and the second liquid; a driving electrode disposed on a sidewall of the cavity; and an insulating layer disposed within the cavity to insulate the driving electrode from the first liquid and the second liquid; wherein the insulating layer is substantially free of flaps and stringers as claimed therein is not present in the invention of Group I.

Groups I and II lack unity of invention because even though the inventions of these groups require the technical feature of an insulating layer, this technical feature is not a special technical feature as it does not make a contribution over the prior art.

Specifically, US 2007/0047095 to Jung et al. teaches an insulating layer (Para. [0032]).

Since none of the special technical features of the Group I or II inventions are found in more than one of the inventions, unity of invention is lacking.

4. Consequently, this opinion has been established in respect of the following parts of the international application:
   - ☐ all parts
   - ☒ the parts relating to claims Nos. 1-22

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

1. Statement

Novelty (N)	Claims	1-22	YES
	Claims	None	NO
Inventive step (IS)	Claims	1-22	YES
	Claims	None	NO
Industrial applicability (IA)	Claims	1-22	YES
	Claims	None	NO

2. Citations and explanations:

Claims 1-22 meet the criteria set out in PCT Article 33(2)-(3), because the prior art does not teach or fairly suggest:

Regarding claim 1, the prior art of record, individually or in combination, does not teach or fairly suggest a method for forming a patterned insulating layer on a conductive layer, the method comprising: removing an annular region of an insulating layer overlying a perimeter of an opening in a mask by laser ablation, an inner portion of the annular region of the insulating layer disposed on a central region of the conductive layer corresponding to the opening in the mask, and an outer portion of the annular region of the insulating layer disposed on the mask, whereby an annular portion of the central region of the conductive layer is uncovered by each of the mask and the insulating layer; and removing the mask from the conductive layer to remove an excess portion of the insulating layer disposed on the mask, whereby a remaining portion of the insulating layer defines the patterned insulating layer disposed on the central region of the conductive layer, and a surrounding region of the conductive layer surrounding the central region of the conductive layer is uncovered by the patterned insulating layer.

Claims 2-18 depend from claim 1, and therefore meet the criteria set out in PCT Article 33(2)-(3) for at least the same reasons as claim 1.

The prior art, as shown below, details some aspects of the invention, however, none of the prior art teaches all the missing limitations either alone or in combination as specified.

Deligianni et al (US 2009/0294989 A1), hereinafter Deligianni, discloses a method for forming a patterned insulating layer on a conductive layer (a layer of insulating material 406 is then deposited over the patterned metal layer 404, para 0040; a patterning process (preferably an etching process, such as reactive ion etching) is carried out to form vertical vias (or deep vias) 408 through the insulating layer 406 , para 0041), the method comprising: removing an annular region of an insulating layer (a patterning process (preferably an etching process, such as reactive ion etching) is carried out to form vertical vias (or deep vias) 408 through the insulating layer 406 ... The vertical vias 408 can have any suitable cross-sectional shape, including... ring-shaped [annular], etc, para 0041).
Deligianni fails to disclose the annular region overlying a perimeter of an opening in a mask by laser ablation, an inner portion of the annular region of the insulating layer disposed on a central region of the conductive layer corresponding to the opening in the mask, and an outer portion of the annular region of the insulating layer disposed on the mask, whereby an annular portion of the central region of the conductive layer is uncovered by each of the mask and the insulating layer; and removing the mask from the conductive layer to remove an excess portion of the insulating layer disposed on the mask, whereby a remaining portion of the insulating layer defines the patterned insulating layer disposed on the central region of the conductive layer, and a surrounding region of the conductive layer surrounding the central region of the conductive layer is uncovered by the patterned insulating layer.

Stats Chippac, Ltd. (US 2015/0228552 A1), hereinafter Stats, discloses a method for forming a patterned insulating layer on a conductive layer (A portion of insulating layer 278 is removed by an etching process with a patterned photoresist layer to expose conductive layer, para 0104), the method comprising: removing a region of an insulating layer by laser ablation (a portion of insulating layers 134 and 136 is removed by laser direct ablation (LDA) using laser 148 to expose conductive layer 132.).
Stats does not disclose wherein the region is an annular region overlying a perimeter of an opening in a mask; an inner portion of the annular region of the insulating layer disposed on a central region of the conductive layer corresponding to the opening in the mask, and an outer portion of the annular region of the insulating layer disposed on the mask, whereby an annular portion of the central region of the conductive layer is uncovered by each of the mask and the insulating layer; and removing the mask from the conductive layer to remove an excess portion of the insulating layer disposed on the mask, whereby a remaining portion of the insulating layer defines the patterned insulating layer disposed on the central region of the conductive layer, and a surrounding region of the conductive layer surrounding the central region of the conductive layer is uncovered by the patterned insulating layer.

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Supplemental Box

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

Regarding claim 19, the prior art of record, individually or in combination, does not teach or fairly suggest a method for forming a patterned insulating layer on a conductive layer, the method comprising: applying a mask to the conductive layer disposed on a wafer comprising a plurality of wells; severing the mask along a perimeter of each of a plurality of central regions of the mask, each of the plurality of central regions overlying a corresponding one of the plurality of wells; removing each of the plurality of central regions of the mask to form a plurality of openings in the mask and uncover a plurality of central regions of the conductive layer each disposed at least partially in a corresponding one of the plurality of wells, whereby a remaining region of the mask surrounding the plurality of openings in the mask covers a corresponding surrounding region of the conductive layer disposed outside the plurality of wells; applying an insulating layer to each of the plurality of central regions of the conductive layer and the remaining region of the mask; removing a plurality of annular regions of the insulating layer each overlying the perimeter of a corresponding one of the plurality of openings in the mask by laser ablation, an inner portion of each of the plurality of annular regions of the insulating layer disposed on a corresponding one of the plurality of central regions of the conductive layer, and an outer portion of each of the plurality of annular regions of the insulating layer disposed on the mask, whereby an annular portion of each of the plurality of central regions of the conductive layer is uncovered by each of the mask and the insulating layer; and removing the remaining region of the mask from the conductive layer to remove an excess portion of the insulating layer disposed on the remaining region of the mask, whereby a remaining portion of the insulating layer defines the patterned insulating layer disposed at least partially within the plurality of wells, and the surrounding region of the conductive layer is uncovered by the patterned insulating layer.

Claims 20-22 depend from claim 19, and therefore meet the criteria set out in PCT Article 33(2)-(3) for at least the same reasons as claim 19.

The prior art, as shown below, details some aspects of the invention, however, none of the prior art teaches all the missing limitations either alone or in combination as specified.

Deligianni discloses a method for forming a patterned insulating layer on a conductive layer (a layer of insulating material 406 is then deposited over the patterned metal layer 404, para 0040; a patterning process (preferably an etching process, such as reactive ion etching) is carried out to form vertical vias (or deep vias) 408 through the insulating layer 406 , para 0041), the method comprising: applying a mask to the conductive layer disposed on a wafer comprising a plurality of wells (The patterned metal layer 404 can be readily formed by first depositing a blanket metal layer (not shown) over the entire top surface of the ILD layer 301, followed by patterning the blanket metal layer (not shown) to form multiple openings 405, para 0039)); applying an insulating layer (a layer of insulating material 406 is then deposited over the patterned metal layer 404, para 0040) ; removing a plurality of annular regions of the insulating layer (a patterning process (preferably an etching process, such as reactive ion etching) is carried out to form vertical vias (or deep vias) 408 through the insulating layer 406 ... The vertical vias 408 can have any suitable cross-sectional shape, including... ring-shaped [annular], etc, para 0041).
Deligianni fails to disclose severing the mask along a perimeter of each of a plurality of central regions of the mask, each of the plurality of central regions overlying a corresponding one of the plurality of wells; removing each of the plurality of central regions of the mask to form a plurality of openings in the mask and uncover a plurality of central regions of the conductive layer each disposed at least partially in a corresponding one of the plurality of wells, whereby a remaining region of the mask surrounding the plurality of openings in the mask covers a corresponding surrounding region of the conductive layer disposed outside the plurality of wells; applying the insulating layer to each of the plurality of central regions of the conductive layer and the remaining region of the mask; removing the plurality of annular regions by laser ablation, each annular region overlying the perimeter of a corresponding one of the plurality of openings in the mask by laser ablation, an inner portion of each of the plurality of annular regions of the insulating layer disposed on a corresponding one of the plurality of central regions of the conductive layer, and an outer portion of each of the plurality of annular regions of the insulating layer disposed on the mask, whereby an annular portion of each of the plurality of central regions of the conductive layer is uncovered by each of the mask and the insulating layer; and removing the remaining region of the mask from the conductive layer to remove an excess portion of the insulating layer disposed on the remaining region of the mask, whereby a remaining portion of the insulating layer defines the patterned insulating layer disposed at least partially within the plurality of wells, and the surrounding region of the conductive layer is uncovered by the patterned insulating layer.

Stats discloses a method for forming a patterned insulating layer on a conductive layer (A portion of insulating layer 278 is removed by an etching process with a patterned photoresist layer to expose conductive layer, para 0104), the method comprising: applying an insulating layer (an insulating or dielectric layer 278 is formed over insulating layer 274 and conductive layer 276 , para 0100); removing a plurality of annular regions of the insulating layer by laser ablation (a portion of insulating layers 134 and 136 is removed by laser direct ablation (LDA) using laser 148 to expose conductive layer 132.).
Stats does not disclose applying the insulating layer to each of the plurality of central regions of the conductive layer and the remaining region of the mask; applying a mask to the conductive layer disposed on a wafer comprising a plurality of wells; severing the mask along a perimeter of each of a plurality of central regions of the mask, each of the plurality of central regions overlying a corresponding one of the plurality of wells; removing each of the plurality of central regions of the mask to form a plurality of openings in the mask and uncover a plurality of central regions of the conductive layer each disposed at least partially in a corresponding one of the plurality of wells, whereby a remaining region of the mask surrounding the plurality of openings in the mask covers a corresponding surrounding region of the conductive layer disposed outside the plurality of wells; each overlying the perimeter of a corresponding one of the plurality of openings in the mask ; an inner portion of each of the plurality of annular regions of the insulating layer disposed on a corresponding one of the plurality of central regions of the conductive layer, and an outer portion of each of the plurality of annular regions of the insulating layer disposed on the mask, whereby an annular portion of each of the plurality of central regions of the conductive layer is uncovered by each of the mask and the insulating layer; and removing the remaining region of the mask from the conductive layer to remove an excess portion of the insulating layer disposed on the remaining region of the mask, whereby a remaining portion of the insulating layer defines the patterned insulating layer disposed at least partially within the plurality of wells, and the surrounding region of the conductive layer is uncovered by the patterned insulating layer.

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Supplemental Box

In case **the space in any of the preceding boxes is not sufficient.**
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Claims 1-22 meet the criteria set out in PCT Article 33(4), and thus have industrial applicability because the subject matter claimed can be made or used in industry.