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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

Ex parte JEAN AUDET, EDMUND D. BLACKSHEAR, MASAHIRO FUKUI, CHARLES L. REYNOLDS, KENJI TERADA, and TOMOYUKI YAMADA

Appeal 2019-003105
Application 15/068,891
Technology Center 2800

Before DONNA M. PRAISS, MICHELLE N. ANKENBRAND, and JEFFREY R. SNAY, *Administrative Patent Judges*.

SNAY, *Administrative Patent Judge*.

DECISION ON APPEAL[1]

STATEMENT OF THE CASE

Appellant[2] filed an appeal under 35 U.S.C. § 134(a) from the Examiner's decision rejecting claims 1–14 and 16–19. We have jurisdiction under 35 U.S.C. § 6(b). We AFFIRM-IN-PART.

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[1] Our Decision refers to the Specification filed Mar. 14, 2016 ("Spec."); Final Office Action dated May 11, 2018 ("Final Act."); Appellant's Appeal Brief filed Oct. 15, 2018 ("Appeal Br."), Examiner's Answer dated Jan. 8, 2019 ("Ans."), and Appellant's Reply Brief filed Mar. 8, 2019 ("Reply Br.").

[2] Appellant is the Applicant, International Business Machines Corporation, which, according to the Appeal Brief, is the real party in interest. Appeal Br. 2.

The subject matter on appeal relates to "a multi-layer substrate with metal layers as a moisture diffusion barrier for reduced electrical performance degradation over time after moisture exposure and methods of design and manufacture." Spec. ¶ 1. The Specification discloses that moisture can enter the package of an electronic circuit because organic substrate materials are sensitive to moisture. *Id.* ¶ 2. As a result, moisture can propagate to an underlying signal line, which causes insertion loss and degraded electrical performance. *Id.* According to the Specification, conventional methods (e.g., the use of dry environments and the use of chemicals to prevent degradation) to address this issue have been problematic. *Id.* ¶ 3.

In view of the above, the Specification discloses a method that includes determining a diffusion rate of water through an insulator material between an upper metal layer and an underlying signal line and calculating a diffusion distance between a plane opening of the upper metal layer and the underlying signal line by using a diffusion coefficient of the insulator material and the diffusion rate. *Id.* ¶ 4. The method can further include establishing environmental conditions, establishing a time in which an electrical circuit will maintain a predetermined electrical performance, and calculating a lateral offset distance between the plane opening and the underlying signal line using the diffusion coefficient, environmental conditions, and time. *Id.*

Independent claim 1 is illustrative and is reproduced below from the Claims Appendix of the Appeal Brief. Limitations at issue are italicized and some indentation added.

1. A method, comprising:

determining a diffusion coefficient of an insulator material provided between an upper metal layer and an underlying signal line;

determining a time for moisture to travel a certain distance through the insulator material provided between the upper metal layer and the underlying signal line based on the diffusion coefficient;

estimating environmental conditions;

providing a time in which an electrical circuit will maintain a predetermined electrical performance;

calculating a lateral offset distance between a plane opening of the upper metal layer and the underlying signal line using the diffusion coefficient, environmental conditions and time; and

manufacturing a semiconductor structure which is composed of the insulator material provided between the upper metal layer and the underlying signal line and the lateral offset distance between the plane opening of the upper metal layer and the underlying signal line, the manufacturing being based on the steps of the determining the diffusion coefficient, the time for moisture to travel a certain distance through the insulator material, the environmental conditions, the providing of the time, and the calculating of the lateral offset distance.

REJECTIONS ON APPEAL

I. Claims 1–14 and 16–19 under 35 U.S.C. § 112(a) as failing to comply with the written description requirement and the enablement requirement; and

II. Claims 1–14 and 16–19 under 35 U.S.C. § 112(b) as being indefinite.

DISCUSSION

Rejection I

Claims 1–14 and 16–19 are rejected under 35 U.S.C. § 112(a) as failing to comply with the written description requirement and the enablement requirement. We separately address the written description and enablement issues below.

Written Description Rejection

The Examiner finds claim 1 fails to comply with the written description requirement because the Specification lacks an actual reduction to practice of the claimed invention or a specific and concrete detailed description of the claimed invention, as evidenced by formulas, flow-charts, sequences of specific and concrete method steps, or multiple complete specific embodiments, which would show Appellant was in possession of the claimed invention as a whole. Final Act. 3–4; Ans. 5. For instance, the Examiner finds the Specification lacks specific teachings (e.g., specific formulas or specific sequences of steps) of how to perform the limitation "calculating a lateral offset distance between a plane opening of the upper metal layer and the underlying signal line using the diffusion coefficient, environmental conditions and time." Final Act. 6; Ans. 11. The Examiner also finds the Specification lacks a specific and detailed description of how to accomplish the limitation "the manufacturing being based on the steps of the determining the diffusion coefficient, the time for moisture to travel a certain distance through the insulator material, the environmental conditions, the providing of the time, and the calculating of the lateral offset distance." Final Act. 5.

Appellant contends the Examiner does not provide evidence or reasons why a person skilled in the art would not recognize that Appellant's written description provides support for the claims. Appeal Br. 7. Appellant cites specific paragraphs of the Specification and drawings to support the argument that the Specification demonstrates Appellant had possession of the claimed invention at the time the application was filed. *Id.* at 8–12; Reply Br. 4–6. For instance, Appellant asserts that paragraph 15 of the Specification discloses that the lateral offset distance takes into account various factors, including diffusion coefficient, humidity, temperature, and time. Appeal Br. 12. Appellant also argues that the Specification includes examples, a flow chart, and equations. *Id.* at 13–14; Reply Br. 3–4. In addition, Appellant contends that the combination of the example disclosed in paragraph 35 and the context provided by paragraphs 15–25 of the Specification and Figure 2 supports the limitation requiring manufacturing a semiconductor structure based on the steps of claim 1. Appeal Br. 12; Reply Br. 3–4.

Appellant's arguments are persuasive. The Examiner's rejection fails to sufficiently explain why one skilled in the art would not recognize from the Specification's disclosure that the inventors were in possession of the claimed invention. With regard to the Examiner's position that the Specification lacks an actual reduction to practice, our reviewing court has "made clear that the written description requirement does not demand either examples or an actual reduction to practice; a constructive reduction to practice that in a definite way identifies the claimed invention can satisfy the written description requirement." *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598

F.3d 1336, 1352 (Fed. Cir. 2010) (en banc) (citing *Falko-Gunter Falkner v. Inglis*, 448 F.3d 1357, 1366–67 (Fed. Cir. 2006)).

The Examiner's finding that the Specification lacks a specific and concrete detailed description of the claimed invention is also insufficient to explain why one skilled in the art would not recognize from the Specification's disclosure that the inventors were in possession of the claimed invention. An express disclosure of the claimed subject matter is not required because the original specification need not describe the claimed subject matter "in haec verba" in order to satisfy the written description requirement. *In re Wright,* 866 F.2d 422, 425 (Fed. Cir. 1989). Rather, the test for sufficiency of a written description is whether the disclosure "'clearly allow[s] persons of ordinary skill in the art to recognize that [the inventor] invented what is claimed.'" *Ariad Pharms., Inc.*, 598 F.3d at 1351 (quoting *Vas–Cath Inc. v. Mahurkar*, 935 F.2d 1555, 1562–63 (Fed. Cir. 1991)). The disclosure must "reasonably convey[ ] to those skilled in the art that the inventor had possession of the claimed subject matter as of the filing date." *Id.* at 1351. Possession means "possession as shown in the disclosure" and "requires an objective inquiry into the four corners of the specification from the perspective of a person of ordinary skill in the art." *Id.*

Here, Appellant's disclosure reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter. For instance, paragraphs 25–34 explain that the diffusion coefficient of an insulator material (e.g., polyimide) can be measured through experimentation or via calculations, such as calculations using Fick's laws of diffusion, which are discussed in the Specification. Paragraphs 16 and 24

disclose that the time for moisture to travel a certain distance can be determined from the diffusion rate for moisture in the material. Paragraphs 22, 23, and 39 disclose determining environmental conditions, particularly humidity levels and temperature. Paragraph 20 discloses shelf life as a target time before degradation in electrical performance occurs, paragraph 39 discussing an estimated shelf life for a device, and paragraph 16 discloses calculating shelf life based upon a given diffusion coefficient. Paragraphs 15–25 disclose determining a lateral offset based on various factors, such as the diffusion coefficient, humidity and temperature (e.g., environmental conditions), and time. Furthermore, we agree that the combination of the example disclosed in paragraph 35 and the context provided by paragraphs 15–25 of the Specification and Appellant's Figure 2 supports the limitation of "the manufacturing being based on the steps of the determining the diffusion coefficient, the time for moisture to travel a certain distance through the insulator material, the environmental conditions, the providing of the time, and the calculating of the lateral offset distance."

The Examiner also finds that certain limitations of claim 1 are broad in scope and that the Specification does not provide "a detailed specific teaching that would encompass the entirety of the claimed invention, in its entire breadth." Final Act. 5; Ans. 9. In other words, the Examiner finds a lack of written description support for the full scope of the claims the Examiner envisions. For instance, the Examiner finds the limitation "estimating environmental conditions" encompasses "any condition," such as the highest or lowest temperature over a period of time, average humidity over a period of time, highest wind speed over a period of time, average level of atmospheric carbon dioxide over a period of time, amount of total

rainfall over a period of time, the pH of a chemical bath the semiconductor structure is submerged in, pollen levels, UV index, average noise level, and the amount of radiation. Final Act. 6; Ans. 6–7. The Examiner further finds the limitation "providing a time in which an electrical circuit will maintain a predetermined electrical performance" "is also incredibly broad, as any time whatsoever is acceptable." Final Act. 3–5.

The Examiner's findings, however, do not properly evaluate whether Appellant's disclosure reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter because it views the claimed subject matter in an overly broad manner. As noted above, the Examiner finds that environmental conditions can encompass conditions such as radiation, pollen levels, and average noise level. Ans. 6. However, the Examiner also finds "[t]here is not even any evidence that one could perform [the claimed invention] for environmental conditions related to moisture diffusion, such as average humidity level, lowest temperature that causes the moisture to diffuse, etc." *Id.* at 20. The latter statement demonstrates a reasonable scope of environmental conditions that one of ordinary skill in the art would consider for moisture diffusion when evaluating whether Appellant's disclosure reasonably conveys to those skilled in the art that the inventor had possession of the claimed subject matter. This comports with Appellant's assertion that paragraphs 22, 23, and 39 of the Specification disclose determining environmental conditions, such as humidity levels and temperature. Appeal Br. 13, 15.

The Examiner's treatment of the limitation "providing a time in which an electrical circuit will maintain a predetermined electrical performance" as encompassing "any time whatsoever" is also overly broad. Appellant's

arguments that paragraph 20 discloses shelf life as the time, paragraph 39 discusses an estimated shelf life for a device, and paragraph 16 discloses calculating shelf life based upon a given diffusion coefficient identify a reversible error in the Examiner's rejection. Appeal Br. 13. These portions of Appellant's disclosure, in combination with the other portions Appellant cites, reasonably convey that the inventors possessed the claimed invention at the time the application was filed.

Accordingly, we do not sustain the Examiner's § 112(a) rejection of claims 1–14 and 16–19 as failing to comply with the written description requirement.

Enablement Rejection

The Examiner concludes Appellant "has not enabled one of ordinary skill in the art as how to make or use the claimed invention," citing the reasons described for the written description rejection. Final Act. 12. The Examiner, however, has not met the initial burden for setting forth a rejection for failing to comply with the enablement requirement.

"[T]o be enabling, the specification of a patent must teach those skilled in the art how to make and use the full scope of the claimed invention without 'undue experimentation.'" *In re Wright*, 999 F.2d 1557, 1561 (Fed. Cir. 1993) (citation omitted). "Whether undue experimentation is needed is not a single, simple factual determination, but rather is a conclusion reached by weighing many factual considerations." *In re Wands*, 858 F.2d 731, 737 (Fed. Cir. 1988). Some experimentation, even a considerable amount, is not "undue" if, e.g., it is merely routine, or if the specification provides a reasonable amount of guidance as to the direction in which the experimentation should proceed. *Id.* at 736–37. Factors to consider for

enablement include "(1) the quantity of experimentation necessary, (2) the amount of direction or guidance presented, (3) the presence or absence of working examples, (4) the nature of the invention, (5) the state of the prior art, (6) the relative skill of those in the art, (7) the predictability or unpredictability of the art, and (8) the breadth of the claims." *Id.* at 737.

Here, the Examiner does not explain why Appellant's Specification does not enable one of ordinary skill in the art to use the claimed invention without *undue* experimentation. For instance, Examiner cites the *Wands* factors and states they "have been considered in the decision of non-enablement," but does not explain how any individual *Wands* factor applies to claim 1, or how the balance of the factors weighs in favor of rejecting claim 1 for lack of enablement. Final Act. 13. Although such an analysis is not necessarily required, it is a useful tool for demonstrating the experimentation needed to make and use the full scope of a claimed invention would be undue.

To the extent the Examiner's comments evaluate some considerations for enablement, such the breadth of the claims, the comments are insufficient to meet the Examiner's initial burden of setting forth a rejection for lack of enablement.[3] For instance, the Examiner summarizes the enablement rejection of claim 1 by stating "[t]he issue is an enablement of the entirety of the claim, for the entire breadth of the claim." Ans. 10. However, as discussed above with regard to the written description rejection, the Examiner's evaluation of the claim limitations, such as the environmental

[3] The Examiner bears an initial burden of setting forth a reasonable explanation as to why it believes that the scope of protection provided by that claim is not adequately enabled. *In re Wright*, 999 F.2d at 1561–62.

conditions and the time in which an electrical circuit will maintain a predetermined electrical performance, is overly broad. Further, to the extent the Examiner considers the quantity of experimentation to be large, some experimentation, even a considerable amount, is not "undue" if, e.g., it is merely routine, or if the Specification provides a reasonable amount of guidance as to the direction in which the experimentation should proceed. *In re Wands*, 858 F.2d at 736–737.

Certain statements by the Examiner also indicate that one of ordinary skill in the art would be capable of performing the individual limitations of claim 1. Specifically, when referencing the limitations of "determining a diffusion coefficient" (the limitation the Examiner identifies as "L1") through "manufacturing a semiconductor structure" (the limitation the Examiner identifies as "L6"), the Examiner finds that "[o]ne can perform each individual step L1 through L6, in isolation from the entirety of the claim scope, based on the skill of one of ordinary skill in the art." Final Act. 3, 5, 7; Ans. 5. The Examiner also indicates that "many companies manufacture semiconductor structures with upper metal layers and underlying signal lines." *Id.* at 7. These findings indicate enablement, especially when the individual limitations are not viewed as broadly as in the § 112(a) rejection.

Accordingly, we do not sustain the Examiner's § 112(a) rejection of claims 1–14 and 16–19 as failing to comply with the enablement requirement.

Rejection II

Claims 1–14 and 16–19 are rejected under 35 U.S.C. § 112(b)

as being indefinite.

Claims 1–6, 8–10, 12–14, and 16–19

The Examiner concludes claim 1 is indefinite because the metes and bounds of the limitation "lateral offset distance" cannot be determined. Final Act. 13–14. Specifically, the Examiner finds the limitation is not a term of art and claim 1 and the Specification do not provide an unambiguous definition. *Id.* at 14. The Examiner finds that paragraph 23 of the Specification describes a lateral offset distance as "e.g., diffusion distance D1" but, because diffusion would occur in all directions at the same average rate, all distances along metal layer 14 in Appellant's Figure 2 would be diffusion distances. *Id.* at 15. The Examiner also finds that paragraph 23 describes "E(max)= E(typ) + diffusion distance D_1" but, when treating the arrows in Figure 2 as vectors, the vector from the E(typ) arrowhead is not equal to the sum of the vectors for E(typ) and D_1. *Id.* The Examiner also finds Figure 2 depicts E(max) in the same position as D1 and, therefore, equivalent to one another, which conflicts with E(max)= E(typ) + diffusion distance D_1, as described in paragraph 23 of the Specification. *Id.* The Examiner rejects claims 2–6, 8–10, 12–14, and 16–19 for the same reasons as claim 1. *Id.*

Appellant asserts that paragraph 23 of the Specification "defines that the lateral offset distance is a diffusion distance D1 calculated from the opening of the outer metal layer 14a to the signal line 14, and can be calculated from the function of E(max)= E(typ) + diffusion distance D1." Appeal Br. 34–35. Appellant also argues that Figure 2 clearly defines the "lateral offset distance" with respect to a device and that it is inaccurate to note from the drawings alone that one would use vector mathematics to

determine the claimed distances. *Id.* at 35–36. Appellant further contends that one of ordinary skill in the art would readily understand from the Specification that D_1, E(max), and E(typ) are distances. Reply Br. 14.

Appellant's Figure 2 is reproduced below.

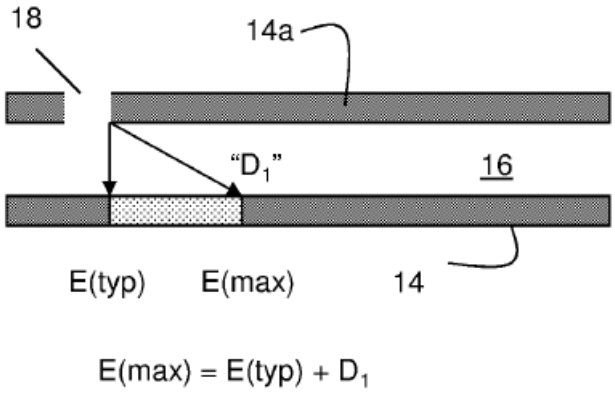

FIG. 2

Figure 2 shows a partial cross-sectional view of a multi-layer substrate.

Appellant's arguments are persuasive. The Specification describes Figure 2 as depicting outer metal layer 14a, opening or via 18 in outer metal layer 14a, signal line 14, and insulator layer 16 between outer metal layer 14a and signal line 14. Spec. ¶¶ 21–22. Paragraph 23 describes "the lateral offset distance, e.g., diffusion distance D_1" as "from the opening 18 of the reference plane (e.g., outer metal layer) 14a to the signal line 14." Therefore, the "lateral offset distance" is the lateral component of the distance from opening or via 18 to signal line 14. This is depicted in Figure 2 as the cross-hatched section of signal line 14 between the tip of the arrowhead for E(typ) and the tip of the arrowhead for D_1.

The Examiner's explanation at page 21 of the Answer confirms this understanding by stating "[h]owever, D1 (the distance along the right arrow) is not 'lateral' in any sense of the word, as 'lateral' would most reasonably

be interpreted as a distance along 14." The premise of this statement appears to treat the arrow for D_1 in Figure 2 as depicting the distance along the length of the arrow (i.e., a distance having a horizontal component and a vertical component in Figure 2). However, the latter portion of the statement is correct by proposing that the "lateral offset distance" is reasonably interpreted as the lateral extent of the distance along signal line 14.

In view of the above, the arrow for D_1 in Figure 2 is used as a drafting tool to indicate the end of the lateral diffusion distance D_1 along signal line 14, not to indicate a vector. Paragraph 23 of the Specification describes D_1, E(max), and E(typ) as distances, not vectors. Further, to the extent the Examiner rejects claim 1 because the "lateral offset distance" can be various distances along signal line 14 in Figure 2, a claim cannot be rejected merely because it might be broad in scope. "[B]readth is not to be equated with indefiniteness." *In re Miller*, 441 F.2d 689, 693 (CCPA 1971).

For these reasons, we do not sustain the Examiner's § 112(b) rejection of claims 1–6, 8–10, 12–14, and 16–19.

Claims 7 and 11

Claim 7 is rejected under § 112(b) because the limitation "the diffusion distance" lacks proper antecedent basis and it is unclear what distance this refers to. Final Act. 15–16. Similarly, claim 11 is rejected under § 112(b) because the limitation "the diffusion rate" lacks proper antecedent basis and it is unclear what this limitation refers to. *Id.* at 16.

Appellant asserts that amendments were submitted for claims 7 and 11 on October 5, 2018, to overcome these rejections, but the Advisory Action of October 15, 2018, did not enter the amendments. Appeal Br. 37, 39. In

other words, Appellant does not dispute that the limitations lack antecedent basis, but indicates claim amendments would address these rejections. Appellant also argues that Appellant's Specification describes "diffusion rate" as a separate concept from diffusion time and diffusion distance. *Id.* at 37–40. The Examiner responds that claims 7 and 11 nevertheless lack proper antecedent basis. Ans. 22.

Because the antecedent basis issues remain for the limitation "the diffusion distance" in claim 7 and the limitation "the diffusion rate" in claim 11, we sustain the Examiner's rejections of claims 7 and 11 under § 112(b).

DECISION

On the record before us and for the reasons given in Appellant's Appeal Brief and above, we affirm-in-part the Examiner's rejections.

In summary:

Claims Rejected	35 U.S.C.§	References/Basis	Affirmed	Reversed
1–14, 16–19	112(a)	Written Description		1–14, 16–19
1–14, 16–19	112(a)	Enablement		1–14, 16–19
1–14, 16–19	112(b)	Indefiniteness	7, 11	1–6, 8–10, 12–14, 16–19
Overall Outcome			7, 11	1–6, 8–10, 12–14, 16–19

TIME PERIOD FOR RESPONSE

No time period for taking any subsequent action in connection with this appeal may be extended under 37 C.F.R. § 1.136(a). *See* 37 C.F.R. § 1.136(a)(1)(iv).

AFFIRMED-IN-PART