

Filed on behalf of:

Patent Owner

By: Alison L. McCarthy (Lead Counsel)

Alison.McCarthy@Troutman.com

Dustin N. Ferzacca (Back-up Counsel)

Dustin.Ferzacca@Troutman.com

Andrew P. Zappia (Back-up Counsel)

Andrew.Zappia@Troutman.com

Paper No. _____

Date: April 17, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD.,
Petitioner,

v.

SIONYX, LLC,
Patent Owner.

Case IPR2025-00165
Patent 9,905,599 B2

PATENT OWNER'S PRELIMINARY RESPONSE

37 C.F.R. § 42.107 and 35 U.S.C. § 313

TABLE OF CONTENTS

	Page
TABLE OF AUTHORITIES	iii
LIST OF PATENT OWNER’S EXHIBITS	iv
CLAIM LISTING FOR U.S. PATENT NO. 11,224,359	v
I. INTRODUCTION	1
II. SUMMARY OF ARGUMENTS	3
III. PETITIONER’S GROUNDS	3
IV. INSTITUTION SHOULD BE DENIED	4
A. Ground 1: Haddad188 (EX1006)	4
1. Petitioner’s Obviousness Argument Is Legally Deficient Because It Fails To Make The Required Showing On Motivation	8
B. Ground 2: Haddad188 (EX1006) In Combination With Shinohara (EX1007)	10
C. Ground 3: Haddad188 (EX1006) In Combination With Mori (EX1009)	10
D. Ground 4: Haddad188 (EX1006) In Combination With Mori (EX1009) and Shinohara (EX1007)	11
E. Ground 5: Hwang (EX1010) In Combination With Konno (EX1011)	11
1. Hwang Does Not Disclose “at least one light sensitive pixel”	11
2. Hwang Does Not Disclose “a peripheral sidewall extending at least partially around the pixel periphery”	16

IPR2025-00165 (Patent 9,905,599)
Patent Owner’s Preliminary Response

F.	Ground 6: Hwang (EX1010) In Combination With Konno (EX1011) and Shinohara (EX1007).....	20
G.	Ground 7: Hwang (EX1010) In Combination With Konno (EX1011) and Mori (EX1009).....	20
H.	Ground 8: Hwang (EX1010) In Combination With Konno (EX1011), Mori (EX1009), and Shinohara (EX1007).....	21
V.	CONCLUSION.....	21
	CERTIFICATE OF COMPLIANCE.....	22
	CERTIFICATE OF SERVICE	23

TABLE OF AUTHORITIES

	Page
CASES	
<i>Belden Inc. v. Berk-Tek LLC</i> , 805 F.3d 1064 (Fed. Cir. 2015)	8, 9, 10
<i>Eli Lilly & Co. v. Teva Pharms. Int’l GmbH</i> , 8 F.4th 1331 (Fed. Cir. 2021)	8
<i>Pfizer, Inc. v. Apotex, Inc.</i> , 480 F.3d 1348 (Fed. Cir. 2007)	9
<i>Procter & Gamble Co. v. Teva Pharms. USA, Inc.</i> , 566 F.3d 989 (Fed. Cir. 2009)	8
<i>SIBIA Neurosciences, Inc. v. Cadus Pharm. Corp.</i> , 225 F.3d 1349 (Fed. Cir. 2000)	9
 CODES, REGULATIONS AND OTHER AUTHORITIES	
35 U.S.C. § 103	4
35 U.S.C. § 313	1
35 U.S.C. § 314(a)	1
37 C.F.R. § 42.107(a)	1
37 C.F.R. § 42.108(c)	1
Memorandum Regarding Interim Processes for PTAB Workload Management (PTAB Mar. 26, 2025)	1, 2

LIST OF PATENT OWNER'S EXHIBITS

PO Exhibit Number	Description
	Filed and Served on March 5, 2025 with Patent Owner's Motion for <i>Pro Hac Vice</i> Admission of Andrew P. Zappia Under 37 C.F.R. § 42.10
2001	Declaration of Andrew P. Zappia in Support of Patent Owner's Motion for <i>Pro Hac Vice</i> Admission
	Filed and Served on April 17, 2025 with Patent Owner's Preliminary Response
2002	Redacted Witness Statement of Dr. Dean Neikirk filed in <i>In the Matter of Certain Sensors With Pixels And Products Containing The Same</i> , Inv. No. 337-TA-1403 (ITC)

CLAIM LISTING FOR U.S. PATENT NO. 11,224,359

1. [1Preamble] A light trapping device, comprising:
 - [1a] at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall extending at least partially around the pixel periphery;
 - [1b] a backside light trapping material at least partially covering the backside surface;
 - [1c] a peripheral light trapping material substantially covering the peripheral sidewall, wherein said peripheral light trapping material is doped with a dopant to create a surface field; and
 - [1d] a reflective layer coupled to the light incident side and having an aperture to allow entry of light into the pixel;
 - [1e] wherein the reflective layer is operable to reflect at least a portion of light impinging thereupon from inside the pixel back into the pixel back into the pixel.
2. The device of claim 1, wherein at least one of the backside light trapping material and the peripheral light trapping material reflects light incident thereon back into the pixel.
3. The device of claim 1, wherein said peripheral light trapping material has a refractive index of less than about 2.1.
4. The device of claim 1, wherein said peripheral light trapping material includes a member selected from the group consisting of an

oxide, a nitride, oxynitrides, a gas, at least a partial vacuum, and combinations thereof.

5. The device of claim 4, wherein said peripheral light trapping material is selected from the group consisting of silicon oxide, silicon nitride, silicon dioxide, and combinations thereof.

6. The device of claim 1, wherein the dopant is boron or antimony.

7. The device of claim 1, wherein the peripheral sidewall extends completely around the pixel periphery.

8. The device of claim 1, wherein the peripheral sidewall extends from the light incident surface to the backside surface.

9. The device of claim 1, wherein said aperture has an effective surface area of less than about 90% of total area of the incident light surface.

10. The device of claim 1, further comprising a lens functionally coupled to the aperture and operable to focus incident light through the aperture and into the pixel.

11. The device of claim 1, wherein at least one of the backside light trapping material and the peripheral light trapping material is a metal layer.

12. The device of claim 1, further comprising a textured region positioned to interact with light incident thereon to increase quantum efficiency of the device.
13. The device of claim 12, wherein said textured region comprises a textured film layer.
14. The device of claim 13, wherein said textured film layer comprises any of silicon dioxide, silicon nitride, amorphous silicon, polysilicon, a metal and combinations thereof.
15. The device of claim 1, wherein the peripheral light trapping material comprises any of aluminum oxide and hafnium oxide.
16. The device of claim 1, wherein the backside light trapping material substantially covers the backside surface.
17. The device of claim 1, wherein the backside light trapping material completely covers the backside surface.
18. The device of claim 1, wherein said peripheral sidewall extends through the pixel substantially from the light incident surface to the backside surface.
19. **[19Preamble]** A light trapping device, comprising:
[19a] at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a

peripheral sidewall extending at least partially around the pixel periphery;

[19b] a backside light trapping material at least partially covering the backside surface;

[19c] a peripheral light trapping material substantially covering the peripheral sidewall;

[19d] a textured region positioned to interact with light incident thereon to increase quantum efficiency of the device; and

[19e] a reflective layer coupled to the light incident side and having an aperture to allow entry of light into the pixel;

[19f] wherein the reflective layer is operable to reflect at least a portion of light impinging thereupon from inside the pixel back into the pixel back into the pixel.

20. The device of claim 19, wherein at least one of the backside light trapping material and the peripheral light trapping material reflects light incident thereon back into the pixel.

21. The device of claim 19, wherein said peripheral light trapping material has a refractive index of less than about 2.1.

22. The device of claim 19, wherein said peripheral light trapping material includes a member selected from the group consisting of an oxide, a nitride, oxynitrides, a gas, at least a partial vacuum, and combinations thereof.

23. The device of claim 22, wherein said peripheral light trapping material is selected from the group consisting of silicon oxide, silicon nitride, silicon dioxide, and combinations thereof.

24. The device of claim 19, wherein said peripheral light trapping material is doped with a dopant to create a surface field.

25. The device of claim 24, wherein the dopant is boron or antimony.

26. The device of claim 19, wherein the peripheral sidewall extends completely around the pixel periphery.

27. The device of claim 19, wherein the peripheral sidewall extends from the light incident surface to the backside surface.

28. The device of claim 19, wherein said aperture has an effective surface area of less than about 90% of total area of the incident light surface.

29. The device of claim 19, further comprising a lens functionally coupled to the aperture and operable to focus incident light through the aperture and into the pixel.

30. The device of claim 19, wherein at least one of the backside light trapping material and the peripheral light trapping material is a metal layer.

31. The device of claim 19, wherein said textured region comprises a textured film layer.

32. The device of claim 31, wherein said textured film layer comprises any of silicon dioxide, silicon nitride, amorphous silicon, polysilicon, a metal and combinations thereof.

33. The device of claim 19, wherein the peripheral light trapping material comprises any of aluminum oxide and hafnium oxide.

34. The device of claim 19, wherein the backside light trapping material substantially covers the backside surface.

35. The device of claim 19, wherein the backside light trapping material completely covers the backside surface.

36. The device of claim 19, wherein said peripheral sidewall extends through the pixel substantially from the light incident surface to the backside surface.

I. INTRODUCTION

Pursuant to 37 C.F.R. § 42.107(a) and 35 U.S.C. § 313, SiOnyx, LLC (“Patent Owner”) submits this Preliminary Response to the Petition for *Inter Partes* Review of claims 1-36 (the “Challenged Claims”) of U.S. Patent No. 9,905,599 (EX1001) (“the ’599 Patent”) filed by Petitioner Samsung Electronics Co., Ltd. on November 29, 2024, with a filing date accorded of November 29, 2024 (Paper 5) and notice mailed on January 17, 2025. This Preliminary Response is timely filed.

It is Petitioner’s burden to show — by the Petition and its supporting evidence — that there is a reasonable likelihood that at least one of the Challenged Claims is unpatentable. *See* 37 C.F.R. § 42.108(c); *see also* 35 U.S.C. § 314(a). For the reasons discussed below, Petitioner has failed to meet this burden.

As an initial matter, Patent Owner’s arguments for discretionary denial under Section 314(a) will be submitted through a separate paper as instructed by the March 26, 2025 Memorandum (the “Memorandum”) from the United States Patent and Trademark Office on discretionary denial.¹ *See* Memorandum

¹ The Memorandum instructs Patent Owners to file a brief separate from the Patent Owner Preliminary Response to seek discretionary denial, within two (2) months

Regarding Interim Processes for PTAB Workload Management (Mar. 26, 2025).

Even if discretionary denial were not warranted, the Petition fails on the merits. Claims 1 and 19 are the only independent claims in the '599 Patent. As discussed below, Petitioner has not met its burden to show a reasonable likelihood that lead references Haddad188² or Hwang, in combination with the other Ground references invalidate either of claims 1 and 19 as asserted in Grounds 1, 3, 5, and 7. Furthermore, because none of the remaining Ground references address the deficiencies of Haddad188 with respect to the independent claims, institution should be denied.

of the date of entry of the Notice of Filing Date Accorded to Petition in IPR proceedings. The Memorandum further provides that if the two (2) month time period expired before the issuance of the Memorandum, a Patent Owner may file its brief seeking discretionary denial within one (1) month following the issuance of the Memorandum. In this proceeding, the two (2) month time period expired on March 17, 2025, so the due date for Patent Owner's submission on discretionary denial is April 26, 2025.

² To the extent not defined herein, defined terms used herein have the same meaning as ascribed to them in the Petition.

II. SUMMARY OF ARGUMENTS

Petitioner has failed to meet its burden to show a reasonable likelihood that at least one of the Challenged Claims is unpatentable over: (i) Haddad188 alone or in combination with Shinohara, or Mori; or (ii) Hwang and Konno combined or in further view of Shinohara and/or Mori.

Petitioner fails to present any proofs or arguments for why a person of ordinary skill in the art (“POSITA”) would have been motivated to modify the figures in Haddad188 with a reasonable expectation of success to arrive at the Challenged Claims. Instead, Petitioner only argues that a POSITA could have modified those figures in Haddad188, which is legally deficient and fatal to the Petition. Likewise, Petitioner fails to demonstrate that Hwang discloses the claimed “at least one light sensitive pixel” or “a peripheral sidewall extending at least partially around the pixel periphery,” because the express disclosures in Hwang contradict Petitioner’s assertions. Therefore, institution should be denied.

III. PETITIONER’S GROUNDS

Petitioner proffers eight (8) Grounds for attacking the Challenged Claims (claims 1-36):

Ground	[Petition] Challenged Claims	Basis for Rejection
1	19-20, 26-32, 34-36	§103: Haddad188 (EX1006)
2	33	§103: Haddad188 (EX1006) and Shinohara (EX1007)
3	1-14, 16-18, 21-25	§103: Haddad188 (EX1006) and Mori (EX1008 / EX1009)
4	15	§103: Haddad188 (EX1006), Mori (EX1008 / EX1009), and Shinohara (EX1007)
5	19-23, 26-32, 34, 36	§103: Hwang (EX1010) and Konno (EX1011)
6	33	§103: Hwang (EX1010), Konno (EX1011), and Shinohara (EX1007)
7	1-14, 16, 18, 24-25	§103: Hwang (EX1010), Konno (EX1011), and Mori (EX1008 / EX1009)
8	15	§103: Hwang (EX1010), Konno (EX1011), Mori (EX1008 / EX1009), and Shinohara (EX1007)

See Petition, 2-4.

As discussed below, Petitioner has failed to meet its burden to show a reasonable likelihood that at least one of the Challenged Claims is unpatentable under these Grounds.

IV. INSTITUTION SHOULD BE DENIED

A. Ground 1: Haddad188 (EX1006)

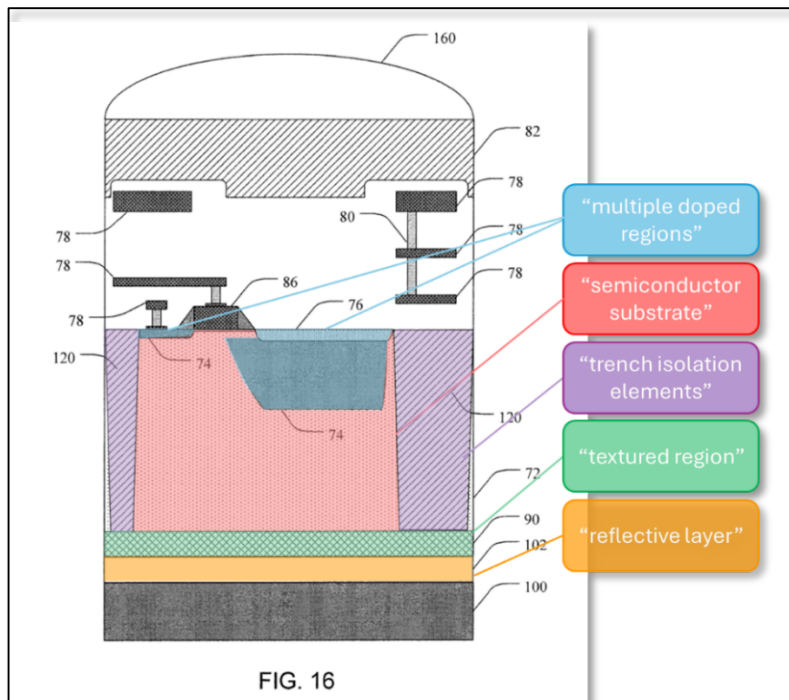
Petitioner posits that Haddad188 discloses or suggests the limitations of claims 19-20, 26-32, and 34-36, relying on Figure 16. Petition, 8-20. Claim 19 is an independent claim that requires “a reflective layer coupled to the light incident

side and having an aperture to allow entry of light into the pixel.” EX1001, 19:38-39. Haddad188 fails to disclose or render obvious at least this element of claim 19 and therefore Ground 1 fails.

To try to establish that Haddad188 includes a “reflective layer coupled to the light incident side and having an aperture to allow entry of light into the pixel”, Petitioner points to the “reflective material layer 166” that is mentioned in the specification. Petition, 16. However, as Petitioner admits, “reflective material layer 166” is not shown in Figure 16 of Haddad188. Petition, 16. To try to remedy this, Petitioner modifies Figure 16 of Haddad188 to include the “reflective material layer 166” by importing structures from a Figure 10 in the '004 Application, which is a provisional application in the claimed priority chain of Haddad188. Petition, 16-17. Petitioner then constructs a new figure that is found nowhere in either Haddad188 or the '004 Application. *See* Petition, 18. The only basis Petitioner offers for constructing this new figure is the assertion that Figures 16 and 10 are similar and that this newly-created figure would have certain benefits. The Petition presents no evidence or explanation for why a POSITA would have been motivated to create this new figure. Likewise, the Petition fails to address in any manner why a POSITA would have had a reasonable expectation of success in constructing this new figure.

Further, this newly created figure lacks fidelity to the specification. What Haddad188 discloses is a “reflecting layer” that can be “coupled to the semiconductor substrate 12.” *See* EX1006, 20:19-20. Specifically, the reflecting layer “can be disposed between the textured region 90 and the carrier support substrate.” *See* EX1006, 23:19-20. The reflector is positioned between the textured region and carrier support substrate to “reduc[e] optical loss and backscattering.” *See* EX1006, 23:20-22.

An annotated version of Haddad188's Figure 16, illustrating a pixel according to one embodiment of the image sensor (including the doped regions, textured and reflective layers, and trench isolation elements), and which is faithful to the teachings in the specification, is set forth below:



EX1006, FIG. 16 (annotated). As described in Haddad188, the position of the reflective layer is between the textured region and the substrate.

The “reflective material layer 166” in Haddad188 is not taught or disclosed as a light trapping material, nor would a POSITA have thought it to be one. A POSITA would not understand Haddad188's disclosure of “increas[ing] the effectiveness of the optical cavity” (EX1006, 25:10) as synonymous with reflecting incident light back into the pixel, which is what the claim requires. See EX1001, 19:40-42.

Based on the specification of Haddad188, a POSITA would understand that apertures in the reflective layer function along with the lens to focus incident light within the pixel, wherein any reflection of light from the aperture is intended to direct light into the pixel in the first instance to avoid issues like crosstalk, rather than serving to trap it in the pixel by reflecting light “back into the pixel.”

EX1001, 19:40-41. The claimed “reflective layer coupled to the light incident side and having an aperture to allow entry of light into the pixel” (EX1001, 19:38-39) is not shown or suggested in Haddad188, and Ground 1 must fail for at least this deficiency.

1. Petitioner's Obviousness Argument Is Legally Deficient Because It Fails To Make The Required Showing On Motivation

Petitioner fails to present any proof that a POSITA would have been motivated to make the proposed modifications to Haddad188 with a reasonable expectation of success, as required to show obviousness. Without that requisite motivation, Petitioner's obviousness argument fails.

“[O]bviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to make* the combinations or modifications of prior art to arrive at the claimed invention.” *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015) (emphasis in original). A Petitioner bears the burden of establishing how and *why* a POSITA would have chosen the cited reference and combine or modify it to arrive at the claimed invention with a reasonable expectation of success. *See id*; *see also Eli Lilly & Co. v. Teva Pharms. Int'l GmbH*, 8 F.4th 1331, 1334 (Fed. Cir. 2021) (citing *Procter & Gamble Co. v. Teva Pharms. USA, Inc.*, 566 F.3d 989, 994 (Fed. Cir. 2009)) (“A party seeking to invalidate a patent based on obviousness must demonstrate ‘by clear and convincing evidence that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing

so.’” (*quoting Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1361 (Fed. Cir. 2007))
(internal quotation marks omitted).

When an obviousness theory relies on a modification, it must be shown that a POSITA “not only *could have made* but *would have been motivated to make* [that modification].” *Belden*, 805 F.3d at 1073 (emphasis in original). While the law allows for obviousness arguments based on a single reference, “there must be a showing of a suggestion or motivation to modify the teachings of that reference.” *SIBIA Neurosciences, Inc. v. Cadus Pharm. Corp.*, 225 F.3d 1349, 1356 (Fed. Cir. 2000). Even if Petitioner’s arguments are accepted as true, the Petition is deficient because Petitioner offers no “showing of a suggestion or motivation to modify” the Haddad188 reference with a reasonable expectation of success. *Id.*

Petitioner fails to show why a POSITA would have been motivated to modify the device disclosed in Haddad188 Figure 16 to incorporate “a reflective layer coupled to the light incident side and having an aperture to allow entry of light into the pixel,” (EX1001, 19:38-39) or a reflective layer such that “the reflective layer is operable to reflect at least a portion of light impinging thereupon from inside the pixel back into the pixel,” (EX1001, 19:40-42) or a peripheral light trapping material such that the “peripheral light trapping material is doped with a dopant to create a surface field.” (EX1001, 20:12-14). Likewise, the Petition is totally silent on whether a POSITA would have had a reasonable expectation of

success in performing such a modification.

Petitioner's failure to articulate a motivation to modify Haddad188 is fatal. Without the requisite motivation, the Petition is legally deficient. At best, Petitioner's allegations concerning claim 19 amount to an argument that Haddad188 *could be modified*. That is not a sufficient basis to support an obviousness theory. "[O]bviousness concerns whether a skilled artisan not only *could have made* but *would have been motivated to make* the combinations or modifications of prior art to arrive at the claimed invention." *Belden Inc.*, 805 F.3d at 1073 (emphasis in original).

B. Ground 2: Haddad188 (EX1006) In Combination With Shinohara (EX1007)

Petitioner asserts that the combination of Haddad188 with Shinohara renders obvious claim 33. Claim 33 depends from claim 19, and therefore Ground 2 fails for at least the reasons set forth above with respect to Ground 1.

C. Ground 3: Haddad188 (EX1006) In Combination With Mori (EX1009)

Petitioner asserts that the combination of Haddad188 with Mori renders obvious claims 1-14, 16-18, and 21-25. Claim 1 is an independent claim that includes, among other limitations, "a reflective layer coupled to the light incident side and having an aperture to allow entry of light into the pixel." EX1001, 18:38-39. This is the same limitation as discussed above with respect to claim 19.

Petitioner agrees that the limitations in claim 1 and in claim 19 are identical and Ground 3 relies only on Haddad188 (and the same newly-created figure) to meet this specific element of claim 1. *See* Petition, 37-46. Thus, Ground 3 fails for at least the reasons that Ground 1 fails, as discussed above.

D. Ground 4: Haddad188 (EX1006) In Combination With Mori (EX1009) and Shinohara (EX1007)

Petitioner asserts that the combination of Haddad188 with Mori and Shinohara renders obvious claim 15. Claim 15 depends from claim 1, and therefore Ground 4 fails for at least the reasons set forth above with respect to Ground 3.

E. Ground 5: Hwang (EX1010) In Combination With Konno (EX1011)

Petitioner asserts that the combination of Hwang with Konno renders obvious claims 19-23, 26-32, 34, and 36. Independent claim 19 is not rendered obvious by Hwang in combination with Konno at least because Hwang does not disclose or suggest “at least one light sensitive pixel having a light incident surface” (EX1001, 19:27-29) or “a peripheral sidewall extending at least partially around the pixel periphery” (EX1001, 19:29-30) as required by claim 19.

1. Hwang Does Not Disclose “at least one light sensitive pixel”

Petitioner presents insufficient evidence that Hwang discloses “at least one light sensitive pixel.” EX1001, 19:27-30; *see also* EX1001, 18:28-31. First, Petitioner's invalidity theory relies on Hwang's “pixel semiconductor pattern

110a” as “teaching or suggesting” the limitation “at least one light sensitive pixel.” Petition, 51-55. However, Petitioner provides insufficient evidence that the “pixel semiconductor pattern 110a” in Hwang is the same as the claimed “light sensitive pixel.”

Petitioner has consistently admitted that a pixel converts light into an electrical signal. EX1031, 22. However, Petitioner fails to submit evidence that Hwang’s “pixel semiconductor pattern 110a” is the component in Hwang that converts light into an electrical signal. Instead, Petitioner and its expert Dr. Lebby identify the photodiode 145 in Hwang as the structure that converts light into an electrical signal. Petition, 52 at fn. 10. Petitioner attempts to sidestep this inconsistency by conflating elements in Hwang’s description, rather than identifying what is the “pixel semiconductor pattern 110a” in Hwang. EX1003, ¶200 at fn. 10. These arguments by Petitioner and Dr. Lebby, which contradict the actual teachings in Hwang, cannot support Petitioner’s positions.

Petitioner lacks sufficient evidence to show that Hwang’s “pixel semiconductor pattern 110a” is a pixel. Hwang’s inventors clearly knew the term “pixel,” as the specification uses the word both as part of the longer phrase “pixel semiconductor pattern” and in the context of generally describing image sensors. *See, e.g.*, EX1010, 1:55-57 (“In accordance with aspects of the present invention also provided is an image sensor capable of minimizing interference between

neighboring pixels.”). To interpret “pixel semiconductor pattern 110a” as equivalent to “pixel” renders two of the three words in the phrase meaningless, and ignores the inventor's clear lexicography. Petitioner provides no explanation for why Hwang uses two different terms: (i) “pixel semiconductor pattern 110a” and (ii) “pixel.” Instead, both Petitioner and Dr. Lebby simply assume the two terms are synonymous.

Petitioner's argument is further undermined by the contradictions between its experts' statements and Petitioner's claim construction positions. The parties agreed on the function of a pixel. In his claim construction holding, the ITC Administrative Law Judge (“ALJ”) noted that “[b]oth parties' experts agree that the ‘pixel’ converts light into electrical signals.” EX1031, 22 (internal quotation marks and citation omitted). Moreover, Petitioner's ITC invalidity expert, Dr. Neikirk, states:

At the heart of a CMOS image sensor lies an array of light-sensitive pixels, each of which has a photodiode capable of detecting light. A photodiode converts incoming photons into electrons and holes (i.e., charge carriers).

EX2002, 11 at Q33. Dr. Neikirk's description of a pixel confirms Petitioner's position that a pixel converts light into electrical signals. In view of the above, Dr. Lebby's insistence that the “pixel semiconductor pattern 110a” is a pixel is at odds

with: (i) Petitioner's own representations at the ITC; (ii) the parties' agreements; and (iii) the findings of the ALJ at the ITC. Indeed, Hwang explains that "photodiode 145" converts light into an electrical signal, not "pixel semiconductor pattern 110a."

Hwang further confirms this when it states that "photodiodes 145 are doped at a low concentration, so that most or the entirety of the photodiodes 145 become depletion regions." EX1010, 6:4-6. The depletion region is the portion of a photodiode where absorbed light generates photocurrent. *See, e.g.*, EX1010, 1:26-29 ("When external light is incident on a depletion region in the photodiode, electron-hole pairs are generated, and the external light is converted to electrical signals."). According to Hwang's explicit description, light is converted to electrical signals only in photodiode 145.

Hwang's description of its depletion region is consistent with the rest of the specification. For example, Hwang's figures show a microlens positioned over "photodiode 145" such that incident light will be focused onto the depletion region. *See, e.g.*, EX1010, Fig. 2; *see also, e.g.*, EX1010, 8:18-19 ("a micro lens 230 **that covers the photodiode 145** is disposed on the color filter") (emphasis added). Critically, the microlens does not extend over the "pixel semiconductor pattern 110a." The limited coverage of Hwang's microlens confirms that Hwang's "pixel semiconductor pattern 110a" is not a pixel. If the entire "pixel semiconductor

pattern 110a” could convert light into an electrical signal, the microlens would be configured to focus incident light into the entire “pixel semiconductor pattern 110a,” not just into the photodiode.

Dr. Lebby's attempts to explain away this inconsistency further muddy the waters. Dr. Lebby's solution to the contradictory positions taken by Petitioner is to argue, once again, that while Hwang's inventors used specific technical language, they actually meant something different. Specifically, Dr. Lebby states:

While Hwang calls element 145 a “photodiode,” a POSITA would understand that term (i.e., the structure that converts light into an electrical signal) encompasses more than just element 145, and would further include the surrounding pixel semiconductor patterns 110a.

EX1003, ¶200 at fn. 10. Dr. Lebby's position relies on interpretations of Hwang's specification inconsistent with Hwang's plain language and explicit disclosure. For Dr. Lebby's argument to prevail, the Board must accept that Hwang intended (i) “pixel semiconductor pattern 110a” to mean “pixel,” and (ii) the disclosed “photodiode” is not the actual photodiode, the actual photodiode includes both the “photodiode” and other components that make up the “pixel semiconductor pattern 110a.”

Such interpretations would directly contradict Hwang's specification.

Petitioner is contorting the prior art into something wholly different than what is expressly disclosed. Thus, Petitioner cannot meet its burden of showing that Hwang discloses "at least one light sensitive pixel" as required in claim 19 of the '599 Patent. Thus, Petitioner has failed to show obviousness, and institution should be denied.

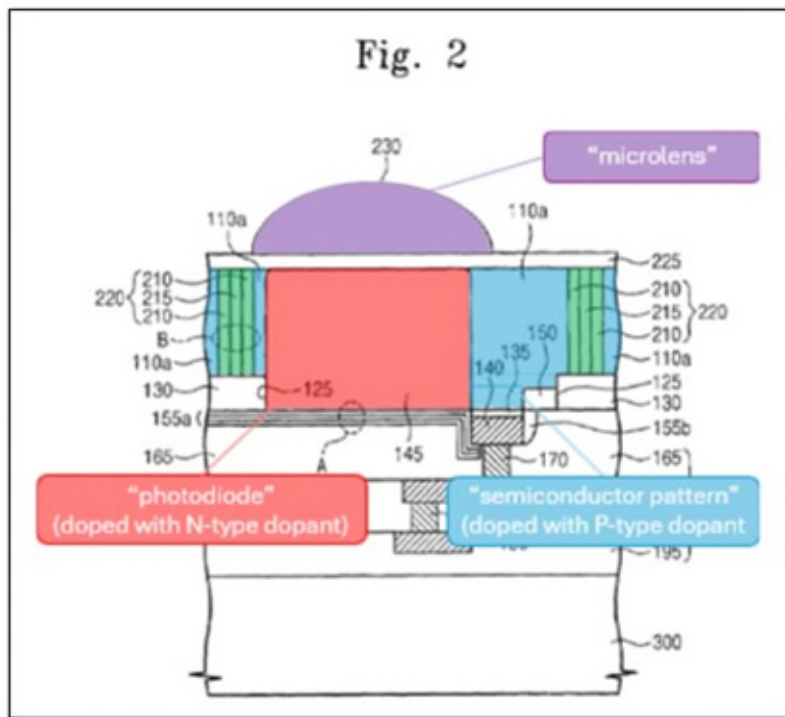
2. Hwang Does Not Disclose "a peripheral sidewall extending at least partially around the pixel periphery"

In addition to Petitioner's failure to establish that Hwang teaches or suggests a light sensitive pixel, Petitioner also equates a "sidewall multilayered reflection layer 220" in Hwang with the claimed "peripheral sidewall extending at least partially around the pixel periphery" (EX1001, 19:29-30) in the '599 Patent with little or no explanation. This "multilayered reflection layer 220" does not, however, optically and electrically isolate pixels, nor does Petitioner attempt to establish that it does so, a critical failure to establish obviousness of this element.

Hwang does not disclose a peripheral sidewall and therefore does not meet this claim element. In Hwang, the pixel semiconductor pattern is designed in a manner that avoids the need to extend around the peripheral sidewall of the pixel. The "multilayered reflection layer 220" shows a physical location that is adjacent to a portion of the "pixel semiconductor pattern 110a." EX1010, 6:7-23.

The claims of the '599 Patent expressly require that the “peripheral sidewall” extends “at least partially around the pixel periphery.” EX1001, 19:29-30. This allows not only for the reduction of optical crosstalk (by preventing light that enters one pixel from traveling into a neighboring pixel) and electrical crosstalk (by preventing electrons generated in the pixel from traveling into a neighboring pixel), but also allows for light to be trapped within the pixel to allow for the better detection of light that enters the pixel. See EX1001, 6:19-21. This improves pixel performance and image quality, particularly in the context of smaller image sensor pixels which have a smaller region for detecting light. See EX1001, 1:18-34.

At best, the Hwang architecture illustrates a “multilayered reflection layer 220” that is positioned near a “pixel semiconductor pattern 110a” that includes a light sensing portion and a large inactive portion, *e.g.*, inactive p-doped portions.



EX1010, Fig. 2 (annotated).

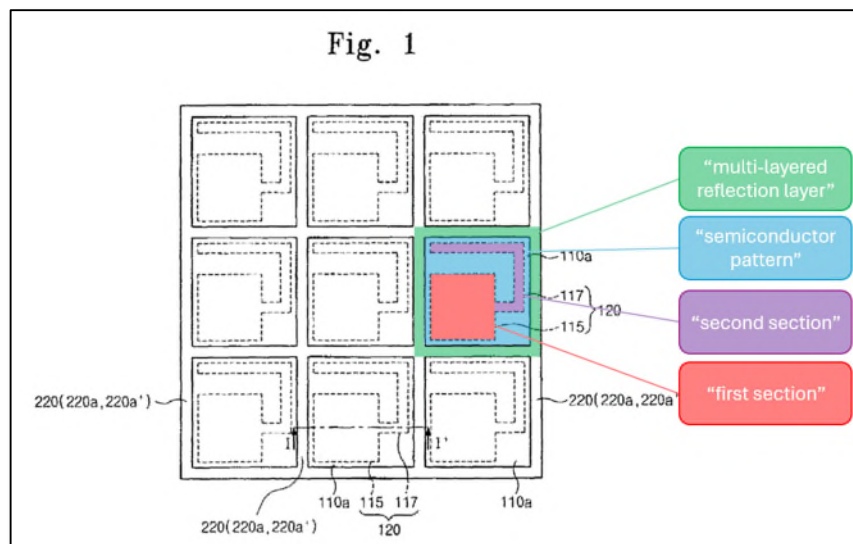
In Hwang, a light sensing portion of the “pixel semiconductor pattern 110a” is positioned proximal to an inactive p-doped portion of the next “pixel semiconductor 110a.” Thus, the “multilayered reflection layer 220” is not providing any meaningful optical isolation between pixels.

Petitioner provides no explanation as to how the “multilayered reflection layer 220” of Hwang is a “peripheral sidewall,” except that it appears to be positioned adjacent to the “pixel semiconductor pattern 110a.” This is not enough to establish that Hwang renders obvious this element of claim 19.

Further, the alleged peripheral sidewall in Hwang does not meet the claimed “peripheral sidewall” because it does not extend around the pixel periphery as

required by claim 19. Instead, the design of Hwang's pixel places the sidewall outside of the pixel as evidenced, for example, by the physical spacing between the active region of the pixel and the periphery of the "pixel semiconductor pattern 110a" described in Hwang and shown in Figure 2, above.

This is because the alleged pixel in Hwang provides significant physical separation between the active region and the boundary of the "pixel semiconductor pattern 110a." *See, e.g.*, EX1010, 6:19-23 ("That is, the sidewall multi-layered reflection layer 220 can be disposed along the boundaries of all of the semiconductor patterns 110a..."). This is illustrated, for example, by Figure 1, which shows that "first section 115" (housing "photodiode 145") is separated on all sides from multi-layered reflection layer by pixel semiconductor pattern 110a.



EX1010, Fig. 1 (annotated). In operation, light is detected by the active region (first section) of the semiconductor pattern (annotated above in red). The regions

outside of the first section are portions of the semiconductor pattern that are not detecting light.

Petitioner alleges that Hwang alone discloses or renders obvious the claimed “peripheral sidewall” (claim element 19[a]) and does not allege that Hwang in combination with any other reference renders obvious the claimed “peripheral sidewall” recited in claim 19. Petition, 51-54. Thus, the Petition fails to show how this claim element is met and Ground 5 must fail.

F. Ground 6: Hwang (EX1010) In Combination With Konno (EX1011) and Shinohara (EX1007)

Petitioner asserts that the combination of Hwang with Konno and Shinohara renders obvious claim 33. Claim 33 depends from claim 19, and therefore Ground 6 fails for at least the reasons set forth above with respect to Ground 5.

G. Ground 7: Hwang (EX1010) In Combination With Konno (EX1011) and Mori (EX1009)

Petitioner asserts that the combination of Hwang with Konno and Mori renders obvious claims 1-14, 16, 18, and 24-25. Claim 1 is an independent claim that includes, among other limitations, “a peripheral sidewall extending at least partially around the pixel periphery.” This is the same limitation as discussed above with respect to claim 19. Petitioner agrees that the limitations in claim 1 and in claim 19 are identical and Ground 7 relies again only on Hwang as meeting this specific element of claim 1, based on the same positions asserted for claim 19. *See*

Petition, 81. Thus, Ground 7 fails for at least the reasons that Ground 5 fails, discussed above. Hwang does not render obvious the claimed “peripheral sidewall extending at least partially around the pixel periphery.”

H. Ground 8: Hwang (EX1010) In Combination With Konno (EX1011), Mori (EX1009), and Shinohara (EX1007)

Petitioner asserts that the combination of Hwang with Konno, Mori, and Shinohara renders obvious claim 15. Claim 15 depends from claim 1, and therefore Ground 8 fails for at least the reasons set forth above with respect to Ground 7.

V. CONCLUSION

For the reasons set forth above, Petitioner has failed to demonstrate a reasonable likelihood that it would prevail with respect to any of the Challenged Claims. Thus, *inter partes* review of the '599 Patent should be denied.

Respectfully submitted,

Date: April 17, 2025

/Alison L. McCarthy/
Alison L. McCarthy (Lead Counsel)
Registration No. 51,998

Counsel for Patent Owner

CERTIFICATE OF COMPLIANCE WITH WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), I certify that this preliminary response complies with the type-volume limits of 37 C.F.R. § 42.24(b)(1) because it contains **4,043** words, according to the word-processing system used to prepare this preliminary response, excluding the parts of this preliminary response that are exempted by 37 C.F.R. § 42.24(c) (including the table of contents, a table of authorities, an exhibits list, a listing of facts, a certificate of service or this certificate of word count, or appendix of exhibits).

Date: April 17, 2025

/Alison L. McCarthy/
Alison L. McCarthy (Lead Counsel)
Registration No. 51,998

Counsel for Patent Owner

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), this is to certify that on this 17th day of April, 2025, I caused to be served a true and correct copy of the foregoing **PATENT OWNER'S PRELIMINARY RESPONSE (with EX2002)** by e-mail (as agreed in the Service Information section of the Petition):

David A. Garr (Lead Counsel)
Reg. No. 74,932
COVINGTON & BURLING LLP
One CityCenter
850 Tenth Street, NW
Washington, DC 20001-4956
Tel: (202) 662-5250
Fax: (202) 778-5250
Service email: dgarr@cov.com
Samsung-SiOnyx-IPR-Cov@cov.com

Counsel for Petitioner

Scott C. Weidenfeller (Back-up Counsel)
Reg. No. 54,531
COVINGTON & BURLING LLP
One CityCenter
850 Tenth Street, NW
Washington, DC 20001
Tel: (202) 662-5923
Fax: (202) 778-5923
Service email: sweidenfeller@cov.com

Counsel for Petitioner

Alice J. Ahn (Back-up Counsel)
Reg. No. 79,829
COVINGTON & BURLING LLP
Salesforce Tower
415 Mission Street, Ste. 5400
San Francisco, CA 94105-2533
Tel: (415) 591-7091
Fax: (415) 955-6591
Service email: aahn@cov.com

Counsel for Petitioner

/Alison L. McCarthy/
Alison L. McCarthy (Lead Counsel)
Registration No. 51,998

Counsel for Patent Owner