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Paper No. _____

Date: January 22, 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 IPR2024-01431
Patent 11,069,737 B2

PATENT OWNER'S PRELIMINARY RESPONSE

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

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LIST OF PATENT OWNER'S EXHIBITS

PO Exhibit Number ("EX")	Description
	Filed and served October 24, 2024 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 January 22, 2025 with Patent Owner's Preliminary Response
2002	Disclaimer in a Patent under 37 C.F.R. § 1.321(a), dated January 22, 2025
2003	Electronic Acknowledgement Receipt for Disclaimer dated January 22, 2025

CLAIM LISTING FOR U.S. PATENT NO. 11,069,737

1. [1Preamble] A photosensitive imager device capable of detecting visible and infrared electromagnetic radiation comprising:
 - [1a] a semiconductor layer having a light incident side and an opposed side, said semiconductor layer having multiple doped regions forming at least one junction,
 - [1b] a textured region comprising a plurality of surface features configured to interact with incident electromagnetic radiation so as to increase the quantum efficiency of the device, wherein the surface features are arranged according to a pattern,
 - [1c] a support substrate coupled to said semiconductor layer, and
 - [1d] a first bonding layer disposed between the semiconductor layer and the support substrate.
2. The device of claim 1, wherein the textured region is located on the light incident side of the semiconductor layer.
3. The device of claim 2, further comprising a device layer coupled to the semiconductor layer on said side opposed to the light incident side.
4. The device of claim 2, wherein the textured region is formed by etching.

5. The device of claim 4, wherein said surface features comprise pyramids.
6. The device of claim 2, further comprising a reflector layer disposed between the textured layer and the support substrate.
7. The device of claim 1, further comprising deep trench isolation for isolating the device.
8. The device of claim 7, wherein said deep trench isolation provides light trapping functionality.
9. The device of claim 1, wherein the semiconductor layer is single crystal silicon.
10. The device of claim 1, wherein the semiconductor layer comprises silicon and germanium.
11. The device of claim 1, wherein the surface features are formed in the semiconductor layer.
12. The device of claim 1, wherein the surface features have a substantially uniform height.
13. The device of claim 1, wherein the surface features are not uniform in height.
14. The device of claim 1, wherein said first bonding layer comprises any of silicon oxide, silicon nitride and amorphous silicon.

15. The device of claim 1, wherein said semiconductor layer has a thickness in a range of about 1 micron to about 10 microns.
16. The device of claim 15, wherein the device exhibits a quantum efficiency of at least about 35% for electromagnetic radiation at a wavelength of about 940 nm.
17. The device of claim 1, wherein said bonding layer has a thickness in a range of about 30 nm to about 3 microns.
18. The device of claim 1, wherein said plurality of surface features have a height in a range of about 50 nm to about 2 microns.
19. The device of claim 1, wherein said plurality of surface features have a height in a range from about 0.35 microns to about 0.7 microns.
20. The device of claim 1, wherein said plurality of surface features are formed by using a patterned mask and photolithography followed by etching.
21. The device of claim 1, wherein said plurality of surface features comprise multiple etched levels.

22. The device of claim 1, wherein said textured region increases optical absorption of the semiconductor layer over an electromagnetic spectrum range of at least about 700 nm to about 1100 nm.

23. The device of claim 1, further comprising a second bonding layer positioned between the first bonding layer and the support substrate.

24. The device of claim 1, wherein the pattern is an at least substantially uniform grid.

25. The device of claim 1, wherein the pattern is a non-uniform arrangement.

26. **[26Preamble]** A method of making a photosensitive image device, comprising:

[26a] providing a semiconductor layer having a light incident side and an opposed side, said semiconductor layer having multiple doped regions forming at least one junction;

[26b] providing a support substrate;

[26c] bonding the semiconductor layer to the support substrate;

[26d] creating a plurality of surface features on one of the semiconductor layer and the support substrate, wherein the surface features are formed via etching;

[26e] depositing an oxide material within at least a portion of the semiconductor layer or support substrate removed during etching; and

[26f] processing the region of the semiconductor layer or support substrate comprising the surface features with CMP after depositing the oxide material.

27. [27Preamble] The method of claim 26, wherein bonding the semiconductor layer to the support substrate comprises:

[27a] depositing a first bonding layer onto the semiconductor layer; and

[27b] bonding the first bonding layer to a second bonding layer disposed on the support substrate.

28. The method of claim 26, wherein the plurality of surface features are formed on the light incident side of the semiconductor layer.

29. The method of claim 26, wherein depositing the oxide material comprises at least partially filling one of trenches, holes, pits, and cones formed in the semiconductor layer during etching.

30. The method of claim 26, wherein the surface features are formed by shallow trench isolation etching.

31. The method of claim 26, wherein the surface features are formed in the semiconductor layer.

32. **[32Preamble]** A photosensitive imager device capable of detecting visible and infrared electromagnetic radiation, comprising:

[32a] a semiconductor layer having a light incident side and an opposed side, said semiconductor layer having multiple doped regions forming at least one junction.

[32b] a textured region comprising a plurality of surface features configured to interact with incident electromagnetic radiation so as to increase the quantum efficiency of the device,

[32c] a support substrate coupled to said semiconductor layer, and

[32d] a first bonding layer disposed between the semiconductor layer and the support substrate,

[32e] wherein the device exhibits a quantum efficiency of at least about 35% for electromagnetic radiation at a wavelength of about 940.

33. The device of claim 32, wherein the textured region is located on the light incident side of the semiconductor layer.

34. The device of claim 33, further comprising a device layer coupled to the semiconductor layer on said side opposed to the light incident side.

35. The device of claim 33, wherein the textured region is formed by etching.

36. The device of claim 35, wherein said surface features comprise pyramids.

37. The device of claim 33, further comprising a reflector layer disposed between the textured layer and the support substrate.

38. The device of claim 32, further comprising deep trench isolation for isolating the device.

39. The device of claim 38, wherein said deep trench isolation provides light trapping functionality.

40. The device of claim 32, wherein the semiconductor layer is single crystal silicon.

41. The device of claim 32, wherein the semiconductor layer comprises silicon and germanium.

42. The device of claim 32, wherein the surface features are formed in the semiconductor layer.

43. The device of claim 32, wherein the surface features have a substantially uniform height.

44. The device of claim 32, wherein the surface features are not uniform in height.
45. The device of claim 32, wherein said first bonding layer comprises any of silicon oxide, silicon nitride and amorphous silicon.
46. The device of claim 32, wherein said semiconductor layer has a thickness in a range of about 1 micron to about 10 microns.
47. The device of claim 32, wherein said bonding layer has a thickness in a range of about 30 nm to about 3 microns.
48. The device of claim 32, wherein said plurality of surface features have a height in a range of about 50 nm to about 2 microns.
49. The device of claim 32, wherein said plurality of surface features have a height in a range from about 0.35 microns to about 0.7 microns.
50. The device of claim 32, wherein said plurality of surface features are formed by using a patterned mask and photolithography followed by etching.
51. The device of claim 32, wherein said plurality of surface features comprise multiple etched levels.

52. The device of claim 32, wherein said textured region increases optical absorption of the semiconductor layer over an electromagnetic spectrum range of at least about 700 nm to about 1100 nm.

53. The device of claim 32, further comprising a second bonding layer positioned between the first bonding layer and the support substrate.

54. The device of claim 32, wherein the surface features are arranged according to a pattern that is an at least substantially uniform grid.

55. The device of claim 32, wherein the surface features are arranged according to a pattern that is a non-uniform arrangement.

EX1001 ('737 Patent), 12:66-16:22.

I. INTRODUCTION

Pursuant to 37 C.F.R. § 42.107(a) and 35 U.S.C. § 313, SiOnyx, LLC (“Patent Owner” or “PO”) submits this Preliminary Response to the Petition for *Inter Partes* Review of claims 1-29 and 31-55 of U.S. Patent No. 11,069,737 (“Petition”) (EX1001) (“the ’737 Patent”) filed by Samsung Electronics Co., Ltd. (“Petitioner”) on September 24, 2024, with a filing date accorded of September 24, 2024 (Paper 6). 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 (defined below) is unpatentable. 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.

The Petition challenges claims 1-29 and 31-55 of the ’737 Patent. Without waiver of any defenses or admission as to any theory of invalidity presented by Petitioner, and solely to narrow the issues presented by the Petition, Patent Owner has disclaimed claims 1, 7-27, 29-32, and 38-55 of the ’737 Patent. *See* EX2002; EX2003. In view of this disclaimer, the U.S. Patent and Trademark Office Patent Trial and Appeal Board (“Board” or “PTAB”) and this Preliminary Response need only address claims 2-6, 28, 33, and 34-37 of the ’737 Patent (the “Challenged

Claims”). *See* 37 C.F.R. § 42.107(e) (“[n]o *inter partes* review will be instituted based on disclaimed claims.”).

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 Haddad138¹ (EX1012) (Ground A-1) or Haddad138 with Jiang (EX1011) (Ground A-3). Despite casting its argument as anticipation, Petitioner has not set forth a case of anticipation of any of the Challenged Claims. Rather, Petitioner relies solely on a modification of the Haddad138 reference for Grounds A-1 and A-3. This removes anticipation as a viable invalidity theory for Ground A-1. Further, even if the Petition were construed to present an obviousness assertion (*see* Ground A-3), Petitioner fails to offer any showing that a person of ordinary skill in the art (“POSITA”) would have made the proposed modification with a reasonable expectation of success, a required showing for obviousness. The Petition has thus failed to provide legally sufficient grounds on which the PTAB may institute this IPR proceeding on Grounds A-1 and A-3.

¹ To the extent not defined herein, defined terms used herein have the same meaning as ascribed to them in the Petition.

As for Ground B-1, Petitioner has failed to meet its burden to show a reasonable likelihood that claim 28 is unpatentable over Yap (EX1011). Yap's disclosure of a pyramidal-shaped semiconductor layer does not disclose or render obvious a "plurality of surface features" as required by claim 28 of the '737 Patent. In both form and function, Yap's device is fundamentally distinct from the Challenged Claims.

III. INSTITUTION SHOULD BE DENIED FOR FAILING TO SHOW THAT THERE IS A REASONABLE LIKELIHOOD THAT THE CHALLENGED CLAIMS ARE UNPATENTABLE

Petitioner proffers three Grounds for attacking the Challenged Claims:

Ground	[Petition] Challenged Claims	[Remaining (Not Disclaimed)] Challenged Claims	Basis for Rejection
A-1	1-11, 13-16, 18-19, 22, 25, 32-42, 44-46, 48-49, 52, and 55	2-6, 33, 34-37	§102 and/or §103: Haddad138 (EX1012)
A-3	16, 32-42, and 44-46, 48-49, 52, and 55	33, 34-37	§103: Haddad138 (EX1012), Jiang (EX1008)
B-1	26, 28-29, and 31	28	§102 and/or §103: Yap (EX1011)

See Petition, 5-7; *see also* EX2002, 1; EX2003.

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. Specifically, Petitioner has not shown that a POSITA would

have modified Haddad138 to have a textured region on the light incident side of the semiconductor layer with a reasonable expectation of success, an element in all claims challenged under Grounds A-1 and A-3. Furthermore, Petitioner has failed to meet its burden to show Yap's pyramid shapes anticipate or render obvious a "plurality of surface features," an element of the challenged Claim under Ground B-1.

A. Ground A-1: Petitioner's Anticipation Assertion Fails And It Offers No Showing That A POSITA Would Have Modified Haddad138

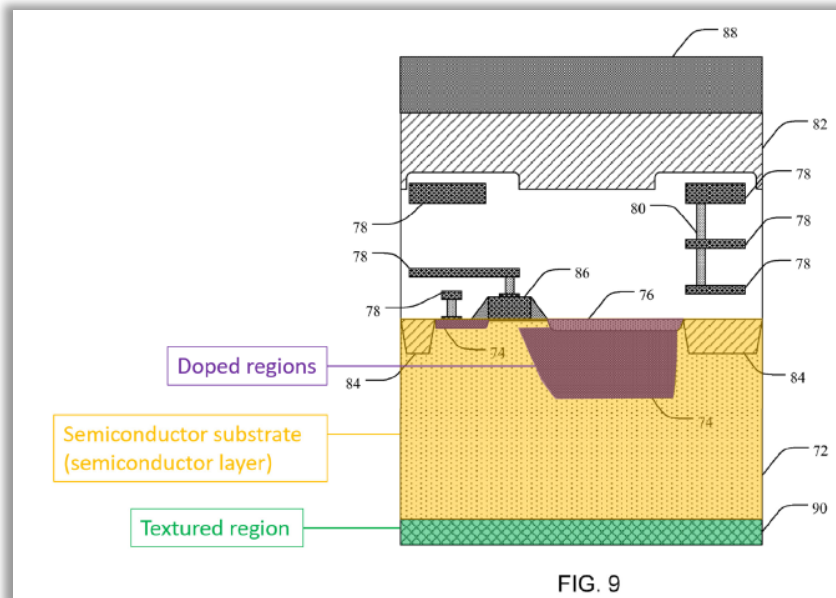
Petitioner argues that Haddad138 anticipates claim 2, stating "Haddad138 discloses this limitation." Petition, 28. However, Petitioner's argument is inconsistent with an anticipation position. Petitioner relies solely on an embodiment of Haddad138 configured without texture on the light incident side of the semiconductor layer and insists claim 2 is invalid because (in a different configuration), Figure 2 would anticipate the claim.

Petitioner's argument fails for two reasons. First, interpreted as an anticipation position, Petitioner's argument fails because the relied-upon embodiment does not meet the challenged limitation. Second, interpreted as an obviousness position (which Petitioner did not assert), Petitioner's argument fails because Petitioner did not provide any motivation to modify Haddad138 with a reasonable expectation of success.

Further, Petitioner's arguments concerning claim 33 merely refers to Petitioner's claim 2 (and disclaimed claim 32) argument; consequently, the failure of the claim 2 argument is dispositive of both claims. The remainder of the Challenged Claims – aside from claim 28 (which is not asserted in Grounds A-1) – depend from one of claims 2 or 33. With the Haddad138's disclosure contradicting Petitioner's anticipation argument, and with Petitioner's obviousness argument lacking the requisite motivation and reasonable expectation of success showing, Ground A-1 fails.

1. Petitioner's anticipation argument is unsupported and contrary to the specification

Petitioner's only asserted theory against claim 2 of the '737 Patent is anticipation by Haddad138, but the embodiment of Haddad138 relied upon by Petitioner does not disclose a device with texture on the light incident side of the semiconductor layer, as required by claim 2. In fact, the opposite is true. Petitioner relies on the embodiment of Haddad138 illustrated in Figure 9, reproduced below:



Petition, 29 (annotated by Petitioner). Claim 2 limits the location of “the textured region” (90, highlighted in green) to “the light incident side of the semiconductor layer” (72, yellow). EX1001 (’737 Patent), Cl. 2. In order for this embodiment of Haddad138 to meet that limitation, light would need to be incident on the device from the bottom side of Figure 9.

Figure 9 of Haddad138 illustrates the device of Figure 7 of Haddad138 after the performance of additional manufacturing steps. EX1012 (Haddad138), [0084] (“FIGS. 7-11 show various steps in the manufacture of a photosensitive pixel.”) Figures 7 and 9 illustrate a “front side illumination (FSI) photosensitive pixel device,” meaning that “light enters the semiconductor substrate from the direction of the multiple doped regions,” e.g., from the top of Figure 9. *Id.*, [0084], [0087], [0049]. Thus, the relied-upon embodiment of Haddad138 does not anticipate claim

2, because it is configured as an FSI (front side illuminated) device with texture on the opposite side of the semiconductor layer.

While still asserting anticipation, Petitioner acknowledges that Figure 9 must be modified in order to meet claim 2. Petitioner describes a back side illuminated (BSI) configuration, and states “[i]n this [BSI] configuration, the bottom surface of the semiconductor substrate 72 (where the textured region 90 is located) corresponds to the claimed light incident side of the semiconductor layer.”

Petition, 30. This admission dooms Petitioner's anticipation argument. Where modification is required to meet the elements of a claim, the argument “invoke[s] the question of obviousness, not anticipation.” *Net MoneyIN, Inc. v. Verisign, Inc.*, 545 F.3d 1359, 1371 (Fed. Cir. 2008); *see also Enplas Display Device Corp. v. Seoul Semiconductor Co.*, 909 F.3d 398, 405 (Fed. Cir. 2018) (“Prior art that must be modified to meet the disputed claim limitation does not anticipate the claim.”). Here, the relied-upon Figure 9 meets claim 2 only if it is modified from the disclosed FSI configuration to a BSI configuration. Petitioner's anticipation argument fails.

2. Petitioner offers no motivation to modify Haddad138

While Petitioner attempts to cast its position against claim 2 as anticipation, as discussed above, Petitioner's argument requires modification of Haddad138. As a result, the only invalidity theory that could be discerned from the Petition might

be one of obviousness. However, even if considered an obviousness assertion, Ground A-1 still fails because Petitioner offers no showing on motivation to combine.

“[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). Here, Petitioner does not offer any showing on any motivation to modify Figure 9 of Haddad138 to change the configuration from a FSI to BSI architecture. Rather, Petitioner presents Haddad138's disclosure of other back side illuminated devices as evidence that the embodiment in Figure 9 (which is disclosed as FSI), at best *could be modified* to be back side illuminated.

By way of analogy, when a reference has separate, distinct disclosures concerning electric cars and gasoline cars, that does not render obvious modifying an electric car embodiment to have elements of the disclosure relating to gas cars. To support such a modification, a Petitioner would need to show that a POSITA would have been motivated to make that modification.

Haddad138 has a disclosure of BSI devices and a separate disclosure of the Figure 9 FSI device. These two disclosures do not allow Petitioner to modify Figure 9 into a BSI device without showing why a POSITA would have made such

a modification. *In re Stepan Co.*, 868 F.3d 1342, 1346 n.1 (Fed. Cir. 2017) (finding a motivation required even when “combining multiple embodiments from a single reference.”)

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). Petitioner offers no showing whatsoever on motivation. Even if Petitioner's arguments are accepted as true, the Petition is deficient because it presents nothing on “showing of a suggestion or motivation to modify” the Haddad¹³⁸ reference. *Id.* Because Petitioner's arguments are legally insufficient to show obviousness, Ground A-1 fails.

3. Petitioner fails to allege a reasonable expectation of success

Setting aside Petitioner's failure to make a showing on motivation, Petitioner's arguments also fail because Petitioner did not allege a reasonable expectation of success. The Federal Circuit has held that obviousness only succeeds if a POSITA “can make the combination with a reasonable expectation of success.” *Gen. Elec. Co. v. Raytheon Techs. Corp.*, 983 F.3d 1334, 1352 (Fed. Cir. 2020). Here, Petitioner offers no showing that a POSITA would be able to modify the embodiment of Figure 9 to be back side illuminated with a reasonable expectation of success. *In re Stepan Co.*, 868 F.3d at 1346 n.1 (“combining

multiple embodiments from a single reference” requires “a reasonable expectation that such a combination would be successful.”) Nor does the disclosure of Haddad138 or the expert declaration of Dr. Lebby (EX1004) address reasonable expectation of success. Ground A-1 fails for this additional reason.

B. Ground A-3: A POSITA Would Not Have Been Motivated To Combine Haddad138 With Jiang To Arrive At The Challenged Claims

All of the Challenged Claims within the scope of Ground A-3 (claims 33, 34-37) ultimately depend from claim 32 (which mirrors claim 2 but is dependent on claim 32), and Ground A-3 relies on the same modification to Figure 9 discussed above. *See* Petition, 54 (relying on discussion of claim 2). As a result, Ground A-3 fails for the same reasons as Ground A-1.

In addition, with regard to claim 33, Petitioner's analysis does not address that claim.

C. Ground B-1: Petitioner Fails To Show That Yap Discloses A “Plurality Of Surface Features”

1. Yap's Pyramid Shapes Are Not A “Plurality Of Surface Features”

Petitioner relies on Yap's “pyramid shapes” as disclosing a “plurality of surface features,” but in both form and function, Yap's “pyramid shapes” are distinct from the claimed surface features. The '737 Patent discloses texture, or surface features, which are nano or micron scale variations in the surface of the

semiconductor layer. EX1001 ('737 Patent), 4:4-28. The texture or surface features function to increase quantum efficiency by increasing the effective optical path length of absorbed light. *Id.*, 5:34-37; 6:48-50.

Yap, on the other hand, discloses a semiconductor layer that is formed into a series of pyramidal shapes. *See, e.g.*, EX1011 (Yap), 8:25-27. The pyramidal-shaped semiconductor layer increases absorption by decreasing reflection, a fundamentally different function than that of the surface features. *See, e.g., id.*, 7:18-19 (“The set of pyramids act to reduce the reflection of the incident light.”) Additionally, Yap’s pyramidal shapes are significantly larger than the ’737 Patent’s surface features; Yap’s height “is large compared to the overall thickness of the light absorbing material, with the pyramid height being about one half of the overall thickness” of the semiconductor layer. *Id.*, 2:53-57. Because Yap’s pyramids are significantly larger than the claimed surface features, and because Yap’s pyramids reduce reflection, rather than increase effective optical path length by inducing multiple passes of incident light, Yap’s use of pyramids does not disclose the claimed surface features.

Petitioner’s reliance on Yap’s pyramids fails because Yap’s pyramids are distinct from the claimed surface features in both form and function. For at least that reason, Petitioner’s Ground B-1 should be rejected.

IV. 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 '737 Patent should be denied.

Respectfully submitted,

Date: January 22, 2025

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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 2,257 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: January 22, 2025

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Counsel for Patent Owner

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6(e), this is to certify that on this 22nd day of January, 2025, I caused to be served a true and correct copy of the foregoing **PATENT OWNER'S PRELIMINARY RESPONSE (with EX2002-2003)** by e-mail (as agreed in the Service Information section of the Petition):

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