

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG ELECTRONICS CO., LTD., SAMSUNG ELECTRONICS
AMERICA, INC., SAMSUNG SEMICONDUCTOR, INC., and SAMSUNG
AUSTIN SEMICONDUCTOR LLC,

Petitioner,

v.

W&WSENS DEVICES INC.,

Patent Owner.

Case PGR2025-00082
Patent No. 12,243,948

PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE

TABLE OF CONTENTS

	Page
I. Introduction.....	1
II. W&W Mischaracterizes How <i>Kuboi</i> ’s Holes Increase Light Absorption	1
III. The ’871 Reexamination Denial Does Not Undermine the Petition.....	4
IV. Grounds 1-4: <i>Kuboi</i> Renders Obvious Claim 1	8
A. <i>Kuboi</i> Discloses an “Array of Pillars”	8
1. The Claimed “Pillar” Is Not Limited to Only Figure 49 of the ’948 Patent	8
2. Claim 1 Is Not Limited to a Particular Fabrication	10
3. <i>Kuboi</i> ’s Pixels Include “Light-Receiving Surfaces” and “Sides”	11
4. W&W’s Arguments Apply the EPR Examiner’s Mapping—Not the Petition’s Analysis	15
B. <i>Kuboi</i> Discloses Pillars Configured to Include Photodetectors and Pillars Configured to Generate Charge Carriers.....	16
1. Claim 1 Does Not Require that the Semiconductor Layers of the Pillars Generate Charge Carriers—Only that the Pillars Generate Charge Carriers.....	17
2. W&W’s Arguments Regarding Light-Shielding Film 19 Are Not Supported by the Record.....	19
C. <i>Kuboi</i> Discloses Holes Fabricated as Recesses at or Under the Light-Receiving Surface	21
D. <i>Kuboi</i> Discloses the Increased Absorption Limitation.....	22
1. The Holes—Not Merely the Organic Material—Drive the Absorption Increase	22

2.	W&W’s “Like Photodetector” Argument Is Contrary to <i>Kuboi</i> ’s Own Disclosure	24
3.	Dr. Lebby’s Analysis Is Not Hindsight	25
4.	<i>Han</i> Corroborates that <i>Kuboi</i> ’s Holes Increase Absorption.....	26
E.	<i>Kuboi</i> Discloses Holes Filled at Least Partly with Solid Dielectric Material.....	26
1.	<i>Kuboi</i> ’s Electron Blocking Film 21 Satisfies the “Filled at Least Partly with Solid Dielectric Material” Limitation.....	27
2.	<i>Alternatively</i> , <i>Kuboi</i> ’s Organic Films 13 Are Solid Dielectric Materials.....	29
V.	Ground 5: Claims 1-16 Lack Enablement Under §112	31
VI.	Conclusion	32

I. Introduction

W&W's Patent Owner's Response (POR) rests on a theme, not a claim analysis. W&W asserts that *Kuboi* takes "an altogether different approach to photodetection" than the '948 patent. POR, 1. W&W is wrong. But more importantly, unpatentability is not measured against the patentee's design philosophy—it is measured against the claims. Indeed, "the name of the game is the claim." *In re Hiniker Co.*, 150 F.3d 1362, 1369 (Fed. Cir. 1998). *Kuboi* need not share the '948 patent's "approach." It need only disclose what the claims recite—and it does so for each of the reasons described in the Petition.

II. W&W Mischaracterizes How *Kuboi*'s Holes Increase Light Absorption

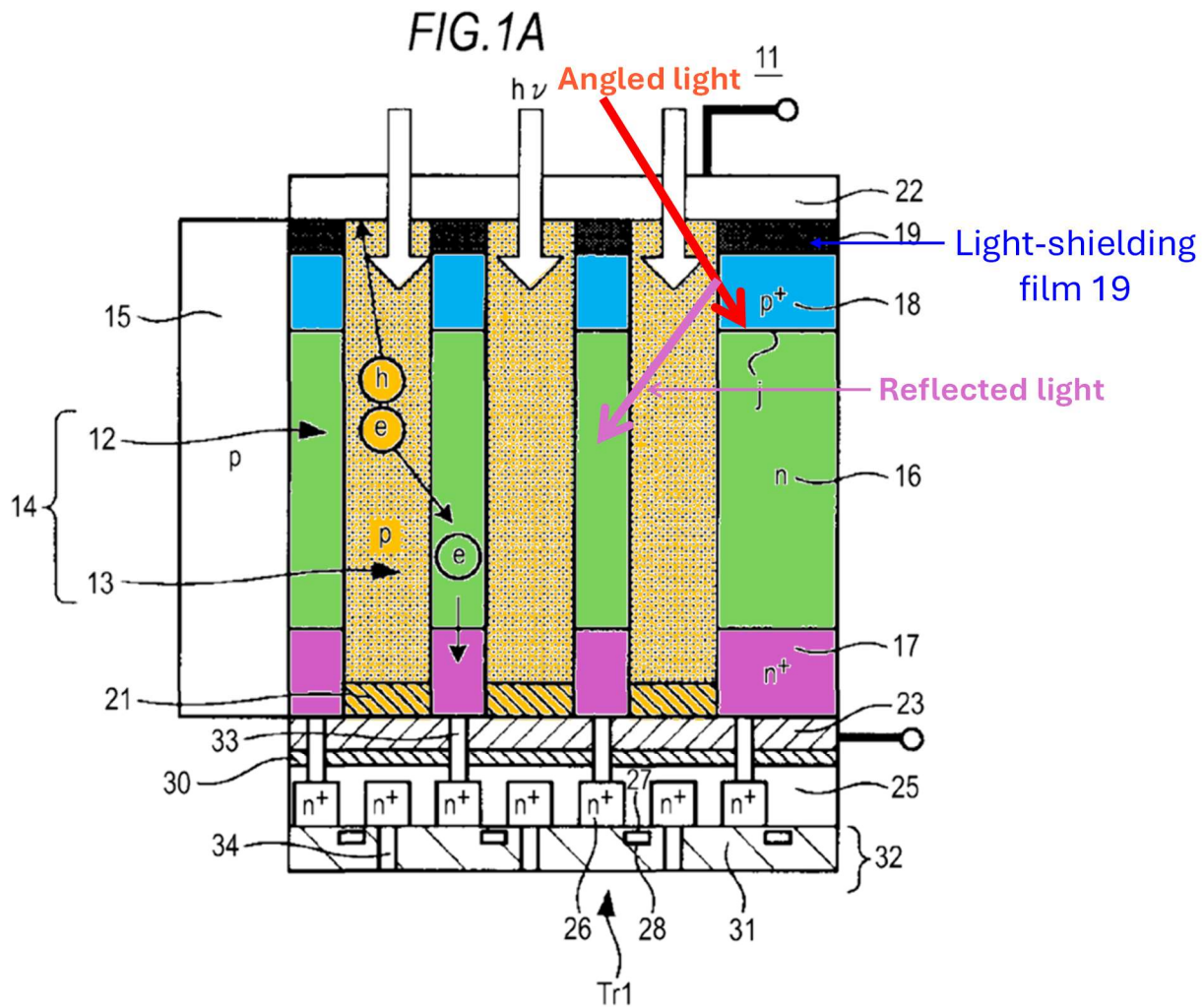
W&W contends that *Kuboi* takes a "different approach to photodetection," contending that light in *Kuboi* is absorbed only by the organic material within the holes, while the surrounding silicon "only transports charge carriers." POR, 1-2; *see also id.*, 8-10, 21-22, 27-34. But this is incorrect.

First, W&W's own description of *Kuboi* confirms that *Kuboi*'s holes serve to increase the absorption of light entering the holes. Light enters each hole and is absorbed by the organic film that fills the hole and abuts its interior surfaces. *Id.*, 29 (*Kuboi*'s pixel includes "holes filled with organic films 13 that absorb incident light"); Ex-2048 ("Lebby-Tr."), 131:19-132:14. *Kuboi* specifically discloses that embedding this absorbing material in holes etched into the semiconductor

“improve[s] the absorption rate of light,” increasing “light absorption efficiency in the photoelectric conversion portion of the pixel.” *Kuboi*, ¶¶[80], [16]-[17].

Kuboi’s holes increase light absorption—the very function W&W attributes to the claimed holes.

Second, W&W’s assertion that *Kuboi*’s surrounding semiconductor absorbs no light and “only transports charge carriers” (POR, 1) is incorrect. When asked by W&W’s counsel how *Kuboi*’s semiconductor would respond to illumination given light-shielding film 19, Dr. Lebby explained that “if light enters the hole at an angle, some of the direct incident light can get into the semiconductor P plus 18,” that “[o]ther light can naturally get into the semiconductor region using reflection or refraction or scattering,” and that the semiconductor accordingly “is going to receive light and be able to generate electrical charge carriers.” Lebby-Tr., 133:10-134:11; *see also id.*, 99:22-101:1 (“light can still get into P region 18 indirectly ... via the holes”), 102:17-104:16. The annotated figure below illustrates direct **angled light** and **reflected light** entering through the holes and reaching the silicon semiconductor:



Kuboi, Fig. 1A (annotated).

Light entering holes is therefore absorbed both by the organic material abutting the holes' interior surfaces and by the semiconductor material abutting the holes' exterior surfaces.¹ W&W's "altogether different approach" theme rests on a mischaracterization of *Kuboi* and is incorrect.

¹ In the parallel district court proceeding, the court recently (July 14, 2026) construed "hole" to be "a void whose primary purpose is to increase the absorption

III. The '871 Reexamination Denial Does Not Undermine the Petition

W&W's arguments are premised on findings regarding *Kuboi* made by an examiner in the denial of an EPR request for the related '871 patent.² POR, 1-2, 15-20; Ex-2040. That reliance is misplaced.

The EPR involved a different patent, different claim language, and different legal question (i.e., substantial new question of patentability). And more

of light entering the void by the light absorbing material abutting the void.”

Ex-1072, 6-11. For each of the reasons described above, *Kuboi*'s hole also meets the district court's construction.

² W&W contends that Petitioner “failed to notify the Board of its filing of ex parte reexamination of the related W&Wsens patents” and related SNQ determinations. POR, 15-16 n.1. W&W argues this violates a PTAB “General Order” (Ex-2044). *Id.* But that Order only expressly applies to the listed proceedings—not this PGR. Ex-2044, 2-6. Moreover, that Order and the Scheduling Order here require “keep[ing] the Board apprised of developments regarding adjudication of validity or patentability of ... substantially similar patent claims.” *Id.*, 1; Paper 18, 2-3. An SNQ determination, however, is not an “adjudication of validity or patentability.” And W&W fails to show that the challenged claims here—and not just individual limitations—are “substantially similar” to those in the cited reexaminations.

importantly, the examiner's findings were not based on either Requestor's actual mapping of the claims to *Kuboi* or the similar analysis in the present Petition. Instead, the examiner *sua sponte* analyzed *Kuboi* in a manner that is materially different from the EPR Request (and the Petition here). The reexamination denial is irrelevant here.

The differences in analyses are material. The '871 EPR Request, like the instant Petition, identified (1) *Kuboi*'s pixels as the claimed "pillars ... configured to include photodetectors and have respective light-receiving surfaces," (2) the bottom surface of the transparent electrode formed atop each pixel as the claimed pillars' "light-receiving surfaces," and (3) the holes within each pixel as the claimed "holes that are fabricated ... at or under the light-receiving surface ... of the pillars." These are each illustrated below:

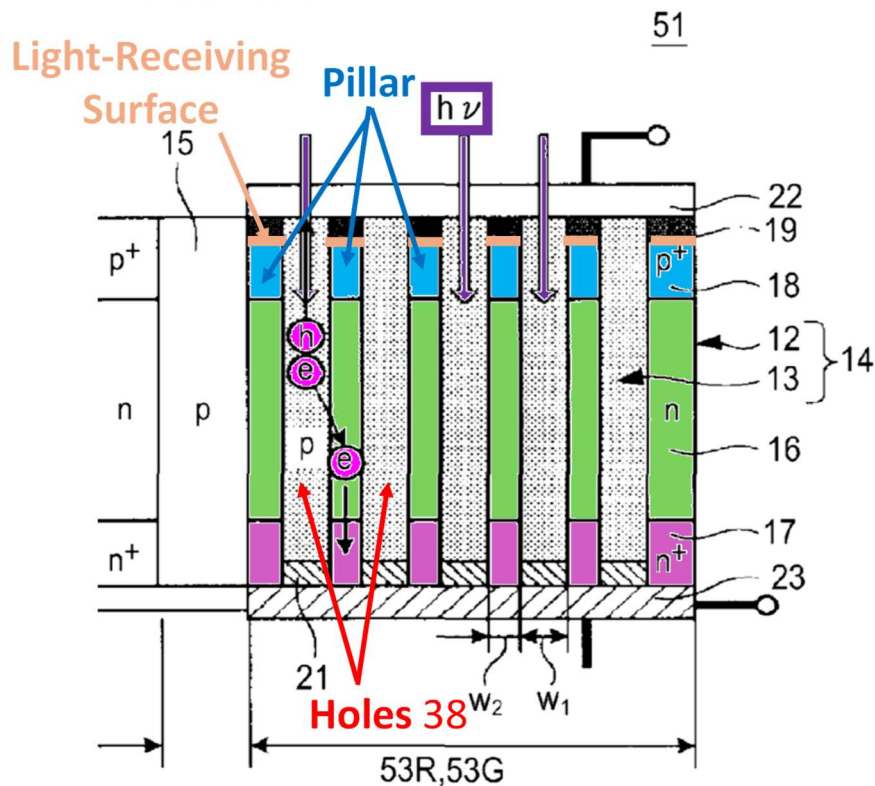
FIG. 6A



6

EPR examiner's Mapping

FIG. 6A



Kuboi, Fig. 6A (excerpted, annotated). But this is not how either the Request or the present Petition analyze *Kuboi*. Indeed, Requestor sought Director review of the denial, confirming that it does not agree with the examiner's analysis.

W&W's assertion that the Office already considered and rejected Petitioner's theory of unpatentability is therefore incorrect. *See* POR, 19-20. The Office considered and rejected only the examiner's incorrect mapping of claims from a different patent to *Kuboi* and not Petitioner's mapping of the '948 patent's claims to *Kuboi*. The '871 EPR denial is thus irrelevant to the Board's analysis.

IV. Grounds 1-4: *Kuboi* Renders Obvious Claim 1

A. *Kuboi* Discloses an “Array of Pillars”

W&W contends that *Kuboi* does not disclose the claimed “array of pillars,” including pillars that incorporate photodetectors having respective “light-receiving surfaces” and “sides.” POR, 27-30. But W&W is incorrect.

The Petition maps the claimed “array of pillars” to *Kuboi*’s pixels. Pet., 15-17. In response, W&W compares a single ’948 patent figure (Figure 49) to *Kuboi*’s pixels in an attempt to narrow the scope of claim 1 to a particular embodiment in the specification. POR, 27-30. This is legally incorrect and inconsistent with other language in claim 1. W&W also contends that *Kuboi*’s pixels do not qualify as “pillars” having respective “light-receiving surfaces” and “sides,” yet this ignores the Petition’s analysis of *Kuboi*. The Board should reject W&W’s arguments.

1. The Claimed “Pillar” Is Not Limited to Only Figure 49 of the ’948 Patent

W&W does not expressly construe “pillar,” instead contending that Figure 49 of the ’948 patent (shown below) illustrates pillars that are “structural features with light receiving surfaces and sides.” POR, 27-28.

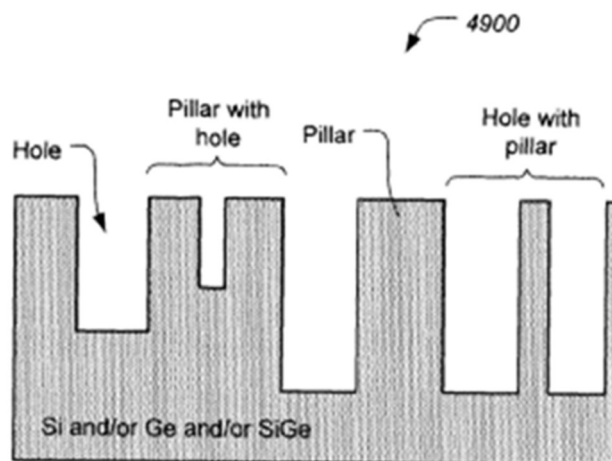


FIG. 49

'948 patent, Fig. 49. But even if Figure 49 illustrates an exemplary pillar, it is well settled that claims cannot be limited to a particular embodiment in the specification. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1323 (Fed. Cir. 2005) (en banc). Claim 1 is not limited to the pillar disclosed in Figure 49, as W&W contends.³

In addition, claim 1 requires “side-isolation comprising solid material between *at least portions of the sides of at least some of the pillars.*” '948 patent, 55:56-57 (emphases added). Claim 1 thus covers arrangements where the solid

³ Even if W&W maintains that it is not narrowing claim 1, the argument improperly attempts to distinguish prior art by comparison to a single embodiment in the specification rather than to the claim. *See Hiniker*, 150 F.3d at 1368-69 (arguments “not commensurate with the claim scope” are unpersuasive).

side-isolation material extends along the entire sides of all the pillars. But this is not what is depicted in Figure 49 because the illustrated pillars do not have side-isolation comprising solid material between at least portions of the sides of at least some of the pillars.⁴ W&W’s effort to distinguish *Kuboi* by limiting the claim to Figure 49 is thus legally improper and inconsistent with claim 1.

2. Claim 1 Is Not Limited to a Particular Fabrication

W&W asserts that “Kuboi’s photodetectors are formed in a bulk silicon substrate that lacks any ‘pillars.’” POR, 29. But claim 1—like the ’948 patent—is not limited to a particular fabrication method. *See* ’948 patent, 55:25-35 (disclosing that “there are many alternative ways of implementing both the processes and apparatuses described herein”).

Instead, claim 1 recites a structure defined by its final, operative configuration—not by its manufacturing process. Nothing in claim 1 requires that a “pillar” protrude from a substrate before surrounding side-isolation material is added or be formed using any particular fabrication technique. Nor does the claim distinguish between structures formed within a bulk substrate and structures

⁴ It is, however, disclosed by *Kuboi*. *Kuboi*’s pixels are separated by element separation region 15, which comprises solid material. Pet., 33-34; *Kuboi*, ¶[55], Figs. 6A, 13.

produced by other manufacturing methods. Absent an express process limitation—which claim 1 does not contain—a structural claim is evaluated based on the structure that results, not the method by which it was made. *See In re Thorpe*, 777 F.2d 695, 697 (Fed. Cir. 1985). Because W&W identifies no claimed structural feature that is absent from *Kuboi*’s pixels, W&W cannot distinguish claim 1.

3. *Kuboi*’s Pixels Include “Light-Receiving Surfaces” and “Sides”

W&W contends that *Kuboi*’s pixels do not qualify as “pillars” having respective “light-receiving surfaces” and “sides,” but W&W never addresses the Petition’s mapping of these limitations to *Kuboi*. *See* POR, 27-30.

a) “Light-Receiving Surfaces”

The Petition identifies the lower surface of *Kuboi*’s transparent upper electrode 22, located on the light-incident side of each pixel, as the claimed “light-receiving surface.” Pet., 18-21. *Kuboi* discloses that incident light enters each pixel through electrode 22 before reaching the photoelectric conversion portion. *Kuboi*, ¶¶[60], [64], Fig. 6A. This is illustrated below.

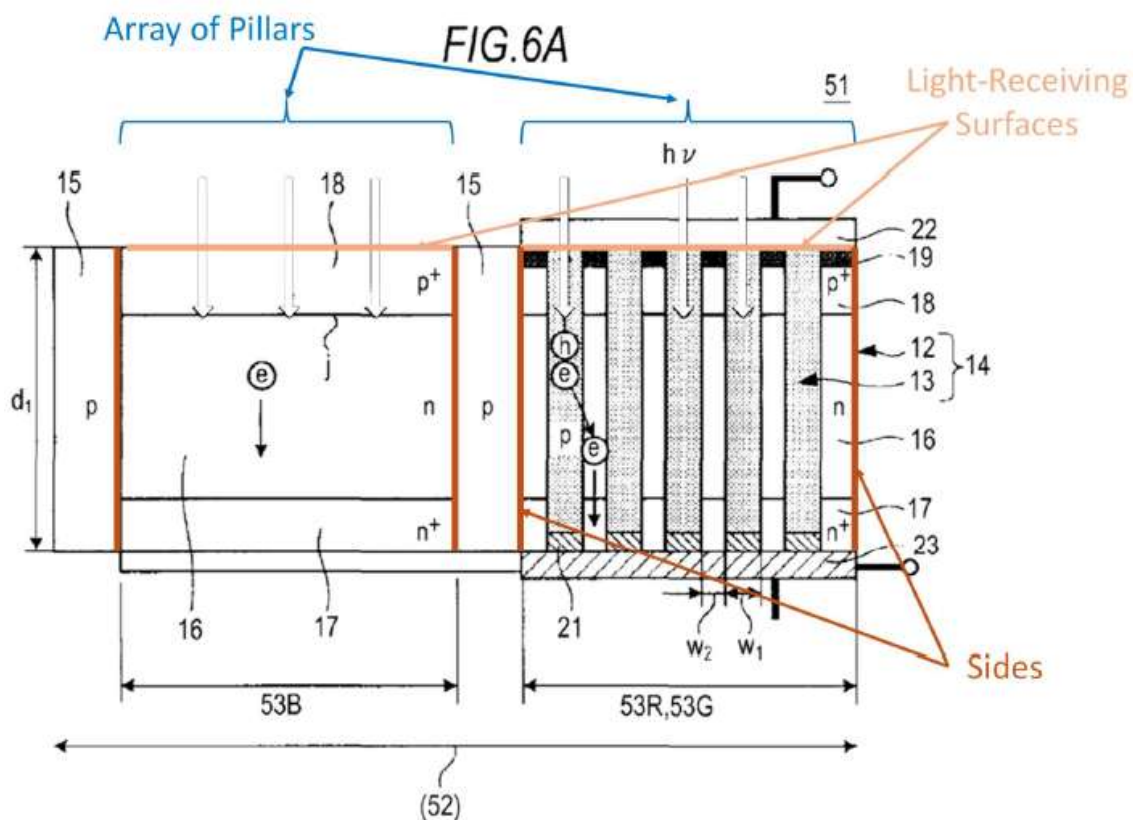
untethered to either the Petition’s mapping or a competing claim construction, cannot rebut the Petition’s showing. 37 C.F.R. § 42.23(b).

W&W’s discussion of *Kuboi*’s other surfaces, such as the top surface of p-type region 18, misses the point. *See* POR, 35-38. The Petition does not rely on those surfaces to satisfy this limitation. Whether those surfaces independently qualify as “light-receiving surfaces” is therefore irrelevant. W&W’s failure to engage with the structure identified in the Petition only underscores the absence of any substantive challenge to the Petition’s mapping.

b) “Sides”

The same analytical failure discussed in the prior section infects W&W’s challenge to the “sides” limitation. Claim 1 requires only that “at least some of the pillars ... have respective ... sides” (’948 patent, 55:39-43)—an unadorned structural term imposing no particular geometric configuration.

The Petition identifies the lateral boundaries of *Kuboi*’s discretized pixels as the claimed “sides.” Pet., 18-21. *Kuboi* discloses a two-dimensional pixel array with defined lateral extents, with adjacent pixels separated by element separation region 15. *Kuboi*, ¶¶[48], [55], Figs. 6A, 6B, 13, 15. This is shown below:



Pet., 21; *Kuboi*, Fig. 6A (annotated). Under the term’s plain meaning, these lateral boundaries are the pillars’ “sides”—and element separation region 15 is the “solid material between at least portions of the sides,” ’948 patent, 55:56-57, as claimed.

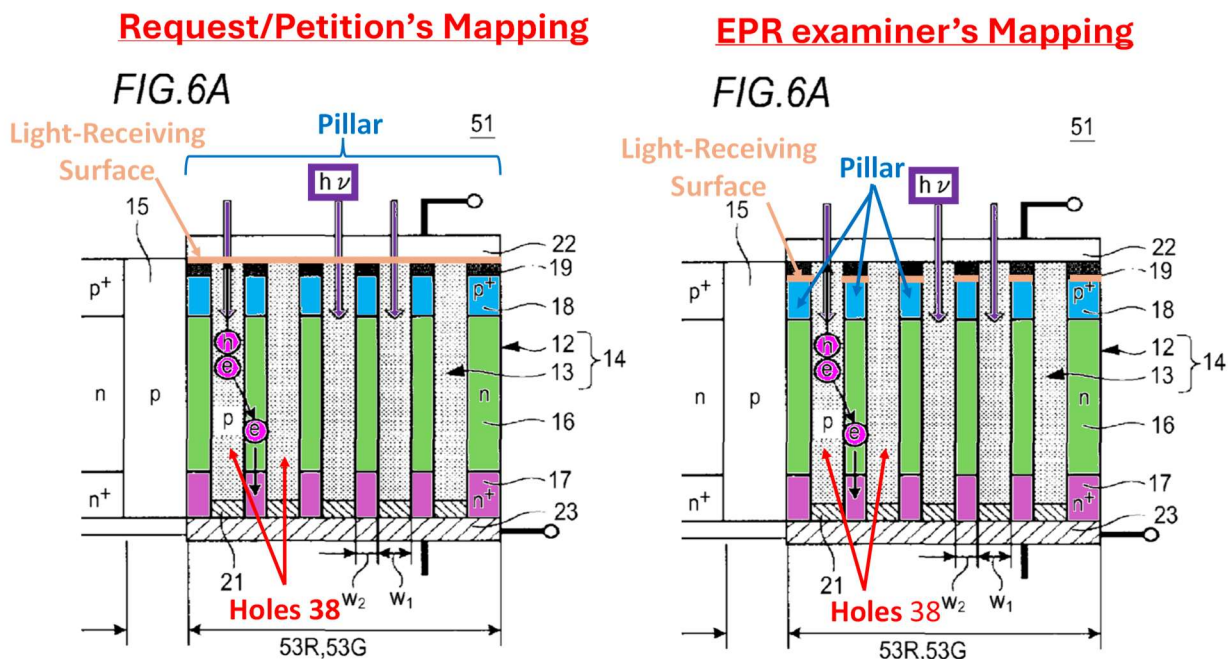
W&W does not meaningfully address the Petition’s analysis of *Kuboi*. It proposes no construction of “sides,” identifies no claim requirement that *Kuboi*’s disclosure fails to satisfy, and offers no explanation why the lateral boundaries of *Kuboi*’s discrete pixels are not “sides” under the term’s plain meaning. W&W’s conclusory assertions do not engage with the Petition’s actual analysis and should be rejected.

4. W&W's Arguments Apply the EPR Examiner's Mapping— Not the Petition's Analysis

W&W's arguments also fail because, rather than engage with the Petition's analysis of *Kuboi*, W&W constructs its arguments around the EPR examiner's analysis of *Kuboi*. POR, 27-30, 33-34 (citing Ex-2040, 9). As explained in §III, the examiner's mapping is materially different from the one advanced in this Petition. Rather than consider and address the EPR Request's positions—which mirrors the Petition's—the examiner *sua sponte* mapped the claimed “pillars” to semiconductor sections between adjacent holes 38 within a pixel. Ex-2040, 9-11; POR, 33-34. Under this incorrect analysis, the examiner found that those semiconductor sections “are not pillars that have respective light-receiving surfaces and are configured to respond to illumination ... by generating electrical charge carriers,” because they are shielded by light-shielding film 19. Ex-2040, 9-11. W&W's arguments here repeat this incorrect analysis. POR, 27-30, 33-34. But again, that is not what Petitioner argues, nor what *Kuboi* discloses.

Petitioner identified *Kuboi*'s pixels—not the shielded semiconductor sections within each pixel—as the claimed pillars, with the lower surface of upper electrode 22 as the claimed “light-receiving surface,” through which incident light enters and proceeds to organic films 13 to generate charge carriers. Pet., 18-22. W&W, however, did not address this analysis. Instead, the differences between the

Petition's analysis and W&W's analysis (mirroring the examiner) are shown below:



Kuboi, Fig. 6A (annotated) (Petition: whole pixel as a pillar, top surface above light-shielding film 19 as light-receiving surface; examiner: inter-hole substructure as pillar, top surface below film 19 as light-receiving surface). W&W's arguments ignore the analysis set forth in the Petition and are thus insufficient.

B. *Kuboi* Discloses Pillars Configured to Include Photodetectors and Pillars Configured to Generate Charge Carriers

W&W argues that *Kuboi* fails to disclose “pillars” “configured to include photodetectors [that] comprise P-doped and N-doped regions and *are configured to respond to illumination*” POR, 30. But that is not what claim 1 recites.

W&W's quotation splices together two separate “wherein” clauses, each with its

own “at least some of the pillars” antecedent: “wherein at least some of the pillars are configured to include photodetectors ... ; [and] wherein at least some of the pillars comprise P-doped and N-doped regions and are configured to respond to illumination” ’948 patent, 53:39-47. Claim 1 thus requires only that some pillars include photodetectors and that some pillars—not photodetectors—comprise the doped regions and respond to illumination. *Kuboi* discloses both. Pet., 18-26. As explained below, claim 1 requires that the pillar as a whole, not the pillar’s P-doped and N-doped regions themselves (or semiconductor region 12), respond to illumination, and W&W’s own amendment of a related divisional to expressly add that requirement confirms that claim 1 does not already require that.

1. Claim 1 Does Not Require that the Semiconductor Layers of the Pillars Generate Charge Carriers—Only that the Pillars Generate Charge Carriers

W&W contends that the P- and N-doped regions must themselves absorb light and generate charge carriers, and it contends that *Kuboi*’s semiconductor layer 12 does not. POR, 30-31. But this is incorrect and misunderstands the claim language.⁵

⁵ Even under W&W’s incorrect interpretation, *Kuboi* meets this limitation. See *supra* §II.

Claim 1 requires that the pillar comprise P-doped and N-doped regions, and it separately requires that the pillar be configured to respond to illumination by generating charge carriers. Nothing requires that the P-doped and N-doped regions themselves respond to illumination by generating charge carriers. Had the patentee intended this, it could have recited that those regions are configured to respond to illumination—it did not.

Under the correct reading of the claim, *Kuboi*'s pixels satisfy both requirements. *Kuboi*'s pixels include P-doped and N-doped regions. Pet., 22-24; *Kuboi*, ¶¶[55]-[56]. And the pixels, as a whole, respond to illumination by generating charge carriers: incident light enters through transparent upper electrode 22 and proceeds into organic photoelectric conversion films 13 embedded within the pixel, generating electron-hole pairs. Pet., 24-26. That the charge generation occurs in organic films 13 rather than in the P-doped and N-doped regions is irrelevant—claim 1 assigns the charge-generating function to the pillar, not to the P-doped and N-doped regions of the pillar.

W&W's prosecution of a related patent underscores that W&W's understanding of the claim language is incorrect. A pending divisional of the '948 patent, U.S. Application No. 19/036,506, originally required that the pillar comprise P-doped and N-doped regions and that the pillar be configured to respond to illumination by generating charge carriers. Ex-1057, 707 ("wherein at least some

of the pillars comprise P-doped and N-doped regions and are configured to respond to illumination with light ... by generating electrical charge carriers”). After the related IPRs were filed, W&W disclosed *Kuboi* to the Office via an IDS and then amended the claims to expressly require that photoelectric conversion occur *within the semiconductor layer*. *Id.*, 279-280 (“wherein each of the photodetectors: (i) has P-doped and N-doped regions of the semiconductor material, (ii) is configured to generate electrical charge carriers in the semiconductor material of the photodetector in response to light”), 337-338, 342, 367-370. To distinguish the amended claims from *Kuboi*, W&W argued that *Kuboi* “generate[s] electrical output only in organic material 13, not in semiconductor material of a photodetector.” *Id.*, 342. Such an amendment would have been unnecessary if claim 1 already required what W&W now contends. W&W cannot now import a limitation it found necessary to add by express amendment in a related application.

2. W&W’s Arguments Regarding Light-Shielding Film 19 Are Not Supported by the Record

W&W argues that Dr. Lebby “admitted that ‘Kuboi has the intention of [using] light-shielding film 19 to prevent direct incident light from entering P region 18 of the semiconductor.’” POR, 31 (citations omitted). But W&W’s argument fails for two reasons, including that it relies on a misunderstanding of the claim language and a mischaracterization of Dr. Lebby’s testimony.

W&W's argument relies on an incorrect mapping of the claim to *Kuboi*. W&W contends that *Kuboi*'s semiconductor layer 12 is not responsive to illumination because the light-shielding film 19 blocks light from entering the semiconductor layer. *Id.* As discussed above, claim 1 recites that "at least some of the pillars ... are configured to respond to illumination with light in selected visible and infrared wavelengths by generating electrical charge carriers." '948 patent, 55:39-47. The Petition maps *Kuboi*'s pixels as a whole—not semiconductor layer 12 specifically (as required by W&W's argument)—to the claimed pillars. Pet., 15-17. As W&W acknowledges, *Kuboi*'s pixels respond to illumination by generating charge carriers in organic films 13 of the red and green pixels and in the semiconductor layers of the blue pixel. POR, 29. The claims require nothing more.

W&W's argument (POR, 31) relies on an excerpted quotation from Dr. Lebby that omits his explanation (which immediately follows the language quoted by W&W) that angled and reflected light reaches—and causes photoelectric conversion in—semiconductor layer 12, notwithstanding film 19. Lebby-Tr., 102:17-103:8, 103:9-104:16; *see supra* §II. Dr. Lebby's complete testimony thus establishes that a POSITA would have understood that light entering the holes will still reach and cause photoelectric conversion in the semiconductor layer, *notwithstanding light-shielding film 19*.

C. *Kuboi* Discloses Holes Fabricated as Recesses at or Under the Light-Receiving Surface

W&W's contention that *Kuboi* fails to disclose claim 1's "holes ... fabricated as recesses" misreads the claim language and mischaracterizes how the Petition analyzes *Kuboi*. See POR, 34-38.

Claim 1 recites "one or more holes that are fabricated as recesses ***at or under*** the light-receiving surface." '948 patent, 55:48-53 (emphasis added). The disjunctive "at or under" unambiguously covers holes located either (i) at the light-receiving surface or (ii) under that surface. The claim imposes no requirement that the holes be formed in or on the light-receiving surface itself. This is dispositive.

As discussed in §IV.A.3.a), Petitioner explains that the lower surface of *Kuboi*'s upper electrode 22 is the claimed pillar's "light-receiving surface." Pet., 18-21. Recognizing this argument, W&W contends that *Kuboi*'s holes are "fabricated into the top of the p-type region 18"—a region located beneath electrode 22. POR, 35-37. But this argument actually confirms, rather than undermines, that *Kuboi* satisfies the limitation: holes formed into the top of p-type region 18 are necessarily formed under the lower surface of electrode 22, which is precisely what the claim's "or under" language covers. W&W's argument thus establishes the very structural relationship the claim requires.

W&W's argument that the top surface of p-type region 18 cannot be a "light-receiving surface," because light-shielding film 19 blocks light from

reaching it, does not address Petitioner’s actual analysis. *See* POR, 37. According to the Petition, the lower surface of *Kuboi*’s upper electrode 22—not the top of region 18—is the light-receiving surface, with the holes beneath it satisfying the “at or under” requirement. Pet., 18-20, 26-30. W&W’s argument is thus not grounded in the record.

D. *Kuboi* Discloses the Increased Absorption Limitation

W&W contends that “Petitioners do not argue that *Kuboi* discloses that the presence of alleged in-pillar holes increases light absorption by at least 1.1 times.” POR, 38. But this is incorrect. Petitioner, citing Dr. Lebby’s declaration, devotes twelve pages to demonstrating exactly that. Pet., 40-52; Lebby, ¶¶175-201.

Indeed, the Petition establishes that *Kuboi*’s structure discloses the 1.1X absorption increase in three independent arguments: (1) Dr. Lebby’s Lambert-Beer analysis applied to *Kuboi*’s disclosed dimensions and published absorption coefficient data; (2) Patent Owner’s representations in the ’948 patent regarding the high contrast grating (HCG) effect; and (3) corroborating disclosure in *Han*. Pet., 40-52; Lebby, ¶¶175-201. W&W’s responses are factually and legally meritless.

1. The Holes—Not Merely the Organic Material—Drive the Absorption Increase

W&W argues that *Kuboi*’s absorption improvement stems solely from the choice of organic material, not the holes. POR, 40. This is technically wrong and

contrary to the record. *Kuboi*'s holes are the structural features that enable the organic material to contribute to light absorption. Without holes, there is no volume within the photodetector to contain the organic material that absorbs light. Indeed, *Kuboi* discloses that embedding organic material within holes "improve[s] the absorption rate of light," resulting in increased "light absorption efficiency in the photoelectric conversion portion of the pixel." *Kuboi*, ¶¶[80], [16]-[17]. The improved absorption is a direct consequence of the holes themselves: without holes, there is no organic material, no enhanced absorption, and no 1.1X improvement.

Moreover, hole geometry directly governs the magnitude of the absorption increase. As the Petition demonstrated, the amount of light absorbed by the organic material depends on the light incidence area A defined by the hole dimensions—a relationship captured by the Lambert-Beer expression $I_0(1-e^{-\alpha d})A$. Pet., 40. Reducing the hole size reduces A and thus reduces the absorption increase, and enlarging the hole size increases A and increases the resulting absorption improvement. *See id.*, 41-44, 95-99; Lebby, ¶¶182-184, 286-288. The holes, therefore, enable and modulate the absorption enhancement. W&W's attempt to decouple the organic material from the holes that define its volume and geometry is technically unsound.

W&W’s reliance on Dr. Lebby’s cross-examination testimony is unavailing. POR, 40-41. Dr. Lebby explained: “If you don’t use the high-absorption material and compare [*Kuboi*’s pixel] to a like pixel, ... you can still invalidate the claim element, but the absorption is less.” Lebby-Tr., 147:7-148:5. Indeed, Dr. Lebby explained that a structural comparison (e.g., hole geometry) illustrates how *Kuboi* meets the 1.1X limitation, regardless of any material’s absorption characteristics. In support, Dr. Lebby cited his HCG analyses and Han analysis, which depend largely on hole geometry, not the organic material’s absorption characteristics. Lebby-Tr., 148:6-13, 151:7-152:4, 152:19-153:13, 156:11-157:7; Lebby, ¶¶188-200.

2. W&W’s “Like Photodetector” Argument Is Contrary to *Kuboi*’s Own Disclosure

W&W argues that a “like photodetector” lacking holes would perform no photon sensing at all, making Dr. Lebby’s comparison “illogical.” POR, 40. *Kuboi* contradicts this argument.

Kuboi explains that the presence of hybrid photoelectric conversion portion 14—i.e., the holes with the organic material—“improve[s] the absorption rate of light.” *Kuboi*, ¶[80]. By its plain terms, this disclosure presupposes a baseline level of photon absorption in the absence of the holes; the holes and organic fill improve photoelectric conversion but are not themselves required. A POSITA would have understood that removing the holes does not eliminate photoelectric conversion as

W&W alleges, but instead results in a device that continues to absorb light through the underlying semiconductor layer, albeit without the disclosed improvement. *See id.*, ¶[6]. Accordingly, a “like photodetector” lacking holes would still perform photoelectric conversion—only without the improved absorption attributable to the hybrid structure—rendering Dr. Lebby’s comparison both logical and firmly grounded in *Kuboi*’s disclosure.

3. Dr. Lebby’s Analysis Is Not Hindsight

W&W does not contest a single numerical input or computation in Dr. Lebby’s analysis or offer any competing calculation. Instead, W&W alleges that “Dr. Lebby’s opinion is based on improper hindsight.” POR, 41. But W&W is incorrect.

For the Lambert-Beer analysis, Dr. Lebby applied *Kuboi*’s pixel dimensions and published absorption-coefficient data to a well-established analytical tool, and the results confirmed that these pixels satisfy the claimed 1.1X absorption increase. Pet., 40-44; Lebby-Tr., 142:15-143:13. Because the analysis relies solely on contemporaneous disclosures, published data, and established physics—not knowledge derived from the inventors of ’948 patent—no hindsight is involved.

Regarding the HCG analysis, the ’948 patent states that structures satisfying the relationship $\lambda/n_1 < \Lambda < \lambda/n_2$ produce a 1.1-100X absorption enhancement. ’948 patent, 12:14-24, 12:49-55. But this relationship was not discovered by the

inventors of the '948 patent. Indeed, the '948 patent acknowledges that this relationship reflects an established principle from Chang-Hasnain—not the inventors. *Id.*, 11:52-64; Ex-1033. Use of this established principle is not hindsight. Dr. Lebby did not modify *Kuboi*, import elements from the '948 patent, or reconstruct *Kuboi* in view of the challenged claims. He simply applied *Kuboi*'s disclosed dimensions—including its 250 nm hole pitch (Λ)—to a formula expressly identified in the prior art. The resulting analysis showed that *Kuboi* satisfies the claimed absorption increase. Pet., 45-50; Lebby-Tr., 150:11-14, 154:8-13.

4. *Han* Corroborates that *Kuboi*'s Holes Increase Absorption

The Petition cites *Han* to corroborate that nanoholes of the same $\sim 1.4 \mu\text{m}$ depth as *Kuboi*'s holes increase absorption by roughly 1.8X—not as disclosing the claimed structure. *Han*, Fig. 4; Pet., 50-52; Lebby, ¶¶200-201. W&W's contention that *Han*'s holes differ from *Kuboi*'s “in-pillar holes” does not address this corroborative purpose, and its assertion that *Han* adds “nothing of probative value” is nothing more than conclusory. See POR, 41-42.

E. *Kuboi* Discloses Holes Filled at Least Partly with Solid Dielectric Material

Kuboi discloses “one or more holes ... [that] are filled at least partly with solid dielectric material” ('948 patent, 55:48-53) for two independent reasons. First, *Kuboi*'s electron blocking film 21—an undisputed solid dielectric

material—independently satisfies the “filled at least partly” requirement under the term’s plain meaning regardless of whether *Kuboi*’s organic film 13 is characterized as dielectric. Second, *Kuboi*’s organic films 13 are themselves solid dielectric materials.

1. *Kuboi*’s Electron Blocking Film 21 Satisfies the “Filled at Least Partly with Solid Dielectric Material” Limitation

Kuboi discloses holes “filled at least partly with solid dielectric material” because “an electron blocking film 21 [made of silicon nitride or silicon oxide and] having a thickness of several tens of nm, for example[,] is formed on the bottom portions of the vertical holes 38.” Pet., 30; Lebbby, ¶¶145-149, 152; *Kuboi*, ¶¶[73], [91]. W&W admits that silicon nitride and silicon oxide are solid dielectric materials. POR, 43. That should end the inquiry: a dielectric film formed within the hole “at least partly” fills it.

W&W argues that “filled at least partly” requires that the dielectric “at least partly fill the volume of the hole—not merely coat a surface at the bottom.” POR, 43. This construction fails for three reasons. First, it contradicts the plain meaning—which W&W agrees governs. *Id.*, 25-26. The phrase “at least partly” requires only that some portion of the hole contain solid dielectric material; it imposes no “volume” requirement. W&W’s construction rewrites the claim to add this limitation. Second, the ’948 patent’s specification confirms that thin dielectric coatings are within the scope of the claims. The specification describes

embodiments where “[t]he sidewalls of the microstructure patterns (pillars or holes) are passivated with dielectric ... (using[,] for example[,] atomic layer deposition ALD),” and where sidewalls of holes are “oxidized or coated with a conformal dielectric.” ’948 patent, 24:34-41, 37:36-42. A POSITA would have understood that ALD and oxidation produce ultra-thin dielectric coatings—the very coatings W&W now seeks to exclude.⁶ Third, the portion of the ’948 patent that W&W cites in support of its construction discloses that filler 916 “fill[s] or partially fill[s] the space between the Si pillars 914.” ’948 patent, 19:30-42; POR, 43 (citing same). This passage thus expressly contemplates partial filling. And in any event, that passage concerns space between pillars, not a hole within a pillar, and says nothing about “at least partly” in the claimed context.

Under the claim’s plain meaning, *Kuboi*’s film 21, formed on the bottom portions of the holes, at least partly fills them. Pet., 30. W&W’s own characterization—that film 21 “coats only the bottom of the holes” (POR, 45)—

⁶ Indeed, when the examiner rejected this limitation in the ’948 patent’s divisional for lack of written-description support (Ex-1057, 421-425), Applicant argued the specification discloses that “in-pillar holes can be oxidized.” *Id.*, 271-272. W&W cannot invoke oxidation as the written-description support for this limitation and now contend that an oxidized hole surface is insufficient.

concedes the point. And even under W&W’s new “volume” construction (*id.*, 43), film 21 necessarily occupies some portion of the hole’s volume and therefore “at least partly fill[s] the volume of the hole.” Thus, *Kuboi*’s film 21 satisfies this limitation.

2. *Alternatively, Kuboi’s Organic Films 13 Are Solid Dielectric Materials*

Kuboi’s organic films 13 are also solid dielectric materials. Pet., 30-31.

W&W contends they cannot be dielectric because they are organic semiconductors that generate signal charges when illuminated. POR, 46-52. But the record confirms otherwise. *Kuboi*’s organic materials are inherently dielectric in their default⁷ dark state and become conductive only transiently upon illumination. Ex-1058, 22 (undoped organic semiconductors “are, in fact, insulators” when not illuminated); Ex-1068, 1-4; Ex-1069, 1, 3; Lebby-Tr., 30:17-32:22, 120:20-121:21, 123:8-124:9, 140:17-141:15. W&W defines a “dielectric material” as “an insulator,” so a material that is insulating in its dark state is dielectric. POR, 46; Ex-2039 (“D’Andrade”), ¶140.

⁷ *Kuboi*’s imaging device targets digital cameras, video cameras, and mobile phones. *Kuboi*, ¶[191]. Such devices spend most of their operational life in a nonimaging state, with the organic material in the dark—and thus dielectric. Lebby-Tr., 32:12-22.

W&W's reliance on the "p-type" designation of *Kuboi's* organic materials to assert doping finds no support in the record. POR, 49. "P-type" denotes only that holes are the majority carriers. Ex-1071, 1 ("*p*-type conductivity represents a material with effective mobility of holes"); Ex-1059, 2 ("p-type materials are hole transporting semiconductors").

Kuboi's undoped organic semiconductors are expressly characterized as "dielectric" materials in the art. Ex-1015, 1-2 ("dielectric films"); Ex-1016, 1, 5 ("thin film porphyrin dielectrics"); *Fathi*, ¶¶[24] ("copper phthalocyanine dielectric"), [27]; Ex-1015, 1-2 (lead phthalocyanine "dielectric layer"); Ex-1016, Title ("porphyrin thin film dielectrics"); *Felten*, ¶¶10, 14; Ex-1070, 1; Ex-1059, 2; Ex-1071, 1; *Asami*, ¶[45]; *Watanabe*, ¶[158]; Lebby-Tr., 137:14-138:9, 140:6-16. Dr. D'Andrade cites no authority for his premise that dark-insulating, light-conductive behavior defines a semiconductor rather than a dielectric. D'Andrade, ¶149. Decades of literature contradict him, describing phthalocyanines as photoconductive insulators. Ex-1061, 11, 37; *Mott*, 2:28-39, 5:34-47; *Mammino*, Abstract, 1:53-59, 2:19-53; *Springett*, 1:6-24 ("insulating in the dark but ... conductive upon exposure to actinic or other radiation"); Lebby-Tr., 121:22-124:9.

W&W thus conflates transient operating behavior with intrinsic classification. Lebby-Tr., 124:10-22, 126:3-127:2, 138:10-139:4. The claim requires a "solid dielectric material"; it does not require the material to remain

dielectric while generating charge carriers. *Kuboi*'s organic films satisfy that requirement.

V. Ground 5: Claims 1-16 Lack Enablement Under §112

W&W argues that the claims are enabled because the HCG effect is not the only disclosed mechanism for the claimed 1.1X increase in light absorption, suggesting that the 1.1X light-absorption increase in a *single-hole* embodiment results from other disclosed mechanisms. POR, 55-56. While the '948 patent lists several mechanisms that W&W "believe[s]" may contribute to absorption enhancement—optical field concentration, resonance, interference, scattering, and HCG effects ('948 patent, 11:52-57)—only its HCG discussion quantifies any enhancement of the absorption coefficient, i.e., the at least 1.1X improvement, and that discussion is expressly and exclusively tied to a periodic hole array (*id.*, 12:49-55). A single hole cannot be periodic. W&W's cited single-hole embodiment thus does not enable the 1.1X limitation.

W&W argues that the '948 divisional's file history "confirms enablement" because the examiner withdrew the §112(a) rejection in response to W&W's arguments. POR, 57-58. W&W omits that it cancelled the rejected claims and presented new claims reciting pillars having a "width of 50-2000 nm." Ex-1057, 707-711, 267-269. The examiner allowed the narrowed claims, confirming the

rejection's premise. Claims 1-16 contain no width limitation and thus retain precisely the scope the examiner found unenabled.

VI. Conclusion

The challenged claims should thus be canceled.

Respectfully submitted,

Dated: August 4, 2026

By: /Joshua L. Goldberg/
Joshua L. Goldberg, Lead Counsel
Reg. No. 59,369

CERTIFICATE OF COMPLIANCE

Pursuant to 37 C.F.R. § 42.24(c)(1), the undersigned hereby certifies that the foregoing Petitioner's Reply to Patent Owner's Response contains 5,598 words, excluding the parts exempted under 37 C.F.R. § 42.24(c) as measured by the word-processing system used to prepare this paper.

Dated: August 4, 2026

By: /Joshua L. Goldberg/
Joshua L. Goldberg, Lead Counsel
Reg. No. 59,369

CERTIFICATE OF SERVICE

The undersigned hereby certifies that a copy of the foregoing **Petitioner's Reply to Patent Owner's Response** was served on August 4, 2026, via email directed to counsel of record for Patent Owner at the following:

James Hannah
Aaron M. Frankel
Jeffrey H. Price
Jeffrey Eng
Jenna Fuller
HERBERT SMITH FREEHILLS KRAMER (US) LLP
333 Twin Dolphin Drive,
Suite 700
Redwood Shores, CA 94065
james.hannah@hsfkramer.com
aaron.frankel@hsfkramer.com
jeffrey.price@hsfkramer.com
jeffrey.eng@hsfkramer.com
jenna.fuller@hsfkramer.com
svdocketingus@hsfkramer.com

Patent Owner has consented to service by email.

Dated: August 4, 2026

/William Esper/
William Esper
Senior Litigation Paralegal
Finnegan, Henderson, Farabow,
Garrett & Dunner LLP