UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

MIANYANG BOE OPTOELECTRONICS TECHNOLOGY CO., LTD.; WUHAN CHINA STAR OPTOELECTRONICS SEMICONDUCTOR DISPLAY TECHNOLOGY CO., LTD.; TIANMA MICROELECTRONICS CO., LTD.; AND VISIONOX TECHNOLOGY, INC.,
Petitioner,

v.

SAMSUNG DISPLAY CO., LTD.
Patent Owner.

Case IPR2023-00988
U.S. Patent No. 10,854,683

PATENT OWNER'S SUR-REPLY

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Ex. 2017	Ho-Kyoon Chung et al., *AMOLED Technology for Mobile Displays*, Society for Information Display (2006)

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Ex. 2073	Amal Ghosh et al., *Short Course S-1: Fundamentals of OLEDs*, Society for Information Display
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Ex. 2075	DE Patent No. 10 2011 053 000 B4 (including certified English translation)
Ex. 2076	D. Braun, *Crosstalk in Passive Matrix Polymer LED Displays*

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Ex. 2078	Priyanka Tyagi et al., *Degradation of Organic Light Emitting Diode: Heat Related Issues and Solutions*, Synthetic Metals 216 (2016)
Ex. 2079	M.M. Azrain et al., *Analysis of Mechanisms Responsible for the Formation of Dark Spots in Organic Light Emitting Diodes (OLEDs): A Review*, Synthetic Metals 235 (2018).
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Ex. 2084	Excerpts from Nilsson & Riedel, *Electric Circuits* (5th ed. 1996) (*served at Dr. Pattison's reply deposition*)
Ex. 2085	Excerpts from Kaplan, *Wiley Electrical and Electronics Engineering Dictionary* (2004) (*served at Dr. Pattison's reply deposition*)

Exhibit	Description
Ex. 2086	Transcript of July 30, 2024 Deposition of Morgan Pattison, Ph.D.

I. Introduction

Patent Owner—supported by the detailed technical analysis of Dr. Kymissis, President of the Society for Information Display—demonstrated significant flaws in Petitioner's hindsight-driven challenge: Petitioner cobbles together disparate references, disregarding (1) substantial structural and operational incompatibilities, (2) the lack of motivation to combine, and (3) the lack of reasonable expectation of success. Petitioner's proposed modifications conflict with the disclosures of Petitioner's references, and would result in *worse* displays. Indeed, it has become clear that Petitioner selectively reads its references (Matthies, Yamada, Phan, and Murai), ignoring important disclosures of those references refuting its theories and the prior art's extensive criticisms of Yamada's approach. Having no meaningful rebuttal, Petitioner impermissibly shifts to new theories, makes inaccurate assertions about the references, and ignores crucial evidence.

Moreover, Petitioner's contentions hinge on unsupported theories of its expert, Dr. Pattison, who has (1) contradicted himself, (2) repeatedly offered testimony inconsistent with his sworn testimony about the same references at trial in the International Trade Commission (ITC), and (3) repudiated under oath his

obviousness theory here.[1] Based on the evidence, including Dr. Kymissis's detailed showing of how Dr. Pattison and Petitioner misread the art and how POSITAs would recognize their proposed modifications conflict with the art's teachings, Dr. Pattison's opinions are not credible and should be given no weight.

For example, Dr. Pattison's reply declaration asserted Matthies does not require uniform spacing of pixels to the edge of a tile, yet admitted the opposite in cross-examination in the ITC:

IPR Reply Declaration (Ex. 1018, ¶56)	**ITC Hearing (Ex. 2083, 307:24-308:2, 308:13-16)**
Matthies does not require that space between a sub-pixel and tile edge always be exactly the same. Instead, Matthies only requires that the "distance between … pixels of two adjacent tiles" be "the same as the … distance of adjacent pixels in the interior of a tile."	Q. And **one thing that Matthies discusses is the importance of having uniform spacing from the edges of its tiles**, correct? A. **Yes**. […] [Q.] And you agree that **Matthies explains that its display tiles include tiles constructed with pixel-forming**

[1] Dr. Pattison was cross-examined as a reply declarant in this proceeding and questioned about his recent ITC trial testimony, Ex. 2083. Dr. Pattison agreed that he testified about the same references and gave true, accurate, and complete testimony at trial. Ex. 2086, 15:10-16:9, 18:8-19:14.

	elements evenly spaced up to the edge of the tiles, right? A. **Yes**.

Dr. Pattison admitted before the ITC that Matthies' Figure 8B, the basis for Ground 1, is a passive-matrix OLED display, yet offers inconsistent testimony here:

IPR Reply Deposition (Ex. 2086, 52:17-20)	**ITC Hearing (Ex. 2083, 304:6-12, 305:11-13)**
Q And **Figures 8A and 8B are passive matrix OLED structures**. Correct? MR. HERMAN: Objection. Form. A **Not necessarily**.	Q. And **that's describing passive-matrix display for Figure 8B**, correct? A. **Yes**. … Q. You agree that **Figure 8A discloses a passive-matrix?** A. **Yes.**

Dr. Pattison's reply declaration misquotes Matthies (he admitted to an example when pressed in deposition, Ex. 2086, 28:16-29:20, 31:22-32:4), and repeatedly mischaracterizes its disclosures, as discussed further below. Perhaps most notably, Dr. Pattison testified at the ITC he does not agree with an argument he and Petitioner continues to advance in a related proceeding. Ex. 2083, 237:15-23. Petitioner has never notified the Board that its expert repudiated his opinion.

II. Petitioner Fails to Show Obviousness.

A. Ground 1: Matthies and Yamada

1. Matthies and Yamada are incompatible.

Petitioner's challenge relies on combining Matthies' Figure 8B, which is undisputedly PMOLED, with Yamada, which is directed to AMOLEDs. Ex. 2009, ¶¶106-114, 123; Ex. 2083, 304:6-12. Patent Owner showed that PMOLED and AMOLED are distinct technologies (which Petitioner does not rebut) and that POSITAs would recognize Matthies' PMOLED quad-pixels were incompatible with Yamada's triple-pixel AMOLED teachings. POR, 7-30. As Dr. Kymissis explained, PMOLEDs and AMOLEDs have important differences impacting pixel arrangements, and it would not have been obvious to modify Matthies' PMOLED based on Yamada's purported disclosures, let alone with a reasonable expectation of success. Ex. 2009, ¶¶47-56 (discussing Exs. 2073-2074, 2076, 2078, 2080), 115-132 (discussing Exs. 2077, 2079).

Petitioner does not rebut Dr. Kymissis's testimony that Figure 8B's PMOLED architecture precludes Petitioner's proposed unequal pixel resizing (POR, 12-13; Ex. 2009, ¶¶121-128), and that POSITAs would understand the degradation profiles to materially differ between PMOLED and AMOLED pixels due to distinct pixel-driving schemes (POR, 12; Ex. 2009, ¶¶47-56, 115-120).

Instead, Petitioner shifts to a completely new argument that Matthies purportedly "also teaches 'active matrix' displays." Reply, 2-5. This is wrong, and also an impermissible new theory.

Petitioner relies on misleading quotations of the word "active" appearing in Matthies. For instance, column 7, lines 15-19 and 42-45 do not say what Dr. Pattison asserts in his reply declaration, Ex. 1018, ¶9, and he admitted in deposition he *misquoted* Matthies. Ex. 2086, 28:16-29:20, 31:22-32:4. Matthies discusses "active and passive" "electronics" or "devices"—*i.e.*, active electrical *components* like transistors, and passive electrical *components* like resistors, under standard definitions in electrical engineering. Matthies, 7:15-19, 7:42-45, 8:20-32; Ex. 2086, 33:6-34:15, 36:21-40:4, 78:5-80:14. Moreover, even "active *circuit*" means something entirely different than "active-*matrix*": an active circuit is a *circuit* with active components; active-matrix refers to an *addressing scheme* for a matrix of pixels each having its own pixel circuit. Ex. 2086, 41:5-42:4; Ex. 1019, 97:21-100:10, 101:4-102:6. Matthies explicitly discusses *passive-matrix* addressing (Matthies, 10:31-33, 3:4-5), but does ***not*** refer to, let alone describe, *active-matrix* addressing, as Dr. Pattison conceded. Ex. 2086, 81:9-12. Nor does Matthies discuss or suggest having individual pixel circuits for each pixel, a defining feature of active-matrix displays. Ex. 2009, ¶¶53-54; Ex. 2086, 62:10-63:8; Ex. 2073, 13-14; Ex. 2074, 9; Ex. 2080, 8-11.

The *only* reference in Matthies to "active matrix" is in connection with Matthies' reference to *manufacturing processes* for forming electrical components *in place* on a substrate (*i.e.*, as an alternative to attaching discrete, pre-formed components). Matthies, 8:21-26. Dr. Pattison agrees. Ex. 2086, 46:8-47:19.

Every disclosure in Matthies indicates its display is passive-matrix. *Compare* Matthies, Fig. 2 ("column drivers," "current sources") *with* Ex. 2074, 6 ("[t]o achieve gray levels [in PMOLED], the column drivers must be current sources"); *compare* Matthies, 10:31-33 ("only one row of pixels is illuminated at any time") *with* Ex. 2080, 5 (in PMOLED, "only one row can be selected and displayed at a time"; in AMOLED, "the turn-on/turn-off and different grayscales can be controlled independently"); *compare* Matthies, Fig. 3 *with* Ex. 2073, 13:

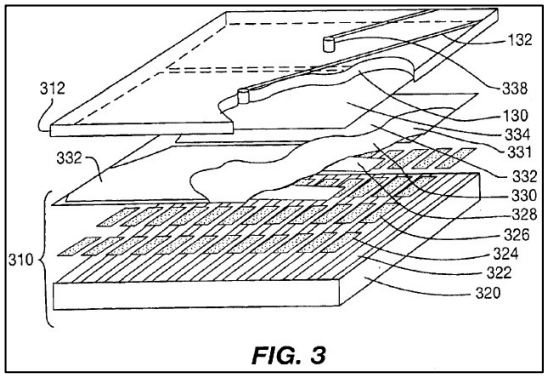
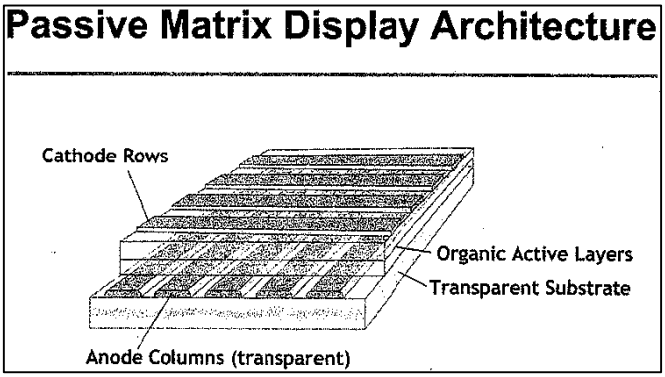


FIG. 3



But even if Matthies contemplated active-matrix designs, that is immaterial. Not only does Matthies not disclose what type of pixel arrangement structure would or could be used in such a hypothetical device, but Petitioner's theory is exclusively

based on modifying Matthies' *passive-matrix* Figure 8B display. Petition, 21-24; DI, 36-37, 38-39.

Petitioner's cited references (Reply, 4) underscore that display architectures impact pixel arrangements. *E.g.*, Ex. 1012, ¶[0025] ("[A]dditional conductive connecting lines will usually be required, particularly for a passive matrix display…. This is not such a problem for active matrix displays…."); *see* Ex. 1019, 68:21-69:8.

Finally, whether the claims could be met by both AMOLEDs and PMOLEDs, Reply 4-5, has no bearing on whether POSITAs would have been motivated to combine Matthies' PMOLED structure with Yamada's AMOLED disclosures when the two technologies are markedly different as they relate to pixel arrangement structures. *Natera, Inc. v. NeoGenomics Lab'ys, Inc.*, 106 F.4th 1369, 1378 (Fed. Cir. 2024) ("Unclaimed factors relevant to the feasibility of creating a useful claimed invention can impact the motivation to combine analysis.").

2. Petitioner's proposed modifications would worsen Matthies' display.

Petitioner's alleged motivation to combine was to avoid "deterioration" and shorter pixel life span. Petition, 35-37; *see also* DI, 30, 32, 45. Petitioner does not dispute Patent Owner's showing that Petitioner's combination would accelerate

deterioration of pixels and *reduce* lifetime because it would keep the blue pixels the same size and shrink the red and green pixels.[2] POR, 14-16; Ex. 2009, ¶¶133-146.

Effectively conceding its original purported motivation fails, Petitioner tries to shift to a completely new theory that its combination would improve "***useful*** lifetime" by "maintain[ing] color or 'white balance.'" Reply, 5-8. This is improper and should be disregarded. Revealingly, Petitioner cites only Dr. Pattison's reply declaration, completely new references, and portions of references never before discussed. Reply, 5-7.

In any event, the new theory is also unsound. Petitioner cites Arnold for the proposition that mere relative resizing of pixels "improves the display's 'useful lifetime' by 'maximiz[ing] the time that the relative luminance of the three-color elements can be maintained….'" Reply, 7. Petitioner's ellipses omit the clause "while minimizing the loss of absolute luminance"—a critical teaching which flatly contradicts Petitioner's combination. Ex. 2011, 2:1-4. As Dr. Kymissis showed, and Petitioner does not rebut, Petitioner's combination results in a significant "loss of

[2] As the Board noted, DI, 32, 47, each of Petitioner's Yamada combinations keep blue pixels the same size. Petition, 29-30, 39-40, 57, 71. Dr. Pattison testified Matthies "purposefully limits" pixel sizes, so blue pixels should not be enlarged. Ex. 1003, ¶¶233, 296-297; *see also id.*, ¶¶231, 532.

absolute luminance" because the green and red pixels are made smaller, with green pixels smallest. Ex. 2009, ¶¶136-137, 144, 228. Arnold specifically *discourages* "reduc[ing] the luminance of the red and green to balance the blue," *i.e.*, Petitioner's combination, because "this lowers the overall brightness": "[o]nce the display becomes too dim, the user may also consider the display to be at the end of its useful lifetime, ***regardless of the relative luminance*** of the three colors." Ex. 2011, 1:63-2:1. Mere relative resizing of pixels does not result in improved useful lifetime; Petitioner's proposal would have the opposite effect.

Petitioner and Dr. Pattison also do not dispute Patent Owner's evidence that different-colored OLED pixels decay at different rates , and non-linearly. Matthies recognized this problem, and provided circuitry to compensate for differential aging of pixels. Ex. 2009, ¶¶140-146. Dr. Pattison also admitted currents applied to sub-pixels must necessarily vary (in magnitude or on-time) for full-color displays, Ex. 2086, 47:20-51:5, contrary to the premise of Petitioner's combination of "similar current" being supplied to all sub-pixels, *E.g.*, Petition, 37. Petitioner's proposal to resize pixels while eliminating Matthies' circuitry would result in color-shifting, rendering the display defective. POR, 15-16; Ex. 2009, ¶175 ("[C]onsitency and

predictability in the white balance is a requirement for … consistency in display operation."); *id*. ¶¶142-143, 170-175.[3]

Moreover, Petitioner ignores criticisms of Yamada, including that Yamada fails to consider "differences in the inherent luminance stability over time of different materials." Ex. 2011, 2:34-41; Ex. 2009, ¶¶173-175. Arnold showed that Yamada's approach results in *shorter* lifetime (3714 hours) than using equally-sized pixels (4115 hours). Ex. 2011, 15:41-16:36.

3. Petitioner's proposed modifications contradict Matthies' design requirements.

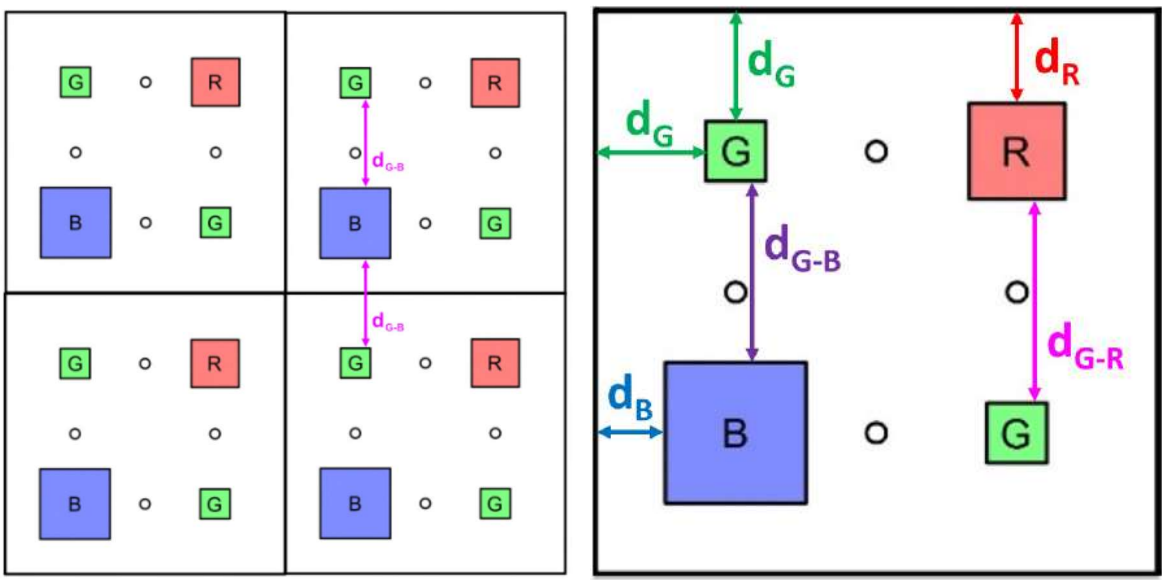
Petitioner does not dispute its proposed combination results in uneven pixel spacing to the edges of tiles. Petitioner incorrectly claims Matthies has no requirement of even spacing to tile edges. Reply, 11-12. Matthies expressly teaches "[t]he tiles are constructed with pixel forming elements evenly spaced up to the edges of the tiles." Matthies, 5:47-48. This spacing is required to "eliminat[e] the visibility of the seams between tiles," one of Matthies' main design goals. *Id.*, 2:2-10. Dr. Kymissis explained why this is critical to Matthies' tiled display. Ex. 2009, ¶¶74, 129-131, 178-183. Dr. Pattison agreed, admitting "one thing that Matthies

[3] Petitioner suggests it might keep Matthies' circuitry *and* resize pixels. Reply, 8. This is yet another new theory, and inconsistent with the Petition's "simplification" rationale, which Patent Owner showed is defective.

discusses is the importance of having uniform spacing from the edges of its tiles," Ex. 2083, 307:24-308:6; *see* Ex. 1003, ¶¶143, 174; Ex. 2062, 127:10-128:18.

Petitioner's proposal would improperly eliminate a "key feature of Matthies' tiled display by making the seams more apparent." Ex. 2009, ¶181. Indeed, Dr. Pattison concedes Matthies relies on equally-sized pixels for the structures necessary to integrate tiles without hindering light-emission, using pixel pitch (P) defined by *equally sized pixels*, and a ***single*** variable D_p requiring pixels' emissive regions to have the *same* width. Ex. 2086, 54:1-56:17. Matthies does not disclose any way to avoid seams being visible if pixels were differently sized.

Further, Petitioner does not dispute that Matthies requires pixel distance within a tile to be the same as pixel distance across adjacent tiles. Reply, 11-12. Yet Petitioner's combination would create *different* pixel distances within and across adjacent tiles. Under Petitioner's proposal, there would be differing distances between adjacent pixels, *e.g.*, green-to-red versus green-to-blue. And a pixel distance within a tile $d_{G\text{-}B}$ would be *different* than a pixel distance across adjacent tiles $d_{G\text{-}R}$, contrary to Matthies' requirements:



Reply, 12; Ex. 2009, ¶190. Petitioner's proposal is inconsistent with Matthies' teachings and requirements.

Additionally, as Dr. Kymissis explained, by varying pixel size and spacing in Matthies' Figure 8B structure, Petitioner's modifications would create a shadowing effect causing color-shifting and inconsistent white balance. Ex. 2009, ¶¶179-183. This is antithetical to Matthies' and Yamada's goals.

4. Petitioner's other arguments fail.

Petitioner's unsupported attorney arguments lack merit.

First, POSITAs would have no reason to try to resize Matthies' quad-pixels (with *differing numbers* of different color pixels) based on Yamada's approach contemplating only triple-pixels (with *equal numbers* of red, green, and blue pixels). POR, 16-18; Ex. 2009, ¶¶147-151. Petitioner's claim that quad-pixels were "considered superior," Reply, 8-9, mischaracterizes prior art. Three of Petitioner's

cited passages describe ***penta***-pixels. Ex. 1012, [0006] (Fig. 2); Ex. 1022, 2:25-29 (Figs. 1-3); Ex. 1017, 3:9-11 (Fig. 2). The fourth describes a quad-pixel having equally-sized sub-pixels with ***two blue*** sub-pixels, Ex. 2012, 2:5-6 (Fig. 4), supporting Dr. Kymissis's unrebutted testimony that POSITAs would have looked to Matthies' quad-pixel with two blue sub-pixels if seeking to apply Yamada's teachings to quad-pixels. Ex. 2009, ¶¶158-163. Petitioner does not dispute Matthies' triple-pixel (Fig. 8A) would be more suitable for resizing based on Yamada. POR, 17-18; Ex. 2009, ¶¶151-157. Moreover, triple-pixels have larger aperture ratios. Ex. 2009, ¶155; Ex. 2062, 175:16-176:5.

Second, even if POSITAs were to try to combine Matthies and Yamada, they would use Matthies' two-blue quad-pixel (which does not practice the challenged claims), not Petitioner's contrived structure. POR, 19-20. Pixel structures are not mere "design alternative[s]." Reply, 9. Matthies explicitly states, and Dr. Pattison does not dispute, that for display technologies where the emission efficiency of blue material is lower than that of green, two-blue quad-pixel structures provide technical benefits. Matthies, 17:5-10; Ex. 2009, ¶¶158-163. Maintaining pixel sizes and increasing the number of blue pixels is consistent with Matthies' design rules, whereas Petitioner's contrived proposal violates them. *See* Section II.A.3.

Third, Petitioner does not dispute its proposed combination would reduce aperture ratio. Petitioner merely asserts aperture ratio is just "one factor" to consider.

Reply, 9-10. This misses the point. Neither Petitioner nor Dr. Pattison disputes that OLEDs had relatively low aperture ratios and POSITAs would have sought to increase them. Ex. 2009, ¶¶144-146, 209. Reducing aperture increases applied current density, decreasing lifetime. Ex. 2009, ¶¶135-136, 155; Ex. 1003, ¶282. By keeping the blue pixel its original size and shrinking the red and green pixels (*supra* note 2), Petitioner reduces aperture ratio for no corresponding benefit. Petitioner's "commercial viability" argument, Reply, 10, is a strawman. Aperture ratio and manufacturability are technical considerations for displays, even if they *also* relate to commercial viability. Ex. 2009, ¶¶40-46, 58-63, 104, 144-145. Dr. Pattison testified cost *is* a consideration for pixel design. Ex. 2062, 93:10-22.

Fourth, Petitioner does not dispute that the prior art (including Yamada) taught that multiple factors including different OLED materials, efficiencies, and chromaticities would need to be considered to select different pixel sizes. Reply, 10. Specifics of OLED materials, luminance stability, chromaticity values, and number of sub-pixels grouped together all affect pixel sizing. Ex. 2009, ¶¶164-177; Ex. 1017, 2:15-28; Ex. 2011, 2:34-41. Dr. Pattison acknowledged a host of factors. Ex. 2062, 92:18-93:22. But he performed no analysis of any of these factors. Ex. 2062, 102:20-103:17, 105:6-9; Ex. 2083, 277:12-288:12, 284:1-5. Petitioner merely asserts Yamada teaches "it is often obviously best to make the blue pixels largest and the green pixels smallest." Reply, 10. This is unsupported. Yamada says nothing about

what is "often" best or what is "typical." Ex. 2009, ¶169. Other references further contradict Petitioner. For example, Arnold found applying Yamada's teachings yields an OLED display with *red pixels larger than blue pixels*, despite lower-efficiency blue OLED material. Ex. 2011, 15:58-16:36; Ex. 2009, ¶¶167-169; Ex. 2086, 24:22-25:12.

Fifth, Yamada's approach was severely criticized in the prior art. What Petitioner calls Yamada's "central premise"—that "emission efficiency" alone determines pixel sizes—is not an accurate description of Yamada, and Yamada was viewed as naïve and faulty. Ex. 2009, ¶¶170-176; Ex. 2083, 281:20-22. Notably, Arnold criticized Yamada and, considering other relevant factors, proposed using *two blue sub-pixels in a quad-pixel structure with equally-sized sub-pixels*. Ex. 2086, 22:16-23:8; Ex. 2011, Fig. 5, 3:9-13, 11:44-55. Yet Dr. Pattison selectively disregards prior art teachings inconsistent with Petitioner's theories, including, for example, from Arnold, Ex. 2086, 27:15-28:5; Ex. 2083, 283:1-285:24, Matthies, Ex. 2062, 61:1-17; Ex. 2083, 308:17-310:13, and Yamada, Ex. 2083, 279:3-280:8.

B. Ground 2: Phan

1. Phan does not teach OLED pixel arrangements.

Petitioner asserts Phan's "pixel arrangement applies to multiple display types, including OLEDs." Reply, 12. Phan does not say this. Dr. Pattison admitted that nothing in the description of any figure of Phan describes OLED pixel arrangements.

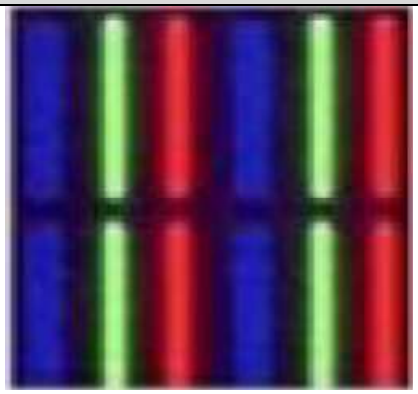
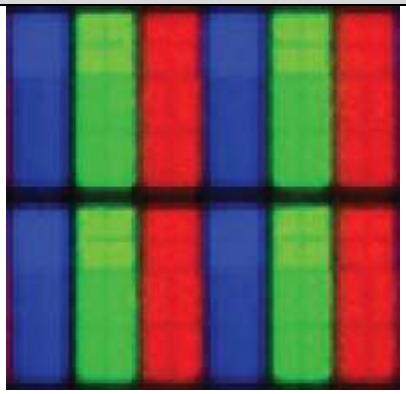
Ex. 2083, 300:16-19. Dr. Kymissis explained in detail that Phan's arrangements do not apply to OLEDs, Ex. 2009, ¶¶77-81, 198-215; Ex. 1019, 111:15-22, and Petitioner offers no evidence in rebuttal.

It is undisputed that Phan *at most* makes one passing reference to "OLED" in a laundry list of purported display technologies, including several that do not exist. Ex. 2009, ¶¶77-78, 201-204; Ex. 2062, 160:4-21; Ex. 2083, 291:6-293:17.

Petitioner pivots to asserting that other patents that never reference Phan suggest Phan's pixel arrangements "can be used by different displays." Reply, 12-13. Petitioner effectively proposes new combinations, which should be rejected. Moreover, the cited excerpts do not support Petitioner's attorney argument.

- Matthies does not say the "same pixel arrangement" is usable with LCD, OLED, and plasma displays. Matthies, 5:28-35.
- Chao identifies types of RGB arrangements. It does not teach that pixels would be identically sized, shaped, or spaced in LCD and OLED. Ex. 2018, ¶[0006].
- Cok is not the same pixel arrangement as Phan. Nowhere does Cok state that each pixel arrangement (or Figure 1 specifically) is suitable for both passive- and active-matrix OLEDs. Ex. 1019, 70:5-18; 72:13-19; Ex. 1017, 2:61-67, 4:8-15.

Dr. Kymissis provided unrebutted testimony that structural differences in displays result in different pixel arrangements. *E.g.*, Ex. 2009, ¶¶33-46, 205, 209-211 (LCD vs. OLED); 47-56 (passive-matrix vs. active-matrix). For example, the "same" RGB stripe arrangement requires large gaps for OLEDs, but not LCD. Ex. 2009, ¶¶39-40, 42-43:

OLED	**LCD**
	
Ex. 2023, 2.	Ex. 2034, 2.

Even Dr. Pattison disagrees with Petitioner. Ex. 2062, 42:2-8 ("A: … pixel layout is a design consideration that can be adjusted … based on the limitations or the facts of the underlying light-emitting technology"); *id*., 45:1-19.

2. Phan does not teach "substantially equidistant" pixels.

Petitioner mischaracterizes Phan to argue it teaches "substantially equidistant" pixels (claim 7). Contrary to Petitioner's assertion, Phan does not require "dots/sub-pixels [to be] regularly spaced in a consistent, repeating pattern." Reply, 13. Phan merely states that, in Figures 1a-1c, each of the "***[p]ixels*** 12a, 12b and 12c *comprise regularly disposed dots* 11." Phan, 4:29-21 (emphasis added). Phan is referring to

dots (i.e., *sub-pixels*) *within* a pixel, not spacing *between pixels* (where, e.g., signal lines may be located). Phan neither states nor suggests the ***overall display*** comprises regularly disposed, equally spaced dots. To the contrary, for example, Figures 10a-b show rectangular quad-pixels, explicitly teaching *different* center-to-center distances between dots in horizontal and vertical directions, as Dr. Pattison admitted. Ex. 2086, 61:4-9; *see* Ex. 2009, ¶225; Phan, 3:56-63, 5:39-46.

Dr. Kymissis explained in detail why Phan has spacing between quad-pixels. Ex. 2009, ¶¶223-229. To argue otherwise, Petitioner alleges Phan's "'static pixel[s] 17' and the 'dynamic pixel[s] 18' have the same 'matrix' 'geometry.'" Reply, 14 (citing Phan, 6:4-23). That is incorrect. Phan at column 6, lines 4-23 simply compares the resolutions of displays using ***triplet*** static pixels versus ***quad*** dynamic pixels. *See* Phan, 5:61-6:3. Triple-pixels and quad-pixels have *different* geometries. Petitioner, citing Phan, 7:59-67, claims Phan requires both its static pixels and dynamic pixels to form a square with no space between them. Reply, 14. Not so. Phan actually says "each quad pixel group as well as of its individual elements are preferable in the form of ***rectangle*** or square," Phan, 7:63-65, and depicts spacing between quad-pixels in Figure 12. Phan does not teach quad pixels must have ***no space*** between them.

Petitioner asserts Phan's figures show "regularly" or "evenly spaced" dots. Reply, 13-14. Phan does not describe its figures as drawn to scale. *Hockerson-*

Halberstadt, Inc. v. Avia Grp. Int'l, Inc., 222 F.3d 951, 956 (Fed. Cir. 2000) ("patent drawings … may not be relied on to show particular sizes if the specification is completely silent on the issue"). And Dr. Pattison admitted Phan's figures do not disclose the structure of, or relative spacing between, dots. Ex. 2086, 62:18-63:19, 67:13-15.

Nor does Petitioner dispute that displays having spacing between pixel units were not uncommon, Ex. 2009, ¶224, that POSITAs would have understood spacing (such as shown in Fig. 12) is necessary for Phan's control circuitry or optical fiber network, *id.*, ¶223, and that spacing would prevent image distortion, *id.*, ¶¶225-229. Arbitrarily removing quad-pixel spacing, as Petitioner does in its proposal, is contrary to Phan's goal of applying dynamic driving to a given grid. *Id.*, ¶229-230; Phan, 2:50-3:19.

Petitioner cannot explain why POSITAs would ignore or eliminate the spacing present in Figure 12. Instead, Petitioner speculates hypothetical problems with dynamic pixels based solely on Dr. Pattison's conclusory assertions. Reply, 15. These fail. While Petitioner speculates separation between quad-pixels could introduce issues such as "reduce[d] blending" and increased risk of individual dots becoming visible, Dr. Pattison did not even know what "reduced visual blending" is, Ex. 2086, 68:15-21, and admitted there would be no visual problems when implementing dynamic pixels with even as many as 6 dots—a significantly larger

area than a quad-pixel with spacing, *id.*, 74:2-17, 69:9-70:1. Petitioner's attempts to conjure possible issues with having gaps between Phan's quad-pixels lack support.[4]

C. Ground 3: Phan and Yamada

1. Phan is incompatible with Yamada.

Here, Petitioner reads Phan's passing reference to "OLED" even more expansively, arguing it shows Phan is "not limited to passive-matrix displays." Reply, 16. But Dr. Kymissis provided unrebutted testimony that Phan teaches passive-matrix displays, which are fundamentally different from active-matrix displays. Ex. 2009, ¶¶47-56, 80-81, 211, 234-238, 116-128. Tellingly, Dr. Pattison offered no response.

Petitioner's claim that Phan applies to AMOLEDs because it "says nothing about OLED TFTs" is disingenuous. Reply, 16. Phan does not discuss OLED pixel arrangements. Moreover, Phan states "higher resolutions cannot be achieved" in LCD displays because the "great number" of TFTs make high-resolution displays "economically not viable." Phan, 2:35-43. As Dr. Kymissis explained, and Petitioner does not dispute, active-matrix OLED displays require *more* TFTs than LCDs would.

[4] Petitioner draws "differently and irregularly sized and shaped" dynamic pixels by misleadingly circling different numbers of dots. Reply, 15. Dr. Pattison admitted circling more than four dots is wrong. Ex. 2086, 71:18-72:4.

Ex. 2009, ¶211. POSITAs would understand Phan describes passive-matrix displays with dynamic pixels to avoid use of TFTs. Ex. 2009, ¶¶235-236.

Petitioner's other attorney arguments are unsupported. Dr. Kymissis provides unrebutted testimony that Cok's Figure 1 (Ex. 1017) is *not* the same pixel arrangement as Phan's Figure 11b, Ex. 1019, 72:13-19, and is *not* described as being used in an active-matrix OLED, Ex. 1019, 70:5-18.

2. Petitioner's proposed resizing conflicts with Phan's crosspoints.

Petitioner's attorney argument attempting to dispute that the Petition's proposed resizing of Phan's dots conflicts with Phan's crosspoints (Reply, 16-17) is belied by Dr. Pattison's contrary admissions. Ex. 2062, 166:12-167:18; Ex. 2083, 297:22-298:4; 299:5-11. As Petitioner notes, Phan adjusts light-emitting areas using "a black mask/barrier." Reply, 17. Dr. Kymissis's unrebutted testimony explains Phan does this by moving the crosspoint along the quad-pixel's diagonal. Ex. 2009, ¶¶83, 241-242, 247-248. This necessarily makes the red pixel the smallest, which would not meet the claims. *Id.*; Ex. 2062, 167:8-18. Petitioner does not dispute Phan's crosspoint resizing is significant to visual perception and Phan's passive-matrix structure. POR, 41; Ex. 2009, ¶¶242-243, 247-250.

3. Petitioner fails to rebut numerous arguments.

Patent Owner showed Petitioner's proposed resizing of breaking apart and introducing arbitrary spacing between Phan's dots is inconsistent with Phan's

disclosures and passive-matrix architecture. POR, 41-44; Ex. 2009, ¶¶244-253. Patent Owner also showed POSITAs looking to modify Phan in view of Yamada's purported teachings would have started with Phan's triple-pixel structure (Figure 3a-b) to combine with Yamada's triple-pixel structure, or used Phan's two-blue quad-pixel rather than the two-green quad-pixel Petitioner assumes. POR, 45-47; Ex. 2009, ¶¶256-265. Petitioner offers no rebuttal.

D. Ground 4: Murai and Yamada

1. Murai does not teach OLEDs.

Patent Owner and Dr. Kymissis explained Murai is directed to LCDs and the figure Petitioner relies on is not an OLED display. POR, 47-49; Ex. 2009, ¶¶267-273. Neither Petitioner nor Dr. Pattison offers any substantive response. It is undisputed there are fundamental differences between LCDs and OLEDs relating to the pixel arrangements that can be used. Ex. 2009, ¶¶33-46.

Murai's single mention of "organic EL display devices," Reply, 17, does not support Petitioner. Murai does not link it to the particular structure Petitioner relies on, and Dr. Pattison's assertion that Murai "can be" OLED, Ex. 1003, ¶471, is conclusory. Petitioner rests on attorney argument that Murai must teach OLEDs because each pixel has a TFT. Reply, 17. This is incorrect. Active-matrix LCDs, which also use TFTs, were well-known. Ex. 2009, ¶30; Phan, 2:35-37; Ex. 2062, 163:2-13. Dr. Kymissis explained "active-matrix LCDs only require one TFT per

pixel," Ex. 2009, ¶236, while OLEDs generally require at least two, underscoring that Murai was disclosing LCDs. *Id.*, ¶¶270-273.

2. There is no motivation to combine Murai with Yamada.

Murai teaches LCDs and its pixel arrangement could not be used in OLEDs. *Supra* Section II.D.1. POSITAs had no reason to apply Yamada, which addresses problems unique to organic emissive materials, to an LCD. POR, 47-49; Ex. 2009, ¶¶33-46, 274-279. Murai's cutouts make no sense for OLED pixels, especially for resizing as Petitioner suggests. Ex. 2009, ¶¶277-287. Petitioner does not dispute these points.

The Petition was explicit that POSITAs would resize pixels "using the method Murai already teaches (different numbers and sizes of cut-offs)." Petition, 71. Patent Owner showed this is inconsistent with Murai and Yamada, and results in a worse display. POR, 50-53; Ex. 2009, ¶¶280-284. Lacking any response, Petitioner backs away from its combination, calling it a mere "conceptual[] illustrat[ion]," and suggesting the references could be combined in some different, unspecified way. Reply, 18. But Petitioner never articulates what this new combination would be.

Petitioner also fails to explain why, for Ground 4, pixels are resized by corner cutouts, contrary to Yamada's purported approach and inconsistent with Petitioner's approach for Ground 3 where Petitioner alleged POSITAs would abandon Phan's crosspoint-resizing for Yamada's purported approach. POR, 51. Petitioner also fails

to respond to Patent Owner's showing that its Murai-Yamada combination would introduce the visual artifacts Murai sought to prevent. POR, 52-53; Ex. 2009, ¶284.

III. Objective Evidence Reinforces Non-obviousness.

A. Copying

Petitioner offers no substantive response to the evidence of copying, which has "even greater weight" given the failures of others (POR, 57-62, 65-68). *Advanced Display Sys., Inc. v. Kent State Univ.*, 212 F.3d 1272, 1285 (Fed. Cir. 2000). Dr. Kymissis explained he is unaware of any alternative pixel arrangement successfully being used in flagship mobile devices (Ex. 2009, ¶¶307-313, 318-324), and Petitioner identifies none.

Patent Owner showed the exemplary Galaxy S22 display practices the challenged claims (POR 69-70; Ex. 2028; Ex. 2009 ¶¶328-330). Petitioner does not assert any limitation is not met. Dr. Pattison's bare assertion that Patent Owner's expert "focuses solely on superficial similarity" (Ex. 1018, ¶118) is belied by the record.

Petitioner fails to address Patent Owner's showing that displays from BOE (Ex. 2041, ¶84) and numerous others (Exs. 2042-2060) copy the inventions. This "evidence of industry copying…[is] strong evidence of nexus." *Apple Inc. v. ITC*, 725 F.3d 1356, 1366 n.4 (Fed. Cir. 2013). Petitioner does not claim (let alone show)

independent development or identify any relevant differences between these replica displays and SDC's displays.

B. Praise

Petitioner does not mention, let alone rebut, Exhibits 2013-2014, 2026-2027, 2038, 2040, and 2068-2072, which exemplify praise specifically directed to the claimed pixel arrangements.

Petitioner's attempt to suggest the praise is unrelated to the claims is unfounded. For example, articles published by DisplayMate (*e.g.*, Exs. 2014, 2027, 2068-2072) demonstrate otherwise. To take one, Ex. 2027—titled "Samsung Diamond Pixels"—praises the "high-tech" "sub-pixel arrangement … [where] the Red, Green, and Blue sub-pixels have very different sizes … [with] vertical, horizontal, and particularly diagonal line segments and vectors … maximiz[ing] the sub-pixel packing and *achiev[ing] the highest possible pixels per inch*." Ex. 2027, 1 (emphasis added). This reinforces the strong nexus to the claims. *Apple*, 725 F.3d at 1366 ("Apple also presented evidence showing a nexus … namely evidence that … those in the industry praised the iPhone's multitouch functionality.").

C. Long-felt Need, Failure of Others, and Skepticism

Petitioner offers no rebuttal to Patent Owner's showing of skepticism. Petitioner does not even *mention* much of the evidence demonstrating the long-felt need for pixel arrangement structures enabling manufacture of full-HD AMOLED

displays for mobile devices and repeated failures of others (*e.g.*, Ex. 2013-2014, 2017-18, 2021-22, 2024, 2034-36, 2064-65).

Petitioner rests on a flawed assertion that, because the need for higher-resolutions is not expressly recited in the claims, it "was not met by the '683 patent." Reply, 22. But specific discussion of advantages in the patent is not required. *See Rambus Inc. v. Rea*, 731 F.3d 1248, 1256-57 (Fed. Cir. 2013). What matters are "advantages inherent in what is specifically disclosed in a patent." *In re Vamco Mach. & Tool, Inc.*, 752 F.2d 1564, 1577 n.5 (Fed. Cir. 1985). The higher resolution and manufacturability flow directly from the claimed structures. Ex. 2009, ¶¶331-333.

Regarding nexus, there is no dispute that SDC's Diamond Pixel arrangement structures practice the claims. Petitioner cannot dispute the advantages (*e.g.*, full-HD resolution) directly result from the unique characteristics of the claimed invention. For example, Ex. 2037 explains "Samsung Display succeeded in innovating resolution by changing the existing rectangular patterning structure to a diamond structure." Ex. 2037, 3.

Petitioner selectively quotes from Ex. 2039 to suggest, inaccurately, that the benefits were "unnecessary" and "marketing puffery." Reply, 24. Ex. 2039 itself refutes this. It praised SDC's "Diamond Sub-Pixels" specifically for enabling "458 pixels per inch," and then stated "*[a]s a result*, … it is absolutely pointless *to further*

increase the display resolution and pixels per inch … for a silly marketing wild goose chase." Ex. 2039, 3 (emphasis added).[5]

Petitioner also asks the Board to ignore the evidence because SDC has other patents. Reply, 21. That other patents "claim different things" and allow for *additional* improvements is immaterial. Nexus can be satisfied even where a patented product's success "was, in fact, based on two factors," one "undisputedly covered" by the claims, and the other "undisputedly not covered by the claims." *Ecolochem, Inc. v. S. Cal. Edison Co.*, 227 F.3d 1361, 1378 (Fed. Cir. 2000).

Finally, Petitioner errs in suggesting that different, lower resolution AMOLED displays having been previously available somehow negates Patent Owner's showings. Reply, 22-23. These were distinct pixel arrangement structures that do not practice the claims. The evidence shows the claimed inventions enabled significant improvements over such prior art AMOLED displays, including in resolutions.

IV. Conclusion

The Board should find the challenged claims patentable.

[5] Patent Owner did not assert "commercial success." Reply, 26.

Date: August 5, 2024

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CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), I certify that the present paper contains 5,277 words based on the word count indicated by the word-processing program used to generate the paper and excluding those portions exempted by 37 C.F.R. §§ 42.24(a) and (b).

Date: August 5, 2024

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6, I hereby certify that the foregoing Patent Owner's Sur-reply was served by electronic mail on the following counsel of record for petitioner:

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