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Paper 46
Date: January 6, 2025

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.

IPR2023-00987
Patent 9,818,803 B2

Before JAMESON LEE, TERRENCE W. McMILLIN, and JOHN A. HUDALLA, *Administrative Patent Judges.*

LEE, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining Some Challenged Claims Unpatentable
Granting-in-Part Petitioner's First Motion to Strike
Dismissing Petitioner's Second Motion to Strike
Dismissing Petitioner's Motion to Exclude
35 U.S.C. § 318(a); 37 C.F.R. §§ 42.5(a), 42.64(c)

I. INTRODUCTION

We instituted an *inter partes* review of claims 1–5 and 19–21 ("challenged claims") of U.S. Patent No. 9,818,803 B2 (Ex. 1001, "the '803 patent") owned by Samsung Display Co., Ltd. ("Patent Owner"). Paper 10 ("Decision to Institute"). We have authority to conduct this *inter partes* review under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. We determine that Mianyang Boe Optoelectronics Technology Co., Ltd., Wuhan China Star Optoelectronics Semiconductor Display Technology Co., Ltd., Tianma Microelectornics Co., Ltd., and Visionox Technology, Inc. (collectively, "Petitioner") have proved by a preponderance of the evidence that claims 1–4 and 19–21 of the '803 patent are unpatentable, but have not proved by a preponderance of the evidence that claim 5 of the '803 patent is unpatentable.

A. Background

Petitioner filed a Petition requesting an *inter partes* review of the challenged claims pursuant to 35 U.S.C. §§ 311–319. Paper 1 ("Pet."). Patent Owner filed a Preliminary Response. Paper 9. The Decision to Institute was entered on January 8, 2024. Paper 10. Thereafter, Patent Owner filed a Response (Paper 19, "PO Resp."), Petitioner filed a reply (Paper 29, "Reply"), and Patent Owner filed a sur-reply (Paper 31, "Sur-reply").

A consolidated oral hearing was held on October 9, 2024, for this proceeding and related proceedings IPR2023-00988 and IPR2023-01075. The hearing transcript has been entered as Paper 44 ("Tr.").

Petitioner filed a Motion to Exclude Evidence. Paper 39 ("Exclude Mot."). Patent Owner filed an opposition to Petitioner's Motion to Exclude

Evidence. Paper 40 ("Exclude Opp."). Petitioner filed a reply to Patent Owner's Opposition to Petitioner's Motion to Exclude Evidence. Paper 41.

Additionally, Petitioner filed a First Motion to Strike (Paper 24, "1st Strike Mot.") to which Patent Owner filed an opposition (Paper 25, "1st Strike Opp.") to which Petitioner filed a reply (Paper 26, "1st Strike Reply"). Petitioner also filed a Second Motion to Strike (Paper 33, "2nd Strike Mot.") to which Patent Owner filed an opposition (Paper 37) to which Petitioner filed a reply (Paper 38).

B. Real Parties-in-Interest

Petitioner identifies Mianyang BOE Optoelectronics Technology Co., Ltd., Wuhan China Star Optoelectronics Semiconductor Display Technology Co., Ltd., Tianma Microelectronics Co. Ltd., Visionox Technology, Inc., and their subsidiaries as the real parties-in-interest. Pet. 3. Patent Owner identifies Samsung Display Co., Ltd., as the real party-in-interest. Paper 7, 2.

C. Related Matters

The parties identify the following two proceedings as related to the '803 patent (Pet. 3; Paper 7, 2):

1. *Certain Active Matrix Organic Light-Emitting Diode Display Panels And Modules For Mobile Devices, And Components Thereof*, Inv. No. 337-TA-1351 (USITC);[1] and

[1] The Initial Determination of the U.S. International Trade Commission ("ITC ID") was entered in this investigation on November 15, 2024. Ex. 2088. With regard to validity of the '803 patent, the Administrative Law Judge determined that no asserted claim of the '803 patent in that proceeding, i.e., claims 5 and 21, was shown to be invalid. *Id.* at 61–66.

2. *Samsung Display Co., Ltd. v. BOE Technology Co., Ltd.*, Case No. 2-23-cv-00309 (E.D. Tex.).

Inter partes review proceedings IPR2023-00988 and IPR2023-01075 involve patents issuing from applications that claim priority to the application which issued as the '803 patent.

D. The '803 Patent (Ex. 1001) [2]

The '803 patent is directed to "a pixel arrangement structure of an organic light emitting diode (OLED) display." Ex. 1001, 1:18–19. The '803 patent indicates that "[a]n organic emission layer included in the pixel of an OLED display may be deposited and formed by using a mask such as a fine metal mask (FMM)." *Id.* at 1:38–40. The '803 patent notes, however, that "[w]hen reducing a gap between the neighboring pixels to obtain a high aperture ratio of the pixel, deposition reliability may be deteriorated," but "[o]n the other hand, when increasing the gap between the pixels to improve the deposition reliability, the aperture ratio of the pixel may be deteriorated." *Id.* at 1:40–45. The '803 patent also indicates that pixels of certain colors may have different lifespans from other pixels, and that the pixel arrangement structure of the OLED display may provide improved life span of the pixels. *Id.* at 7:25–32.

The '803 patent states that a "pixel refers to a minimum unit for displaying an image (for example, the minimum addressable unit of the display)." Ex. 1001, 3:55–57. The '803 patent also states that an exemplary embodiment "provides a pixel arrangement structure for an OLED display

[2] The '803 patent issued from Application No. 13/614,197, filed September 12, 2013, and claims priority to KR 10-2012-0022967, filed March 6, 2012. Ex. 1001, codes (21), (22), (30).

having an improved aperture ratio of a pixel while efficiently setting up a gap between the pixels." *Id.* at 1:59–62.

Figure 1 of the '803 patent is reproduced below.

FIG.1

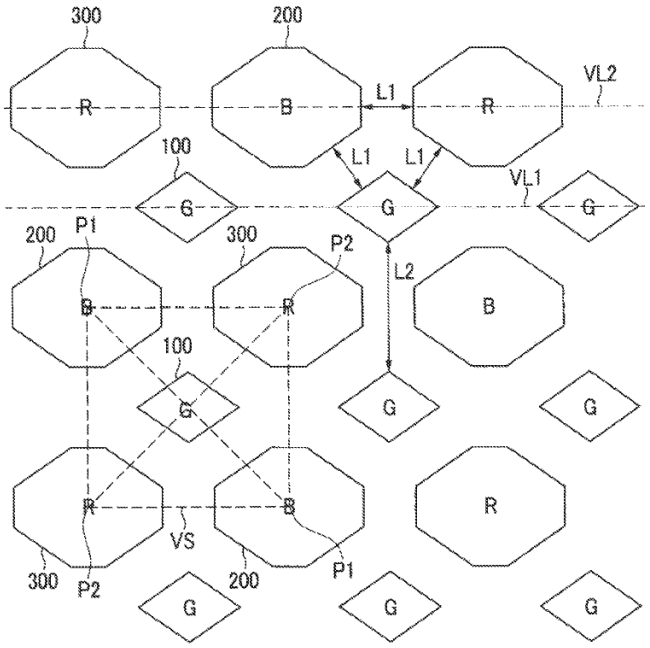


Figure 1 is "a view of a pixel arrangement structure of an OLED display." Ex. 1001, 2:66–67. "[T]he pixel arrangement structure of the OLED display includes a plurality of first pixels 100, a plurality of second pixels 200, and a plurality of third pixels 300." *Id*. at 3:52–55. First pixels 100 emit green light, second pixels 200 emit blue light, and third pixels 300 emit red light. *Id.* at 4:11–12, 4:30–31; 4:43–44.

According to the '803 patent, "each of the first pixels 100 has a smaller area than neighboring second pixels 200 and third pixels 300, and has a quadrilateral (i.e., four-sided) shape." Ex. 1001, 4:4–7. "The second pixels 200 are arranged diagonally with respect to the first pixels 100, such as at first vertices P1 along one diagonal of a virtual square VS having one

of the first pixels 100 as a center point (or center) of the virtual square VS." *Id.* at 4:14–18. "In a similar fashion, the third pixels 300 are arranged diagonally with respect to the first pixels 100, such as at second vertices P2 along the other diagonal of the virtual square VS." *Id.* at 4:18–21.

According to the '803 patent, "[e]ach of the third pixels 300 has a larger area than the neighboring first pixel 100 and the same area as each of the second pixels 200." Ex. 1001, 4:32–34. The '803 patent indicates that "by enclosing each of the first pixels 100 by a pair of the second pixels 200 and a pair of the third pixels 300, the aperture ratio of the first pixels 100, the second pixels 200, and the third pixels 300 may be improved." *Id.* at 5:20–23.

The '803 patent further states:

> [T]he gap of the first length L1 is formed between adjacent pairs of the first pixels 100 and the second pixels 200, between adjacent pairs of the first pixels 100 and the third pixels 300, and between adjacent pairs of the second pixels 200 and the third pixels 300. In addition, the gap of the second length L2 that is longer than the first length L1 is formed between the neighboring ones of the first pixels 100. This results in improved deposition reliability when using a fine metal mask to form the green, blue, and red organic emission layers respectively included in the first pixels 100, the second pixels 200, and the third pixels 300.

Ex. 1001, 5:9–19.

Figure 2 of the ’803 patent is reproduced below.

FIG.2

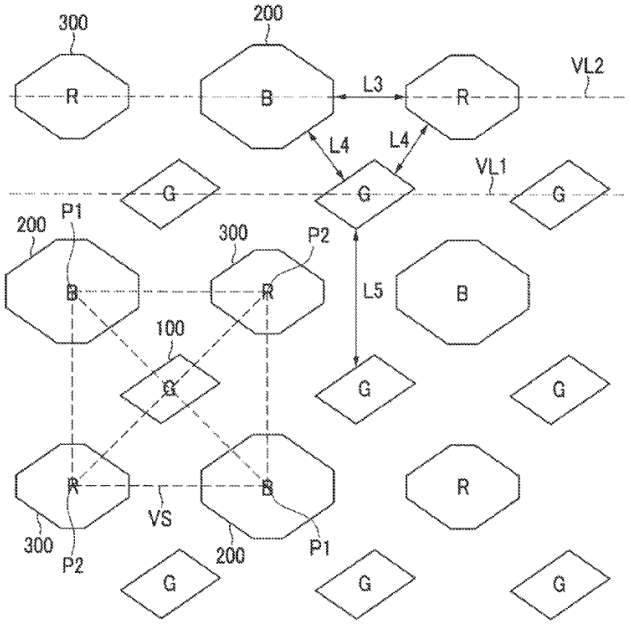


Figure 2 is “a view of a pixel arrangement structure of an OLED display.” Ex. 1001, 3:1–3. In Figure 2, “[t]he plurality of first pixels 100 have the same quadrilateral shape (e.g., a parallelogram)” and “the second pixels 200 have a larger area than the third pixels 300.” *Id.* at 5:67–6:2. According to the ’803 patent, because “the second pixels 200 that emit blue have the shortest life span,” “the second pixels 200 have a larger area than the third pixels 300, thereby suppressing the deterioration of the life span of the OLED display.” *Id.* at 6:44–49.

Figure 5 of the ’803 patent is reproduced below.

FIG.5

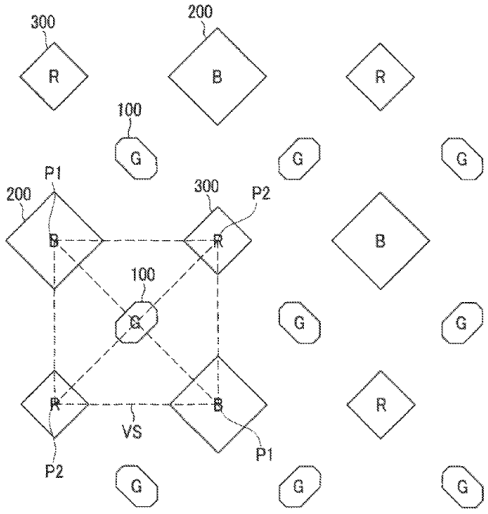


Figure 5 is “a view of a pixel arrangement structure of an OLED display.” Ex. 1001, 3:9–10. According to the ’803 patent, “the neighboring first pixels 100 have a[n] octagonal shape and are symmetrical to each other, while the second pixels 200 have a larger area than the third pixels 300.” *Id.* at 8:31–34. The ’803 patent states that “[t]his results in improved deposition reliability in the deposition process using the fine metal mask to form the green, blue, and red organic emission layers respectively included in the first pixels 100, the second pixels 200, and the third pixels 300.” *Id.* at 8:34–38.

Claim 1 is independent and claims 2–5 and 19–21 each depend, directly or indirectly, from claim 1. Claim 1 is reproduced below:

> 1. [1-pre] A pixel arrangement structure of an organic light emitting diode (OLED) display, comprising:
>
> [1-a] a plurality of pixels for displaying an image on the OLED display and comprising:
>
> [1-a(1)] a first pixel having a center coinciding with a center of a virtual square;
>
> [1-a(2)] a second pixel separated from the first

pixel and having a center at a first vertex of the virtual square;

[1-a(3)] another first pixel on a line defined by the center of the virtual square and the first vertex, the first pixel, the second pixel, and the other first pixel being consecutive pixels on the line from among the plurality of pixels; and

[1-a(4)] a third pixel separated from the first pixel and the second pixel, and having a center at a second vertex neighboring the first vertex of the virtual square,

[1-b] wherein the second pixel has a larger area than that of the third pixel, and

[1-c] wherein the first pixel is configured to emit green light.

Ex. 1001, 8:58–9:9.[3]

E. Evidence relied on by Petitioner and Declarations

Petitioner relies on the following references:

U.S. Patent No. 6,897,855 B1, filed Feb. 16, 1999, issued May 24, 2005 (Ex. 1004, "Matthies");

U.S. Patent No. 7,091,986 B2, filed Dec. 5, 2003, issued Aug. 15, 2006 (Ex. 1005, "Phan");

Japanese Patent No. 4496852 B2, filed June 10, 2004, issued July 7, 2010 (Exs. 1006, 1007, "Murai");[4] and

U.S. Patent No. 6,366,025 B1, filed Feb. 24, 2000, issued Apr. 2, 2002 (Ex. 1008, "Yamada").

[3] The bracketed labels correspond to those used by Petitioner to reference the claim elements. Pet. 20–34, 46–54, 65–74. We use the same labels here for ease of reference, understanding, and consistency.

[4] Murai is a Japanese-language publication (Ex. 1006) that was filed with an English translation (Ex. 1007, 1–15). Our citations to Murai refer to the English translation.

Petitioner relies on the Declaration of P. Morgan Pattison, Ph.D. Ex. 1003. Patent Owner relies on the Declarations of Ioannis Kymissis, Ph.D. (Ex. 2009), Aris K. Silzars, Ph.D. (Ex. 2061), and Adam Fontecchio, Ph.D. (Ex. 2063).

F. Asserted Grounds of Unpatentability

Petitioner asserts that the challenged claims of the '803 patent are unpatentable based on the following grounds (Pet. 5):

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–5, 19–21	103(a)[5]	Matthies, Yamada
1–4, 19–21	103(a)	Phan
5	103(a)	Phan, Yamada
1–5, 19–21	103(a)	Murai, Yamada

II. ANALYSIS

A. Burden of Proof

The Petitioner has the burden of proving unpatentability by a preponderance of the evidence. 35 U.S.C. § 316(e). That burden never shifts to Patent Owner except in limited circumstances not present here. *In re Magnum Oil Tools Int'l, Ltd.*, 829 F.3d 1364, 1375 (Fed. Cir. 2016). "Preponderance of the evidence means the greater weight of evidence, evidence which is, more convincing than the evidence which is offered in

[5] The Leahy-Smith America Invents Act ("AIA"), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. §§ 102 and 103. Because the '803 patent claims priority to an application filed before March 16, 2013 (the effective date of the relevant amendments), the pre-AIA versions of §§ 102 and 103 apply.

opposition to it." *United States v. C.H. Robinson Co.*, 760 F.3d 1376, 1383 (Fed. Cir. 2014) (internal quotations omitted).

B. Level of Ordinary Skill in the Art

Citing testimony from Dr. Pattison, Petitioner contends a person of ordinary skill in the art "would have had a degree in electrical engineering, materials science, physics, or a similar discipline, along with 2 years of professional experience working with display design, including OLED displays, or an equivalent level of skill, knowledge, and experience." Pet. 12 (citing Ex. 1003 ¶¶ 37–40). Petitioner further notes that such a person of ordinary skill in the art "would have been aware of and generally knowledgeable about OLED materials, and display pixel design, layout, and operation." *Id*. (citing Ex. 1003 ¶ 40). We adopted Petitioner's definition in the Decision to Institute. Paper 10, 11.

Patent Owner proposes that

> consistent with the finding in the related ITC Investigation for the related '578 patent, that a person of ordinary skill in the art ("POSITA") would have had a relevant technical degree in Electrical Engineering, Computer Engineering, Material Science, Physics, or the like, and experience in electroluminescence and the design of active-matrix displays or pixel arrangements for such displays.

PO Resp. 4–5 (citing Ex. 2009 ¶ 64; Ex. 2001, 15). Patent Owner describes its proposal as containing "slightly different language" than Petitioner's definition and does not explain why we should adopt its proposal over Petitioner's articulation. *Id.* Notwithstanding, Patent Owner contends that "Petitioner fails to establish unpatentability under either [party's] definition." *Id*.

For purposes of this Decision, we again adopt Petitioner's definition of the level of ordinary skill in the art. It is supported by the testimony of Dr. Pattison, and appears consistent with what is reflected by the content of the applied prior art references. *Cf. Okajima v. Bourdeau*, 261 F.3d 1350, 1354–55 (Fed. Cir. 2001) (the applied prior art may reflect an appropriate level of skill).

We find Patent Owner's articulation of the level of ordinary skill to be imprecise, because Patent Owner does not specify the amount of experience possessed by an ordinarily skilled artisan. The unbounded reference to "experience" is vague and overly broad, as it could mean 1 year of experience or over 30 years of experience, for example. In addition, the '803 patent is directed to "a pixel arrangement structure of an (OLED) [organic light emitting diode] display" (Ex. 1001, 1:54–56), whereas Patent Owner's proposed experience is tied to "active-matrix displays." PO Resp. 5. Given that the field of OLED displays includes both passive and active matrix designs (*see generally* Ex. 2009 ¶¶ 40–56), we see no reason to restrict the relevant experience to active matrix displays. For these reasons, we do not adopt Patent Owner's definition of the level of ordinary skill in the art.

C. Claim Construction

We use the same claim construction standard that would be used to construe a claim in a civil action under 35 U.S.C. § 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent. 37 C.F.R. § 42.100(b)

(2022). The claim construction standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc) is applicable.

Claim terms are generally given their ordinary and customary meaning as would be understood by one with ordinary skill in the art in the context of the specification, the prosecution history, other claims, and extrinsic evidence including expert and inventor testimony, dictionaries, and learned treatises, although extrinsic evidence is less significant than the intrinsic record. *Phillips*, 415 F.3d at 1312–17. Usually, the specification is dispositive, and it is the single best guide to the meaning of a disputed term. *Id.* at 1315.

The specification may reveal a special definition given to a claim term by the patentee, or the specification or prosecution history may reveal an intentional disclaimer or disavowal of claim scope by the inventor. *Phillips*, 415 F.3d at 1316. If an inventor acts as his or her own lexicographer, the definition must be set forth in the specification with reasonable clarity, deliberateness, and precision. *Renishaw PLC v. Marposs Societa' per Azioni*, 158 F.3d 1243, 1249 (Fed. Cir. 1998). The disavowal, if any, can be effectuated by language in the specification or the prosecution history. *Poly-Am., L.P. v. API Indus., Inc.*, 839 F.3d 1131, 1136 (Fed. Cir. 2016).

Only those claim terms that are in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Realtime Data, LLC v. Iancu*, 912 F.3d 1368 (Fed. Cir. 2019) ("The Board is required to construe 'only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.'" (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

Petitioner states that "[f]or purposes of this petition . . . the terms of the '803 patent's claims do not require further construction and can be afforded their plain and ordinary meaning." Pet. 12. Patent Owner states that "[n]o specialized constructions are necessary in this proceeding." PO Resp. 4. We agree with the parties that it is not necessary to conduct express claim construction for any claim term.

D. Alleged Obviousness of Claims 1–5 and 19–21 over Matthies and Yamada

1. The Law on Obviousness

A claim is unpatentable if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. 35 U.S.C. § 103(a); *see KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, so-called secondary considerations, including commercial success, long-felt but unsolved needs, failure of others, and unexpected results. *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17–18 (1966).

When evaluating a combination of teachings, we must also "determine whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue." *KSR*, 550 U.S. at 418 (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). "[T]here must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *In re Kahn*, 441 F.3d at 988.

"[W]here a party argues a skilled artisan would have been motivated to combine references, it must show the artisan 'would have had a reasonable expectation of success from doing so.'" *Arctic Cat Inc. v. Bombardier Recreational Prods. Inc.*, 876 F.3d 1350, 1360–61 (Fed. Cir. 2017) (quoting *In re Cyclobenzaprine Hydrochloride Extended-Release Capsule Patent Litig.*, 676 F.3d 1063, 1068–69 (Fed. Cir. 2012)).

2. Overview of Matthies (Ex. 1004)

Matthies is directed to "large-area display devices which are formed as an array of tiled display devices." Ex. 1004, 1:8–10. Matthies states that by "[b]uilding a large-area display out of smaller tiles has been recognized as a desirable solution," because "the basic unit of manufacture is relatively small," which "reduces manufacturing costs." *Id.* at 1:56–65. Matthies explains that "[n]o practical tiled display system has yet been developed" because "[w]hat has been missing is a fabrication technology that allows a display to be constructed so that pixels can be brought up to the very edge . . . while at the same time allowing for electronics to address each tile, even those tiles completely surrounded by other tiles." *Id.* at 1:66–2:7.

Figure 1 of Matthies is reproduced below.

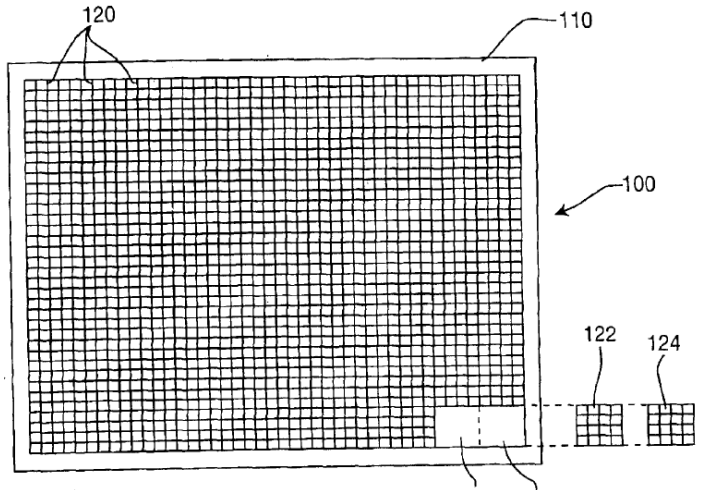


FIG. 1

Figure 1 "is a front plan drawing of a large area display device from which two tiles have been removed." Ex. 1004, 3:49–50.

According to Matthies, "display 100 is a tiled display in which emissive or reflective elements, on which the image pixels are formed, are built as relatively small arrays on tiles 120 and assembled into a frame to produce the large-area display having a large number of pixel forming elements." *Id.* at 5:38–42. Matthies indicates that "[a]lthough the display 100 is shown as being formed from tiles having 16 pixel forming elements in a four by four array, it is contemplated that each tile may include many more pixels." *Id.* at 5:56–59.

Matthies states that in an exemplary embodiment, "the pixel forming elements are made from an organic light emitting diode (OLED) material." Ex. 1004, 6:17–19. According to Matthies, "[t]he active portion . . . of the pixels occupies only about 1/4 of the total pixel area." *Id.* at 15:67–16:1. Matthies indicates "that this spacing of the pixels leaves room along the edges of the display for the vias . . . to connect to the row and column electrodes of the pixel without interfering with the regular spacing of the pixels across tile boundaries." *Id.* at 16:5–9.

Figure 7 of Matthies is reproduced below.

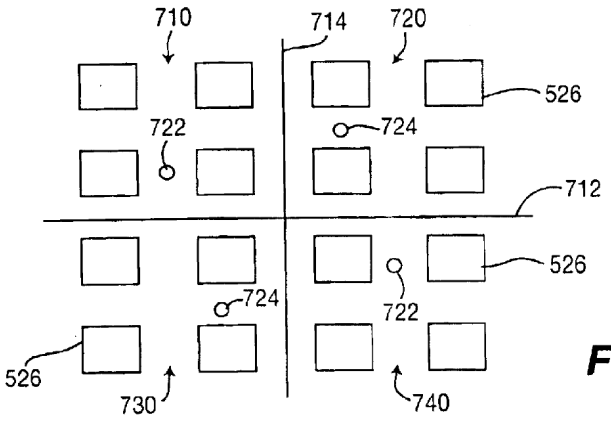


FIG. 7

Figure 7 "is a pixel diagram which shows an exemplary pixel layout for portions of four tiles." Ex. 1004, 4:6–7. "In the layout shown in FIG. 7, the active portions 526 of the pixels are centered in their respective pixel regions and the vias which connect the row and column electrodes of the display to the electronics are formed between respective pixel elements." *Id.* at 16:22–26. "The distance between the edge of an active region 526 and the edge 712 of the display is equal on all sides of the tile." *Id.* at 16:26–28.

With respect to the general illustration in Figure 1, Matthies describes:

> The tiles are constructed with pixel forming elements evenly spaced up to the edges of the tiles. As described below with reference to FIGS. 15 through 19, the tiles are formed such that, when they are joined, the inter-pixel distance between the edge pixels of two adjacent tiles is the same as the inter-pixel distance of adjacent pixels in the interior of a tile.

Ex. 1004, 5:47–53. Similarly, Matthies again states: "The edges of the tiles are desirably carefully formed to ensure that the tiles display has no visible seams between the tiles. One criterion for the tiles is that the spacing between the pixels separated by the tile seam is the same as the spacing of pixels on the tile." *Id.* at 8:37–41.

Figure 8B of Matthies is reproduced below.

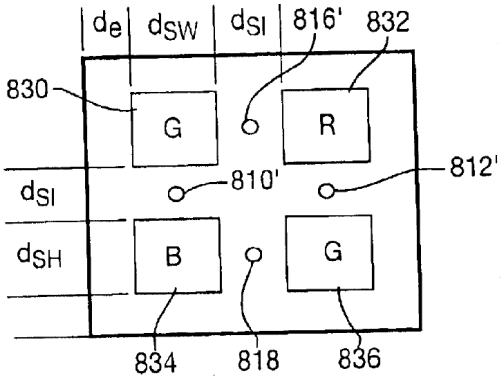


FIG. 8B

Figure 8B is "a front-plan view of an alternative single color pixel structure which includes separate sub-pixels." Ex. 1004, 4:12–13. According to

Matthies, Figure 8B illustrates a "color pixel structure" that "includes four sub-pixel elements, 830, 832, 834 and 836." *Id.* at 16:62–64. "Two of these sub-pixel elements, 830 and 836 emit green light when stimulated while the other two pixel elements, 832 and 834 emit red and blue light, respectively." *Id.* at 16:64–66. Matthies indicates that "[t]his structure is known as a quad sub-pixel structure." *Id.* at 16:67. According to Matthies, "[t]he geometry of the quad sub-pixel structure is defined by the dimensions d_{SH}, the height of the sub-pixel, d_{SW}, the width of the sub-pixel, d_e, the distance from the active sub-pixel areas to the edge of the pixel area, and d_{SI}, the distance between adjacent sub-pixels." *Id.* at 17:16–20. Matthies further provides a table of exemplary dimensions for d_{SH}, d_{SW}, d_e, and d_{SI}. *Id.* at 17:24–29 (Table 2).

Matthies further describes:

> The basic light emitting structure consists of a thin organic polymer layer sandwitched between a pair of appropriately selected and patterned electrodes. Current flowing form one electrode to the other electrode causes the organic polymer to emit light. At least one of the electrodes is desirably transparent to the emitted light. Indium tin-oxide is the usual material used for this purpose. OLED materials provide high brightness and high efficiency, and are relatively low cost materials.
>
> An exemplary display structure according to the present invention is formed in two parts: a display section and an electronics section. These two parts are made separately and then joined to form a complete tile. The display section consists of a transparent glass layer on which are transparent column electrodes are disposed. The OLED material is deposited onto these layers, as the active (i.e., light emitting) medium. Row electrodes are deposited as the final display layer.

Ex. 1004, 6:19–36.

Matthies teaches that a "tile may also include circuitry which automatically adjusts the pixel brightness to compensate for aging of the display material," such as a "small light sensor over one or more pixel positions which continually monitors the brightness of that pixel and adjusts the current level applied to that pixel—and the current levels applied to all of the other pixels on the display—to compensate for variations in pixel brightness due to aging of the display." Ex. 1004, 11:47–58. Matthies also teaches "that the decay in the brightness of an OLED pixel that occurs with aging can be predicted" by, for example, "measuring the current and time for a particular pixel, and integrating the product of current and time" or by "monitor[ing] the voltage that is applied to the pixel." *Id.* at 11:61–12:16. Matthies indicates that the "methods for adjusting the current applied to a pixel in order to maintain a predetermined brightness level may be combined with any other method either as a check or to augment the performance of the other method." *Id.* at 12:41–46.

3. Overview of Yamada (Ex. 1008)

Yamada relates to an "electroluminescence (EL) display apparatus." Ex. 1008, 1:6–7. Yamada discusses an "EL display apparatus" including "emissive regions 1B [blue], 1R [red], and 1G [green] for the display pixel of the respective color . . . arranged in a matrix configuration." *Id.* at 2:55–60. Yamada indicates that "the emission efficiency of the emissive layer for emitting light of various colors differs with each color." *Id.* at 2:53–54. According to Yamada, when the pixels "all have identical emissive areas in size," "in order to obtain the same luminance at the display pixels having a low emission efficiency, a current larger than that supplied to the other display pixels having a high emission efficiency must be supplied." *Id.* at 2:55–64. Yamada teaches that "[t]his causes the life of those display

pixels having a low emission efficiency, in particular, to shorten, and also possibly causes the life of the EL display apparatus to shorten." *Id.* at 2:64–67.

Yamada purports to improve upon these aspects of EL displays by way of "a color display device, in which a display pixel having an emissive element is provided for every color, wherein the emissive area of the display pixel of any one color, among the display pixels of various colors, is different in size from the emissive area of the display pixel of another color." Ex. 1008, 3:17–22. According to Yamada,

> [b]y setting the emissive area of the display pixel, namely, the emissive area of the emissive element, in accordance with the emission efficiency of the emissive element as in the foregoing, and by supplying, for example, the same power to the emissive elements of colors having different emission efficiencies, it becomes possible to have the same emission luminance at the various display pixels.

Id. at 3:65–4:5. Therefore, Yamada states "it is possible to prevent the deterioration from accelerating when a load is selectively placed on the emissive element having low emission efficiency and extend the life of the display device." *Id.* at 4:11–14.

Figure 4 of Yamada is reproduced below.

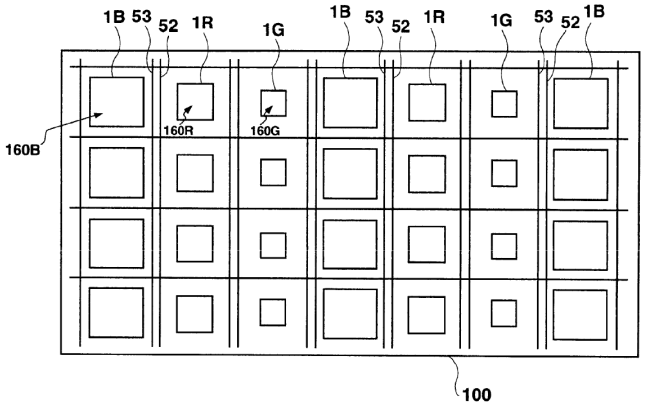


Fig. 4

Figure 4 is a "conceptual diagram showing emissive region areas of the EL display apparatus." Ex. 1008, 6:24–25. According to Yamada, Figure 4 "is a top plan view of an EL display apparatus 100" representing "a case where the respective display pixels emit red (R), green (G), and blue (B) light." *Id.* at 6:49–52. "[I]n the case of FIG. 4, the emissive area of the green display pixel 1G is provided as the smallest," while "[e]missive regions 1R and 1B of the other colors are formed with a larger area than that of emissive region 1G." *Id.* at 7:6–10. Yamada indicates that while in Figure 4 the "[a]rea of green emissive region 1G<area of red emissive region 1R<area of blue emissive region 1B," "the order in size of the emission region areas is not fixed at the above-mentioned green<red<blue, but is determined by the emission efficiency of the emissive materials that are used." *Id.* at 7:10–19.

4. Independent Claim 1

We find below that Petitioner has not set forth a persuasive rationale for combining Matthies and Yamada. We first discuss Petitioner's contentions for the preamble of claim 1 and limitations [1-a], [1-a(1)], [1-a(2)], [1-a(3)], [1-a(4)], and [1-c] of claim 1. Thereafter, we explain why Petitioner has not set forth a persuasive rationale to combine the teachings of Matthies and Yamada to meet limitation [1-b].

a) Preamble [1-pre]

The preamble of claim 1 recites "[a] pixel arrangement structure of an organic light emitting diode (OLED) display." Ex. 1001, 8:58–59. Petitioner asserts: "Matthies discloses a tiled 'electronic display device.'" Pet. 20 (citing Ex. 1004, 1:8–10.) The Petitioner also asserts: "The display can be an 'OLED . . . display' that includes OLED 'pixel forming elements.'" *Id.* (citing Ex. 1004, 5:29–30, 6:18–22, 16:40–43) (alteration in original). Patent Owner does not argue otherwise.

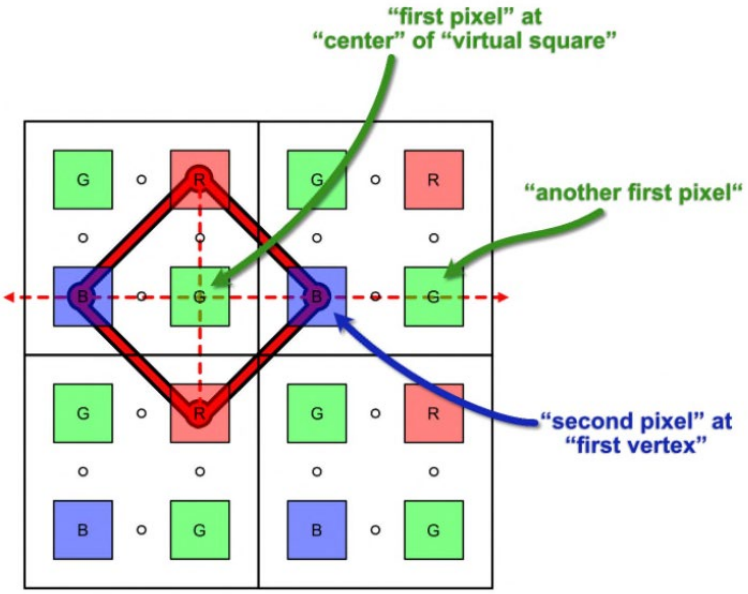
b) Limitations [1-a], [1-a(1)], [1-a(2)], [1-a(3)], [1-a(4)], and [1-c]

Limitation [1-a] recites "a plurality of pixels for displaying an image on the OLED display." Ex. 1001, 8:60–61. Petitioner explains:

> Matthies relates to an "OLED . . . display device." (Ex. 1004, 3:6–7, 5:29–30, 6:18–22, 16:40–43.) This device is formed as a "tiled display" that includes a multitude of "picture element[s]" or "pixels." (Ex. 1004, Abstract; *see also id*., 2:35–37.) In one embodiment, the display pixels can be formed from "red(R) . . ., green (G) . . . and blue (B) . . . sub-pixels," each of which is formed from an "OLED material[.]" (Ex. 1004, 16:40–44; 13:1–2.)
>
> The sub-pixels receive "image data for display." (*Id*., 2:58–63.) Each sub-pixel can [be] "controlled by a single row and column electrode pair." (*Id*., 16:38–41; *see also id*., 9:10–13; Fig. 2.) There can be a large number of sub-pixels in each of the display's tiles (*i.e.*, from 16 to 896). (*Id*., 5:54–61.)
>
> In the '803 patent, the "term pixel refers to a minimum unit for displaying images." (Ex. 1001, 1:31–32; 3:55–56.) Matthies includes such a "**plurality of pixels**" (its red, green, and blue OLED sub-pixels are its display's minimum unit). And, Matthies' sub-pixels together form an "**OLED display**" for "**displaying an image**." (Ex. 1003, ¶¶ 151–159.)

Pet. 21 (all alterations in original). Patent Owner does not present a contrary argument in this regard.

Petitioner then presents an expanded version of tile 124 in Figure 1 of Matthies, reproduced below with Petitioner's color annotations, to illustrate how limitations [1-a(1)], [1-(a)(2)], [1-a(3)], and [1-c] are met by Matthies:

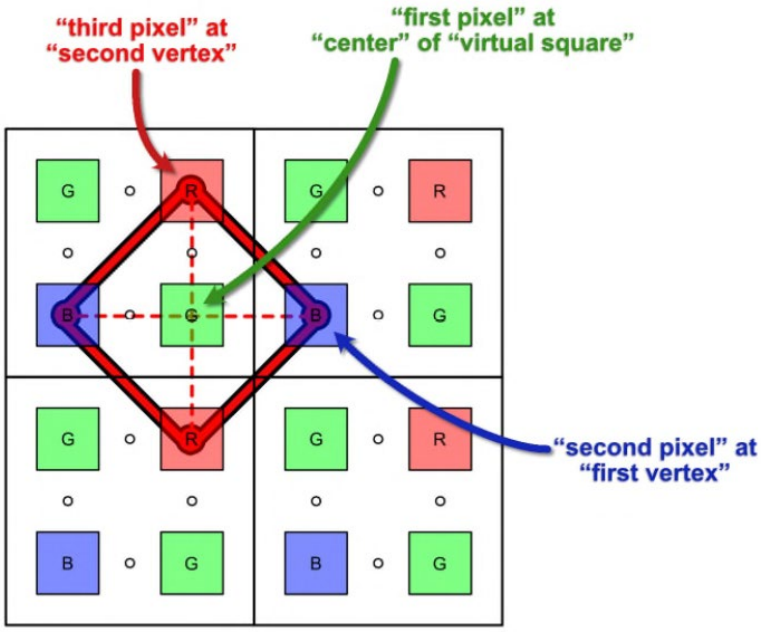


In this illustration, Petitioner expands tile 124 in Figure 1 of Matthies, with color annotations of elements including "another first pixel," "second pixel at a first vertex," "first pixel at center of virtual square," and "virtual square" to show Matthies's disclosure of limitations [1-a(1)], [1-(a)(2)], [1-a(3)], and [1-c]. Pet. 25–29.

Specifically, the illustration shows a first pixel (green) having a center coinciding with the center of a virtual square (red sides), which is limitation [1-a(1)]. The illustration shows a second pixel (blue) separated from the first pixel and having a center at a first vertex of the virtual square, which is limitation [1-a(2)]. The illustration shows another first pixel (green) on a line defined by the center of the virtual square and the first vertex, where the first pixel, the second pixel, and the other first pixel are consecutive pixels on the line, which is limitation [1-a(3)]. Limitation [1-c] recites that the first pixel is configured to emit green light. As shown in the illustration, the first pixel is green. Patent Owner does not present a contrary argument with regard to these contentions of Petitioner.

Limitation [1-a(4)] recites: "a third pixel separated from the first pixel and the second pixel, and having a center at a second vertex neighboring the first vertex of the virtual square." Ex. 1001, 9:4–6.

Petitioner presents an expanded version of tile 124 in Figure 1 of Matthies, reproduced below with color annotations from Petitioner, with elements including "first pixel at center of virtual square," "second pixel at a first vertex," "third pixel at second vertex," and "virtual square" to show how limitation 1-a(4) is met by Matthies:



The illustration shows a third pixel (red) separated from the first pixel (green) and the second pixel (blue), and having a center at a second vertex neighboring the first vertex of the virtual square. Pet. 29–30. Patent Owner does not present a contrary argument with regard to these contentions of Petitioner.

c) Limitation [1-b]

Limitation [1-b] recites "wherein the second pixel has a larger area than that of the third pixel." Ex. 1001, 9:7–8. Petitioner relies on a combination of Matthies and Yamada for limitation [1-b]. Pet. 30–31.

(1) Petitioner's Reasoning

Petitioner explains:

> Matthies explains that it also "contemplates both larger and smaller pixel apertures." ([Ex. 1004,] 17:36–28.) Further, sub-pixel spacing can also be made "different" if needed. (*Id*., 17:31–33; *see also id*., 19:9–10 (referencing the use of "different pixel pitches").)
>
> Yamada provides an example of an array of red, green, and blue pixels that are differently sized and have different amounts of pixel-to-pixel spacing. Like Matthies, Yamada relates to an "electroluminescent display apparatus." (Ex. 1008, 1:6–10.) Also like Matthies, Yamada explains that such a display includes red, blue, and green "pixel[s] . . . arranged in a matrix configuration." (*Id*., 2:55–60; *see also id*., 6:44–7:2.) In such a display, the different colors' "emission layer[s]" have different "emission efficienc[ies]." (*Id*., 2:53–54.) To account for this, Yamada re-sizes the pixels "in accordance with . . . emission efficiency." (*Id*., 2:5–60, 3:16–27.) Yamada explains that in a typical OLED display, the "green pixel" has the highest efficiency and is thus made smallest, while the "blue pixel" has the lowest efficiency and is made largest. (*Id.*, 7:3–12, 8:19–28; 8:47–52; 10:52–55; 11:4–15; *see also* 3:38–44, 3:51–57.)

Pet. 30–31 (alterations in original).

Petitioner relies on Yamada's Figure 4 (Pet. 21), reproduced below:

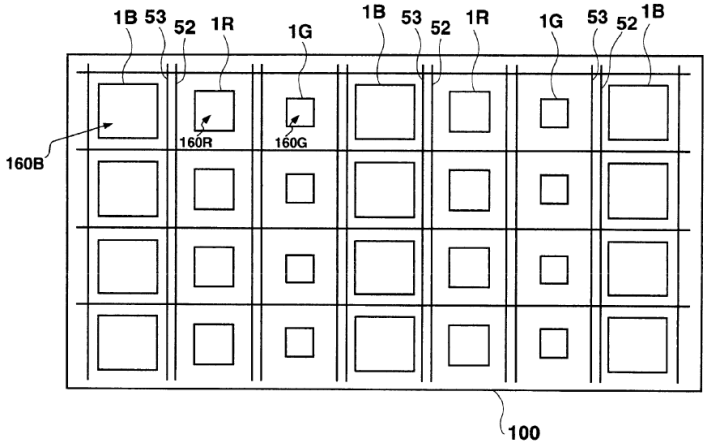


Fig. 4

Figure 4 shows the emissive regions areas of the electroluminescent display apparatus according to an embodiment of Yamada. Ex. 1008, 6:24–26.

Yamada describes what is shown in Figure 4 as follows:

> As shown in FIG. 4, the display pixels for the various colors are arranged in a matrix configuration on the substrate. The emissive areas of the display pixels differ among 1R, 1B, and 1G. Specifically, in the case of FIG. 4, the emissive area of the green display pixel 1G is provided as the smallest. Emissive regions 1R and 1B of the other colors are formed with a larger area than that of emissive region 1G. More specifically in this case: Area of green emissive region 1G<area of red emissive region 1R<area of blue emissive region 1B.
>
> The order in size of the areas of the green, red, and blue emission regions 1G, 1R, and 1B is dependent on the emission efficiency of the emissive materials of the organic EL element 160. Therefore, the order in size of the emission region areas is not fixed at the above-mentioned green<red<blue, but is determined by the emission efficiency of the emissive materials that are used.

Ex. 1008, 7:3–18. Yamada also indicates that its teachings are applicable to an arrangement of the display pixels in a "delta layout" and a "diagonal layout" besides the "stripe layout" shown in Figure 4. *Id*. at 12:37–40.

Yamada further provides a specific example of an area ratio among pixels of different colors: "The ratio of emissive areas of the colors required to achieve a luminance of '1' among all the colors is set to 1/10:1/3.8:1/1.8=1:2.6:5.6." *Id*. at 11:8–10.

Petitioner further explains:

> Following these teachings, rather than making all the sub-pixels all the same size, a POSITA [person of ordinary skill in the art] would have understood that Matthies' sub-pixels should be re-sized in accordance with their emission efficiencies such that the "first pixels" (the green sub-pixels) are smallest, the "second pixels" (the blue sub-pixels) are largest, and the "third pixels" (the red sub-pixels) have an intermediate size. The same "quad sub-pixel structure" taught by Matthies would continue to be used (just with re-sized pixels). (*See* [Ex. 1003] ¶¶ 222–224).

Pet. 32.

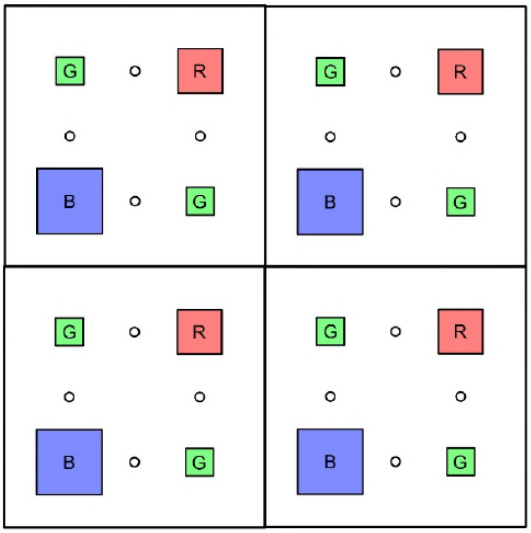
As motivation to combine, Petitioner points to Yamada's teaching that it was a problem in prior art OLED devices that the red, green, and blue pixels all have the same size, because the different colored pixels have different emissive efficiencies. Pet. 39 (citing Ex. 1008, 2:55–63). Petitioner notes Yamada's disclosure that to achieve consistent pixel luminance with same-sized pixels, the pixels with lower emission efficiencies, such as blue pixels, must be supplied with a larger current than the pixels with higher emission efficiencies, such as green, and that that causes the pixels supplied with a larger current, such as blue pixels, to have a shorter life span. *Id.* (citing Ex. 1008, 2:55–66). Petitioner further notes Yamada's disclosure that when the size of pixels of different colors are the same, color balance is difficult to achieve and would require adjustments in the supplied current which causes deterioration of pixels supplied with the higher current. *Id.* (citing Ex. 1008, 3:1–6).

Petitioner explains:

> To address this problem, Yamada teaches that the pixels with lower emission efficiencies (blue) should be made larger than pixels with higher emission efficiencies (green). (*See* [Ex. 1008], 3:38–44, 3:51–57; 7:3–12, 8:19–28; 8:47–52; Figs. 4, 9.) Because the pixels have different sizes, luminance can be balanced while supplying each of the pixels with similar amounts of current or power. (*See id*., 3:65–4:9.) This avoids the deterioration problem experienced in prior art OLED displays with same-sized pixels and "extend[s] the life of the display devices." (*See id*., 4:5–14; *see also* 10:61–11:3.) As an added benefit, the overall display design becomes "simplified" and "extremely easy to control" as each pixel is supplied with "the same amount of power." (*Id*., 4:57–5:8; *see also id*., 5:41–49; Ex. 1003, ¶¶ 268–273.)

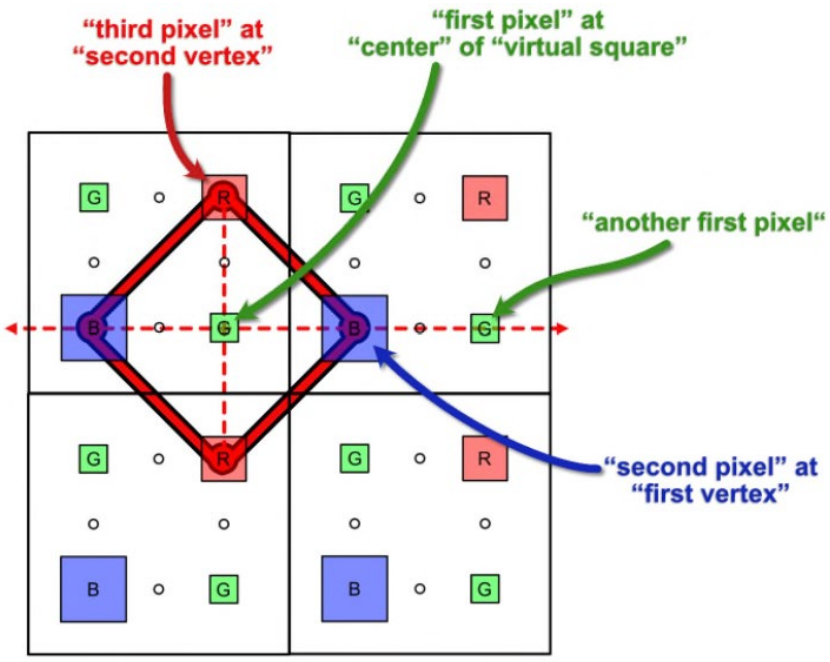
Pet. 39–40. Additionally, Petitioner asserts that one of ordinary skill in the art would have recognized that applying Yamada's re-sizing teachings to Matthies would have provided Matthies with greater design flexibility. *Id*. at 43. In that regard, Petitioner explains that reducing the size of the more luminant green and red pixels while leaving the size of the blue pixels the same would create additional space for Matthies's vias. *Id*. at 43–44 (citing Ex. 1003 ¶ 297).

Petitioner provides an illustration of a modified tile of Matthies, with pixels re-sized according to Yamada's formula of 1:2.6:5.6 for green to red to blue:



Pet. 33. The illustration shows Matthies' "quad sub-pixel structure" but with the sizes of the sub-pixels modified according to the formula given in Yamada for green to red to blue as 1:2.6:5.6. *Id*. at 32. Petitioner explains: "consistent with Matthies' teachings, it continues to be the case that no pixel occupies more than '1/4 of the total pixel area.'" *Id*. (citing Ex. 1004, 15:67–16:2, 13:11–14).

Petitioner then provides the following illustration of a modified Matthies pixel configuration according to the re-sizing teachings of Yamada, with color annotations to show satisfaction of all elements of claim 1, i.e., the claimed virtual square, the claimed first pixel at the center of the virtual square, the claimed another first pixel, the claimed second pixel at the first vertex of the virtual square, and the claimed third pixel at a second vertex of the virtual square, where the first pixel, the second pixel, and the other first pixel being consecutive pixels on a line defined by the center of the virtual square and the first vertex, *where the second pixel is larger than the third pixel*, and where the first pixel emits green light:



Pet. 33. In this illustration from the Petition, Petitioner has modified Matthies' pixel configuration according to the re-sizing teachings of Yamada. *Id.*

(2) Discussion

(a) Matthies's Constraint on Sizing

Patent Owner provides an annotated version of Matthies's Figure 8B, reproduced below.

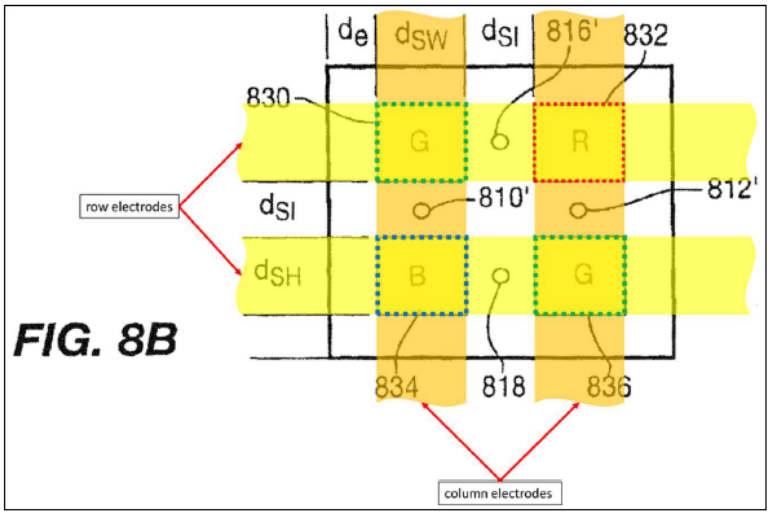


FIG. 8B

PO Resp. 13. Figure 8B of Matthies illustrates a pixel structure including four separate sub-pixels, two green, one blue, and one red, and Patent Owner has colored row electrodes yellow and column electrodes orange with labels leading to them by red arrows. *Id.*; Ex. 1004, 4:12–13. Patent Owner explains:

> The light-emitting area in Matthies' PMOLED [passive matrix OLED] is defined by the overlap of Matthies' row and column electrodes. Thus, in Matthies' Figure 8B (. . . with annotations), all pixels in the same row (e.g., green pixel 830 and red pixel 832 in the top row) have the same height, and all pixels in the same column (e.g., green pixel 830 and blue pixel 834 in the left column) have the same width . . . .
>
> A POSITA would have recognized that, unlike in Yamada, changing the size of a pixel in Matthies' Figure 8B would entail changing the size of its row and/or column electrode, which would both (1) change the size of all the other pixels defined by that row and/or column electrode and (2) have electrical effects that could diminish display performance.

PO Resp. 13–14 (citing Ex. 1004, 17:10–20, Fig. 8B; Ex. 2009 ¶¶ 121–128).

Patent Owner further explains: "Matthies' geometric requirements flow from its PMOLED design, as each pixel is defined by the overlap of column and row electrodes, and two different color pixels are found on each row (and column) electrode." PO Resp. 26. Patent Owner asserts that Petitioner ignores that its proposed re-sizing is incompatible with Matthies. *Id.* at 28–29. For example, Patent Owner notes:

> Blue pixel 834 and green pixel 836 have the same height as the row electrode, and blue pixel 834 and green pixel 830 have the same width as the column electrode. To make the green pixel smaller would entail making one or both electrode narrower, which would make the blue pixel correspondingly smaller (and would also have electrical and other effects).

Id. at 29 (citing Ex. 2009 ¶ 193).

We agree with Patent Owner's assertions. Petitioner has not adequately explained how Matthies's sub-pixels may be made larger or smaller, individually, to implement Yamada's pixel sizing in order of emission efficiency, i.e., the most efficient green pixels being the smallest, with the moderately efficient red pixels being larger and the least efficient blue pixels being the largest.

Petitioner responds by asserting that "Matthies repeatedly explains that the pixels making up its display can have different sizes and shapes. (*E.g.*, Matthies, 17:36-37 (referencing 'larger and smaller pixel apertures'); 18:63-64 ('[o]ther tile configurations are contemplated'); 19:8-12 ('different pixel pitches' can be employed).)" Reply 11 (alteration in original). None of the referenced text, however, conveys that within each individual tile the various colored pixels optionally may have different sizes. Nor does Dr. Pattison testify about how an ordinarily skilled artisan would have resized Matthies's pixels based on the referenced text to achieve Petitioner's proposed spacing. Rather, these references broadly cover the entire display made up of all the tiles. In addition, Petitioner wrongly conflates the concepts of "pixel pitch" and "pixel size" in making its arguments. *See id.* at 10–11; Tr. 04:24–105:4. "Pixel pitch" refers to spacing between pixels and is not necessarily indicative of pixel size. *See* Ex. 1004, 24:9–11 ("A display tile has an array of pixels equally spaced a distance known as P, the pixel pitch."). For these reasons, we do not agree with Petitioner that Matthies contemplates differently sized pixels within each tile of the display, or differently sized pixels along the column or row electrodes of the display.

We credit, instead, the testimony of Dr. Kymissis, in paragraphs 121–128 of his Declaration (Ex. 2009), explaining the difficulties of

accomplishing individual sizing of pixels. For instance, Dr. Kymissis testifies:

> If a POSITA were to try to change the size of a pixel in the PMOLED shown in Figure 8B, that would require changing the size of a row and/or column electrode, but doing so would also change the size of all the other pixels defined by that row and/or column electrode." Dr. Pattison does not give any explanation of how the pixel sizes could be individually arbitrarily changed into the proportions that he suggests should be used, and it is not clear how such a display could be made.

Ex. 2009 ¶ 123.

> It is not a simple matter to resize the row and/or column electrodes to be irregular. An engineer would have to somehow design and develop a mask to pattern each of the row and column electrodes to be shaped to accommodate the alternatingly large and small pixel shapes required by Dr. Pattison's combination. Patterning the electrodes would further add a process step, increasing manufacturing costs and reduce yield. Additionally, if a POSITA were to try to make such irregularly sized electrodes, that would have an effect on the IR voltage drop, which would need to be compensated differently than in a typical PMOLED display with uniformly sized electrodes, thus adding additional complexity to the design. This would necessitate changes not only to the structure of the electrodes, but also to the display driver circuitry for applying the appropriate voltages to the row and column electrodes to allow the OLED to display images.

Id. ¶ 124.

In its Reply, Petitioner does not dispute Patent Owner's assertion that varying pixel sizes within each tile in accordance with emissive efficiency as Petitioner has proposed for the passive-matrix display of Matthies would be problematic or Dr. Kymissis' testimony that it is not clear how it could be done. Instead, Petitioner shifts its focus to active-matrix displays, which do not use row and column electrodes. Reply 2–4.

In the Reply, Petitioner asserts:

> Matthies does explain that "exemplary embodiment[s]" "employ[] a passive addressing technique." (Matthies, 10:31-33.) But it **also** teaches "active matrix" displays. Petition, 13 (quoting Matthies, 8:21–26). In fact, Matthies **repeatedly** states that it is equally applicable to both actively and passively driven OLEDs. (*Id.*, 7:15-19 ("display" can be "active and passive"); 7:42-45 ("active" or "passive . . . circuits" can be employed); 8:21-23 ("electronics," such as "pixel driving circuitry[,]" can be "both active and passive"); 8:20-26 (referencing "active matrix circuits" particularly with "high temperature" substrates); 8:30-33 (use of either "active or passive devices" is contemplated).)

Reply 2–3 (emphasis by Petitioner) (alterations in original). On that basis, Petitioner further asserts: "Here, a POSITA plainly would have understood—just as Matthies itself states—that Matthies' OLED pixel arrangements can be used in both passive- and active-matrix displays." *Id.* at 3. Additionally, Petitioner asserts that numerous other references teach that the same pixel layout can be employed with both passive- and active-matrix OLEDS. *Id.* at 4.

For reasons discussed below, these reply contentions by Petitioner distort the disclosure of Matthies, are misplaced and unpersuasive, and also raise an impermissible new argument.

Petitioner's citations to Matthies's teachings of active circuit components do not cure the deficiencies in its rationale for modifying the passive matrix display embodiment in Matthies's Figure 8B, because Petitioner does not persuasively show how such active components would allow for differently sized pixels in a passive matrix display. These deficiencies would remain even if we assumed, *arguendo*, that the cited teachings regarding active electronics from Mathies pertained specifically to active matrix OLED displays, which they do not.

In its Sur-reply, Patent Owner explains:

> 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. 1018, 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.*, a an alternative to attaching discrete, preformed 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").

Sur-reply 5–7 (alterations in original).

Dr. Pattison acknowledges that Matthies does not use the term "active matrix addressing." Ex. 2086, 81:9–12. We agree with Patent Owner that nowhere does Matthies disclose or describe having an individual circuit for

each pixel. Petitioner has not persuasively shown any such disclosure in Matthies.

There is just one mention of "active matrix" in Matthies:

> The electronics which form the image processing and pixel driving circuitry are mounted on the layers. Electronics are used in the broadest sense to include both active and passive, and both discrete devices mounted on the layers and devices formed in place by processes such as those now used to make active matrix circuits for displays on various high temperature substrates.

Ex. 1004, 8:20–26. Petitioner does not persuasively show how such electronic components would inform one of ordinary skill in the art how to make differently sized pixels in a passive matrix display as Petitioner has proposed with respect to a modification of Mathies's Figure 8B.

Rather, as recognized by Dr. Pattison (Ex. 2086, 46:8–47:19), Matthies states that the electronics forming its disclosed "image processing and pixel driving circuitry" may be created two ways: (1) mounting discrete devices on a substrate; or (2) forming devices in place on the substrate using processes like those used to make active matrix circuits. *See* Ex. 1004, 8:20–26. Regarding the second option, Dr. Pattison recognized that this refers to "a whole field of making transistors and passive components that are integrated into electronics." Ex. 2086, 47:10–19. In this sense, the reference to "active matrix" simply identifies known semiconductor manufacturing processes. It does not teach or suggest implementing Matthies's embodiments with active-matrix OLED circuits which provide for variable sizing of individual pixels. And, regardless of how an ordinarily skilled artisan would have understood the mentions of the word "active" in Matthies, Petitioner never explains how Matthies's passively driven

embodiment in Figure 8B would have been modified to accommodate differently sized pixels.

We find that Matthies does not disclose or describe an active-matrix embodiment for the pixel layout shown in Figure 8B. We agree with Patent Owner that "[e]very disclosure in Matthies indicates its display is passive-matrix." Sur-reply 6.

Petitioner additionally argues that "**[b]oth** passive- and active-matrix OLEDs are embraced [by the challenged claims]." Reply 4. Petitioner asserts that "Patent Owner's arguments to the contrary essentially require more specificity and detail from the prior art than the '803 patent itself provided." *Id.* at 5. Patent Owner has not argued that the challenged claims exclude active-matrix or passive-matrix OLED displays. That the '803 patent itself does not describe how to implement pixels of varying sizes in a passive-matrix display does not help the Petitioner here, because in this proceeding it is Petitioner who bears the burden of proof and who needs to show a reasonable expectation of success in accomplishing what it proposes.

For the foregoing reasons, Petitioner has not shown why or how an ordinarily skilled artisan would have implemented Yamada's teachings of different pixel sizes in Matthies's disclosed passive-matrix display.

We further agree with Patent Owner that even assuming Matthies discloses an active-matrix display embodiment, Petitioner may not, at the time of the Reply, switch its position to rely on it, because the Petition did not rely on any such embodiment. Sur-reply 7. Patent Owner correctly states: "Petitioner's theory [in the Petition] is exclusively based on modifying Matthies' passive-matrix Figure 8B display. Petition, 23-26; DI, 16, 20-21." *Id.*

(b) Petitioner's Proposal Reduces Lifetime of Green and Red Pixels

Patent Owner asserts that "[a]lthough the purported rationale for Petitioner's proposed combination is to *increase* the lifetime of Matthies' display (Pet. at 40-41), Petitioner's proposed modifications would have had the opposite effect, *shortening* its lifetime. Ex. 2009, ¶¶133-139." PO Resp. 14. Patent Owner notes that Petitioner relies on Yamada as teaching to make the blue light-emitting area larger to lower the current density for blue light emission and thus lengthening the lifetime of blue pixels. *Id.* at 15 (citing Pet. 19, 70). Patent Owner explains:

> But Petitioner's proposed modifications to Matthies' structure do not make the blue light-emitting area larger. They would not reduce the blue pixels' current density or extend their lifetime. Instead, Petitioner's proposal would shrink the red and green pixels, substantially reduce their light-emitting areas, increasing their current densities and reducing their lifetimes. Ex. 2009, ¶¶136-137.
>
> Petitioner's proposed combination would **reduce** the lifetime of Matthies' display overall, contradicting Petitioner's purported rationale for it. Ex. 2009, ¶¶136-137. And AMOLEDs like those in Matthies were already well-known to suffer from short lifetimes. A POSITA would have had no reason to make Petitioner's proposed combination nor a reasonable expectation of success in doing so. *Id.*, ¶¶136–139.

Id. at 15–16. These assertions are supported by the cited testimony of Dr. Kymissis. Dr. Kymissis testifies: "By reducing the sizes of the red and green pixels, Dr. Pattison's proposed modification would require a significantly higher current current density to be supplied to the red and green pixels to maintain the same brightness as before." Ex. 2009 ¶ 137. Dr. Kymissis also testifies: "And by reducing the sizes of the red and green pixels, the life of the red and green pixels would be **reduced**." *Id.* ¶ 136.

Dr. Kymissis further also testifies: "a POSITA, particularly a POSITA concerned with the lifetime of the display, would not have sought to reduce the sizes of any of the pixels, as Dr. Pattison suggests, because doing so would decrease the lifetime of the display." *Id.* We credit these testimony of Dr. Kymissis.

Petitioner does not dispute that reducing the size of the red and green pixels would reduce the lifetime of the red and green pixels. Petitioner responds to Patent Owner's assertion as follows:

> Patent Owner is also wrong when it argues that Matthies' display lifetime will purportedly not be "extend[ed]" unless Matthies' blue pixels are made "larger." Response, 15. While it is of course true that supplying a lower current density to blue pixels will increase those pixels' lifetime, this is only half the story. The art teaches that it is also important for pixels to age at approximately the same rate relative to each other. (Ex. 1017, ¶¶ 34-38.
>
> Here, Yamada explains that if increased "load is selectively placed" on a subset of pixels, their "deterioration" is "accelerated" relative to the other pixels. (Yamada, 3:62-4:14; see also 5:4-8.) This not only increases the risk of individual pixel failure, but it also decreases the display's overall "service life" by making it more difficult to maintain color or "white balance." (*Id.*, 11:48-55; see also 2:64-67 (application of larger currents to certain pixels impacts overall "life of the EL display apparatus").) So, resizing OLEDS pixels in accordance with emission efficiency both prevents less efficient blue pixels from failing earlier and prevents different pixel aging rates from impacting display usability over time. (Ex. 1017, ¶¶ 45-48.)
>
> This same concept is also discussed elsewhere. For instance, another reference cited in the Petition explains that by resizing an OLED display's pixels, the "light emitting elements will age at approximately the same rate. . ." (Ex. 1015, 4:32-37.) This in turn avoids the "color shift expressed" when pixels age differently. (*Id.*, 4:43-45.) Another reference similarly explains

> that "[t]o maintain a well-balanced, full color display, it is important that the relative luminance of the three-colored materials be maintained throughout the lifetime of the display." (Ex. 2011, 1:50-56.) Once again, this improves the display's "useful lifetime" by "maximiz[ing] the time that the relative luminance of the three-color elements can be maintained. . . ." (*Id.*, 2:1-4.)

Reply 5–7 (alterations in original). In summary, Petitioner asserts that the useful life of an OLED display is dictated not only by the lifetimes of the individual pixels, "but also by how long proper color and white balance can be maintained," and that "[b]y applying Yamada's teachings, a POSITA would have understood that Matthies' pixels would all age at or near the same rate." *Id.* at 7.

We agree with Patent Owner that the above-noted response by Petitioner in the reply presents an impermissible new argument that its proposed combination would improve the useful lifetime of the display by maintaining color or white balance longer. The original theory in the Petition simply is that (1) because blue pixels have lower emission efficiencies, they require a larger current, and the larger current reduces the lifetime of the blue pixels thus impacting the overall life of the display, and (2) to solve that problem Yamada proposes to make the blue pixels larger than pixels with higher emission efficiencies. Pet. 39–40. For example, the Petition states: "To address this problem [shorter lifetime of blue pixels and complications resulting therefrom], Yamada teaches that the pixels with lower emission efficiencies (blue) should be made larger than pixels with higher emission efficiencies (green)." *Id.* Petitioner does state in the Petition: "As an added benefit, the overall display design becomes 'simplified' and 'extremely easy to control' as each pixel is supplied with

'the same amount of power." *Id.* at 40. But this added benefit is hinged on Petitioner's explanation of the base benefit, i.e., making the blue pixels larger.

"Petitioner may not submit new evidence or argument in reply that it could have presented earlier, e.g., to make out a prima facie case of unpatentability." PTAB Consolidated Trial Practice Guide November 2019 (CTPG), 73–74. Section 42.23(b), Title 37, Code of Federal Regulations provides: "A reply may only respond to arguments raised in the corresponding opposition." Although a reply may respond to arguments raised in the PO Response, "'Respond,' in the context of 37 C.F.R. § 42.23(b), does not mean proceed in a new direction with a new approach as compared to the positions taken in a prior filing." CTPG, 74. Petitioner's argument in the Reply changes the thrust and direction of its original argument in the Petition and thus is not entitled to consideration. We decline to consider it.

Thus, we are not persuaded that, based on Yamada's teachings, one of ordinary skill in the art would have modified the pixel sizing in Matthies as proposed by Petitioner.

(3) Conclusion for Limitation [1-b]

We conclude that Petitioner has not persuasively shown that an ordinarily skilled artisan would have combined Matties and Yamada in the manner suggested by Petitioner to meet limitation [1-b].

d) Conclusion for Claim 1

For the foregoing reasons, Petitioner has not set forth a persuasive reason for one of ordinary skill in the art to combine the teachings of Matthies and Yamada in the manner suggested by Petitioner. Petitioner has

not shown by a preponderance of the evidence that claim 1 would have been obvious over the combination of Matthies and Yamada.

5. Dependent Claims 2–4 and 19–21

Claims 2–4 and 19–21 each depend, directly or indirectly, on claim 1. The deficiencies in Petitioner's accounting for claim 1, as discussed above, equally apply to claims 2–4 and 19–21. Petitioner has not shown by a preponderance of the evidence that claims 2–4 and 19–21 would have been obvious over the combination of Matthies and Yamada.

E. Alleged Obviousness of Claims 1–4 and 19–21 over Phan

1. Overview of Phan

Phan is a U.S. patent directed to a "display comprising pixels and dots." Ex. 1005, 1:18–19. Phan indicates that such a display may be one of a number of display technologies including an OLED display. *Id.* at 1:19–29. According to Phan, "[t]he pixels generally consist of so-called dots representing the three basic colours red, green and blue." *Id.* at 1:59–61. Phan discloses displays in which "each dot has a receiver of its own . . . to convert digital information transmitted through [a] network . . . into luminous intensity levels for [the] dots." *Id.* at 5:16–19. Phan discloses "dynamic generation of pixels wherein a one-pixel logical unit is formed by grouping adjacent dots, with adjacent pixels being physically superimposed and the dynamic pixels being generated by sequential addressing at a rate such that said generation is not perceivable by the human eye." *Id.* at 2:66–3:4.

Figures 11a and 11b of Phan are reproduced below.

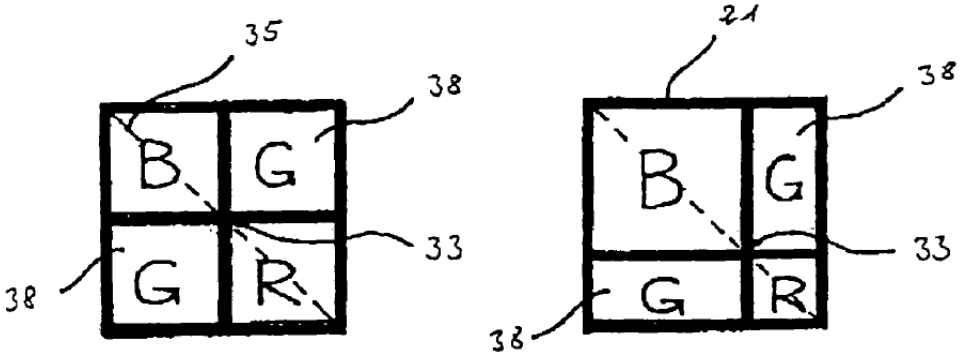


FIG. 11a FIG 11b

Figure 11a "shows a square quad pixel where the crosspoint 33 is in the centre of the four dots (individual elements) of equal light emitting area and space, contoured by black mask or black barrier ribs 21 with the same structure." Ex. 1005, 5:47–50. Figure 11b "shows a typical square quad pixel where the crosspoint 33 moving along the diagonal line 35 forms two dots (individual elements) of equal light emitting area and space 38 of green color (G)." *Id.* at 5:51–54.

Figure 12 of Phan is reproduced below.

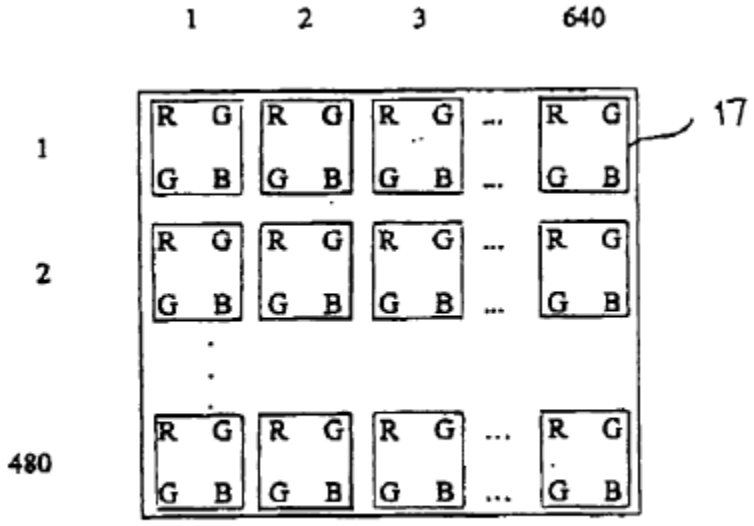


FIG. 12

Figure 12 "shows a quad pixels display with a resolution of 480x640 static pixels 17." Ex. 1005, 4:5–6, 5:55–56.

Petitioner notes that Phan issued August 15, 2006, and contends that Phan qualifies as prior art under 35 U.S.C. § 102(b). Pet. 16. Patent Owner does not contest the prior art status of Phan. We determine that Phan qualifies as prior art under 35 U.S.C. § 102(b) because Phan's issue date of August 15, 2006, is more than one year before the earliest effective filing date of the challenged claims, which is March 6, 2012. Ex. 1001, code (30); Ex. 1005, code (45).

2. Independent Claim 1

a) Preamble [1-pre]

The preamble of claim 1 recites "[a] pixel arrangement structure of an organic light emitting diode (OLED) display." Ex. 1001, 8:58–59. Petitioner cites Phan's teaching of a "display comprising pixels and dots." Pet. 46 (quoting Ex. 1005, 1:18–19) (citing Ex. 1005, 2:51–53). Petitioner contends that Phan's "teachings can be employed with various 'display technologies,' including 'Organic Light Emitting Diode (OLED)' displays." *Id.* (quoting Ex. 1005, 1:18–29) (citing Ex. 1003 ¶¶ 324–327). Petitioner also notes that "Phan includes two sets of example pixel designs," including the "quad pixel" designs of Figure 11a and 11b. *Id.* at 58–59 (citing Ex. 1005, 5:47–54). Petitioner contends that an ordinarily skilled artisan would have been motivated to use these pixel designs with the displays referenced elsewhere in Phan with "every reason to believe that those pixels can be successfully employed." *Id.* at 59 (citing Ex. 1003 ¶¶ 401–403); *see also* Ex. 1003 ¶ 321 (similar testimony from Dr. Pattison). In its Reply, Petitioner argues that, like Phan, "[n]umerous prior art references" teach that "the same pixel arrangement can be used by different displays." Reply 12–

13 (citing Ex. 1004, 5:28–35; Ex. 2018 ¶ 6). Petitioner specifically cites a reference known as Cok[6] for teaching that "the very same 'pixel pattern' shown in Figure 11b of Phan is useful with both 'passive-matrix or active matrix' OLEDs." *Id.* at 13 (citing Ex. 1015, 2:61–67, 4:8–15, Fig. 1).

Patent Owner disputes that Phan's pixel arrangements apply to OLEDs. PO Resp. 31–34; Sur-reply 15–16. Patent Owner argues that Phan makes a single passing reference to OLEDs among a "laundry list of every conceivable display technology," which does not "mean that [Phan's] embodiments of pixel arrangements were for OLEDs or for each of the listed alleged 'display technologies.'" PO Resp. 31–32 (citing Ex. 2009 ¶ 202); *see also* Sur-reply 16 (similar argument). Patent Owner also argues that "Phan does not state, nor suggest, that the pixel arrangements it draws, or Figures 11a and 11b specifically, would be suitable for an OLED display." PO Resp. 33.

As further evidence that Phan's embodiments do not relate to OLEDs, Patent Owner notes that "Phan mentions only CRT, LCD, LED, PDP, and FED in the sole portion of its specification containing any substantive discussion of the display technologies."[7] PO Resp. 33–34 (footnote omitted) (citing Ex. 1005, 1:56–2:46; Ex. 2009 ¶ 204) (footnote omitted). In a similar fashion, Patent Owner argues that an ordinarily skilled artisan would have known that Phan's mentions of "displays using 'optical fiber network[s]' and 'receivers' do not relate to OLEDs." *Id.* at 33 (alteration in original)

[6] U.S. Patent No. 6,867,549 B2, filed Dec. 10, 2002, issued Mar. 15, 2005 (Ex. 1015, "Cok").

[7] Patent Owner notes that the mention of "LED" in this context refers to "solid-state light-emitting diodes, which are distinct from OLEDs." PO Resp. 33 n.5 (citing Ex. 2009 ¶ 204). Petitioner does not dispute this.

(citing Ex. 1005, 5:9–24; Ex. 2009 ¶ 203). Patent Owner also argues that "Phan's virtual driving method—the heart of Phan's disclosure—would not be feasible in an OLED display." *Id.* at 34 (citing Ex. 1005, 2:35–38, 5:23–24, 5:55–60; Ex. 2009 ¶¶ 207–215). Patent Owner additionally notes that "Phan's figures depict essentially no spacing between adjacent dots," which is "not feasible for an OLED display due to issues of color mixing of the organic light-emitting materials and shorting between adjacent pixels." *Id.* (citing Ex. 2009 ¶¶ 205–206).

Finally, Patent Owner argues that Petitioner's allusions to other prior art references that use the same pixel arrangement for different types of displays should be rejected because they "do not support Petitioner's attorney argument" and because they effectively amount to new combinations. Sur-reply 16.

At the outset, we note that claim 1 includes no specific limitations directed to OLEDs other than reciting that the claimed "plurality of pixels" display an image on an OLED display. *See* Ex. 1001, 8:56–9:9. More specifically, claim 1 includes no limitations directed to the '803 patent's disclosures about "power lines for driving each of the pixels, such as a gate line, a data line, a driving power line" or "an anode, an organic emission layer, and a cathode" corresponding to the pixels. *Id.* at 3:58–66. Indeed, the '803 patent states that "[t]hese configurations are technologies known in the art and further description thereof is omitted for ease of description." *Id.* at 3:66–4:1. Nor does claim 1 include limitations directed to the '803 patent's disclosures about manufacturing OLED displays (*see id.* at 1:38–45) or the different lifespans for various organic materials (*see id.* at 7:25–32).

Thus, Petitioner's obviousness analysis need not account for these aspects of an OLED display.

Given this background, we note that the parties' disputes regarding Phan turn on whether Phan teaches that its disclosed pixel arrangements can be applied to OLED displays. We find that it does.[8] In the "Field of the Invention" section, Phan states that "[t]he *invention* [of Phan] relates to a display comprising pixels and dots, including but not limited to" various "display technologies" including "Organic Light Emitting Diode (OLED)." Ex. 1005, 1:17–29 (emphasis added). Accordingly, we find that Phan fairly suggests that the pixel arrangements disclosed in Phan—which are part of Phan's "invention"—may be applied to OLEDs. *See Twitter, Inc. v. VidStream LLC*, 825 F. App'x 844, 850 (Fed. Cir. 2020) (quoting *Bradium Techs. LLC v. Iancu*, 923 F.3d 1032, 1049 (Fed. Cir. 2019)) ("[W]hen conducting an obviousness analysis, the Board must consider a prior art reference 'not only for what it expressly teaches, but also for what it fairly suggests.'"). In making this finding, we note that obviousness is determined from the perspective of a person of ordinary skill in the art (*see* 35 U.S.C. § 103(a)), who in this case would have had "2 years of professional experience working with display design, including OLED displays." *See supra* § II.B. In light of this specific experience, we find that an ordinarily skilled artisan would have been inclined to link Phan's disclosed pixel arrangements with OLEDs based on the plain statement about related

[8] Patent Owner contends that the preamble is limiting (PO Resp. 31), whereas Petitioner takes no position on this issue (*see* Tr. 6:12–22). Because Petitioner shows persuasively that Phan teaches the preamble, we need not determine whether the preamble is limiting. *See Realtime Data*, 912 F.3d at 1375.

"display technologies" in Phan's "Field of the Invention" section. *See, e.g.*, Ex. 1003 ¶¶ 321, 399–403. For these reasons, we disagree with Patent Owner's assertion that "Phan does not teach about OLED displays." PO Resp. 33.

The fact that Phan teaches OLED displays among "a laundry list of every conceivable display technology, including non-existent technologies" does not undermine Phan's express statement that its disclosed invention relates to OLED displays, which themselves were known at the time of the '803 patent. *See* Ex. 1017 ¶ 96; Ex. 1018, 18:6–9. We also find Patent Owner's citation (PO Resp. 32) to *Otsuka Pharm. Co. v. Sandoz, Inc.*, 678 F.3d 1280, 1294 (Fed. Cir. 2012), regarding the alleged "laundry list" to be inapposite. *Otsuka* merely observes how a skilled artisan would not have understood a "'laundry list' of potential central nervous system controlling effects" in the involved patent to mean that every one of the trillions of compounds encompassed by that patent is a potential antipsychotic. *Id.* at 1293–94. *Otsuka* does not discredit the use of a list in a prior art patent to associate related technologies with a disclosed invention, as Patent Owner seems to imply. And, as discussed above, Phan expressly associates OLED displays with its allegedly inventive arrangements of pixels. *See* Ex. 1005, 1:17–29.

We also are persuaded by Petitioner's contentions (Pet. 46, 58–59) that an ordinarily skilled artisan would have considered Phan's pixel designs as "an obvious starting place when implementing the rest of what Phan teaches," including the "displays referenced elsewhere in Phan." *See, e.g.*, Ex. 1003 ¶¶ 324–327, 399–403; Ex. 1005, 1:18–29, 2:51–53. We consider the application of Phan's pixel arrangements to OLED displays—which

themselves are disclosed in Phan—to be among the "inferences and creative steps that a person of ordinary skill in the art would employ." *KSR*, 550 U.S. at 418.

Patent Owner's arguments focus on the particular embodiments of Phan, which allegedly are limited to technologies other than OLED. *See* PO Resp. 33–34 (stating that Phan mentions only CRT, LCD, LED, PDP, and FED display types and certain circuitry that is not associated with OLEDs); *see also* Sur-reply 15–16 (arguing that Phan's pixel arrangements do not apply to OLEDs). For example, Patent Owner argues that "Phan's virtual driving method—the heart of Phan's disclosure—would not be feasible in an OLED display." PO Resp. 34 (citing Ex. 2009 ¶¶ 207–215). But "[a] reference must be considered for everything it *teaches* by way of technology and is not limited to the particular *invention* it is describing and attempting to protect." *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1076 (Fed. Cir. 2015) (alteration in original) (quoting *EWP Corp. v. Reliance Universal Inc.*, 755 F.2d 898, 907 (Fed. Cir. 1985)). Thus, regardless of whether Phan focuses on other display technologies and/or particular algorithms in its embodiments, we must still consider Phan's teaching of OLEDs being a display technology related to its pixel arrangement disclosures.

We further note that many of Patent Owner's arguments are rooted in its conception of how "Phan's figures depict essentially no spacing between adjacent dots." PO Resp. 34. As such, Patent Owner argues that an ordinarily skilled artisan would have recognized that the spacing "was not feasible for an OLED display due to issues of color mixing of the organic light-emitting materials and shorting between adjacent pixels." *Id.* (citing Ex. 2009 ¶¶ 205–206). Yet, contrariwise, Patent Owner acknowledges that

"Phan does not describe its figures as drawn to scale." Sur-reply 18–19 (citing *Hockerson-Halberstadt, Inc. v. Avia Grp. Int'l, Inc.*, 222 F.3d 951, 956 (Fed. Cir. 2000)). Given that we generally do not rely on patent drawings for showing particular sizes (*see Hockerson-Halberstadt*, 222 F.3d at 956), we do not agree that the alleged spacing in Phan's drawings would have impeded an ordinarily skilled artisan from using Phan's pixel designs in OLED displays.

Regarding Patent Owner's argument that an ordinarily skilled artisan "would not have had a reasonable expectation of success in making Phan an OLED display" (PO Resp. 34), we have considered Dr. Kymissis's supporting testimony. *See* Ex. 2009 ¶ 215. He relies on the same arguments discussed above in which Patent Owner attempts to cabin Phan's teachings within the specific (non-OLED) embodiments disclosed. *See id.* Against this showing, Petitioner cites Dr. Pattison's testimony and contends that an ordinarily skilled artisan would have expected success employing Phan's pixel designs with the displays referenced elsewhere in Phan. Pet. 58–59 (citing Ex. 1003 ¶¶ 400–403). We find Dr. Pattison's testimony regarding expected success more persuasive because it is consistent with Phan's express statement that its disclosed invention relates to OLEDs. *See* Ex. 1005, 1:17–29. We also note that the '803 patent itself acknowledges that OLED componentry, such as power lines for driving OLED pixels, was known in the art. *See* Ex. 1001, 3:58–4:1. This is consistent with Petitioner's assertions regarding expected success in implementing Phan's pixel arrangement in an OLED display. Finally, at least one other contemporaneous reference cited by Petitioner, Cok, discloses the same pixel arrangement as Phan (*compare* Ex. 1005, Fig. 11b, *with* Ex. 1015,

Fig. 1) and states that it is for "an OLED display device" (Ex. 1015, 4:8–13), which also is consistent with Petitioner's assertions of expected success.

For these reasons, we are persuaded that Phan teaches, or at least fairly suggests, that its disclosed pixel arrangements may be implemented as an OLED display.

b) Limitation [1-a]

Claim 1 further recites "a plurality of pixels for displaying an image on the OLED display." Ex. 1001, 8:60–61. Petitioner cites Phan's teaching of a display including "so-called pixels" that "consist of so-called dots representing the three basic colours of red, green and blue." Pet. 46 (quoting Ex. 1005, 1:57–61). Petitioner maps the recited "plurality of pixels" to Phan's dots, which Petitioner calls Phan's display's "minimum [display] unit." *Id.* at 47 (citing Ex. 1003 ¶¶ 328–335). Petitioner also cites the same teachings discussed above from the preamble for teaching the "OLED display" and contends that the display is "intended to allow for generation of a high resolution image." *Id.* (internal quotation and alteration omitted) (citing Ex. 1003 ¶¶ 336–338; Ex. 1005, 2:51–3:25, 4:19–24).

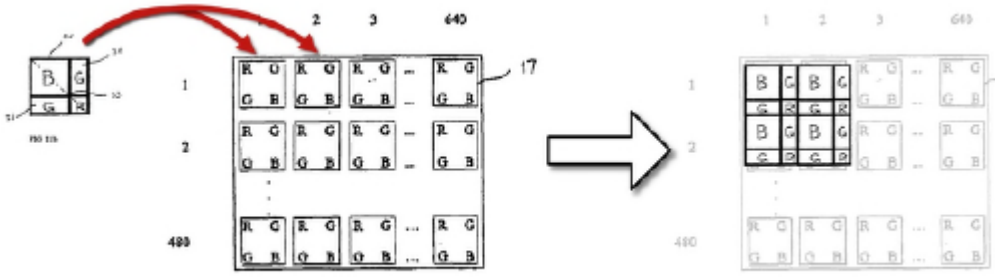
Patent Owner does not dispute this limitation apart from its arguments discussed above with respect to the preamble. We are persuaded that Phan's dots teach the recited "pixels." *See, e.g.*, Ex. 1005, 1:57–61. We also are persuaded that Phan teaches OLED displays and the use of such displays for generating images. *See, e.g.*, Ex. 1003 ¶¶ 336–338; Ex. 1005, 1:18–29, 2:51–3:25, 4:19–24.

c) Limitations [1-a(1)], [1-a(2)], [1-a(3)], [1-a(4)], and [1-c]

Claim 1 further recites "a first pixel having a center coinciding with a center of a virtual square." Ex. 1001, 8:62–63. A later limitation recites that

"the first pixel is configured to emit green light." *Id.* at 9:9. Petitioner cites Phan's teaching of pixels that "comprise regularly disposed dots 11 radiating the basic colours red (red dot 13), green (green dot 14) and blue (blue dot 15)." Pet. 48 (quoting Ex. 1005, 4:29–32). As such, Petitioner maps the recited "first pixel" to Phan's green dots. *Id.* at 49–50, 54 (citing Ex. 1003 ¶¶ 371–373; Ex. 1005, 4:29–32, Fig. 11b).

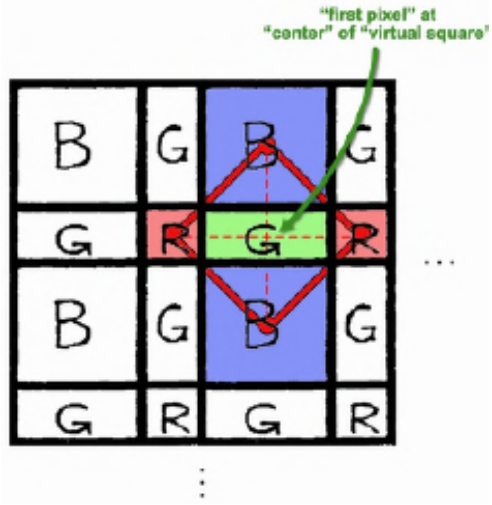
For the recited "virtual square," Petitioner cites Phan's teaching of disposing square pixels in a grid pattern. Pet. 48 (citing Ex. 1005, 4:41–43). Petitioner further cites Phan's Figure 2a, which Petitioner calls "an example of a 'display with square pixels' (like that shown in Figure 1a) 'with well-known static pixels being shown within squares, and the dynamic pixels of the invention within circles.'" *Id.* (quoting Ex. 1005, 3:33–36, 4:41–47) (citing Ex. 1005, Figs. 1a, 2a). Petitioner also cites the "quad pixel" arrangement disclosed in Figure 11b of Phan and contends it can be implemented in the "quad pixel display" of Figure 12 from Phan. *Id.* at 48–49 (citing Ex. 1005, 5:47–60, Figs. 11–12). Petitioner depicts this concept in the following illustration from the Petition, which includes annotated versions of Phan's Figure 11b and 12, as reproduced below.



Id. at 49. In this illustration, Petitioner indicates how "[u]se of the pixel structure shown in Fig. 11b in a grid or matrix [as shown in Figure 12] to produce Phan's display results in what this limitation requires." *Id.* (citing

Ex. 1005, 4:29–32, 4:41–43, 5:47–54, Figs. 11b, 12). Petitioner contends that, "[d]ue to the use of a square pixel shape that is regularly arranged in an identically repeating matrix, Phan's dots form a ***'virtual square'*** with a green dot at its ***'center."***" *Id.* at 50.

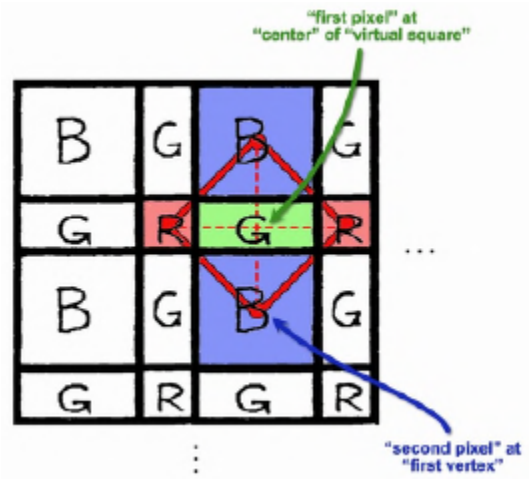
To summarize these contentions, Petitioner provides the following illustration in the Petition.



Pet. 50 (citing Ex. 1003 ¶¶ 339–356). In this illustration from the Petition, Petitioner shows the recited "virtual square" as a red square and indicates with a green arrow how a green "first pixel" is at the center of the virtual square. *Id.*

Claim 1 further recites "a second pixel separated from the first pixel and having a center at a first vertex of the virtual square." Ex. 1001, 8:64–65. Petitioner cites the same teaching of dots from Phan and maps the "pair of second pixels" to the blue dots in particular. Pet. 50 (citing Ex. 1005, 4:29–32, Fig. 11b). Petitioner contends that adjacent dots are "separated" based on Phan's teaching that dots are "surrounded by a black mask or black barrier ribs 21 to obtain a higher contrast." *Id.* (citing Ex. 1005, 4:33–37, Figs. 1a–c, 10a–11b). For the center of the second pixel being "at a first

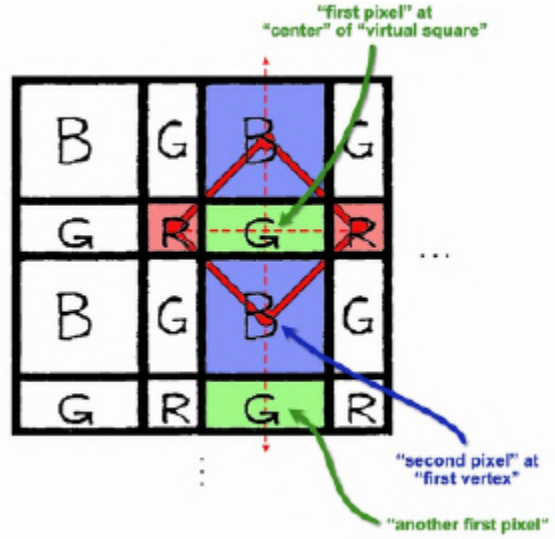
vertex of the virtual square," Petitioner contends that, "due to the use of square pixels arrange[d] in a matrix or grid, Phan's blue dots are located at a ***'first vertex'*** of the square formed around the green dot." *Id.* at 50–51. To summarize these contentions, Petitioner provides the following illustration in the Petition:



Id. at 51 (citing Ex. 1003 ¶¶ 357–361). In this illustration from the Petition, Petitioner shows the recited "virtual square" as a red square, indicates with a green arrow how a green "first pixel" is at the center of the virtual square, and indicates with a blue arrow how a blue "second pixel" is at a first vertex of the virtual square. *Id.*

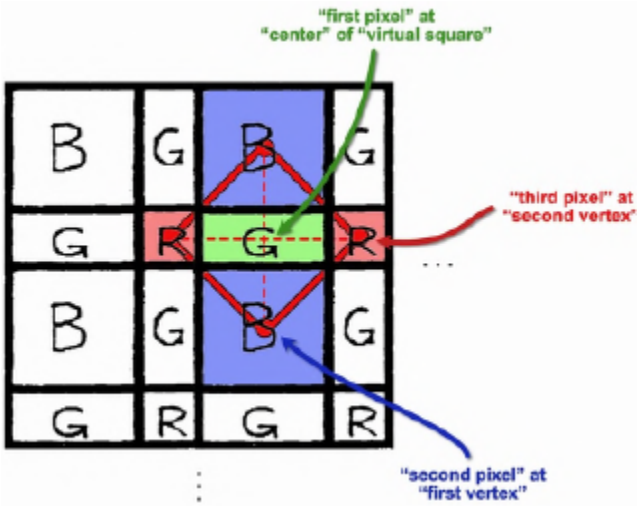
Claim 1 further recites "another first pixel on a line defined by the center of the virtual square and the first vertex, the first pixel, the second pixel, and the other first pixel being consecutive pixels on the line from among the plurality of pixels." Ex. 1001, 8:66–9:3. Petitioner cites Phan's teachings that its pixels and dots are identical and regularly disposed in a repeating matrix. Pet. 51 (citing Ex. 1005, 4:29–32, Fig. 11b). Continuing its analysis based on Phan from above, Petitioner contends that "[t]his results in ***'another first pixel'*** being located ***'consecutive[ly]'*** after the 'second pixel' on a ***'line'*** passing through the 'first' and 'second pixel[s].'"

Id. (second and third alterations in original). To summarize these contentions, Petitioner provides the following illustration in the Petition.



Id. at 52 (citing Ex. 1003 ¶¶ 362–364). In this illustration from the Petition, Petitioner shows the recited "virtual square" as a red square, indicates with one green arrow how a green "first pixel" is at the center of the virtual square, indicates with another green arrow "another" green "first pixel," and indicates with a blue arrow how a blue "second pixel" is at a first vertex of the virtual square. *Id.*

Claim 1 further recites "a third pixel separated from the first pixel and the second pixel, and having a center at a second vertex neighboring the first vertex of the virtual square." Ex. 1001, 9:4–6. Petitioner cites Phan's teaching of pixels including red, blue, and green dots, and Petitioner maps the recited "third pixel" to the red dots. Pet. 52 (citing Ex. 1005, 4:29–32, Fig. 11b). Continuing its analysis based on Phan from above, Petitioner contends the red dots "are located on the ***'second vertex'*** of the square formed around the green dot" and "***'neighbor[]'*** the square's 'first vertex.'" *Id.* (alteration in original). To summarize these contentions, Petitioner provides the following illustration in the Petition.



Id. at 53 (citing Ex. 1003 ¶¶ 365–367). In this illustration from the Petition, Petitioner shows the recited "virtual square" as a red square, indicates with a green arrow how a green "first pixel" is at the center of the virtual square, indicates with a blue arrow how a blue "second pixel" is at a first vertex of the virtual square, and indicates with a red arrow how a red "third pixel" is at a second vertex of the virtual square. *Id.*

Patent Owner disputes Petitioner's conception of how Phan's quad pixel arrangement from Figure 11b would be implemented in the display of Figure 12. PO Resp. 35–37. In particular, Patent Owner argues that "Petitioner inexplicably changes the arrangement and geometry of Phan's Figure 12 to remove the spacings between the adjacent quad-pixels." *Id.* at 35–36. Patent Owner further argues that "Petitioner and Dr. Pattison offer no justification for changing Phan's display to remove its clearly-disclosed spacings between adjacent quad-pixels, which would allow, for example, placement of wiring for Phan's '[c]ontrol circuitry,' or 'optical fiber network.'" *Id.* at 37 (citing Ex. 1005, 5:20–24, Fig. 5; Ex. 2009 ¶¶ 220–221). Patent Owner additionally argues that "Petitioner's changes are also incompatible with Phan's dynamic pixel approach" insofar as "the visual

locus of the *dynamic* quad-pixel disclosed by Phan . . . will be perceived by the viewer to be shifted from the physical center of the *static* quad-pixel." *Id.* at 36–37 (citing Ex. 1005, Figs. 9.1–9.8; Ex. 2009 ¶¶ 225–226). Patent Owner explains that this would result in "distortion and poor image quality," which "would contradict Phan's goal of improving resolution and image quality through 'variable generation of pixels from existing dots,' *i.e.*, its 'dynamic generation of pixels.'" *Id.* (citing Ex. 1005, 2:54–3:19; Ex. 2009 ¶¶ 225–230).

Patent Owner also offers its own counterexample of how pixel spacing would be implemented when combining Phan's Figures 11b and 12, which is shown in the following illustration from the Patent Owner Response.

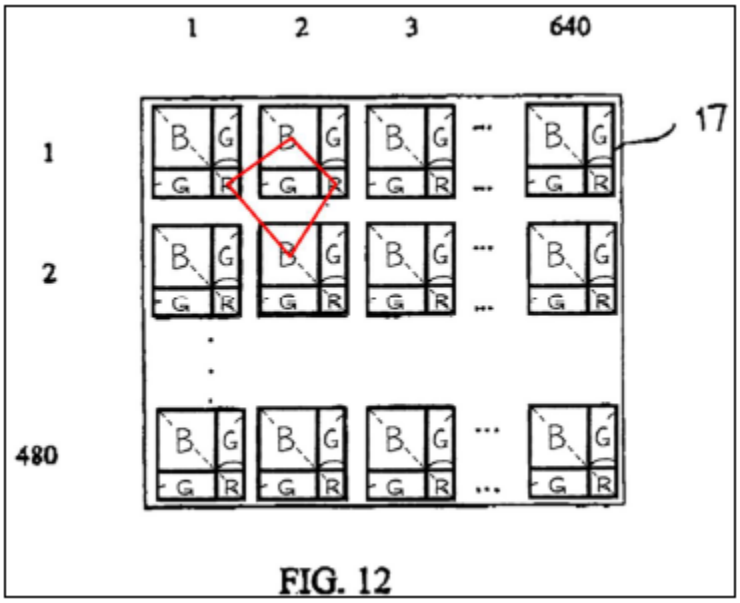


FIG. 12

PO Resp. 35. This illustration presents Patent Owner's conception of how the pixel arrangement of Phan's Figure 11b would be implemented in the display of Phan's Figure 12. *Id.* In particular, Patent Owner has indicated its conception of Petitioner's mapping of the recited "virtual square" with a red irregular quadrilateral. *Id.* Given that the sides of the red quadrilateral

are irregular and do not form a square, Patent Owner argues that "the 'first pixel' (green) does **not** have a center coinciding with a center of a virtual square." *Id.* (citing Ex. 2009 ¶¶ 216–219).

Petitioner replies that "all of Phan's figures show displays with the dots/sub-pixels regularly spaced in a consistent, repeating pattern." Reply 13 (citing Ex. 1005, Figs. 2a–b, 7, 9–9.8, 12–12d). Petitioner again emphasizes Phan's teachings that "pixels are 'regularly disposed' in a repeating 'grid' or 'matrix.'" *Id.* (citing Ex. 1005, 2:51–53, 4:29–50). Petitioner also counters Patent Owner's arguments about Phan's static and dynamic pixels by noting that (1) Phan teaches them as having the same matrix geometry and (2) Phan depicts them has having the same shape and geometry across the display. *Id*. at 14 (citing Ex. 1005, 6:4–23, 7:59–67, Figs. 2a–b, 4a–b, 5, 7, 8–8.12, 9–9.8, 12a–12d). According to Petitioner, "[t]his is purposeful" because "employing dynamic pixels that 'overlap[]' the 'static pixels' allows a 'given grid' to have an 'enhanced' or 'higher' 'resolution.'" *Id.* at 14–15 (quoting Ex. 1005, code (57), 2:51–53) (second alteration in original); *see also* Ex. 1017 ¶ 68 (Dr. Pattison testifying that "Phan['s] display includes not only static pixels, but many dynamic pixels that are the same size as the static pixels for purposes of increasing the display's effective resolution."). Petitioner additionally argues that it is Patent Owner's counterexample based on Phan, not Petitioner's proposal, that renders Phan's dynamic pixels unworkable, leading to variances in brightness from pixel-to-pixel and adding spaces so as to introduce distortion. Reply 15 (citing Ex. 1017 ¶¶ 73–79). Petitioner contends that this result "would all be contrary to Phan's teaching that its dynamic pixels

are meant 'not to be perceivable by the human eye.'" *Id.* (citing Ex. 1005, 2:57–59).

Although Patent Owner states that "Phan does not describe its figures as drawn to scale," Patent Owner argues in its Sur-reply that Figure 12 of Phan depicts spacing between sub-pixels. Sur-reply 18–19. Patent Owner also argues

> that displays having spacing between pixel units were not uncommon . . . , that [persons of ordinary skill in the art] would have understood spacing (such as shown in Fig. 12) is necessary for Phan's control circuitry or optical fiber network . . . , and that spacing would prevent image distortion.

Id. at 19 (citing Ex. 2009 ¶¶ 223–229). Patent Owner additionally argues that "removing quad-pixel spacing . . . is contrary to Phan's goal of applying dynamic driving to a given grid." *Id.* (citing Ex. 1005, 2:50–3:19; Ex. 2009 ¶¶ 229–230).

Patent Owner's arguments are premised on its interpretation of spacing between pixels in Phan's Figure 12. *See* PO Resp. 35 ("Phan's Figure 12 shows spacings between each quad-pixel"); Sur-reply 18 (stating that Phan "depicts spacing between quad-pixels in Figure 12"). As stated above, however, we do not interpret Phan's teachings as being limited by the spacing depicted in Figure 12. Indeed, Patent Owner acknowledges that "Phan does not describe its figures as drawn to scale." Sur-reply 18–19. Further, as discussed above, we generally do not rely on patent drawings for showing particular sizes. *See Hockerson-Halberstadt*, 222 F.3d at 956.

As noted by Petitioner, the figures in Phan—including Figure 12—depict pixels having the same shape and geometry across the display. Reply 14 (citing Ex. 1005, Figs. 2a–b, 4a–b, 5, 7, 8–8.12, 9–9.8, 12a–12d). Phan also teaches that pixels and dots are "regularly disposed" in a "grid." *See,*

e.g., Ex. 1004, 2:51–53, 4:29–50, 5:47–54. Based on these teachings, we are persuaded that an ordinarily skilled artisan would have had reason to dispose Phan's pixels and dots in a regular pattern in the manner suggested by Petitioner. In fact, Dr. Kymissis agreed that it was common in the art of OLED displays to repeat unit pixel designs across a display. *See* Ex. 1018, 105:9–12, 106:2–6. Further, we do not agree with Patent Owner's argument (*see* PO Resp. 34; Sur-reply 18–19) that regular spacing is necessarily incompatible with dynamic driving of pixels. Patent Owner appears to base this argument on the need to dispose "Phan's control circuitry or optical fiber network" among the quad pixels. *See* Sur-reply 19 (citing Ex. 2009 ¶ 223). Yet Patent Owner has not explained how equal spacing precludes the disposition of such elements. Nor does Dr. Kymissis's supporting testimony establish as much. *See* Ex. 2009 ¶ 223.

We also have considered Patent Owner's arguments (PO Resp. 36–37; Sur-reply 19) about shifting of the visual locus and the potential for distortion in Petitioner's proposed pixel arrangement. Based on the full trial record, we are more persuaded by Petitioner's position because Petitioner shows persuasively how Phan's dots are intended to be evenly spaced. *See, e.g.*, Pet. 48–53; Ex. 1003 ¶¶ 339–367. This is supported by every drawing figure in Phan, which shows even spacing for both static and dynamic pixels. *See, e.g.*, Ex. 1005, Figs. 2a–b, 4a–b, 5, 7, 8–8.12, 9–9.8, 12a–12d. Notably, Phan does not disclose any need for "spacing between each quad-pixel to prevent distortion and poor image quality," as is suggested by Patent Owner (PO Resp. 37), even though Phan discloses embodiments with sub-pixels of unequal sizes. Phan also teaches that dynamic pixels are not meant to be perceptible by the human eye (Ex. 1005, 2:57–59), which renders the

uneven spacing in Patent Owner's counterexample—and the attendant distortion and brightness variances (*see, e.g.*, Ex. 1017 ¶¶ 73–79)—implausible, or at least outside of the natural reading of Phan.

For these reasons, we are persuaded that the "virtual square" limitations of claim 1 would have been obvious in light of Phan's teachings. *See* Pet. 48–53.

d) Limitation [1-b]

Claim 1 further recites that "the second pixel has a larger area than that of the third pixel." Ex. 1001, 9:7–8. Petitioner cites the embodiment in Figure 11b of Phan (reproduced above) where "the central 'crosspoint' of the pixel has been shifted 'along diagonal line 35' resulting in dots with non-equal areas." Pet. 53–54 (citing Ex. 1003 ¶¶ 368–370; Ex. 1005, 5:47–54, Fig. 11b). Thus, according to Petitioner, Figure 11b shows the blue dot as having a larger area than the red dot. *Id.* Patent Owner does not dispute this limitation apart from its arguments discussed above. Based on Phan's Figure 11b embodiment, we are persuaded that Phan's blue dot (i.e., "second pixel") has a larger area than the red dot (i.e., "third pixel"). *See, e.g.*, Ex. 1003 ¶¶ 368–370; Ex. 1005, 5:47–54, Fig. 11b.

e) Secondary Considerations of Nonobviousness

"[E]vidence rising out of the so-called 'secondary considerations' must always when present be considered en route to a determination of obviousness." *Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.*, 699 F.3d 1340, 1349 (Fed. Cir. 2012) (quoting *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1538 (Fed. Cir. 1983)). "For objective evidence of secondary considerations to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the *claimed invention*." *In re Huai-Hung Kao*,

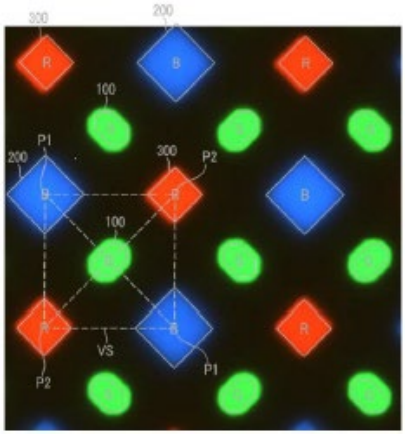
639 F.3d 1057, 1068 (Fed. Cir. 2011). Patent Owner argues that "Petitioner's obviousness theories are . . . undercut by extensive objective evidence of non-obviousness, including long-felt need, failure of others, skepticism, praise, and copying." PO Resp. 58–74; Sur-reply 25–28. Petitioner disputes that there is a nexus between the challenged claims and the asserted secondary considerations. Reply 20–22.

We now consider Patent Owner's evidence of secondary considerations of nonobviousness starting with its assertion of a nexus between the '803 patent and the Samsung Galaxy S22 Ultra smartphone. We then turn to Patent Owner's arguments regarding long-felt need, failure of others, industry praise, and copying.

(1) Nexus

Patent Owner contends that it "successfully mass-produced full-HD [full high definition] AMOLED [active-matrix OLED] displays for the first time in the world beginning with the AMOLED display for the Samsung Galaxy S4, overcoming skepticism and satisfying the industry's long-felt need." PO Resp. 71–72 (citing Ex. 2009 ¶¶ 347–349). According to Patent Owner, "the '803 Patent's 'Diamond Pixel' arrangement has been widely adopted in AMOLED displays for flagship mobile devices, including every Samsung Galaxy and Apple iPhone model that has used AMOLED displays." *Id.* at 72 (citing Ex. 2009 ¶ 349); *see also id.* at 65–66 (stating that Patent Owner's "'Diamond Pixel' arrangement . . . embodies the invention claimed in the '803 Patent"). As an example, Patent Owner cites, but does not analyze in its briefs, a "Galaxy S22 ULTRA Claim Chart" in support of its contention that "the Samsung Galaxy S22 Ultra product practices all challenged claims of the '803 Patent." *Id.* at 72 (citing Ex. 2009 ¶¶ 350–352; Ex. 2028 (claim chart); Ex. 2063); *see also* Sur-reply 25 (citing

same). Patent Owner also provides one teardown image in support of its showing of nexus, which is reproduced below.



PO Resp. 72–73 (citing Ex. 2029, 5). This image from the Patent Owner Response is what Patent Owner calls "[a] teardown image . . . of the pixel arrangement obtained from a Galaxy S22 Ultra sample . . . with Figure 5 of the '803 Patent superimposed."[9] *Id.* Patent Owner additionally argues that "Petitioner does not assert any limitation is not met." Sur-reply 25; *see also id.* at 27 ("Regarding nexus, there is no dispute that [Patent Owner's] Diamond Pixel arrangement structures practice the claims.").

[9] In its Opposition to Petitioner's first motion to strike, which was filed after the Patent Owner Response, Patent Owner implies that the teardown images in the Response speak for themselves and, as such, are entitled to a presumption of nexus. *See* 1st Strike Opp. 3–4; *see also* Tr. 102:19–103:15 (similar argument by Patent Owner's counsel at the oral hearing). Petitioner argues that Patent Owner did not assert an entitlement to a presumption of nexus in the Response, and that Patent Owner's Opposition is an improper vehicle to introduce such an argument. 1st Strike Reply 1. We agree with Petitioner that Patent Owner did not address in the Response whether the Samsung Galaxy S22 Ultra smartphone is coextensive with the claims of the '803 patent. *See id.*; Reply 21. Accordingly, we decline to consider any argument that Patent Owner is entitled to a presumption of nexus.

> Further addressing nexus, Patent Owner argues that
>
> > [p]racticing the claims of the '803 Patent is what enabled the manufacture of full HD AMOLED displays suitable for mobile devices by striking the Patent's novel balance of improving the aperture ratio of the AMOLED display (by enlarging the emissive areas) and allowing an increased density of pixels while allowing for a more reliable deposition of the organic material (by ensuring sufficient gaps between pixels), and improving the display lifetime.

PO Resp. 73 (citing Ex. 2009 ¶¶ 353–356). Patent Owner also argues that "[t]he challenged claims achieve the abovementioned benefits by reciting pixel arrangements with specific groupings, shapes, sizes, and layouts of the red, green, and blue OLED sub-pixels." *Id.* (citing, *inter alia*, Ex. 2009 ¶¶ 353–356). According to Patent Owner, the pixel arrangement of the '803 patent allowed Patent Owner "to overcome manufacturing and design obstacles to attaining higher-resolution and higher brightness AMOLED displays that relate to the sensitive light-emitting organic layers of OLEDs." *Id.* at 74 (citing, *inter alia*, Ex. 2009 ¶¶ 353–356).

Petitioner argues that Patent Owner "has not even alleged—[l]et alone established—that any of the products it identifies are 'coextensive' with the claims." Reply 21. By Petitioner's reckoning, "[t]his makes sense, as the Samsung Galaxy S22 Ultra—and the other referenced products—are smartphones" whereas "[t]he '803 patent is not directed to a smartphone." *Id.* Petitioner also argues that Patent Owner does not establish that the asserted secondary considerations are the direct result of the unique characteristics of the claims and not the prior art. *Id.* Petitioner also argues that the claimed pixel arrangement "is at best ***indirectly*** responsible for any purported success, praise, and need satisfaction" given Patent Owner's statement that the arrangement "allowed [Patent Owner] to overcome

manufacturing and design obstacles." *Id.* at 21–22 (alteration in original) (quoting PO Resp. 73–74). Petitioner additionally argues that "[i]t is actually Patent Owner's 'highly sophisticated evaporation technology' that permits higher OLED resolutions." *Id.* at 22 (quoting Ex. 2065, 5) (citing Ex. 1018, 45:6–22).

A patent owner is entitled to a presumption of nexus when it shows that the asserted objective evidence is tied to a specific product that "embodies the claimed features, and is coextensive with them." *Brown & Williamson Tobacco Corp. v. Philip Morris, Inc.*, 229 F.3d 1120, 1130 (Fed. Cir. 2000). A patent owner is further "afforded an opportunity to prove nexus by showing that the evidence of secondary considerations is the direct result of the unique characteristics of the claimed invention." *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373–74 (Fed. Cir. 2019) (internal quotation omitted).

We agree with Petitioner (Reply 21; 1st Strike Reply 1) that Patent Owner is not entitled to a presumption of nexus because Patent Owner does not make any showing of coextensiveness between the Samsung Galaxy S22 Ultra smartphone and the claims of the '803 patent. Thus, Patent Owner necessarily must prove nexus "by showing that the evidence of secondary considerations is the direct result of the unique characteristics of the claimed invention." *Fox Factory*, 944 F.3d at 1373–74 (internal quotation omitted). We now discuss Patent Owner's proffered evidence of a direct nexus, and we find that it is entitled to little or no weight.

First, Patent Owner relies on the claim chart at Exhibit 2028 to support its statement that "the Samsung Galaxy S22 Ultra product practices all challenged claims of the '803 Patent." PO Resp. 72. We find below that

Patent Owner's mere mention of the claim chart at Exhibit 2028 without any explanation in the Patent Owner Response amounts to improper incorporation by reference in contravention of 37 C.F.R. § 42.6(a)(3). *See infra* § II.H. We grant Petitioner's motion to strike this statement below, and we accord it no weight in our nexus analysis. *See id.*

Second, Patent Owner's provision of "[a] teardown image . . . of the pixel arrangement obtained from a Galaxy S22 Ultra sample . . . with Figure 5 of the '803 Patent superimposed" (PO Resp. 72–73) is conclusory and entitled little or no weight. Indeed, the Patent Owner Response does not even provide a citation supporting the provenance of the annotated figure. One would have to look at paragraph 350 of Dr. Kymissis's declaration to find that annotated figure, which in turn cites Dr. Fontecchio's images of the Galaxy S22 Ultra teardown and Dr. Fontecchio's declaration. Ex. 2009 ¶ 350 (citing Ex. 2029, 5; Ex. 2063). We can only assume that Dr. Kymissis applied the annotations to an image provided by Dr. Fontecchio. Further, even if we were to overlook these gaps, we would accord little weight to the annotated figure because the overlaid aspects from Figure 5 of the '803 patent do not necessarily embody or account for all of the limitations of the challenged claims. In the absence of any explanation from Patent Owner, we find Patent Owner's annotated figure unavailing. In addition, the fact that Petitioner does not dispute the correspondence between particular limitations of the '803 patent claims and the Galaxy S22 Ultra smartphone (*see* Sur-reply 25, 27) is of no consequence given that Patent Owner has the burden of production on the issue of nexus. *See WMS Gaming, Inc. v. Int'l Game Tech.*, 184 F.3d 1339, 1359 (Fed. Cir. 1999).

Third, to the extent that Patent Owner might separately assert a nexus between Patent Owner's so-called "Diamond Pixel" arrangement[10] and the claims of the '803 patent, Patent Owner does not substantiate such a nexus with evidence or analysis. *See* PO Resp. 71–74. Although Patent Owner uses "Diamond Pixel" as a shortcut way of referring to a pixel arrangement (*see id.* at 61–62, 65–66, 68, 72; Sur-reply 26–27), Patent Owner has neither established what the term "Diamond Pixel" encompasses, nor attempted to compare a "Diamond Pixel" arrangement to the claims of the '803 patent separate from its arguments related to the Galaxy S22 Ultra smartphone. The closest Patent Owner comes to providing a separate nexus analysis for a "Diamond Pixel" arrangement is in the Sur-reply, where it provides quotes from an exhibit titled "Samsung Diamond Pixels." Sur-reply 26 (quoting Ex. 2027, 1). Yet Patent Owner's mere mention of a "sub-pixel arrangement . . . [where] 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" is not keyed to any challenged claim. *Id.* (alterations in original) (quoting Ex. 2027, 1); *see also* PO Resp. 66 (similar quotation). Thus, we accord such mentions of "Diamond Pixel" arrangements no weight with respect to nexus. By extension, Patent Owner's attempts to tie the Samsung Galaxy S4 and iPhone X smartphones to "Diamond Pixel" arrangements (*see* PO Resp. 64, 66–68, 71–72) suffer from the same deficiencies related to nexus.

Fourth, we agree with Petitioner (Reply 21–22) that Patent Owner's statement about the claimed pixel arrangement helping Patent Owner

[10] "Diamond Pixel" appears to be an advertising mark. *See* PO Resp. 61 (indicating that the term is a trademark).

"overcome manufacturing and design obstacles" (PO Resp. 74) tends to show an indirect link between the alleged secondary considerations and the challenged claims. Petitioner also argues persuasively (Reply 21) that a pixel arrangement is but a component of the Samsung Galaxy S22 Ultra *smartphone*, which also tends to undermine a showing of nexus for considerations tied to the smartphone. *See Fox Factory*, 944 F.3d at 1374 (discussing how there is "no or very little correspondence" between a product and a patent claim where "the patented invention is only a component of a commercially successful machine or process"). Finally, Petitioner also cites some of Patent Owner's own proffered evidence that suggests that it is Patent Owner's "highly sophisticated evaporation technology" that permits higher resolution OLEDs for its smartphones. *See* Ex. 2065, 5. This too tends to undermine Patent Owner's showing of nexus.

For these reasons, we accord Patent Owner's evidence of a nexus between the claims of the '803 patent and the Samsung Galaxy S22 Ultra smartphone little to no weight. We also find that Patent Owner does not establish any nexus between devices allegedly embodying a so-called "Diamond Pixel" arrangement and the claims of the '803 patent. Despite the weak evidence of nexus in this case, we still consider Patent Owner's evidence of long-felt need, failure of others, industry praise, and copying below.

(2) Long-Felt Need

Patent Owner argues that in the early 2010s, "AMOLED displays for mobile devices suffered from a significant shortcoming—namely the difficulty of manufacturing higher resolution displays." PO Resp. 58 (citing Ex. 2009 ¶¶ 313–322; Ex. 2013, 3). Thus, Patent Owner argues that

> [t]here was a long-felt need to develop pixel arrangements that would enable the manufacture of high-resolution AMOLED displays that would provide superior image quality, particularly displays with sufficiently high pixel densities (measured as pixels-per-inch or 'PPI'), aperture ratio, and lifetime to support 'full high definition' ('full-HD') graphics in mobile devices.

Id. at 58–59 (citing Ex. 2009 ¶¶ 315–319); *see also id.* at 59–61 (further discussion about alleged manufacturing challenges). Patent Owner asserts that "the '803 Patent's novel pixel arrangement, which became widely recognized as the 'Diamond Pixel™' arrangement, enabled the manufacture of full-HD AMOLED displays suitable for mobile devices, satisfying the industry's longstanding need." *Id.* at 61; *see also* Sur-reply 27 (citing Ex. 2009 ¶¶ 353–356) (similar argument). Patent Owner also argues that alleged needs for higher resolutions and manufacturability of displays need not be expressly recited in the challenged claims as long as these "advantages [are] inherent in what is specifically disclosed in a patent." Sur-reply 27 (quoting *In re Vamco Mach. & Tool, Inc.*, 752 F.2d 1564, 1577 n.5 (Fed. Cir. 1985)).

Petitioner argues that the things Patent Owner cites as being long-felt needs, including "'AMOLED displays' with 'sufficiently high pixel densities' and 'full HD' 'graphics in mobile devices,'" are not claimed in the '803 patent. Reply 23 (quoting PO Resp. 58–59). A such, Petitioner argues that no such needs could be met by the '803 patent. *Id.* Petitioner also cites information in Patent Owner's exhibits showing "not only optimism, but that there were numerous available OLED displays on the market long before the patent was filed." *Id.* at 23–24 (citing Ex. 2016, 1; Ex. 2019, 14; Ex. 2020, 3, 7; Ex. 2023, 1; Ex. 2025, 2; Ex. 2039, 2; Ex. 2074, 15).

Patent Owner's assertion of long-felt need is tied to the so-called "Diamond Pixel" arrangement (*see* PO Resp. 62; Sur-reply 27); as discussed

above (*see supra* § II.E.2.e).(1)), Patent Owner fails to substantiate a nexus to the "Diamond Pixel" arrangement. Further, even if we were to assume that some resolution and manufacturability benefits might flow from certain devices within the scope of the challenged claims, the record does not substantiate that these benefits satisfied a particular unmet need related to manufacturing higher resolution OLEDs. As noted by Petitioner (Reply 22), record evidence credits Patent Owner's "highly sophisticated evaporation technology" as allowing mass production of OLEDs with higher resolutions. Ex. 2065, 5. Other record evidence substantiates commercialization of OLED displays as of the time of the patent. *See, e.g.*, Ex. 2020, 3, 7; Ex. 2023, 1; Ex. 2025, 2; Ex. 2039, 2. Further, the claimed pixel arrangements could conceivably be used in displays having various densities and resolutions and with displays produced by both difficult and easy manufacturing processes. This lack of correspondence between the alleged need and the challenged claims undermines Patent Owner's assertion of long-felt need. *See Therasense, Inc. v. Becton, Dickinson & Co.*, 593 F.3d 1325, 1336 (Fed. Cir. 2010) (holding that where claims are broad enough to cover devices that either do or do not solve the identified problem, objective evidence of non-obviousness fails because it is not commensurate in scope with the claims which the evidence is offered to support).

For these reasons, we accord Patent Owner's evidence of long-felt need little or no weight.

(3) Failure of Others

Patent Owner also argues that "display manufacturers and researchers proposed many AMOLED pixel arrangements in an attempt to answer the industry's calling for full-HD AMOLED displays suitable for mobile devices." PO Resp. 61 (citing Ex. 2009 ¶¶ 330–336). Patent Owner argues

that these "wide-ranging efforts" did not result in success. *Id.* at 61–62; *see also id.* at 62–63 (further detailing alleged failures of others). Accordingly, Patent Owner argues that "the industry was highly skeptical that a pixel arrangement could be devised that would enable the manufacture of full-HD AMOLED displays for mobile devices," and that LCDs were viewed as a preferred alternative. *Id.* at 64 (citing Ex. 2009 ¶¶ 326–328). Patent Owner even argues that "[c]ontinued research efforts *after* the inventions of the '803 Patent also failed to result in a successful pixel arrangement that has been adopted for use in flagship mobile devices." *Id.* at 64–66 (alleging failure of a pixel arrangement by Petitioner Mianyang BOE). According to Patent Owner, "it was only [Patent Owner's] innovative 'Diamond Pixel' arrangement, which embodies the invention claimed in the '803 Patent, that was ultimately successful at enabling the manufacture of full-HD mobile AMOLED displays." *Id.* at 65–66 (citing Ex. 2009 ¶¶ 347–348).

Petitioner argues that the alleged lack of available "full-HD AMOLED displays suitable for mobile devices" is irrelevant because "[t]he claims do not require AMOLED displays, HD, or mobile devices." Reply 24 (quoting PO Resp. 61). Further, Petitioner argues that "numerous working AMOLED displays existed before the '803 patent." *Id.*

Patent Owner's assertions are again tied to the so-called "Diamond Pixel" arrangement (*see* PO Resp. 63, 65–66), but Patent Owner has failed to substantiate a nexus to the "Diamond Pixel" arrangement. *See supra* § II.E.2.e).(1). We also agree with Petitioner that record evidence supports the commercialization of OLED displays as of the time of the patent, which tends to disprove that others had failed. *See, e.g.*, Ex. 2020, 3, 7; Ex. 2023, 1; Ex. 2025, 2; Ex. 2039, 2. Moreover, to the extent Patent Owner's

assertions of failure by others are tied to manufacturing of high-resolution displays (*see, e.g.*, PO Resp. 64–66), such assertions fail for the same reasons as Patent Owner's long-felt need assertions discussed above. *See supra* § II.E.2.e).(2). Specifically, Patent Owner's proffered evidence related to display resolution and manufacturing is not commensurate in scope with the claims. *See Therasense*, 593 F.3d at 1336. Thus, we accord Patent Owner's evidence of failure of others little or no weight.

(4) Industry Praise

Patent Owner cites "significant praise" for the so-called "Diamond Pixel" arrangement that Patent Owner associates with the '803 patent, including "praise for the full-HD resolution and superior image quality of the AMOLED displays implementing these arrangements." PO Resp. 66–68 (citing Ex. 2009 ¶¶ 336–339; Ex. 2027, 1; Ex. 2067). Patent Owner further argues that "Samsung Galaxy S4's AMOLED display was the first commercial embodiment of the '803 Patent" and "[p]raise for the Galaxy S4's AMOLED display, and specifically the novel pixel arrangement of the '803 Patent that enabled full HD, was overwhelming." *Id.* at 66 (citing Ex. 2013, 3; Ex. 2026, 2; Ex. 2037, 3). Patent Owner also cites praise for the iPhone X and other "[f]lagship mobile devices," which also "adopted [Patent Owner's] AMOLED displays implementing the pixel arrangement of the '803 Patent." *Id.* at 67–68 (citing Ex. 2038, 1–2; Ex. 2039, 3, 5; Ex. 2040; Exs. 2068–2072). Patent Owner additionally cites an award presented by the Commissioner of South Korea's Intellectual Property Office to inventor Sang-Shin Lee. *Id.* at 68 (citing Ex. 2066, 9).

Petitioner criticizes Patent Owner's evidence of industry praise for the Samsung Galaxy S4 and the iPhone X because Patent Owner only attempts to show a nexus to the Samsung Galaxy S22 Ultra. Reply 24 (citing PO

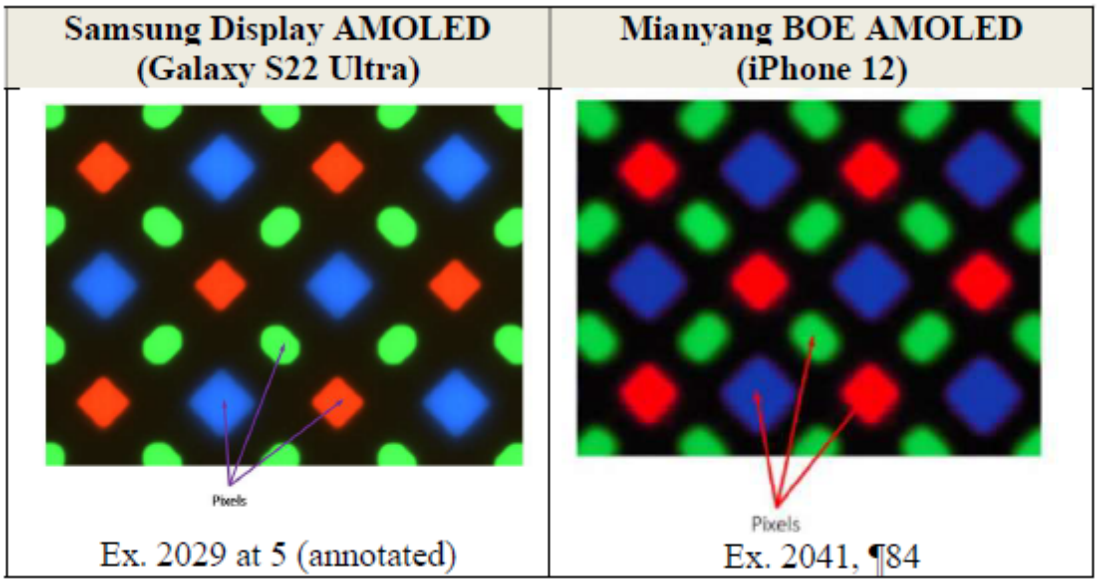
Resp. 66–68, 71–72). Petitioner also criticizes Patent Owner's reference to an award by the Korean Patent Office as being devoid of explanation tying it to the '803 patent. *Id.* Petitioner additionally argues that "pixel arrangement is simply one among many product features discussed in Patent Owner's exhibits" and that various other features, such as precision display calibration, lower screen reflectance, high dynamic range, night shift mode, true tone viewing, super dim setting, and viewing angle performance, "are also important." *Id.* at 25 (citing Ex. 2039, 2–5). Petitioner further argues that "enhancements to the circuit structure" of the Galaxy S4 allowed for an improved contrast ratio, reduced power consumption, increased outside visibility, and a thinner display with a reduced bezel. *Id.* (quoting Ex. 2037, 4).

As discussed above, Patent Owner's attempt to establish a nexus between the claims of the '803 patent and the so-called "Diamond Pixel" arrangement is entitled to little or no weight. *See supra* § II.E.2.e).(1). Thus, Patent Owner's alleged evidence of praise for the "Diamond Pixel" structure (PO Resp. 66–68) is entitled to little or no weight. Given that Petitioner's only evidence of nexus for the Samsung Galaxy S4 and the iPhone X smartphones is tied to the "Diamond Pixel" arrangement (*see supra* § II.E.2.e).(1)), we likewise accord little or no weight to Patent Owner's alleged evidence of praise for these smartphones. *See* PO Resp. 66–68. Finally, Patent Owner cites no creditable analysis or evidence tying the cited Korean Patent Office award to the challenged claims. *See id.* at 68.

For these reasons, we accord Patent Owner's evidence of industry praise little or no weight.

(5) Copying

Patent Owner argues that "widespread copying of [Patent Owner's] patented pixel arrangements is evident from teardown photographs of commercially-available AMOLED display products that employ near carbon copies of [Patent Owner's] pixel arrangements. PO Resp. 68 (citing Ex. 2009 ¶¶ 340–346). In particular, Patent Owner argues that "Petitioner Mianyang BOE copied [Patent Owner's] pixel arrangements to commercialize AMOLED displays for products including the iPhone 12." *Id.* at 69 (citing Ex. 2009 ¶ 341). In support of this argument, Patent Owner provides the following illustration.



PO Resp. 69 (citing Ex. 2029, 5; Ex. 2041 ¶ 84). In this illustration from the Patent Owner Response, the left image shows a pixel arrangement labeled "Samsung Display AMOLED (Galaxy S22 Ultra)" and the right image shows a pixel arrangement labeled "Mianyang BOE AMOLED (iPhone 12)." *Id.* According to Patent Owner, this illustration demonstrates that "the pixel arrangement used in Mianyang BOE's AMOLED display for the iPhone 12 is nearly identical to [Patent Owner's] patented pixel

arrangement," as exemplified by an image of an AMOLED display from a Galaxy S22 Ultra smartphone. *Id.*

Patent Owner additionally alleges "[w]idespread copying" by "numerous vendors of replacement AMOLED displays for mobile phones." PO Resp. 69 (citing Exs. 2042–2061). According to Patent Owner, the pixel arrangements in these replacement displays "not only infringe the challenged claims . . . , they bear such similarity to those of Samsung Display that they demonstrate copying." *Id.* at 69–70 (citing Ex. 2009 ¶¶ 342–346; Exs. 2042, 2043; *Medtronic, Inc. v. Teleflex Innovations S.a.r.l.*, 70 F.4th 1331, 1339–42 (Fed. Cir. 2023)). Patent Owner also provides a number of "[e]xemplary teardown images of such replica products . . . with Figure 5 of the '803 Patent overlayed on top" to support its analysis. *Id.* at 70–71 (citing Ex. 2029, 5; Ex. 2044, 4; Ex. 2045, 5; Ex. 2046, 6; Ex. 2047, 6; Ex. 2048, 5). Patent Owner compares these images with an image of an AMOLED display from a Galaxy S22 Ultra smartphone. *Id.*

Petitioner disputes Patent Owner's allegations of "widespread copying" because Patent Owner "does nothing more than (1) allege infringement and (2) compare product images." Reply 25 (citing PO Resp. 68–71). Petitioner argues that copying requires a showing of more than just similarity between the challenged patent and a competitor's product. *Id.* (citing, *inter alia*, *Liqwd, Inc. v. L'Oreal USA, Inc.*, 941 F.3d 1133, 1137 (Fed. Cir. 2019); *Iron Grip Barbell Co. v. USA Sports Inc.*, 392 F.3d 1317, 1325 (Fed. Cir. 2004); *Instiute Pasteur v. Focarino*, 738 F.3d 1337, 1347–48 (Fed. Cir. 2013)).

We first turn to Patent Owner's allegation that Petitioner Mianyang BOE's pixel arrangement for the iPhone 12 copied Patent Owner's patented

pixel arrangements. Patent Owner bases its analysis on a comparison to an image from a Samsung Galaxy S22 Ultra smartphone. *See* PO Resp. 70. As discussed above, however, we accord Patent Owner's evidence of nexus between the claims of the '803 patent and the Samsung Galaxy S22 Ultra smartphone little to no weight. *See supra* § II.E.2.e).(1). Thus, the basis of Patent Owner's copying analysis is dubious. The remainder of Patent Owner's analysis consists of an image comparison and an allegation that the images are "nearly identical." PO Resp. 69, 70–71; *see also* Ex. 2009 ¶¶ 345–346 (Dr. Kymissis's testimony regarding same). We find this analysis to be rudimentary at best. And, even if this were probative evidence of similarity, "[n]ot every competing product that arguably falls within the scope of a patent is evidence of copying" because "[o]therwise every infringement suit would automatically confirm the nonobviousness of the patent." *Iron Grip Barbell*, 392 F.3d at 1325. Indeed, our reviewing court's "case law holds that copying requires evidence of efforts to replicate a specific product." *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1246 (Fed. Cir. 2010). Patent Owner has presented no such evidence here. Thus, we accord Patent Owner's evidence of copying related to Mianyang BOE little or no weight.

We next turn to Patent Owner's allegations of "widespread copying" related to vendors of replacement AMOLED displays. Patent Owner relies on, *inter alia*, claim charts at Exhibits 2042 and 2043 to support its statement that certain vendors' pixel arrangements infringe the challenged claims. PO Resp. 69. As discussed below, we find that Patent Owner's incorporation of arguments by reference to these claim charts (and Dr. Kymissis's accompanying testimony) constitutes a violation of 37 C.F.R. § 42.6(a)(3).

See infra § II.H. We grant Petitioner's motion to strike this statement alleging infringement below, and we accord it no weight in our copying analysis. *See id.* Moreover, as above, the basis of Patent Owner's comparison is dubious because Patent Owner's evidence of nexus between the claims of the '803 patent and the Samsung Galaxy S22 Ultra smartphone is entitled to little or no weight. *See supra* § II.E.2.e).(1). For these reasons, we accord Patent Owner's evidence of copying related to replacement vendors little or no weight.

Considering all evidence of alleged copying presented by Patent Owner, we accord it little or no weight.

(6) Other Considerations

Although Patent Owner makes certain references to the "success[]" of its products (*see, e.g.*, PO Resp. 71–72), Patent Owner acknowledges that it is not asserting evidence of commercial success as a secondary consideration of nonobviousness. Sur-reply 28 n.5.

(7) Conclusion Regarding Secondary Considerations of Nonobviousness

Having considered the entire trial record, we accord Patent Owner's asserted evidence of secondary considerations of nonobviousness little or no weight.

f) Conclusion Regarding Claim 1

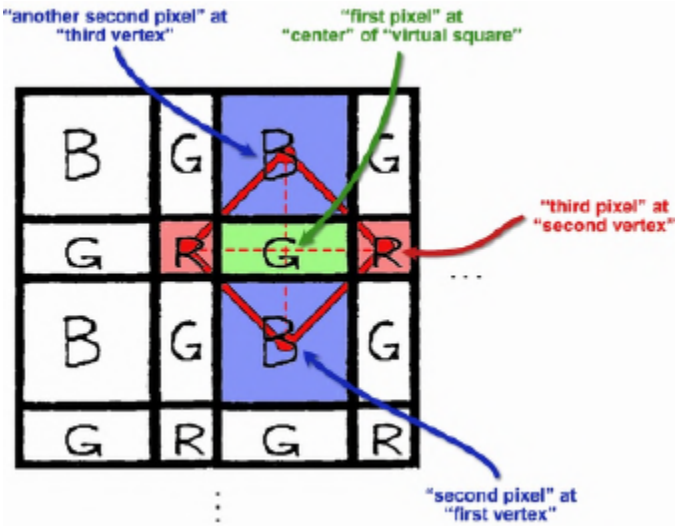
Petitioner has shown persuasively that Phan teaches or suggests all limitations of claim 1 in light of the knowledge of a person of ordinary skill in the art. We have considered Patent Owner's evidence of nonobviousness. Petitioner has shown by a preponderance of the evidence, inclusive of Patent

Owner's evidence of nonobviousness, that the subject matter of claim 1 would have been obvious over Phan.[11]

3. Dependent Claim 2

Claim 2 depends from claim 1 and recites that "the plurality of pixels further comprises another second pixel separated from the first pixel and having a center at a third vertex neighboring the second vertex of the virtual square" and that "the second pixels are separated from each other by the first pixel." Ex. 1001, 9:10–16. Petitioner again cites Phan's teaching that pixels are all "identical" and "regularly disposed" in a repeating matrix. Pet. 54 (citing Ex. 1005, 4:29–32, Fig. 11b). Continuing its analysis based on Phan from claim 1, Petitioner contends that "***'another second pixel'*** is located at a ***'third vertex'*** of the same 'virtual square'" and that the "'third vertex' ***'neighbor[s]'*** the square's 'second vertex.'" *Id.* (alteration in original). Petitioner again notes Phan's teaching of a black mask that separates adjacent dots. *Id.* (citing Ex. 1005, 4:33–36, Figs. 1a–c, 10a–11b). Petitioner further contends that "a '***first pixel'*** (Phan's green dot) is located between and further ***'separate[s]'*** the ***'second pixel'*** and ***'another second pixel'*** (two of Phan's blue dots)." *Id.* (alteration in original). To summarize these contentions, Petitioner provides the following illustration in the Petition.

[11] The ITC Administrative Law Judge determined that claim 1, and claims 2–4 and 21 that depend, directly or indirectly, from claim 1, are not anticipated by Phan under 35 U.S.C. § 102. Ex. 2088, 61–64. The Administrative Law Judge did not consider the obviousness rationale in this ground based on Phan under 35 U.S.C. § 103, particularly with respect to the "virtual square" limitation of claim 1. *See supra* § II.E.2.c).

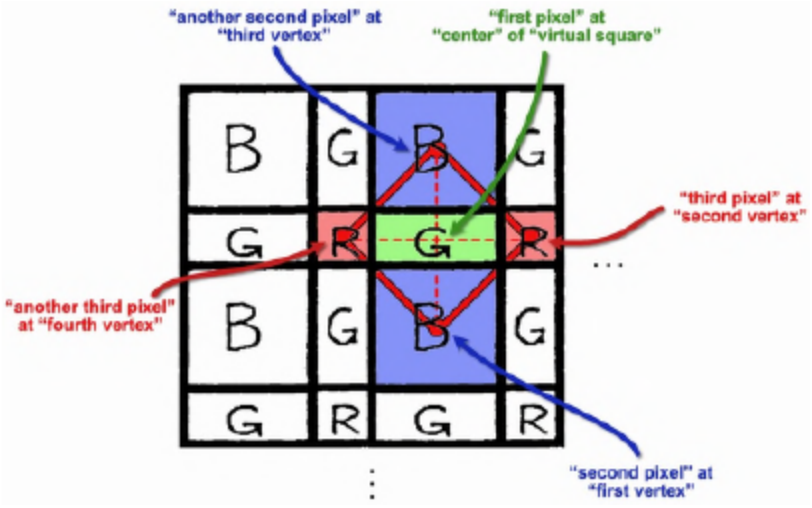


Id. at 55 (citing Ex. 1003 ¶¶ 374–380). In this illustration from the Petition, Petitioner shows the recited "virtual square" as a red square, indicates with a green arrow how a green "first pixel" is at the center of the virtual square, indicates with one blue arrow how a blue "second pixel" is at a first vertex of the virtual square, indicates with a second blue arrow how "another second pixel" is at a third vertex of the virtual square, and indicates with a red arrow how a red "third pixel" is at a second vertex of the virtual square. *Id.*

Patent Owner relies on the same arguments discussed above for claim 1. Based on Phan's Figure 11b embodiment as implemented in the quad pixel display of Figure 12, we are persuaded that Phan teaches the additional limitations of claim 2. *See, e.g.*, Pet. 54–55; Ex. 1003 ¶¶ 374–380. Our analysis regarding secondary considerations of nonobviousness discussed above for claim 1 applies equally to this claim. *See supra* § II.E.2.e). Thus, we determine that Petitioner has shown by a preponderance of the evidence that the subject matter of claim 2 would have been obvious over Phan.

4. Dependent Claim 3

Claim 3 depends from claim 2 and further recites that "the plurality of pixels further comprises another third pixel separated from the first pixel and having a center at a fourth vertex neighboring the third vertex of the virtual square" and that "the third pixels are separated from each other by the first pixel." Ex. 1001, 9:17–23. Petitioner again cites Phan's teaching that pixels are all "identical" and "regularly disposed" in a repeating matrix. Pet. 55 (citing Ex. 1005, 4:29–32, Fig. 11b). Continuing its analysis based on Phan from claim 2, Petitioner contends that "***'another third pixel'*** is located at a ***'fourth vertex'*** of the 'virtual square' centered on the green dot" such that the "'fourth vertex' ***'neighbor[s]'*** the square's 'third vertex'" and "a '***first pixel'*** (Phan's green dot) is located between and ***'separate[s]'*** the ***'third pixel'*** and ***'another third pixel'*** (two Phan's red dots)." *Id.* (alterations in original). To summarize these contentions, Petitioner provides the following illustration in the Petition.



Pet. 56 (citing Ex. 1003 ¶¶ 381–385). In this illustration from the Petition, Petitioner shows the recited "virtual square" as a red square, indicates with a green arrow how a green "first pixel" is at the center of the virtual square,

indicates with one blue arrow how a blue "second pixel" is at a first vertex of the virtual square, indicates with a second blue arrow how "another second pixel" is at a third vertex of the virtual square, indicates with one red arrow how a red "third pixel" is at a second vertex of the virtual square, and indicates with a second red arrow how "another third pixel" is at a fourth vertex of the virtual square. *Id.*

Patent Owner relies on the same arguments discussed above for claim 1. Based on Phan's Figure 11b embodiment as implemented in the quad pixel display of Figure 12, we are persuaded that Phan teaches the additional limitations of claim 3. *See, e.g.*, Pet. 55–56; Ex. 1003 ¶¶ 381–385. Our analysis regarding secondary considerations of nonobviousness discussed above for claim 1 applies equally to this claim. *See supra* § II.E.2.e). Thus, we determine that Petitioner has shown by a preponderance of the evidence that the subject matter of claim 3 would have been obvious over Phan.

5. Dependent Claim 4

Claim 4 depends from claim 3 and further recites that "the second pixels and the third pixels enclose the first pixel in the virtual square." Ex. 1001, 9:24–26. Petitioner cites Phan's teaching of employing pixels with dots arranged in a square shape. Pet. 56 (citing Ex. 1005, 3:65–4:4, 4:29–30, 4:54–55, 5:47–54, Figs. 2a–b, 11b, 12). Continuing its analysis based on Phan from claim 3, Petitioner contends that "Phan's ***'second pixels'*** (the blue dots) and ***'third pixels'*** (the red dots) surround and ***'enclose'*** its ***'first pixel'*** (the green dot) in the center of a ***'virtual square.'***" *Id.* at 56–57 (citing Ex. 1003 ¶¶ 386–389). Petitioner also cites the same illustration reproduced above in the analysis of claim 3. *Id.*

Patent Owner relies on the same arguments discussed above for claim 1. Based on Phan's Figure 11b embodiment as implemented in the quad pixel display of Figure 12, we are persuaded that Phan teaches the additional limitations of claim 4. *See, e.g.*, Pet. 56–57; Ex. 1003 ¶¶ 386–389. Our analysis regarding secondary considerations of nonobviousness discussed above for claim 1 applies equally to this claim. *See supra* § II.E.2.e). Thus, we determine that Petitioner has shown by a preponderance of the evidence that the subject matter of claim 4 would have been obvious over Phan.

6. Dependent Claims 19 and 20

Claim 19 depends from claim 1 and further recites that "the first pixel, the second pixel, and the third pixel are configured to emit different color lights." Ex. 1001, 10:48–50. Claim 20 depends from claim 19 and recites that "the second pixel and the third pixel are configured to emit blue light and red light, respectively." *Id.* at 10:51–53. Petitioner cites the same analysis from claim 1 in which it maps the recited "first pixel," "second pixel," and "third pixel" to Phan's green, blue, and red dots, respectively. Pet. 57–58 (citing Ex. 1005, 4:29–32, Figs. 11b, 12); *see also supra* § II.E.2.c) (analysis for [1-a(1)] through [1-a(4)]).

Patent Owner relies on the same arguments discussed above for claim 1. For the same reasons discussed above, we are persuaded that Phan teaches pixels of different colors with the "second pixel" being blue and the "third pixel" being red. *See, e.g.*, Ex. 1005, 4:29–32, Figs. 11b, 12; *see also supra* § II.E.2.c) (analysis for [1-a(1)] through [1-a(4)]). Our analysis regarding secondary considerations of nonobviousness discussed above for claim 1 applies equally to these claims. *See supra* § II.E.2.e). Thus, we

determine that Petitioner has shown by a preponderance of the evidence that the subject matter of claims 19 and 20 would have been obvious over Phan.

7. Dependent Claim 21

Claim 21 depends from claim 1 and further recites that "the second pixel has a larger area than that of the first pixel." Ex. 1001, 10:54–55. Similar to its analysis for limitation [1-b], Petitioner cites Phan's teachings relative to Figure 11b in which the crosspoint is shifted along a diagonal line in a quad pixel to create a blue dot (i.e., a "second pixel") that is larger than a green dot (i.e., a "first pixel"). Pet. 58 (citing Ex. 1005, Fig. 11); *see also supra* § II.E.2.d) (analysis for [1-b]).

Patent Owner relies on the same arguments discussed above for claim 1. Based on Phan's Figure 11b embodiment, we are persuaded that Phan's blue dot (i.e., "second pixel") has a larger area than the green dot (i.e., "first pixel"). *See, e.g.*, Ex. 1005, 5:47–54, Fig. 11b. Our analysis regarding secondary considerations of nonobviousness discussed above for claim 1 applies equally to this claim. *See supra* § II.E.2.e). Thus, we determine that Petitioner has shown by a preponderance of the evidence that the subject matter of claim 21 would have been obvious over Phan.

F. Alleged Obviousness of Claim 5 over Phan and Yamada

Claim 5 depends from claims 4, 3, 2, and 1. Ex. 1001, 8:58–9:31. Claim 5 further recites limitation [5-a]: "the first pixel, the second pixels, and the third pixels have polygonal shapes," and limitation [5-b]: "each of the second pixels and each of the third pixels has a larger area than the first pixel." *Id.* at 9:27–31; Pet. 59–60. We find below that Petitioner has not put forth a persuasive rationale for combining Phan and Yamada, which Petitioner relies on to meet limitation [5-b]. We first discuss Petitioner's

contentions for limitation [5-a], and then explain why Petitioner has not set forth a persuasive rationale to combine the teachings of Phan and Yamada to meet limitation [5-b].

1. Limitation [5-a]

Petitioner asserts that Phan's Figures 11a and 11b, reproduced below, teach limitation [5-a] (Pet. 59–60):

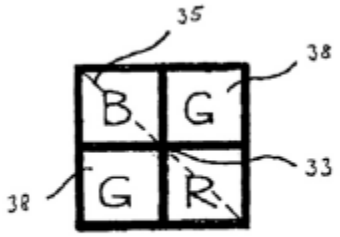


FIG. 11a

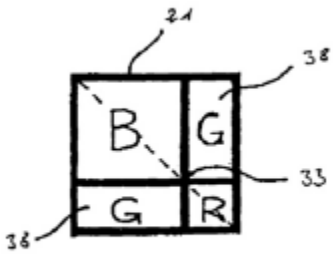


FIG 11b

Figure 11a shows a square quad-pixel where the crosspoint is at the center of the four dots or individual elements of equal light emitting area and space, contoured by black mask or black barrier ribs with the same structure. Ex. 1005, 3:64–67. Figure 11b shows a typical square quad-pixel where the crosspoint moving along the diagonal line forms two dots (individual elements) of equal light emitting area and space of green color (G). *Id.* at 4:1–4.

Petitioner asserts:

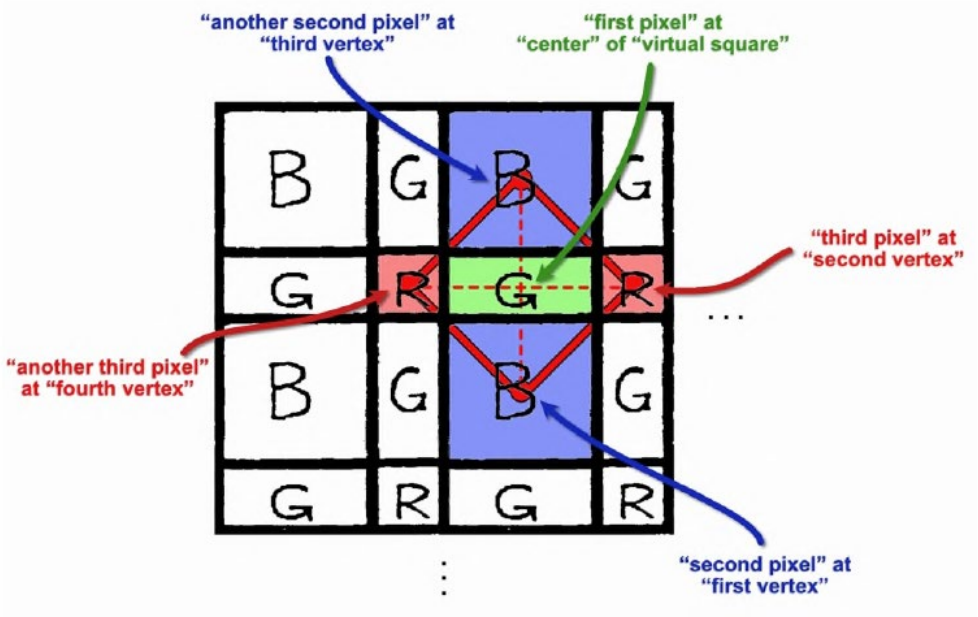
> Phan explains that the dots making up its pixels can be formed as a "square quad." (Ex. 1005, 5:47–54.) For instance, in Fig. 11a, each dot is an "equal" part of the "square" pixel (and thus is also square). (*Id*., 5:47–50.) And, in Fig. 11b, while the overall pixel still has a square shape, the "crosspoint" that separates the dots has "mov[ed]" along a "diagonal line" resulting in square and rectangular shaped dots. (*Id*., 5:51–54.)

Pet. 59 (alteration in original). Thus, according to Petitioner, each of the dots shown in the illustration above is either square or rectangular, both of which are polygonal as is required by claim 5. *Id.*

2. Limitation [5-b]

a) Petitioner's Reasoning

The illustration Petitioner relies on to show satisfaction of claim 4 from which claim 5 depends is reproduced below:



Pet. 56–57. The illustration is Petitioner's depiction of the resulting arrangement when the quad pixel structure of Phan's Figure 11b is substituted into the pixel display structure of Phan's Figure 12, which shows a first pixel, a second pixel, another second pixel, a third pixel, and another third pixel. *Id.*

Although Phan teaches that its second pixel (blue) can be made larger than its first pixel (green), Petitioner acknowledges that Phan does not provide an example where its third pixel (red) is also made larger than the first pixel as is required by limitation 5-b. Pet. 60. Petitioner asserts, however, that it would have been obvious to one of ordinary skill in the art

to re-size Phan's dots according to Yamada's teachings of sizing the pixels according to the emission efficiency of each color's emissive element, i.e., the pixel with a color having the highest emission efficiency, green, is made the smallest, and the pixel with a color having the lowest emission efficiency, blue, is made the largest. *Id.* at 60–62. Regarding motivation to combine the teachings of Phan and Yamada, Petitioner states:

> A POSITA would have been motivated to apply Yamada to Phan in the manner discussed above for the same reasons it would have been obvious to apply Yamada to Matthies. (Ex. 1003, ¶¶ 433–442.) As explained, it was well-known that adjusting pixel size—and making pixels with lower emission efficiencies (like blue pixels) larger and pixels with higher emission efficiencies (like green pixels) smaller—reduces deterioration and improves display life. . . . A POSITA would have recognized that applying Yamada to Phan would have similarly improved the life of Phan's display. (Ex. 1003, ¶¶ 434–437.) By making the blue pixels largest and the green pixels smallest, display deterioration and dot failure would have been reduced. (*Id*.)

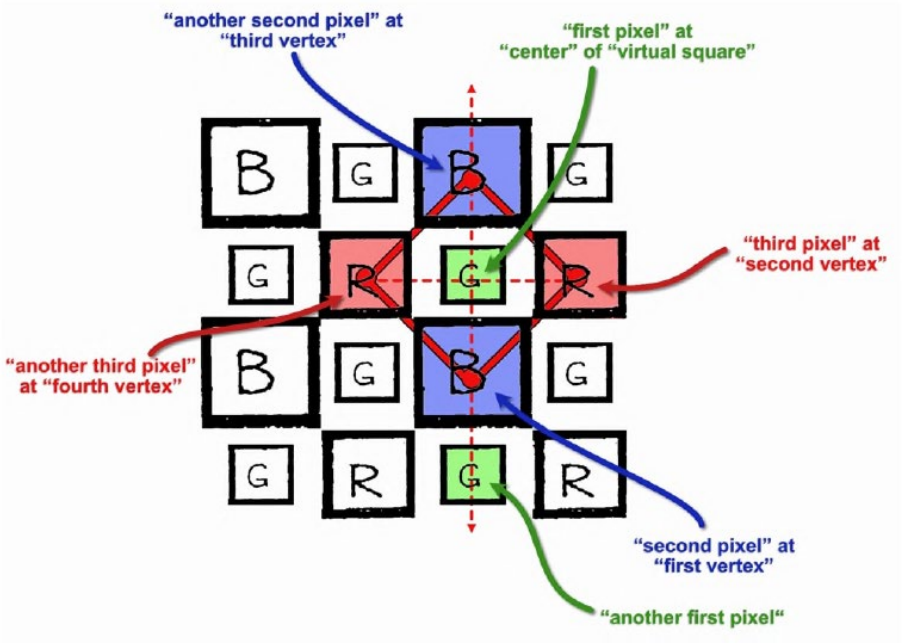
Id. at 62–63. Additionally, Petitioner asserts that re-sizing pixels according to their emission efficiency was also known to simplify display design because each pixel can be supplied with the same current or power. *Id.* at 63 (citing Ex. 1003 ¶¶ 438–439).

Petitioner generally refers back to its reasoning for combining Yamada and Matthies as being equally applicable to this ground. Pet. 62. For instance, Petitioner asserts that, according to Yamada, to achieve constant pixel luminance with same-sized pixels, pixels with lower emission efficiency, like blue, must be supplied with a larger current than pixels with higher emission efficiency, like green, but supplying the blue pixels with a larger current shortens their lives. *Id.* at 39–40. Petitioner asserts that, to address this problem, Yamada teaches that the pixels with lower emission

efficiencies (blue) should be made larger than pixels with higher emission efficiencies (green), and that this solution avoids the deterioration problem and lengthens the life of the display. *Id.*

Petitioner identifies several other reasons for combining teachings. Pet. 41–43. But they all hinge on the base motivation that enlarging the size of blue pixels would extend their lifetimes and thus improve the overall life of the display and are not presented as motivations independent of that base motivation. For example, Petitioner indicates that extending the life of the blue pixels would create a more balanced luminance that would obviate the need for additional adjustment circuitry to tailor the supplied current on a pixel-by-pixel basis. *Id.* at 41–42.

Petitioner provides an illustration of the resulting pixel display structure which applies Yamada's pixel sizing teachings to Phan:



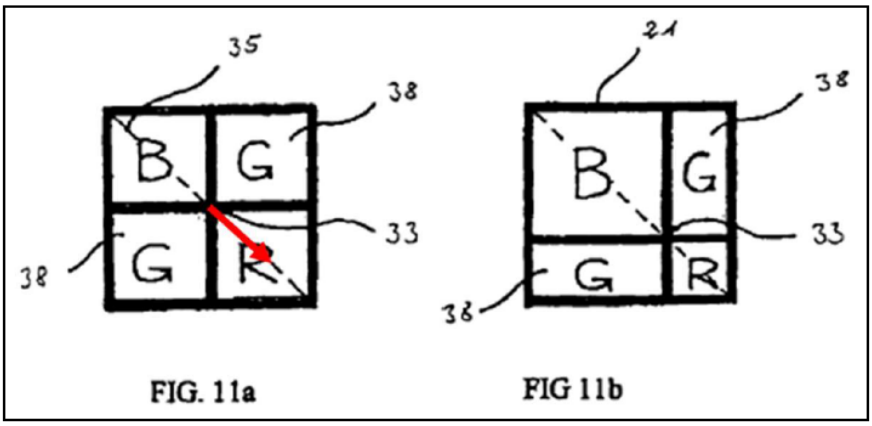
The illustration is Petitioner's depiction of the resulting pixel display structure that incorporates Yamada's teaching about sizing pixels according to their emission efficiency to Phan's pixel display. Pet. 61–62. Petitioner

explains that the blue dots maintain their original size, the green dots are made the smallest, and the red dots are of an intermediate size between the blue dots and green dots. *Id*. at 61. According to Petitioner, the sizing requirements of claim 5 are thus met by the combined teachings of Phan and Yamada. *Id.* at 62.

b) Patent Owner's Arguments

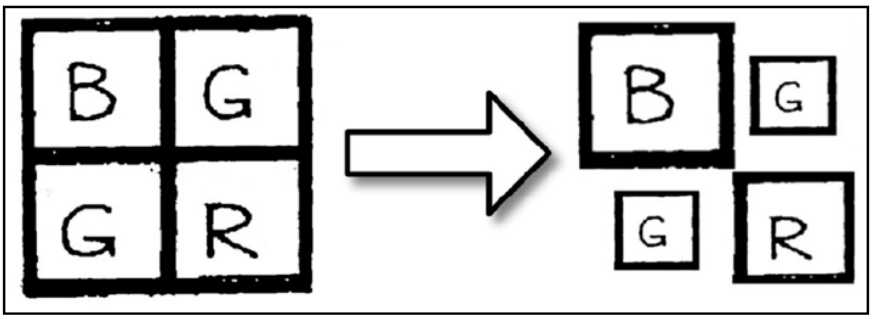
Patent Owner argues:

> *First*, for reasons as discussed above in connection with Ground 1, a POSITA would have understood that keeping the blue pixel the same size and shrinking the red and green pixels would require higher current density to be applied to the red and green pixels, accelerating their aging and reducing display lifetime. These effects would be exacerbated because Phan's passive-matrix displays require high driving voltages and current densities. [Ex. 2009] ¶¶245-246. The Petition's proposed combination of Phan with Yamada would have the opposite effect of Petitioner's purported motivation to combine of extending display lifetime. *Id.*
>
> *Second*, Petitioner's proposed modification conflicts with Phan's express teachings concerning how to adjust the relative sizes of subpixels (dots) in a quad-pixel structure. *Id.*, ¶247. Phan discloses that the relative sizes of the dots in its square quad-pixel are changed by moving the crosspoint—i.e., the point at which the corners of all four pixels meet —along a diagonal line of the square, for example along the red arrow. Phan, 5:51-54.



[The illustration shows Phan's manner of adjusting pixel sizes, by moving the crosspoint (Patent Owner added a red arrow to note the direction of crosspoint movement).] *Id.*, Figs. 11a, 11b. As shown in Figures 11b, when the blue pixel's size is increased, each green pixel is necessarily made an intermediate size and the red pixel is necessarily made smallest. Ex. 2009, ¶248.

Phan teaches adjusting the sizes of dots without adding space between subpixels—keeping the overall aperture ratio constant—by moving the crosspoint along a diagonal line. Phan, 5:43-46, 5:51-54. Petitioner inextricably breaks apart Phan's quad-pixel, contrary to Phan's requirements, and introduces arbitrary spacing between the subpixels without any support in Phan:



[The illustration shows Petitioner's modification of Phan's unmodified quad-pixel.] Pet. at 61. *Not only is this inconsistent with Phan's teachings about the crosspoint, but it is inconsistent with Phan's passive-matrix design constraining adjustments of pixel sizes*. Ex. 2009, ¶¶249–250. Indeed,

> Petitioner provides no reason for ignoring Phan's Figure 11b in enlarging the blue pixel.

PO Resp. 41–43 (emphasis added except for first and second).

c) Discussion

(1) Deficient Manner of Resizing Phan's Pixels

Patent Owner asserts that Petitioner's manner of resizing Phan's pixels "conflicts with Phan's express teachings concerning how to adjust the relative sizes of subpixels (dots) in a quad pixel structure," and "is inconsistent with Phan's passive-matrix design constraining adjustments of pixel sizes." PO Resp. 41–43. Petitioner does not dispute Patent Owner's assertion (*id.* at 38) that Phan explicitly concerns passive-matrix displays as an alternative to actively-driven displays.

Dr. Kymissis has testified that for passive-matrix OLEDs, the light-emitting area is defined by the overlap of row and column electrodes and, consequently, the pixels in the same row have the same height and the pixels in the same column have the same width. Ex. 2009 ¶¶ 123, 250. Dr. Kymissis further has testified that changing the size of a row or column electrode would change the size of all the pixels in that row or column. *Id.* With respect to the testimony of Dr. Kymissis, Petitioner identifies no countering testimony from its own expert Dr. Pattison. We credit the testimony of Dr. Kymissis, and find that for the passive-matrix display of Phan, the pixels in the same row must have the same height and the pixels in the same column must have the same width.

Phan describes that the sizes of the dots in its square quad-pixel are changed by moving the crosspoint, the point at which the corners of all four pixels meet, along a diagonal line of the square. Ex. 1005, 5:51–54. Phan's

Figure 11b shows one such example where the crosspoint has been moved toward the lower right and is reproduced below:

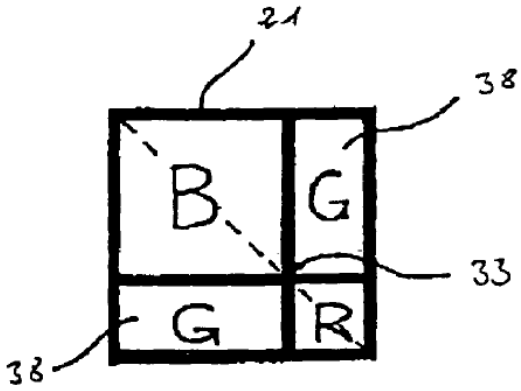
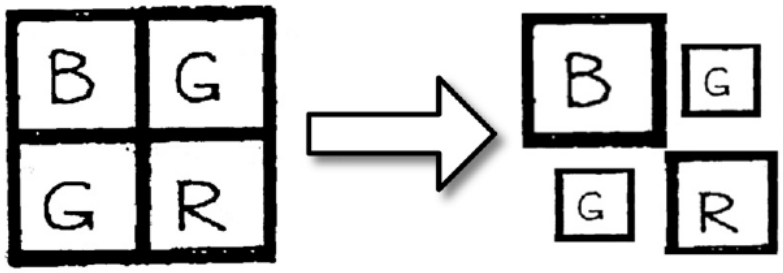


FIG 11b

Figure 11b shows a square quad-pixel where crosspoint 33 has been moved from the center along diagonal line 35. *Id.* at 5:51–54. As is readily apparent from Figure 11b, as compared to their sizes when the crosspoint is at the center of the square, the blue pixel has been made bigger and the red pixel has been made smaller than both the blue pixel and the green pixels. This described manner of resizing is consistent with the structural requirements of a passive-matrix OLED where the pixels in the same row have the same height and the pixels in the same column have the same width. Ex. 2009 ¶¶ 123, 250.

In contrast, Petitioner's proposed manner of adjustment of pixel sizes foregoes the crosspoint movement, separates the four sub-pixels of the square quad-pixel, and includes intermediate spacing among the four, as shown below:



Pet. 61. Phan's Figure 11a is on the left, showing an unmodified quad-pixel with four equal sized square color light emitting sub-pixels contiguous to each other, and the modified structure purportedly according to Yamada's teachings is shown on the right, with an arrow pointing from left to right between the unmodified quad-pixel on the left and the modified quad-pixel structure. The modified structure has made the red sub-pixel R smaller than the blue sub-pixel B, and the two green sub-pixels G even smaller than the red sub-pixel R. The four sub-pixels in the modified structure are separated from each other by intermediate spacing.

Petitioner's proposed modified structure of Phan is not compatible with Phan's passive matrix OLED to which Petitioner applies the proposed modification. In the above-reproduced illustration of the modified structure, the pixels in the same row do not have the same height and the pixels in the same column do not have the same width.

Petitioner's expert, Dr. Pattison, testifies with respect to Petitioner's illustrated modified structure that "[w]hile the pixels are no longer touching each other as they are shown to be in Figure 11a, a POSITA would have understood that there already is space (even if not depicted) between the pixels to allow for the intermediate signal lines." Ex. 1003 ¶ 428.
Dr. Pattison also testifies that the modification simply decreases the size of the green and red pixels "so as to allow all the pixels to be supplied with the

same current." *Id.* ¶ 429. Such testimony does not aid Petitioner because it does not change the fact that in the modified structure the pixels in the same row do not have the same height and the pixels in the same column do not have the same width.

Petitioner asserts:

> Patent Owner also argues that the Petition's example application of Yamada to Phan "violates Phan's requirement of adjusting the pixel sizes along a crosspoint." Response, 40, 41. It does not. Phan explains that "[t]he precise arrangement of the various color dots . . . is not critical" so long as this arrangement is "identical" from pixel-to-pixel. (Phan, 4:37–40; 5:3-5.) "Other pixel shapes are contemplated" besides those shown. (*Id.*, 5:32.) And per Phan, pixels' light emitting areas can be "adjust[ed]" using a black mask/barrier. (*Id.*, Abstract, 1:30-34.) So, far from "violat[ing]" any "requirement" in Phan, the Petition merely follows Phan's teachings.

Reply 16–17 (alterations in original). This explanation does not address and respond to the fact that Petitioner's proposed modification does not result in pixels in the same row having the same height and the pixels in the same column having the same width as would be necessary with the structure of Phan's passive-matrix OLED, even assuming that other pixel shapes are contemplated besides those expressly shown.

We also have considered Petitioner's argument that Cok's Figure 1 pixel arrangement—which is similar to Phan's Figure 11b pixel arrangement—is used in an active-matrix OLED. Reply 16 (citing Ex. 1015, Fig. 1). Although Cok makes general statements about the application of its disclosed invention to "passive-matrix or active-matrix [OLED] devices" (Ex. 1015, 2:61–67), Cok does not specify whether its Figure 1 embodiment pertains to active- or passive-matrix OLEDs. *See id.* at 4:8–13; *see also* Ex. 1018, 70:5–18 (Dr. Kymissis's testimony regarding same). And, even if

we were to assume that Cok's Figure 1 pixel arrangement might be applicable to active-matrix OLEDs, this fact still would not cure the deficiencies in Petitioner's obviousness rationale. Specifically, Petitioner offers no explanation why or how Phan's passively driven pixel arrangement would be resized in a manner at odds with Phan's own teachings to allegedly achieve the pixel arrangement of claim 5. We also note that Cok's Figure 1 pixel arrangement does not resemble Petitioner's proposed pixel arrangement for this ground, which undermines Petitioner's argument. *Compare* Ex. 1015, Fig. 1, *with* Pet. 61–62 (illustrations).

For the foregoing reasons, we find Petitioner has not persuasively shown how or why one of ordinary skill in the art would have adapted the pixel structure of Phan based on Yamada as proposed by Petitioner.

(2) Petitioner's Proposal Reduces Lifetime of Red and Green Pixels

Patent Owner asserts that Petitioner has not proposed to enlarge the size of the blue pixel as disclosed by Yamada but to keep the size of the blue pixel the same, reduce the size of the red pixel, and reduce the size of the two green pixels even more. PO Resp. 37 (citing Pet. 61). Patent Owner explains:

> for reasons as discussed above in connection with Ground 1 [obviousness over Matthies and Yamada], a POSITA would have understood that keeping the blue pixel the same size and shrinking the red and green pixels would require higher current density to be applied to the red and green pixels, accelerating their aging and reducing display lifetime. These effects would be exacerbated because Phan's passive-matrix displays require high driving voltages and current densities. [Ex. 2009] ¶¶245-246. The Petition's proposed combination of Phan with Yamada would have the opposite effect of Petitioner's purported motivation to combine of extending display lifetime. *Id.*

Id. at 41. These assertions are supported by the cited testimony of Dr. Kymissis. For instance, Dr. Kymissis testifies:

> [B]y reducing the red and green light-emitting areas, Dr. Pattison [Petitioner's expert]'s combination would require a higher current density to be applied to the red and green pixels to drive them at the same amount of brightness as before, thus accelerating aging of the red and green pixels and reducing display lifetime. In Phan's passive-matrix displays, the aging and lifetime effects of higher driving voltages and current densities would be further exacerbated.

Ex. 2009 ¶ 245.

Petitioner does not dispute that reducing the size of the red and green dots would reduce the lifetime of the red and green dots. Petitioner does not dispute that this result would be exacerbated by the higher driving voltages and current densities associated with Phan's passive-matrix display. Petitioner responds to Patent Owner's assertion as follows: "Patent Owner also repeats many of the same arguments it makes elsewhere, *i.e.*, applying Yamada *would not extend display life*, . . . *E.g.*, Response, 40-47. As explained. these arguments lack merit. *Supra* Sections II.A.3, II.B.2." Reply 17 (emphasis added).

Petitioner relies on the same arguments it asserts on this same issue in the context of the ground of unpatentability based on Yamada and Matthies. We have already discussed and rejected those arguments in our discussion of the alleged obviousness of claim 1 over Yamada and Matthies. For the same reasons, we determine Petitioner has not shown that its proposed combination of Phan and Yamada would extend the life of the display, which further undermines Petitioner's reason for combining the teachings of Phan and Yamada.

d) Conclusion for Limitation [5-b]

For the foregoing reasons, we conclude that Petitioner has not set forth a persuasive rationale to combine the teachings of Phan and Yamada to meet limitation [5-b].

3. Conclusion for Claim 5

Petitioner has not proved by a preponderance of the evidence that claim 5 would have been obvious over Phan and Yamada.

G. Alleged Obviousness of Claims 1–5 and 19–21 over Murai and Yamada

1. Overview of Murai

Murai is a Japanese patent directed to "a color image display device" that seeks to "display color images having a high-quality appearance." Ex. 1007 ¶¶ 1, 5. Murai indicates that the display device may be "an organic EL display device[]." *Id*. ¶ 58. Murai discloses a color image display device that "has unit pixels . . . made up of four dots disposed as a grid in the vertical and horizontal direction." *Id*. ¶ 28. To display higher-quality images, Murai calls for regularly disposing the unit pixels and effectively utilizing all regions of the screen so that the "overall aperture ratio can be improved." *Id*. ¶¶ 10, 42. Figure 3 of Murai is reproduced below.

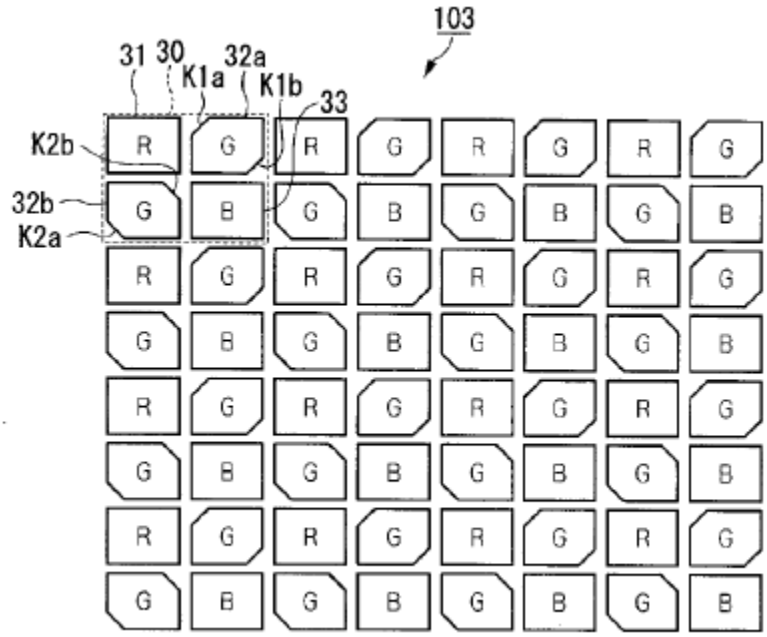


Figure 3 is "a plane view illustrating dot shape and dot arrangement in a color image display device." Ex. 1007 ¶ 27. "The unit pixels 30 are configured by four dots: one first dot 31, two second dots (32a and 32b), and one third dot 33, as a combined display unit." *Id*. ¶ 28. "[T]he second dots (32a and 32b) are configured by a first auxiliary dot 32a disposed on a top right corner of a rectangle made by the unit pixel 30 and a second auxiliary dot 32b disposed on a bottom left corner of the rectangle." *Id*. "[T]he first auxiliary dot 32a and the second auxiliary dot 32b are disposed diagonally in the rectangle made by the unit pixel 30." *Id*.

According to Murai, "the first auxiliary dot and the second auxiliary dot [may] be shaped having cut-off portions wherein at least one corner of the rectangular shape is cut off, and [may] be disposed so that there is a cut-off portion near a space between the first auxiliary dot and the second auxiliary dot." Ex. 1007 ¶ 11.

2. *Independent Claim 1*

We find below that Petitioner has not set forth a persuasive rationale for combining Murai and Yamada. We first discuss Petitioner's contentions for the preamble of claim 1 and limitations [1-a], [1-a(1)], [1-a(2)], [1-a(3)], [1-a(4)], and [1-c] of claim 1. Thereafter, we explain why Petitioner has not set forth a persuasive rationale to combine the teachings of Murai and Yamada to meet limitation [1-b].

a) Preamble [1-pre]

The preamble of claim 1 recites "[a] pixel arrangement structure of an organic light emitting diode (OLED) display." Ex. 1001, 8:58–59. Petitioner asserts: "Murai teaches a 'color image display device'" that includes "colored 'dots' arranged into 'unit pixels[s].'" Pet. 65 (citing Ex. 1007 ¶¶ 1, 6) (alteration in original). Petitioner contends that Murai's display "can be 'an organic EL display device.'" *Id*. (citing Ex. 1007 ¶ 58). Patent Owner argues that "Murai does not disclose or suggest that any of its figures, let alone Figure 3, represent how an OLED display . . . could or would be implemented." PO Resp. 48–49 (citing Ex. 2009 ¶¶ 277–278). We need not decide whether the preamble is limiting and whether Murai meets the preamble recitation because the alleged ground of obviousness based on Murai and Yamada is deficient in other ways.

b) Limitation [1-a]

Limitation [1-a] recites "a plurality of pixels for displaying an image on the OLED display and comprising." Ex. 1001, 8:60–61. Petitioner refers to Murai's Figure 3 and asserts the figure shows "multiple red (R), green (G), and blue (B) dots 31, 32a, 32b, and 33 arranged into unit pixels 30." Pet. 65 (internal quotation marks omitted) (citing Ex. 1007 ¶¶ 28–29). Murai's Figure 3 is reproduced below.

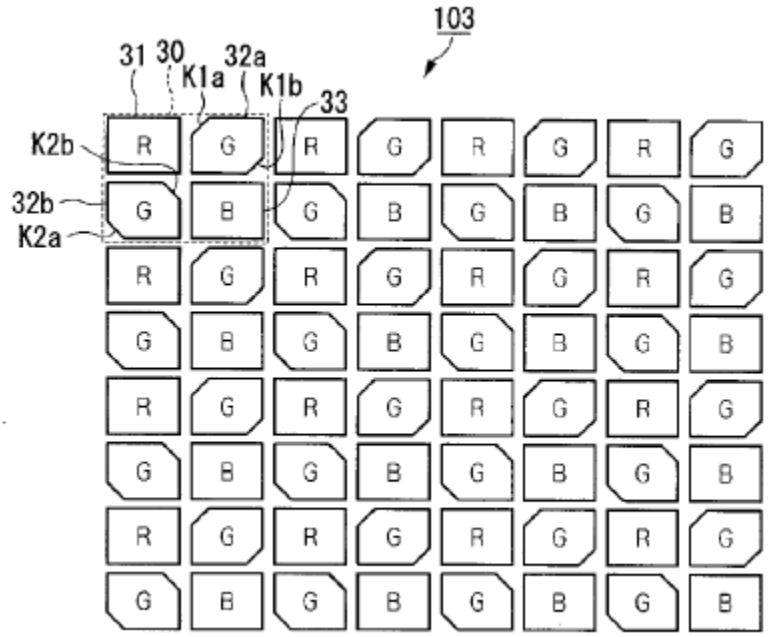
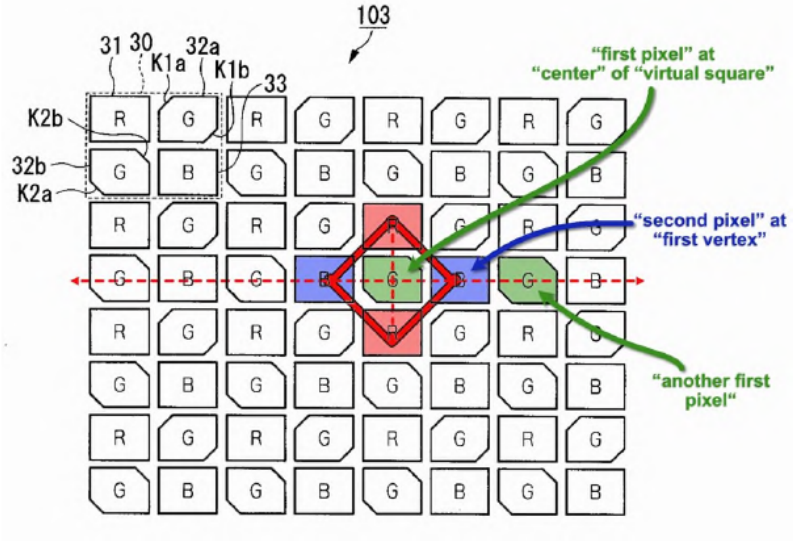


Figure 3 is "a plane view illustrating dot shape and dot arrangement in a color image display device." Ex. 1007 ¶ 27. Petitioner asserts Murai characterizes its dots (31, 32a, 32b, and 33) as pixels. Pet. 66 (citing Ex. 1007 ¶ 16). Petitioner further contends that Murai's dots are equivalent to the claim's "pixel" because the '803 patent teaches a "pixel" is the "minimum unit for displaying images," and Murai's dots "are the minimum unit of Murai's display." *Id*. (citing Ex. 1003 ¶¶ 461–466). Patent Owner reiterates its arguments that Murai does not teach an OLED display. PO Resp. 48–49 (citing Ex. 2009 ¶¶ 277–278). We need not resolve the issue because the alleged ground of obviousness based on Murai and Yamada is deficient in other ways.

c) Limitations [1-a(1)], [1-a(2)], [1-a(3)], [1-a(4)], and [1-c]

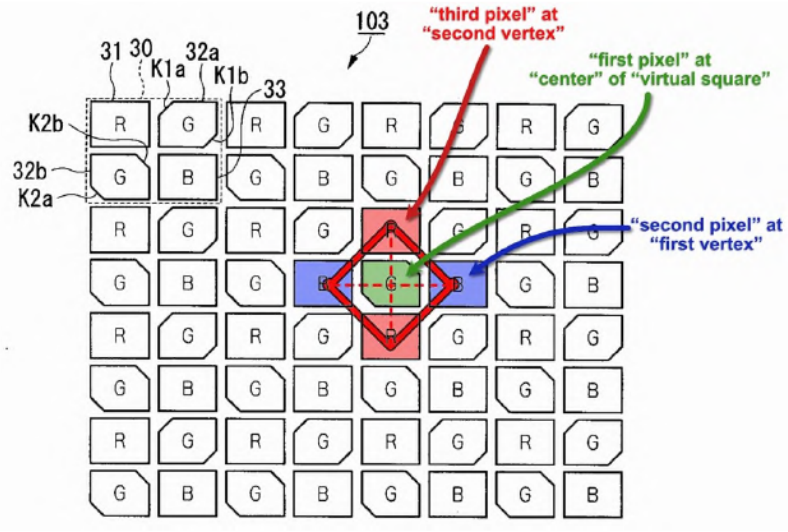
Petitioner presents multiple annotated versions of Murai's Figure 3, one of which is reproduced below, to illustrate how limitations [1-a(1)], [1-a(2)], and [1-a(3)] are met by Murai. Pet. 68–70.



In this version of Murai's Figure 3, Petitioner identifies elements including a "first pixel at center of virtual square," "second pixel at first vertex," and "another first pixel." *Id.* at 70 (internal quotations omitted). Specifically, the illustration shows a red-lined virtual square and a first pixel (green) at the center of the virtual square, which is limitation [1-a(1)]. Pet. 68 (citing Ex. 1003 ¶¶ 467–480). The illustration shows a second pixel (blue) separated from the first pixel and having a center at a first vertex of the virtual square, which is limitation [1-a(2)]. *Id.* at 69 (citing Ex. 1003 ¶¶ 481–484). The illustration shows another first pixel (green) on a line defined by the center of the virtual square and the first vertex, where the first pixel, the second pixel, and the other first pixel are consecutive pixels on the line, which is limitation [1-a(3)]. *Id.* at 70 (citing Ex. 1003 ¶¶ 485–488).

Limitation [1-a(4)] recites "a third pixel separated from the first pixel and the second pixel, and having a center at a second vertex neighboring the first vertex of the virtual square." Ex. 1001, 9:4–6.

Petitioner presents another annotated version of Murai's Figure 3, reproduced below, with color annotations including "first pixel at center of virtual square," "second pixel at a first vertex," "third pixel at second vertex," to show how limitation [1-a(4)] is met by Murai. Pet. 71 (internal quotations omitted).



In this version of Murai's Figure 3, Petitioner identifies a third pixel at a second vertex of the virtual square. Specifically, the illustration shows a third pixel (red) separated from the first pixel (green) and the second pixel (blue), and having a center at a second vertex neighboring the first vertex of the virtual square. *Id.* at 70–71 (citing Ex. 1003 ¶¶ 489–492).

Limitation [1-c] recites "wherein the first pixel is configured to emit green light." Ex. 1001, 9:9. Petitioner asserts that "Murai's display includes 'green (G)' dots/pixels" and references the above figures as teaching a green pixel at the center of a virtual square. Pet. 74 (citing Ex. 1003 ¶¶ 512–514). In rebuttal, Patent Owner argues that the combination of Murai and Yamada does not disclose a virtual square. PO Resp. 49–53. We need not decide whether the Murai and Yamada combination discloses a virtual square

because, for reasons discussed below, the Petition is deficient with respect to limitation [1-b].

d) Limitation [1-b]

Limitation [1-b] recites "wherein the second pixel has a larger area than that of the third pixel." Ex. 1001, 9:7–8. Petitioner relies on a combination of Murai and Yamada to meet limitation [1-b]. Pet. 71.

(1) Petitioner's Reasoning

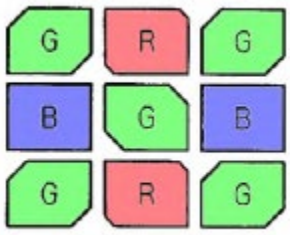
Petitioner asserts Murai teaches that its "dots/pixels can include a 'cut-off portion' that adjusts the dot area." Pet. 71 (citing Ex. 1007 ¶¶ 6, 11). Petitioner then proposes combining Murai's dot/pixel "cut-off portion" with Yamada's teachings to yield second pixels (blue dots) with a larger area than both of the other pixels (the green and red dots). *Id.* at 74 (citing Ex. 1003 ¶¶ 507–510).

Petitioner asserts: "A POSITA would have been motivated to apply Yamada to Murai in the manner discussed above for the same reason it would have been obvious to apply Yamada to both Matthies and Phan. Pet. 80. Petitioner states that "Yamada teaches an OLED display with red, green, and blue pixels re-sized 'in accordance with the emission efficiency of' each color's 'emissive element.'" *Id.* at 73 (citing Ex. 1008, 2:55–60, 3:16–27). According to Petitioner, Yamada discloses that re-sizing of the pixels according to emission efficiency, i.e., pixels with lower emission efficiency (blue) made larger than pixels with higher emission efficiency (green), avoids a pixel deterioration problem caused by supplying pixels with lower emission efficiency with higher current, and lengthens the overall life of the display. *Id.* at 39–40. Petitioner states: "As an added benefit, the overall display design become 'simplified' and 'extremely easy to control' as each pixel is supplied with 'the same amount of power.'" *Id.* at 40.

Petitioner further explains:

> Applying [Yamada] to Murai results in what the claim requires: Murai's dots would be relatively resized per Yamada using the method Murai already teaches—different numbers and sizes of cutouts—such that **"*second pixels*"** (the blue dots) have a **"*larger area*"** than both of the other **"*pixel[s]*"** (the green and red dots). (Ex. 1003, ¶¶ 507-510.)

Pet. 74 (second alteration in original). Petitioner provides an illustration as reproduced below:



Id. Petitioner's illustration depicts 9 dots from Murai's Figure 3 dot arrangement comprising red, green, and blue dots. *Id.* The green dots have two cutouts making the green dots the smallest. *Id.* The red dots also have two cutouts but are larger than the green dots. *Id.* Lastly, the blue dots have no cutouts and thus are the largest of the colored dots. *Id*.

Petitioner asserts that this illustration shows "an example" of how a POSITA would have combined Yamada and Murai to meet the limitation [1-b]. Pet. 74.

(2) Discussion

(a) Not Balancing for Reduced Aperture Ratio

Patent Owner asserts that downsizing Murai's pixels based on Yamada's teachings is "incompatible" with Murai's goal of improving the display's overall aperture ratio. PO Resp. 53 (citing Ex. 1007 ¶ 42; Ex. 2009 ¶ 298). Patent Owner asserts that "Petitioner's modifications would reduce

the aperture ratio and thereby undercut Murai's very purpose." *Id.* at 55. For reasons discussed below, we agree with Patent Owner.

Patent Owner's expert, Dr. Kymissis, explains:

> Further, Murai's disclosures—including its very reason for having cutoff corner positions in the green dots in Figure 3—are incompatible with Yamada's teachings. Murai's goal is to "improve[]" the "aperture ratio" (*i.e.*, the light-emitting area of the display) by packing pixels very closely together. Murai, ¶¶ [0010], [0042]. Dr. Pattison's proposed modification of Murai, purportedly based on Yamada's teachings, would *reduce* the display aperture ratio, and do so for no benefit.

Ex. 2009 ¶ 298 (emphasis in original) (alteration in original). Additionally, Dr. Kymissis explains:

> Murai, in the context of LCD displays having dots placed closely together, observes that diagonal lines of green dots can create visible streaks. Murai, ¶¶ [0004]-[0005]. Thus, Murai's solution to avoid these unwanted streaks is to cut out alternating corners on adjacent green dots to increase their separation, while **maximizing the light-emitting area**. Murai, ¶¶ [0008], [0010], [0011], [0012], [0042].

Id. ¶ 299 (emphasis added). Thus, improving the aperture ratio of the display, i.e., increasing the overall light-emitting area of the display, is Murai's goal even as it cuts off corners of various dots/pixels in its disclosed embodiments. In other words, Murai conveys that it does not want to cut off too much of the dots/pixels, which would further reduce the aperture ratio.

In its Reply, Petitioner does not dispute that Murai has a goal of improving the display's overall aperture ratio or that its proposed combination of Murai and Yamada would further reduce the display's aperture ratio from that which is already reduced by Murai's cutting of two corners of the green dots. Reply 19–20.

Petitioner has not persuasively shown that one of ordinary skill in the art would have been motivated to combine the teachings of Murai and Yamada in the manner proposed by Petitioner. Our reviewing court has explained that, regarding a showing of proper motivation to combine teachings, when one "motivating benefit comes at the expense of another benefit, . . . the benefits, both lost and gained, should be weighed against one another." *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006) (citing *Winner Int'l Royalty Corp. v. Wang*, 202 F.3d 1340, 1349 n.8 (Fed. Cir. 2000)); *see also Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 795 (Fed. Cir. 2021).

Here, it is uncontested that a stated goal of Murai is to increase the aperture ratio of the display, and that, contrariwise, Petitioner's proposed combination of Murai and Yamada would decrease the aperture ratio of the display. *See* Reply 19–20; Ex. 1007 ¶¶ 10, 42; Ex. 2009 ¶ 298. The Petition does not attempt to balance, or otherwise take into account, the loss of aperture ratio when resizing Murai's pixels according to Yamada's teachings. Pet. 80–82 (citing Ex. 1003 ¶¶ 547–562). Similarly, Petitioner in its Reply also fails to balance the alleged benefits with corresponding drawbacks in reduction of aperture ratio. Reply 19 (citing Pet. 81–82).

In its Reply, Petitioner asserts that "it would have been well within the ability of a POSITA to balance the benefits provided by Murai's pixel arrangement with Yamada's teachings to implement a working display." Reply 19–20. The assertion is not supported by any expert testimony. Also, the assertion, even if true, is misplaced. It would be mere speculation to assume that one of ordinary skill in the art would have determined that the alleged benefits in increased lifetime of the display outweighs the

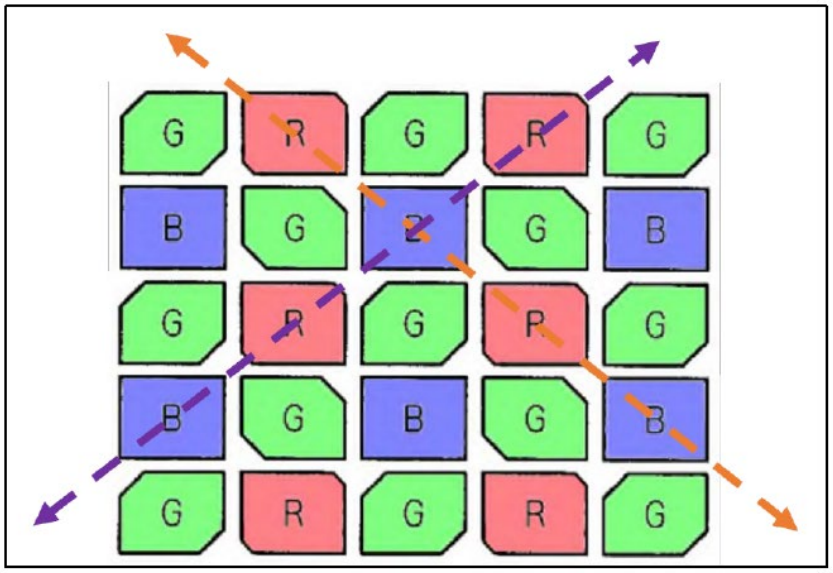
disadvantages brought about by reduced aperture ratio due to decreasing the sizes of the red and green dots. Petitioner has not established that that is so.

Further, Patent Owner argues:

> [I]f it were possible to make such a densely packed display as Murai's Figure 3 with OLED and make cutouts of the dots, Petitioner's proposed combination may introduce unwanted visual artifacts, contrary to Murai's purpose. Murai's embodiments do not have the asymmetry of Petitioner's proposal and have blue and red dots equally sized. In Petitioner's combination, a top-left-to-bottom-right diagonal of red and blue dots may exhibit a different degree of color mixing and streaking effects than a top-right-to-bottom-left diagonal of red and blue dots. A POSITA would have had no motivation to make Petitioner's proposed modifications, nor a reasonable expectation of success. Ex. 2009, ¶306.

PO Resp. 56. Dr. Kymissis explains:

> [I]n the illustration below, I have taken the 3x3 pixel array drawn by Dr. Pattison and tiled it to form a 2 more rows and 2 more columns. When looking along the orange diagonal, there are 0 cut-off corners along that diagonal. On the other hand, when looking along the purple diagonal, there are 2 cut-off corners in each red pixel along that diagonal. This would result in an asymmetry in the degree of color mixing and streaking effects in images along the two diagonals. In contrast, none of Murai's embodiments suffer from this asymmetry introduced by Dr. Pattison's proposed combination because the blue and red dots are always equally sized in Murai's embodiments. A POSITA would have had no motivation to make Dr. Pattison's proposed modifications, and would not have had a reasonable expectation of success.



[The illustration depicts color mixing and streaking effects Dr. Kymissis opines would exist in Petitioner's proposed modification of Murai in view of Yamada]

Ex. 2009 ¶ 306.

Petitioner does not dispute that the illustration it provided would, in fact, have the color mixing and streaking effects explained by Dr. Kymissis. Instead, Petitioner answers:

> The Petitioner's example, however, was merely meant to conceptually illustrate one way to apply Yamada. Petition, 71-74. Murai is open to the use of variably sized pixels with differently arranged cutouts. *(E.g.*, Murai, [0013], [0048]-[0052].) The Petition simply noted that this invites application of Yamada. Petition, 81-82. And it would have been well within the ability of a POSITA to balance the benefits provided by Murai's pixel arrangement with Yamada's teachings to implement a working display.

Reply 19–20. Even if true, the argument does not aid Petitioner, because it confirms that Petitioner has not even attempted to balance the alleged benefits of Yamada's teachings with the disadvantage of reducing aperture ratio in Murai, which is an explicit concern of Murai.

Absent such balancing by Petitioner, we are not persuaded that one of ordinary skill in the art would have implemented Yamada's teaching in Murai regarding resizing colored dots/pixels in the manner proposed by Petitioner.

(b) Petitioner's Proposal Reduces Lifetime of Red and Green Dots/Pixels

Patent Owner asserts that one of ordinary skill in the art "would have understood that reducing the sizes of the green and red pixels while keeping the blue pixels their same size would not extend the overall lifetime of Murai's display. Ex. 2009, ¶305. *See supra*." PO Resp. 56 (citing Ex. 2009 ¶ 305). Patent Owner also asserts: "Maintaining the blue pixels' size would not reduce the current density supplied to them that "[m]aintaining the blue pixels' size would not reduce the current density supplied to them so as to extend the display lifetime. Likewise, reducing the sizes of the green and red pixels would require increasing the current densities supplied to those pixels, shortening their lives." *Id.*

Dr. Kymissis testifies:

> [A] POSITA would have understood that reducing the sizes of the green and red dots while keeping the blue dots the same size would not extend the overall lifetime of Murai's display, for the same reasons discussed above in Sections X.A.3, X.B. In brief, according to Dr. Pattison's theory underlying his proposed combination with Yamada, blue OLED materials have lower emission efficiency, requiring blue pixels to be driven at a higher current density which promotes degradation of the organic material, shortening its lifetime. Yamada, 2:60-67; 11:11-15. But Dr. Pattison's proposed combination to keep blue dots the same size would maintain, not reduce the current density applied to the blue dots and thus would not extend the lifetime of the display. At the same time, Dr. Pattison's proposed combination would require increasing the current density applied to each of the red and green dots to maintain the same luminance and

> brightness, shortening the lifetime of those pixels and thus reducing the lifetime of the display. A POSITA would have had no reason to make such changes to Murai.

Ex. 2009 ¶ 305.

Petitioner does not dispute that reducing the size of the red and green dots would reduce the lifetime of the red and green dots. Petitioner responds to Patent Owner's assertion as follows: "Patent Owner concludes by once again repeating its arguments regarding *display lifetime*, ... Response, 56-57. These fare no better here. *Supra* Sections II.A.3." Reply 20 (emphasis added). Petitioner relies on the same arguments it asserted on this same issue in the context of the grounds of unpatentability based on Matthies and Yamada. We have already discussed and rejected those arguments in our discussion of the alleged obviousness of claim 1 over Matthies and Yamada. For the same reasons, we determine that Petitioner has not shown that its proposed combination of Murai and Yamada would extend the life of the display, which further undermines Petitioner's reason for combining the teachings of Murai and Yamada.

(c) Murai's Cutouts Not Useful for OLEDs

Patent Owner asserts:

> Petitioner disregards the reasons for Murai's cut-outs. Having packed dots especially closely together in its display, Murai observes that its diagonal lines of close green dots create visible streaks, which Murai avoids by cutting-out alternating corners on the green dots to increase their separation and improve "visual connectivity" of individual unit pixels, Murai, ¶[0011], Fig. 6(a). In an OLED display, however, different-colored pixels must be spaced farther apart due to manufacturing requirements, and a POSITA would not have viewed Murai's cut-outs as necessary. Ex. 2009, ¶¶299. For instance, Yamada's disclosed emissive area ratios of 1:2.6:5.6 between green, red, and blue pixels, or alternatively 1:14.2:35—which Petitioner cites, Pet. at 32;

> Yamada, 11:8-10, 11:34-39—would result in separations of green dots sufficient to nullify the reason for Murai's cut-out portions. A POSITA would not have been motivated to make this combination nor had a reasonable expectation of success in doing so. Ex. 2009, ¶¶299-301.

PO Resp. 53–54.

We agree with Patent Owner that Petitioner has not persuasively shown why an ordinarily skilled artisan would have re-sized Murai's dot arrangement based on Yamada using additional corner cutouts as suggested by Murai. First, even though Murai mentions OLED devices (*see* Ex. 1007 ¶ 58), Petitioner has not persuasively shown that Murai's corner cutouts would be useful in the context of OLED displays, particularly when considering that OLED displays are spaced farther apart than the LCD displays that Murai primarily addresses. *See* Ex. 2009 ¶ 300. This problem is exacerbated when considering the OLED emissive area ratios from Yamada that Petitioner and Dr. Pattison cite in support of making the combination (*see* Pet. 73; Ex. 1003 ¶¶ 219, 258, 418, 508), because the combination "would result in such large cut-off corners and separations between green dots that it would nullify the reason for implementing Murai's cut-off corners." Ex. 2009 ¶ 301; *see also* Ex. 1008, 11:4–15, 11:34–39 (emissive area ratios from Yamada). Petitioner's failure to establish how Murai's corner cutouts are suitable in the context of OLED displays further undermines Petitioner's reason for combining the teachings of Murai and Yamada.

(3) Conclusion on Limitation [1-b]

We conclude that Petitioner has not persuasively shown that an ordinarily skilled artisan would have combined Murai and Yamada in the manner suggested by Petitioner to meet limitation [1-b].

e) Conclusion for Claim 1

For the forgoing reasons, Petitioner has not set forth a persuasive reason for one of ordinary skill in the art to combine the teachings of Murai and Yamada in the manner suggested by Petitioner. Petitioner has not proved by a preponderance of the evidence that claim 1 would have been obvious over the combination of Murai and Yamada.

3. Claims 2–5 and 19–21

Claims 2–5 and 19–21 each depend, directly or indirectly, from claim 1. The deficiency of Petitioner's accounting for claim 1, as discussed above, equally applies to claims 2–5 and 19–21. Petitioner has not proved by a preponderance of the evidence that any of claims 2–5 and 19–21 would have been obvious over the combination of Murai and Yamada.

H. Petitioner's First Motion to Strike

Petitioner moves to strike a sentence of Patent Owner's Response that allegedly incorporates arguments from Exhibit 2028. 1st Strike Mot. 1. The sentence states: "For example, the AMOLED display used in the Samsung Galaxy S22 Ultra product practices all challenged claims of the '803 Patent. Ex. 2009, ¶¶350–352; Ex. 2028 (Galaxy S22 ULTRA Claim Chart); Ex. 2063." *Id.* (quoting PO Resp. 72). Petitioner faults Patent Owner for failing to explain the basis for this statement in the Response and instead "simply say[ing] so and point[ing] to Exhibit 2028 (a 20-page claim chart) for the supporting argument." *Id.* at 1, 5. Petitioner argues that this amounts to improper incorporation by reference of an argument for which Patent Owner bears the burden of production. *Id.* at 2. Petitioner also argues that Patent Owner cannot merely explain in exhibits its contention that the Samsung Galaxy S22 Ultra practices the claims of the '803 patent. *Id.* at 2–

3; *see also* Exclude Reply 2 (citing Ex. 2009 ¶ 352) (arguing that "Dr. Kymissis's declaration is no better" because "he includes a bare citation to Ex. 2028 without engaging in any explanation or claim-by-claim elaboration.").

Patent Owner characterizes the claim chart at Exhibit 2028 "as supporting *evidence* for . . . nexus arguments that are thoroughly presented in the [Patent Owner Response]." 1st Strike Opp. 1. Patent Owner notes that the Response presents a "teardown image . . . of the pixel arrangement obtained from a Galaxy S22 Ultra . . . with Figure 5 of the '803 Patent superimposed." *Id.* at 3 (alteration in original) (citing PO Resp. 72–73); *see also supra* § II.E.2.e).(1) (reproducing referenced teardown image). Accordingly, Patent Owner argues that the Response "cites Exhibit 2028, a claim chart mapping the challenged claims to the same teardown image presented in the [Patent Owner Response], as additional evidence." 1st Strike Opp. 3; *see also* Exclude Opp. 1 (citing Ex. 2009 ¶ 352) (describing Exhibit 2028 as "a claim chart prepared by Patent Owner's expert, Dr. Kymissis, explaining his opinion that the Galaxy S22 Ultra practices the challenged claims of the '803 Patent").

37 C.F.R. § 42.6(a)(3) states that "[a]rguments must not be incorporated by reference from one document into another document." In this case, Patent Owner's Response states the following in support of its nexus arguments: "[T]he AMOLED display used in the Samsung Galaxy S22 Ultra product practices all challenged claims of the '803 Patent. Ex. 2009, ¶¶350-352; Ex. 2028 (Galaxy S22 ULTRA Claim Chart); Ex. 2063." PO Resp. 72. But Patent Owner's argument amounts to a conclusion without any explanation.

To understand Patent Owner's argument, one must synthesize four separate exhibits: Dr. Kymissis's declaration (Ex. 2009 ¶¶ 350–352), the proffered claim chart (Ex. 2028), teardown images of the Galaxy S22 Ultra (Ex. 2029), and another declaration by Dr. Fontecchio (Ex. 2063). Specifically, one must first turn to paragraphs 351 of Kymissis's declaration to learn that "[a] software package called ImageJ was used to obtain certain information about the images of the Galaxy S22 Ultra's pixel arrangement structures." Ex. 2009 ¶ 351. Notably, Dr. Kymissis never states how he obtained the Galaxy S22 Ultra images, but he seemingly relies on a single unexplained reference to "Ex. 2063." *See id.* ¶ 350. Turning to Exhibit 2063, one would learn that Dr. Fontecchio "t[ore] down and obtain[ed] photographs from an AMOLED display in a Samsung Galaxy S22 Ultra smartphone product." Ex. 2063 ¶ 2. In turn, Dr. Fontecchio's images are contained in Exhibit 2029.[12] *Id.* ¶ 3. Then, one would have to turn to the claim chart itself at Exhibit 2028 for a limitation-by-limitation analysis comparing the claims of the '803 patent and the Galaxy S22 Ultra smartphone, which relies on Dr. Fontecchio's images. *See* Ex. 2028. None of this is mentioned in the main document, Patent Owner's Response. As such, the Board is forced to "play archeologist with the record" in order to understand Patent Owner's arguments, which "is precisely what the rule against incorporation by reference was intended to prevent." *Gen. Access Sols., Ltd. v. Sprint Spectrum L.P.*, 811 F. App'x 654, 657–58 (Fed. Cir. 2020).

[12] We also note that Dr. Fontecchio does not explain his methodology for obtaining the teardown images at Exhibit 2029.

We also have considered Patent Owner's inclusion of "[a] teardown image (Ex. 2029 at 5) of the pixel arrangement obtained from a Galaxy S22 Ultra . . . with Figure 5 of the '803 Patent superimposed." PO Resp. 72–73; *see also supra* § II.E.2.e).(1) (reproducing referenced teardown image). Although Patent Owner characterizes the claim chart of Exhibit 2028 as "additional evidence" supporting the annotated teardown image (1st Strike Opp. 3), we do not agree with Patent Owner that this solves its incorporation problem relative to Exhibit 2028. Although Petitioner does not ask us to strike the annotated image or the sentence that supports it,[13] we agree with Petitioner that the "the explanation of [its] connection to the '803 patent is found only in exhibits." 1st Strike Reply 3. Indeed, the context for this annotated image is only discernable with reference to some of the same exhibits discussed in the previous paragraph. *See, e.g.*, Ex. 2009 ¶ 350 (citing Ex. 2029, 5; Ex. 2063).

For these reasons, we *grant* Petitioner's motion to strike the following statement from Patent Owner's Response at page 72: "For example, the AMOLED display used in the Samsung Galaxy S22 Ultra product practices all challenged claims of the '803 Patent. Ex. 2009, ¶¶350-352; Ex. 2028 (Galaxy S22 ULTRA Claim Chart); Ex. 2063." *See* 37 C.F.R. § 42.6(a)(3).

Petitioner also moves to strike another sentence in the Patent Owner Response: "Petitioner Mianyang BOE copied Samsung Display's pixel arrangements to commercialize AMOLED displays for products including the iPhone 12. Ex. 2009, ¶341." 1st Strike Mot. 1–2 (quoting PO Resp. 69).

[13] In our analysis of secondary considerations of nonobviousness above, we accord the annotated teardown image little to no weight based on its lack of evidentiary support.

Petitioner argues that Patent Owner's statement "relies on its expert declaration and an 80-page district court complaint cited therein (Ex. 2041) to explain the allegation." *Id.* at 5; *see also id.* at 2 (noting that paragraph 341 of Dr. Kymissis's declaration in turn cites Exhibit 2041, the complaint from the Texas litigation). Petitioner again argues that Patent Owner has relegated the basis of its arguments to exhibits, which amounts to improper incorporation by reference. *Id.* at 1–2.

Patent Owner disputes that its argument relies on an 80-page complaint at Exhibit 2041. 1st Strike Opp. 2. Rather, Patent Owner argues that it only utilizes "a specific teardown image from paragraph 84 of a district court complaint." *Id.*

We agree with Patent Owner that it only relies on the complaint from the Texas litigation at Exhibit 2041 for providing a particular teardown image that it uses as part of a side-by-side comparison in its Response. *See* Ex. 2009 ¶ 341 (citing Ex. 2041 ¶ 84) (reproducing the same image from PO Resp. 69 and explaining that it is a "teardown image . . . of the pixel arrangement used in Mianyang BOE's AMOLED display used in the iPhone 12 and comes from a complaint filed against Mianyang BOE"). Patent Owner does not incorporate any comparison or analysis from that complaint. Thus, we *deny* Petitioner's motion to strike the following sentence at page 69 of Patent Owner's Response: "Petitioner Mianyang BOE copied Samsung Display's pixel arrangements to commercialize AMOLED displays for products including the iPhone 12. Ex. 2009, ¶341."

Petitioner additionally moves to strike a third passage of Patent Owner's Response in which Patent Owner alleges copying by vendors of replacement AMOLED displays. *See* 1st Strike Mot. 1–2. Although

Petitioner's motion to strike omits certain parts of the relevant passage, we reproduce the passage in its entirety below:

> Widespread copying of the '803 Patent's inventions is further evident from samples of AMOLED displays distributed by numerous vendors of replacement AMOLED displays for mobile phones. Exs. 2042-2061. These pixel arrangements not only infringe the challenged claims (*see, e.g.*, Ex. 2042 (chart mapping claims 1-5 and 19-21 to Group Vertical AMOLED Display); Ex. 2043 (chart mapping claims 1-5 and 19-21 to Sourcely Plus AMOLED Display)), they bear such similarity to those of Samsung Display that they demonstrate copying. Ex. 2009, ¶¶342–346. *See, e.g.*, *Medtronic, Inc. v. Teleflex Innovations S.a.r.l.*, 70 F.4th 1331, 1339–42 (Fed. Cir. 2023) (circumstantial evidence of "evidence of access to and substantial similarity with a patented product" can show copying (emphasis omitted)).

PO Resp. 69–70 (partially quoted at 1st Strike Mot. 2). Petitioner faults Patent Owner for not "articulating in its Response why certain third-party displays purportedly 'infringe the challenged claims'" and instead "mak[ing] a bald allegation in its Response and then point[ing] to Exhibits 2042 and 2043 (both 20-page claim charts) for the actual explanation." 1st Strike Mot. 5 (citing PO Resp. 69). Petitioner once again argues that Patent Owner has relegated the basis of its arguments to exhibits, which amounts to improper incorporation by reference. *Id.* at 1–2.

Patent Owner argues that its Response provides an explanation of the alleged copying and "presents exemplary side-by-side comparisons of teardown images of the pixel arrangements in SDC's AMOLED products and teardown images of replica products." 1st Strike Opp. 2 (internal quotations omitted) (citing PO Resp. 69–71). As such, Patent Owner argues that the claim charts at Exhibits 2042 and 2043 are "*further evidence*." *Id.*

We agree with Petitioner that Patent Owner has improperly incorporated by reference the basis for Patent Owner's allegation that "[t]hese pixel arrangements . . . infringe the challenged claims (*see, e.g.*, Ex. 2042 (chart mapping claims 1-5 and 19-21 to Group Vertical AMOLED Display); Ex. 2043 (chart mapping claims 1-5 and 19-21 to Sourcely Plus AMOLED Display))." PO Resp. 69. To understand this argument, one must resort to paragraph 342 of Dr. Kymissis's declaration to learn that Dr. Kymissis had reviewed teardown images provided by Dr. Silzars. Ex. 2009 ¶ 342 (citing Exs. 2044–2061). In turn, Dr. Silzars testifies in his declaration that Exhibit 2044 includes teardown images from a Group Vertical AMOLED display sample, whereas Exhibit 2046 includes teardown images from a Sourcely Plus AMOLED display sample. Ex. 2061 ¶¶ 3, 5. Returning to Dr. Kymissis's declaration, one would learn that Dr. Kymissis used ImageJ software on Dr. Silzars's images at Exhibits 2044 and 2046 to obtain data about the Group Vertical and Sourcely Plus AMOLED displays. Ex. 2009 ¶ 343. Dr. Kymissis used this data to create the claim charts located at Exhibits 2042 and 2043. *Id.* These claim charts contain limitation-by-limitation analyses comparing the Group Vertical and Sourcely Plus AMOLED display to the claims of the '803 patent, which is the basis of Patent Owner's allegation of infringement. *See* Exs. 2042, 2043. Patent Owner's tactic of rolling up all of this background information into a single conclusory sentence about alleged infringement amounts to improper incorporation by reference.

We also have considered Patent Owner's arguments about the claim charts at Exhibits 2042 and 2043 being further evidence to certain other of Patent Owner's assertions, such as its presentation of side-by-side

comparison of teardown images with an image of Patent Owner's Galaxy S22 Ultra with Figure 5 of the '803 patent overlaid on top. 1st Strike Opp. 2 (citing PO Resp. 69–71). Again, this does not solve the incorporation issue regarding alleged infringement, because the explanation about infringement, i.e., the "mapping" of the challenged claims, is found only in exhibits. *See* 1st Strike Reply 3.

For these reasons, we *grant* Petitioner's motion to strike the following statement from Patent Owner's Response on page 69: "These pixel arrangements . . . infringe the challenged claims (*see, e.g.*, Ex. 2042 (chart mapping claims 1-5 and 19-21 to Group Vertical AMOLED Display); Ex. 2043 (chart mapping claims 1-5 and 19-21 to Sourcely Plus AMOLED Display))." *See* 37 C.F.R. § 42.6(a)(3).

I. Petitioner's Second Motion to Strike

Petitioner moves to strike Exhibit 2083, which comprises excerpts of testimony from Dr. Pattison in the ITC Investigation, and the portions of Patent Owner's Sur-reply that rely on it. 2d Strike Mot. 1. We do not rely on this information in rendering this Decision, so we *dismiss as moot* Petitioner's motion to strike these materials and the portions of the Sur-reply that refer to them.

Petitioner also moves to strike the portions of Patent Owner's Sur-reply that rely on two dictionary excerpts that were introduced during the second deposition of Dr. Pattison. 2d Strike Mot. 1, 4. The excerpts, which were identified as "Exhibit 2084" and "Exhibit 2085" at the deposition, are not of record in this proceeding. *Id.* at 4–5. We do not rely on this information in rendering this Decision, so we *dismiss as moot*

Petitioner's motion to strike the portions of the Sur-reply that refer to the dictionary excerpts.

Petitioner additionally reiterates its arguments from its First Motion to Strike related to Exhibits 2028 and 2041–2043. 2d Strike Mot. 1, 5. We have already discussed these arguments above with respect to Petitioner's First Motion to Strike. *See supra* § II.H.

For these reasons, we *dismiss as moot* Petitioner's Second Motion to Strike.

J. Petitioner's Motion to Exclude

Petitioner moves to exclude Exhibit 2028, which is a claim chart supporting Patent Owner's allegations of a nexus between the challenged claims and the Samsung Galaxy S22 Ultra smartphone, as inadmissible hearsay. Exclude Mot. 1 (citing Fed. R. Evid. 802). We already have stricken Patent Owner's reference to this claim chart in Patent Owner's Response. *See supra* § II.H. As such, we do not rely on this exhibit in rendering this Decision. Thus, we *dismiss as moot* Petitioner's motion to exclude Exhibit 2028.

Petitioner moves to exclude Exhibit 2041, which is the complaint from the Texas litigation, as inadmissible hearsay. Exclude Mot. 2 (citing Fed. R. Evid. 802). Petitioner argues that the complaint constitutes hearsay because "it is an out-of-court statement that Patent Owner improperly relies on to establish the structure possessed by a BOE product." *Id.* This exhibit relates to Patent Owner's evidence of copying as a secondary consideration of nonobviousness, which we have accorded little to no weight above. *See supra* § II.E.2.e).(5). We also have determined that certain challenged claims are unpatentable despite this evidence. *See supra* § II.E.2–7. Under

these circumstances, we find the better course of action is to maintain a complete record of the evidence to facilitate review rather than to exclude this exhibit. Thus, we *dismiss as moot* Petitioner's motion to exclude Exhibit 2041.

Petitioner moves to exclude Exhibits 2042 and 2043, which are claim charts supporting Patent Owner's allegations of copying related to Group Vertical and Sourcely Plus AMOLED displays, as inadmissible hearsay. Exclude Mot. 2–3 (citing Fed. R. Evid. 802). We already have stricken Patent Owner's references to these claim charts in Patent Owner's Response. *See supra* § II.H. As such, we do not rely on these exhibits in rendering this Decision. Thus, we *dismiss as moot* Petitioner's motion to exclude Exhibits 2042 and 2043.

Petitioner moves to exclude Exhibits 2044–2060, which allegedly are teardown images of various replacement AMOLED displays, as lacking authentication. Exclude Mot. 3–4 (citing Fed. R. Evid. 901). Petitioner notes that Dr. Silzars testifies in his supporting declaration (Exhibit 2061) "only that he 'understand[s]' that the products 'were purchased' from 16 different entities." *Id.* (alteration in original) (quoting Ex. 2061 ¶ 2). Petitioner likewise moves to exclude Exhibit 2061, Dr. Silzars's declaration, because Dr. Silzars lacks "personal knowledge of the origin of any of the products discussed in his declaration." *Id.* at 4–5 (citing Fed. R. Evid. 602). All of these exhibits relate to Patent Owner's evidence of copying as a secondary consideration of nonobviousness, which we have accorded little to no weight above. *See supra* § II.E.2.e).(5). We also have determined that certain challenged claims are unpatentable despite this evidence. *See supra* § II.E.2–7. Under these circumstances, we find the better course of action is

to maintain a complete record of the evidence to facilitate review rather than to exclude these exhibits. Thus, we *dismiss as moot* Petitioner's motion to exclude Exhibits 2044–2061.

III. CONCLUSION[14]

Petitioner has shown, by a preponderance of the evidence, that the subject matter of claims 1–4 and 19–21 of the '803 patent would have been obvious over Phan. Petitioner has *not* shown, by a preponderance of the evidence, that (1) the subject matter of claim 5 of the '803 patent would have been obvious over the combination of Phan and Yamada; (2) the subject matter of claims 1–4 and 19–21 of the '803 patent would have been obvious over the combination of Matthies and Yamada; or (3) the subject matter of claims 1–4 and 19–21 of the '803 patent would have been obvious over the combination of Murai and Yamada.

We *grant* Petitioner's First Motion to Strike as to the following statement from page 72 of Patent Owner's Response: "For example, the AMOLED display used in the Samsung Galaxy S22 Ultra product practices all challenged claims of the '803 Patent. Ex. 2009, ¶¶350-352; Ex. 2028 (Galaxy S22 ULTRA Claim Chart); Ex. 2063." We also *grant* Petitioner's First Motion to Strike as to the following statement on page 69 of the Patent

[14] Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this Decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. *See* 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. *See* 37 C.F.R. § 42.8(a)(3), (b)(2).

Owner's Response: "These pixel arrangements . . . infringe the challenged claims (*see, e.g.*, Ex. 2042 (chart mapping claims 1-5 and 19-21 to Group Vertical AMOLED Display); Ex. 2043 (chart mapping claims 1-5, and 19-21 to Sourcely Plus AMOLED Display))." We *deny* Petitioner's First Motion to Strike as to the following statement from page 69 of Patent Owner's Response: "Petitioner Mianyang BOE copied Samsung Display's pixel arrangements to commercialize AMOLED displays for products including the iPhone 12. Ex. 2009, ¶341."

We *dismiss as moot* Petitioner's Second Motion to Strike and Petitioner's Motion to Exclude.

In summary:

Claim(s)	**35 U.S.C. §**	**Reference(s)/Basis**	**Claim(s) Shown Unpatentable**	**Claim(s) Not shown Unpatentable**
1–5, 19–21	103(a)	Matthies, Yamada		1–5, 19–21
1–4, 19–21	103(a)	Phan	1–4, 19–21	
5	103(a)	Phan, Yamada		5
1–5, 19–21	103(a)	Murai, Yamada		1–5, 19–21
Overall Outcome			1–4, 19–21	5

IV. ORDER

Accordingly, it is

ORDERED that claims 1–4 and 19–21 of the '803 patent are unpatentable;

FURTHER ORDERED that claim 5 of the '803 patent is not unpatentable;

FURTHER ORDERED that Petitioner's First Motion to Strike (Paper 24) is *granted-in-part* and *denied-in-part* as indicated above;

FURTHER ORDERED that Petitioner's Second Motion to Strike (Paper 33) is *dismissed as moot*;

FURTHER ORDERED that Petitioner's Motion to Exclude (Paper 39) is *dismissed as moot*; and

FURTHER ORDERED that, because this is a Final Written Decision, parties to this proceeding seeking judicial review of our decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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