

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 VISIONIX TECHNOLOGY, INC.,
Petitioner,

v.

SAMSUNG DISPLAY CO., LTD.
Patent Owner.

Case IPR2023-00987
U.S. Patent No. 9,818,803

PATENT OWNER'S PRELIMINARY RESPONSE

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PATENT OWNER'S EXHIBIT LIST

Exhibit	Description
Ex. 2001	Claim Construction Order, Inv. No. 337-TA-1351
Ex. 2002	Agreed Upon and Remaining Disputed Claim Terms, Inv. No. 337-TA-1351
Ex. 2003	U.S. Patent No. 5,644,327

I. Introduction

U.S. Patent No. 9,818,803 B2 (the “’803 patent”) discloses innovative arrangements and structures of pixels for an organic light emitting diode (“OLED”) display that improve aperture ratio, image quality, manufacturability, and display lifetime of OLED displays. *See, e.g.*, Ex. 1001, 1:38–2:62, 7:12–32, 8:34–45. Organic light-emitting layers of OLED displays are formed through deposition processes that present design and manufacturing challenges. The ’803 patent explains, for example, 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” and that “[w]hen reducing a gap between the neighboring pixels to obtain a high aperture ratio of the pixel, deposition reliability may be deteriorated.” *Id.* at 1:38–42. In addition, organic materials used to emit different color light are susceptible to deterioration, and at different rates. *See, e.g., id.* at 7:25–28.

The inventive pixel arrangements of the ’803 patent overcome the manufacturing challenges associated with organic light emitting layers and improve image quality by designing blue OLED pixels, red OLED pixels, and green OLED pixels in particular arrangements and configurations, with defined spacing and differences in size among the pixels. *See, e.g., id.* at 7:3–32, 8:25–45. Rather than grouping a single red, a single blue, and a single green pixel as the basis for the display (a so-called “RGB” structure), the pixel arrangements of the ’803 patent

employ a greater number of green pixels than blue and red pixels. In the pixel arrangements of the '803 patent, the green pixel is smaller than the red and blue pixels, and alternating red and blue pixels are formed around each green pixel positioned at vertices of a “virtual square” centered on the green pixel. *See, e.g., id.* at 4:4–63. The blue pixels have larger areas than the red pixels. *See, e.g., id.* at 6:43–50. The arrangement increases the relative area of the light-emitting regions of the pixels (*i.e.*, the aperture ratio) while spacing the pixels sufficiently to allow for reliable deposition of the organic light emitting material and improving the lifespan of the display. *See, e.g., id.* at 5:16–26, 6:43–50.

By increasing the aperture ratio of the OLED display, the OLED displays of the '803 patent are made brighter and the image quality is improved. The non-pixel area is taken up by elements such as “power lines for driving each of the pixels, such as a gate line, a data line, a driving power line, and the like”; and “an insulation layer, such as a pixel defining layer,” all of which must be included for the OLED display to operate properly. *Id.* at 3:58–63. As the '803 patent explains, by using the claimed pixel arrangements, “the manufacturing time and the manufacturing cost of the OLED display [associated with forming the pixels] may be reduced and the display quality of the image of the OLED display may be improved,” and “improved life span” of the display is achieved. *See, e.g., id.* at 6:40–50.

Petitioner's challenges to the '803 patent cobble together disparate references that a POSITA would have had no reason to combine and disregard fundamental differences and incompatibilities between the references. Indeed, Petitioner's fundamental premise across all of its proposed combinations—*i.e.*, that a POSITA would want to **reduce** the aperture ratio (and hence brightness and image quality) of an OLED display—has no basis in the prior art and is contrary even to references on which Petitioner purports to rely. Petitioner also relies on prior art disclosures that do not relate to OLED technology and that would not have led a POSITA to the inventions of the '803 patent that are specifically addressed to OLED displays. As explained further below, the Petition and its supporting declaration are fundamentally flawed and, at best, evinces an improper attempt to reconstruct the claimed invention of the '803 patent through hindsight starting from the inventions themselves.

Petitioner relies primarily on Matthies, which discloses a large-area tiled display using a passive matrix OLED (PMOLED). Petitioner attempts to combine Matthies with Yamada's teachings directed to an active matrix OLED (AMOLED) display. But there would not have been a reasonable expectation of success in making the combination Petitioner proposes for a number of reasons, starting with the fact that passive and active matrix OLED technologies operate differently in material ways that make these references incompatible. Further, Matthies' large-area

tiled display—which is created by connecting multiple displays (“tiles”) presenting separate sub-images that together form a full image—expressly requires even spacing between the pixels and between the pixels and the edges of the tiles, including to eliminate the visibility of the seams between the tiles. In the face of this teaching requiring uniform spacing of pixels, Petitioner proposes a combination that necessitates uneven spaces between the pixels.

And even beyond that, a POSITA would not have been motivated to combine the prior art references in the way Petitioner argues. Yamada discloses a pixel structure where a single red pixel, a single green pixel, and a single blue pixel are aligned in a stripe. If attempting to combine Matthies with Yamada, a POSITA would if anything have looked to the similar stripe pattern disclosed in Matthies. Petitioner does not explain why a POSITA would instead have turned to Matthies’ quad pixel structure, let alone the specific quad pixel structure that contains two green pixels, a red pixel, and a blue pixel, instead of the stripe embodiment that would match Yamada’s disclosure.

Moreover, according to Petitioner, Yamada teaches that a blue OLED pixel has a low emission efficiency (Pet. at 19 (quoting Ex. 1008 at 8:47–52)), and Matthies explicitly teaches that in such a situation a quad pixel structure should contain two blue pixels, not Petitioner’s arbitrarily selected quad pixel structure containing two green pixels (Ex. 1004 at 17:6–10). At best, a POSITA might have

been motivated to double the number of blue pixels with respect to green and red pixels. But a POSITA certainly would not have been motivated to keep the blue pixel the same size and to decrease the size of the green and red pixels as Petitioner proposes, which would decrease the aperture ratio, with no corresponding benefit.

Specifically, according to Petitioner, Yamada teaches that “the ‘emissive element of a color with the lowest emission efficiency’ (blue) is made ‘larger’” to improve the display’s life span. Pet. at 19 (quoting Ex. 1008 at 3:38–44, 3:51–57, 7:3–12, 8:19–28, 8:47–52, 10:52–55, 11:4–15). But Petitioner’s combination does not make the blue pixel larger; it keeps the blue pixel the same size and simply makes the red and green pixels smaller. This would do nothing to improve the display’s life span, as it would not reduce the current to the blue pixel, and it would decrease the aperture ratio below Matthies’ already low 25% aperture ratio. A POSITA therefore would not have been motivated to make Petitioner’s combination of Matthies and Yamada.

Petitioner next relies on Phan, which mentions OLED just once in passing in the “Field of the Invention” as the seventh item in a long list of display technologies including “any light sources known or invented in the future.” Ex. 1005 at 1:17–29. The disclosure on which Petitioner relies says nothing about OLED, but instead discloses a distinct type of display in which each color dot has a receiver of its own to convert digital information transmitted through a network that preferably is an

optical fiber network. *Id.* at 5:16–20. This indicates that the disclosed display is something other than an OLED display, which does not have or require such a network. At the same time, Petitioner presents misleading drawings purportedly based on figures from Phan, which fail to account for the gaps between Phan’s quad subpixels that Phan makes clear are present in its design. *See* Ex. 1005, Fig. 12. Petitioner fails to address that those gaps would necessarily preclude the pixels from forming a “virtual square” as required by the claims of the ’803 patent. In Ground 3, Petitioner proposes combining Phan with Yamada. But as discussed below, this combination fails because of Phan’s deficiencies discussed above and, even beyond that, a POSITA would not have been motivated to combine Phan with Yamada for many of the same reasons discussed above regarding the combination of Matthies and Yamada (*e.g.*, a POSITA would not have been motivated to select a quad pixel structure with two green pixels or to reduce aperture ratio and display brightness).

Regarding Ground 4 based on Murai, much like with Phan, Petitioner presents misleading drawings (that distort figures from Murai) in an effort to portray a “virtual square” that would not actually be present in Murai or the proposed modification to Murai. The challenged claims require vertices of the virtual square to be located at the center points of a blue pixel and a red pixel. However, Petitioner does not connect the center points of Murai’s blue and red pixels as the ’803 patent’s claims require. When the center points are connected, the resulting shape is not a

“virtual square” as alleged. In addition, Petitioner’s arguments suffer from many of the same defects as Petitioner’s Matthies arguments (*e.g.*, a POSITA would not have been motivated to select a quad pixel structure with two green pixels or to reduce aperture ratio and display brightness). Further, Petitioner’s combination goes against Murai’s objective. The very reason Murai cuts out certain corner portions of its green pixels is because they are too close together in Murai’s arrangement, which, like the ’803 patent, is designed to maximize aperture ratio. But Petitioner’s proposed combination with Yamada would significantly *reduce* the aperture ratio by further shrinking the areas of the red and green pixels, flatly contrary to Murai’s teachings. Not only would Petitioner’s proposal contravene Murai’s goal of maximizing the aperture ratio, it would undercut the very reason for Murai’s disclosure of cutting out certain corners of green pixels, as it would enlarge the spacing between green pixels, obviating the need for cutting corners of those pixels. Therefore, a POSITA would not be motivated to make the proposed combination.

The petition should be denied.

II. The ’803 Patent

As discussed above, to address manufacturing challenges for OLED displays associated with the deposition of organic light-emitting layers, the ’803 patent discloses an innovative arrangement of pixels in an OLED display that provides benefits such as an improved aperture ratio, reduced manufacturing time and cost,

improved picture quality, and increased lifetime. *See, e.g.*, Ex. 1001 at 1:54–62, 5:20–26, 6:43–50. The arrangement uses more green pixels than red and blue pixels, and arranges the pixels in particular configurations that maximize the aperture ratio of the display while maintaining adequate separation to allow for reliable deposition of the organic material. The arrangement includes blue pixels that are larger than the red pixels and green pixels, and in which the red pixels and blue pixels are arranged in alternating lines so as to form vertices of a “virtual square” centered around the center of a green pixel. *Id.*, Figs. 1–5.

Claim 1 of the ’803 patent recites:

1. A pixel arrangement structure of an organic light emitting diode (OLED) display, comprising:

a plurality of pixels for displaying an image on the OLED display and comprising:

a first pixel having a center coinciding with a center of a virtual square;

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

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

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,

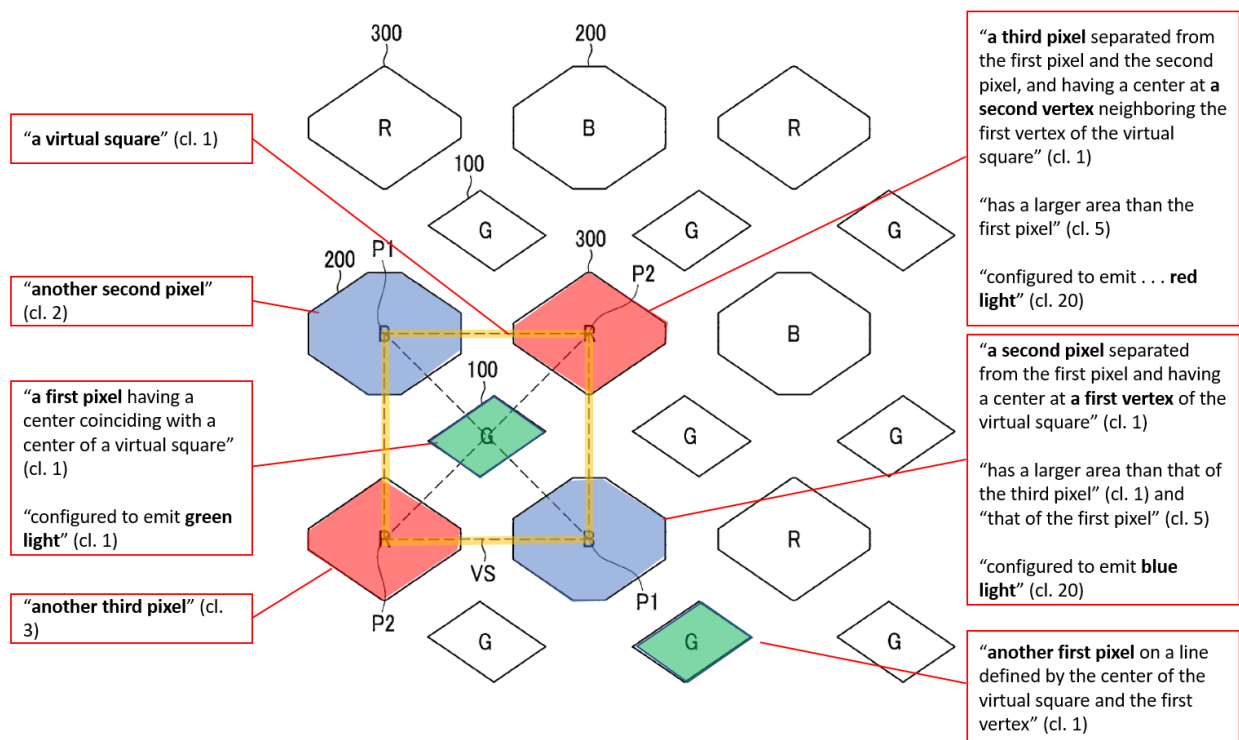
wherein the second pixel has a larger area than that of the third pixel, and

wherein the first pixel is configured to emit green light.

The '803 patent explains, with reference to Figure 1, that in this structure, “the gap of the second length L2 [between adjacent green pixels] that is longer than the first length L1 is formed between the neighboring ones of the first pixels 100” and “[t]his 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 at 5:13–19.

Figure 3 of the '803 patent is reproduced below with annotations to illustrate key claim limitations:

FIG.3



III. Claim Construction

Patent Owner notes that on September 11, 2023, the Administrative Law Judge in the related ITC Investigation No. 337-TA-1351 issued a claim construction order. The order did not construe any claim terms of the '803 patent. *See* Ex. 2001. In addition, the parties in the ITC Investigation submitted a list of claim constructions to which the parties agreed, which included certain claim terms of the '803 patent. *See* Ex. 2002.

For purposes of this Preliminary Response, Patent Owner does not believe that any specialized constructions are necessary. The Petition fails to establish a reasonable likelihood of prevailing under any claim interpretation.

IV. Level of Ordinary Skill in the Art

Patent Owner notes that the September 11, 2023 claim construction order in the related ITC Investigation No. 337-TA-1351 did not include any finding on the level of ordinary skill in the art with respect to the '803 patent. *See* Ex. 2001.

For purposes of this Preliminary Response, Patent Owner does not believe it is necessary to define the level of ordinary skill in the art.

V. Petitioner Has Not Established a Reasonable Likelihood of Prevailing as to Any Challenged Claim.

A. Ground 1: Petitioner Fails to Demonstrate a Reasonable Likelihood that Claims 1–5 and 19–21 Are Obvious Over Matthies and Yamada

Petitioner argues that the combination of “Matthies (Ex. 1004) and Yamada (Ex. 1008), when considered in view of the knowledge of a POSITA, render claims 1–5 and 19–21 obvious.” Pet. at 19. A POSITA would not have been motivated to combine Matthies and Yamada as proposed by Petitioner for several reasons, as discussed in more detail below. First, Matthies and Yamada are incompatible because Matthies is directed to a large-area tiled display using a passive matrix technology and Yamada is directed to a non-tiled display using an active matrix technology. Second, even if a POSITA tried to combine Matthies with Yamada, they would have started from the embodiment of Matthies in which a red pixel, a green pixel, and a blue pixel are aligned in a stripe, which is also Yamada’s preferred pixel arrangement. Third, even if a POSITA tried to use Matthies’ quad pixel arrangement as the starting point of a combination, they would not have included two green pixels in the arrangement, but rather would have included two blue pixels for reasons Matthies and Yamada explain. Fourth, even if a POSITA were to include two green pixels in Matthies, they would not have kept the area of the blue pixel the same size and reduced the areas of the green and red pixels as Petitioner proposes, because

such a modification would be inconsistent with Matthies' design and Yamada's disclosures. For each of these independent reasons, Petitioner's arguments fail.

1. Matthies' Display Technology Is Incompatible with Petitioner's Proposed Combination, and Petitioner Fails to Demonstrate a Reasonable Expectation of Success of the Combination

With Ground 1, Petitioner seeks to combine concepts from two different technologies, without making any showing of why or how a POSITA would expect that the technologies of one could reasonably be applied to the other. As discussed below, the two references are incompatible in material respects and, further, Petitioner's proposed modifications are inconsistent with the disclosures of these references.

a. Matthies Discloses a Passive Matrix "Display Tile" for Building a "Large-Area" Tiled Display

Matthies is directed to "large-area display devices which are formed as an array of tiled devices." Ex. 1004 at 1:8–10. That is, it proposes an approach for making large (wall-sized or larger) displays out of a tiled array of smaller displays. *See id.* at 1:18–25 (describing applications such as "[h]ome theater" and "simulation of the real world"); Ex. 2003 (U.S. Patent No. 5,644,327)¹ at 7:33–35 (explaining

¹ U.S. Patent No. 5,655,327 is "incorporated by reference [into Matthies] for its teaching on tiled displays." Ex. 1004 at 2:11–14.

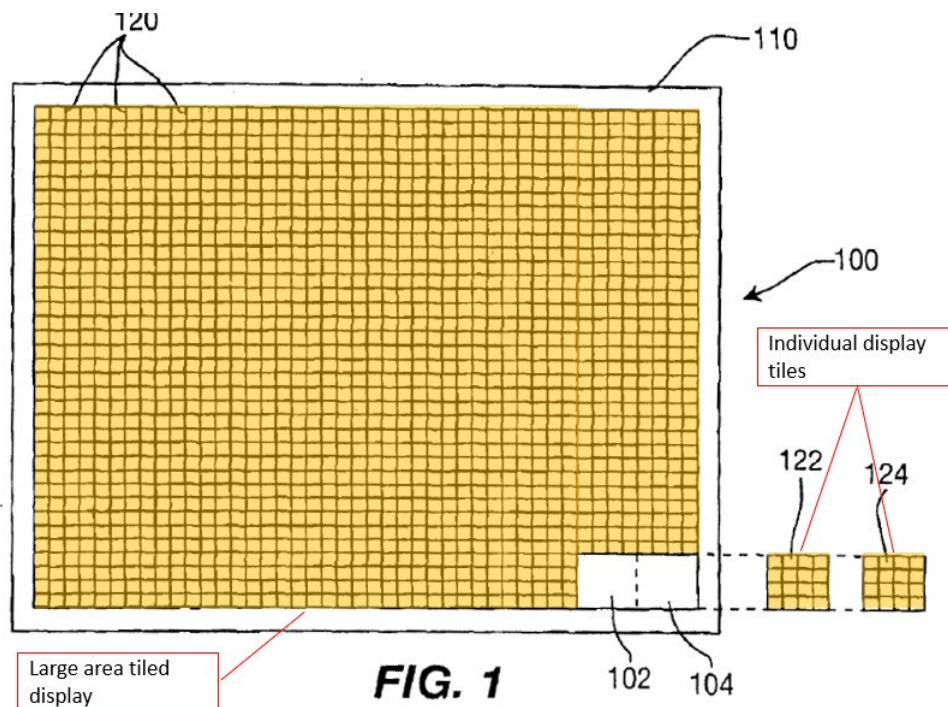
that “it is possible to create very large (wall-sized) display panels, by tiling individual display devices”).

As Matthies explains:

No practical tiled display system has yet been developed (video walls formed by abutting conventional CRT displays are not considered tiled because of their wide separations between adjacent displays). What 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 (actually, with in [sic] $\frac{1}{2}$ pixel spacing period of the edge), while at the same time allowing for electronics to address each tile, even [with] those tiles completely surrounded by other tiles.

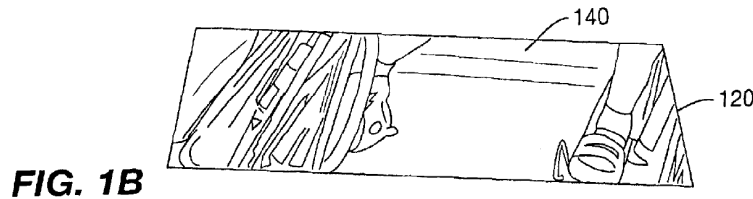
Ex. 1004 at 1:66–2:7.

To this end, Matthies discloses a tile structure comprising a passive matrix OLED display, which can be used to create a large area display, as shown below in Figure 1.



Id., Fig. 1 (annotated).

Each individual display tile would show only a section of a video image as shown below in Figure 1B, and the large area tiled display would combine the sections from the tiles to show the full video image.



Id., Fig. 1B.

Importantly, the display tiles in Matthies are passive matrix OLED (PMOLED) displays. *See* Ex. 1004 at 10:31–33 (“The exemplary embodiment of the invention employs a passive addressing technique within a block in which only one row of pixels is illuminated at any time.”).² In Matthies’ PMOLED display, a basic light emitting structure consists of a red, green, or blue organic light-emitting polymer layer sandwiched between a row electrode and a column electrode as shown below in Figure 3.

² Although Matthies includes general statements that “[e]lectronics 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,” *id.* at 8:21–26, the display structures that it actually depicts (and on which Petitioner relies) are all passive matrix OLEDs.

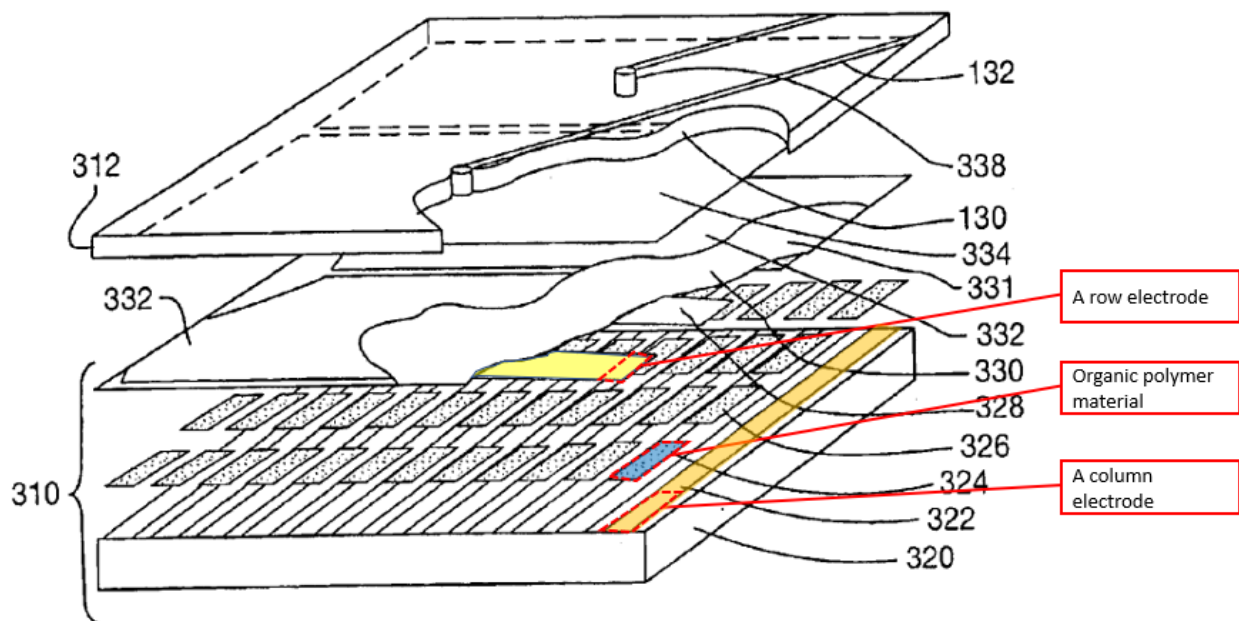
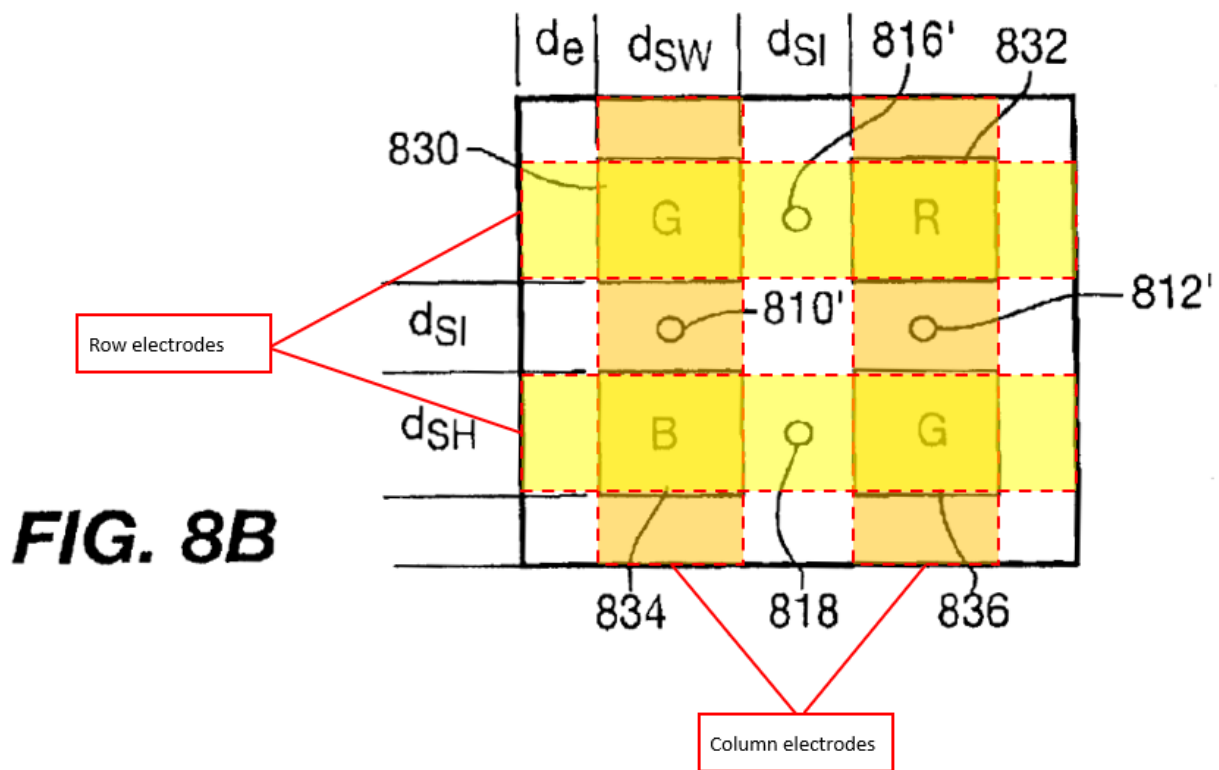


FIG. 3

Id., Fig. 3 (annotated). “Current flowing from one electrode to the other electrode causes the organic polymer to emit light.” *Id.* at 6:22–23. The emissive area of a pixel is defined by the area where a column electrode and a row electrode cross (*i.e.*, the region of overlap of the vertical and horizontal electrodes), with a display material sandwiched in between. *Id.* at 6:19–21. “The amount of light emitted by a pixel when it is turned on is controlled by controlling the level of current applied to the pixel in the on state.” *Id.* at 10:21–23.

The quad structure in Figure 8B on which Petitioner relies is a PMOLED display having “two row electrodes . . . and two column electrodes,” which create the four pixels where the electrodes cross as shown below. *Id.* at 17:10–12.

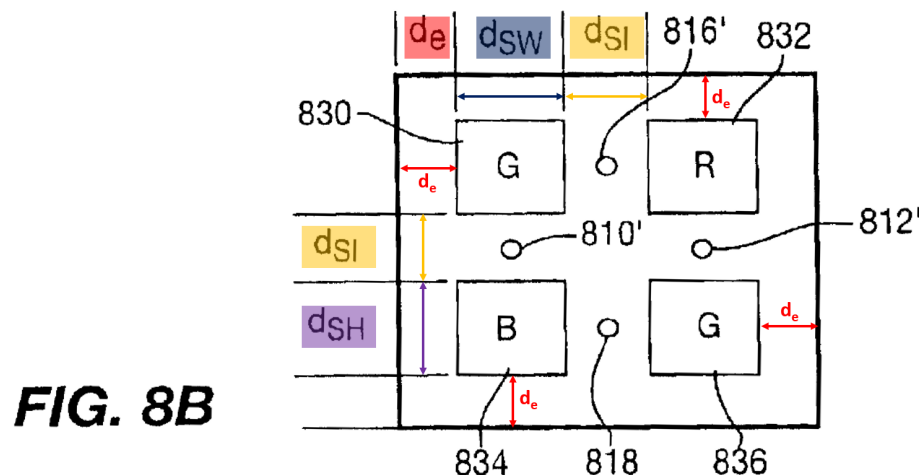


Id., Fig. 8B (annotated). Each of the electrodes is connected to the electronics section by a via, *id.* at 17:13–16, and the voltage difference between the column electrode and the row electrode causes the pixel at their crossing to emit light.

b. Petitioner Does Not Make Any Showing of Why a POSITA Would Expect that Yamada’s Disclosures on Varying Pixel Size in Active Matrix Displays Would Be Applicable to Matthies’ Passive Matrix Display Tiles

The Petition’s Ground 1 argues for combining Matthies with Yamada in a way that would require a POSITA to discard Matthies’ teaching of tiles arranged with uniformly-sized pixels spaced apart such that the gap between adjacent pixels is the same throughout the display. Matthies explains that “[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.” Ex. 1004 at 17:16–20. As shown in Matthies’ Figure 8B, and described in Table 2, the pixels are equally sized ($0.25p$ high by $0.25p$ wide), there are equal spaces of $0.25p$ between the sub-pixels, and there is a uniform distance (d_e) of $0.125p$ between the outermost sides of each sub-pixel and the edge of the tile:



Id., Fig. 8B (annotated).

This arrangement is key to Matthies’ ability to build its large display using smaller display tiles: the uniform pitch ensures that the pixels within a tile are aligned with pixels in adjacent tiles, no matter how many tiles are added. Petitioner does not establish why a POSITA would be motivated to change that arrangement.

Nevertheless, Petitioner proposes to modify Matthies’ structure using differently-sized pixels, on the basis that the Yamada reference teaches differently-sized pixels. Yet Yamada uses an active matrix OLED (AMOLED) display, unlike

Matthies' PMOLED display. *See* Ex. 1008 at 1:6–9 (“The present invention relates to an electroluminescence display apparatus comprising an electroluminescence (hereinafter also referred to as EL) element and a thin film transistor (hereinafter referred to as TFT) element.”). In an AMOLED display, there are thin-film transistors (TFTs) arranged in a matrix, and each pixel is controlled individually by a TFT. For example, in Figure 6B of Yamada, the source 43s of the TFT 40 is connected to the anode 161, and the anode 161 is in contact with the emissive element layer 165 through an opening in the planarization insulting film 167 as shown below:

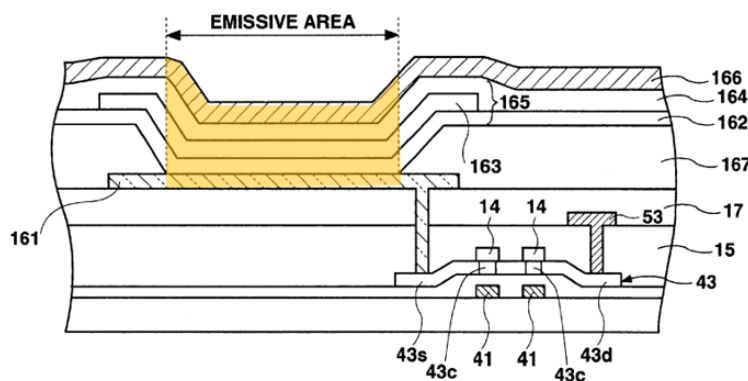


Fig. 6B

Id., Fig. 6B (annotated). “[T]he region actually emitting light, namely, the emissive area,” is the area that “is in contact with the emissive element layer 165 and the anode 161.” *Id.* at 10:39–44.

Petitioner all but ignores the differences between the PMOLED in Matthies and the AMOLED in Yamada. Indeed, while the Petition includes six pages of

argument as to why a POSITA may have wanted to resize Matthies' pixels in view of Yamada, Pet. at 39–44, it is almost silent when it comes to arguing how a POSITA could have had any reasonable expectation of success in performing this modification. Pet. at 44–45.

Petitioner has the burden of showing reasonable expectation of success. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1379 (Fed. Cir. 2015) (“Dynamic, as the petitioner, had the burden of persuasion to prove unpatentability by a preponderance of the evidence, and this burden never shifted.”). Yet the Petition includes only a single paragraph on this topic, which is reproduced in full below:

A POSITA would also have had a more than a [sic] reasonable expectation of success. (*See id.*, ¶¶ 309–318.) Again, it was routine in the art to resize OLED pixels to improve display lifetime. (*Id.*, ¶ 310.) Indeed, Matthies itself already contemplates that the sizes of and space between its pixels can adjusted [sic]. (*E.g.*, Ex. 1004, 17:31–37; *see also id.*, 12:9 (referencing the possibility of different “geometry of the pixels”).) Further, Matthies also invites use of different “other methods” “to maintain a predetermined brightness level” of its pixels. (*Id.*, 12:41–46.) Thus, a POSITA would have considered application Yamada [sic] to amount to nothing more than the use of known [sic] design option—that Matthies itself already allows for—to solve a known prior art problem. (Ex. 1003, ¶¶ 311–313.) Moreover, Yamada explains that the benefits of its invention—improved life and design simplification—are not limited to just the example pixel “arrangement[s]” shown in its figures, but also extend to other “layouts[.]” (Ex. 1008, 12:37–40.) This would not only have further motivated application of Yamada’s teachings, but would have emphasized to a POSITA that combination would be successful. (Ex. 1003, ¶¶ 314–316.) Finally, both Matthies and Yamada relate to pixel designs intended for use with OLED displays. (*Id.*, ¶¶ 317–318.) This

similarity in purpose would have given a POSITA yet another reason to believe that the references' teachings would be successfully used together. (*Id.*)

Pet. at 44–45.

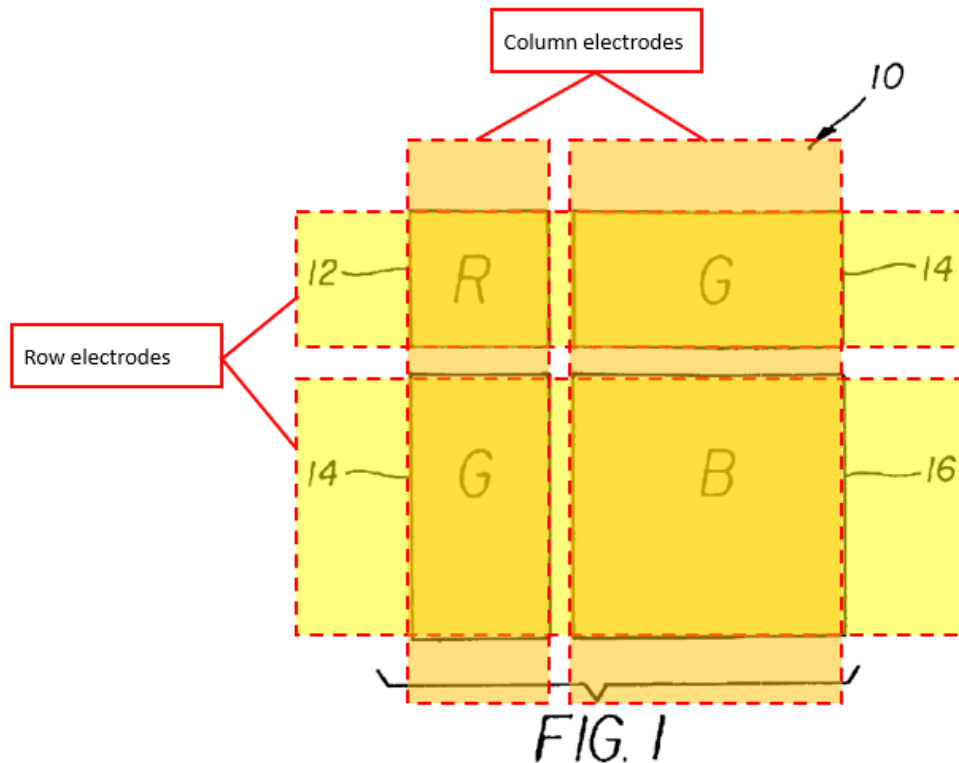
This paragraph fails to explain why or how a POSITA would have had a reasonable expectation of success. The first half of the paragraph builds up to a conclusion that “a POSITA would have considered application Yamada [sic] to amount to nothing more than the use of known [sic] design option . . . to solve a known prior art problem.” *Id.* But that relates to motivation to combine, not reasonable expectation of success. *See KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007) (“When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp.”). The second half of the paragraph fares no better, as it merely cites Yamada’s goals, without addressing how or why a POSITA would understand that Petitioner’s proposed combination of Matthies and Yamada would reasonably expect to achieve those goals. Moreover, Petitioner ignores the differences between AMOLEDs and PMOLEDs, and the complications that result from attempting the combination Petitioner puts forward, as discussed further below.

Petitioner relies on its expert’s assertion that “it was well-known and routine in the art to resize OLED pixels to improve display lifetime.” Ex. 1003, ¶ 310 (cited

by Pet. at 44). For this statement, the expert appears to rely on the existence of two *other* OLED displays that include non-uniform pixel sizes. Ex. 1003, ¶¶ 306–307 (citing Exs. 1011, 1015). Yet the expert says nothing about how the OLED pixels *in the passive matrix display tiles of Matthies* could be sized differently from one another. In fact, as discussed in Section V.A.1.a above, the emissive area of a pixel in Matthies is defined by the area where a column electrode and a row electrode cross (unlike in an AMOLED). Accordingly, decreasing a pixel size in Matthies by decreasing the width of a column electrode or a row electrode would have the consequence of decreasing the sizes of all other pixels that share the same electrode. *See Unified Patents LLC v. Divx LLC*, IPR2019-01379, Paper 52, *36–37 (“Although proof of physical or bodily incorporation is not required, a satisfactory explanation of ‘*how* the combination of the . . . references [is] supposed to work’ is necessary to support [a conclusion of obviousness].”) (quoting *Personal Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 994 (Fed. Cir. 2017)). Therefore, Matthies’ design presents impediments to changing the sizes of the pixels as Petitioner proposes, and a POSITA would not have had a reasonable expectation of success in doing so.

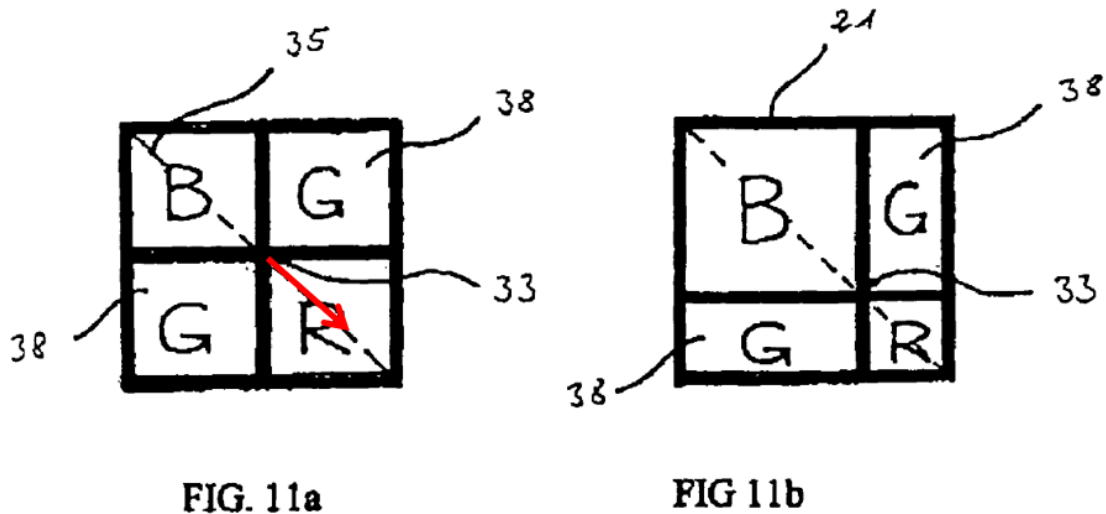
This problem is acutely illustrated by the display structure of Exhibit 1015 (Cok), on which Petitioner’s expert relies. In the only quad pixel structure disclosed in Cok, the upper row electrode would contain a red pixel and a first green pixel, the lower row electrode would contain a second green pixel and a blue pixel, the left

column electrode would contain the red pixel and the second green pixel, and the right column electrode would contain the first green pixel and the blue pixel, as shown below:



Ex. 1015, Fig. 1 (annotated). The green pixels would have been made smaller than the blue pixel by making the upper row electrode narrower than the lower row electrode and making the left column electrode narrower than the right column electrode. The consequence of this arrangement is that the red pixel, which is at the crossing of the upper row electrode and the left column electrode would be even smaller than the green pixels. In fact, Cok's inventors knew of Yamada's teachings, *id.* at 1:63–2:8, yet Cok does not show any quad pixel arrangement where a blue pixel is larger than a red pixel, which in turn is larger than green pixels.

Phan, on which Petitioner relies for its Grounds 2 and 3, illustrates the same constraint, showing that the green pixels are made to be smaller than the blue pixel only by making the red pixel even smaller than the green pixels:



Ex. 1005, Figs. 11a (annotated), 11b.

In addition, in Yamada, the pixels are arranged in a matrix of stripes in which each stripe is an RGB structure containing a single red, a single blue, and a single green pixel as shown below in Figure 4:

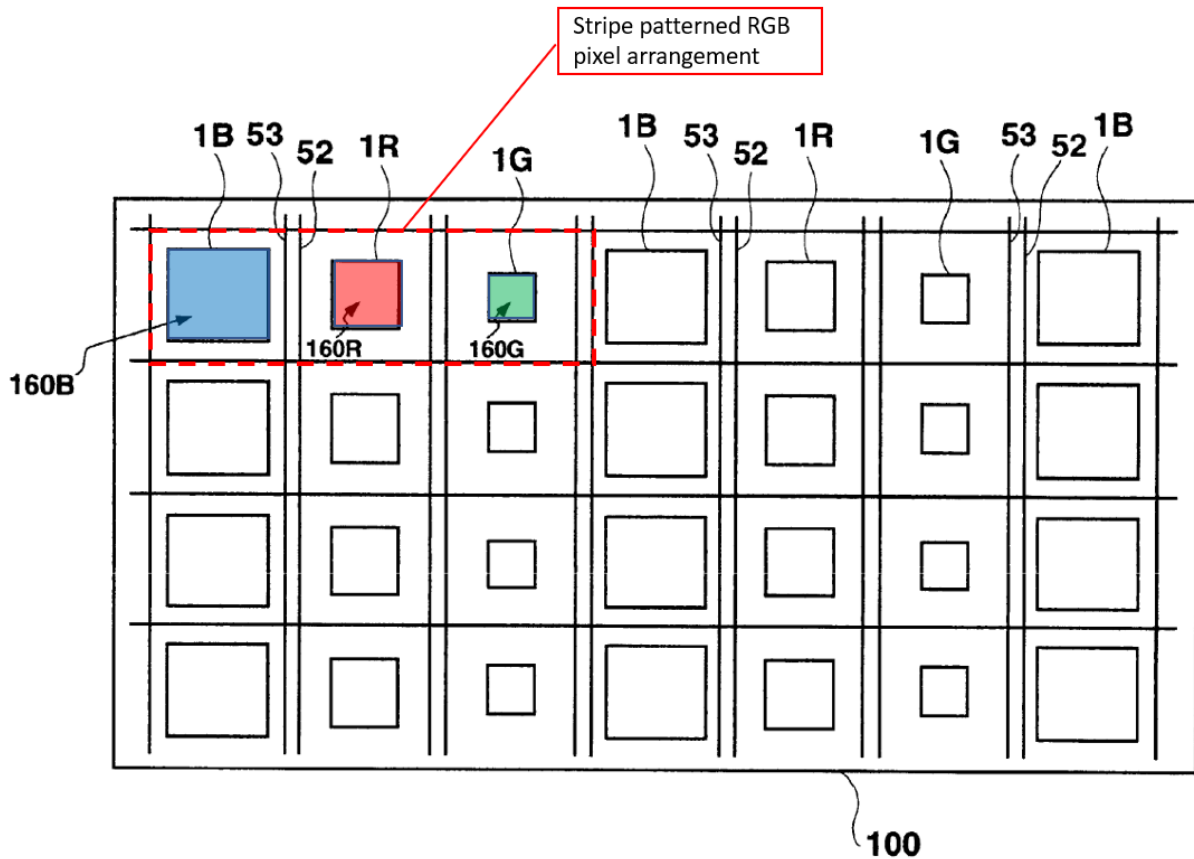


Fig. 4

Id., Fig. 4 (annotated). Although Figure 4 of Yamada appears to show square-shaped pixels, Yamada explains that Figure 4 represents only “a conceptual diagram” of emission regions. *See* Ex. 1008 at 6:24–26; *see also id.* at 6:65–7:2. Figure 5 of Yamada—which Yamada describes as “a schematic top plan view of one display pixel of the EL display apparatus,” *id.* at 6:27–29—shows what pixels would actually look like according to Yamada’s designs. *Id.* at 6:61–7:2. Figure 5 shows a portion of a green pixel 160G and a blue pixel 160B:

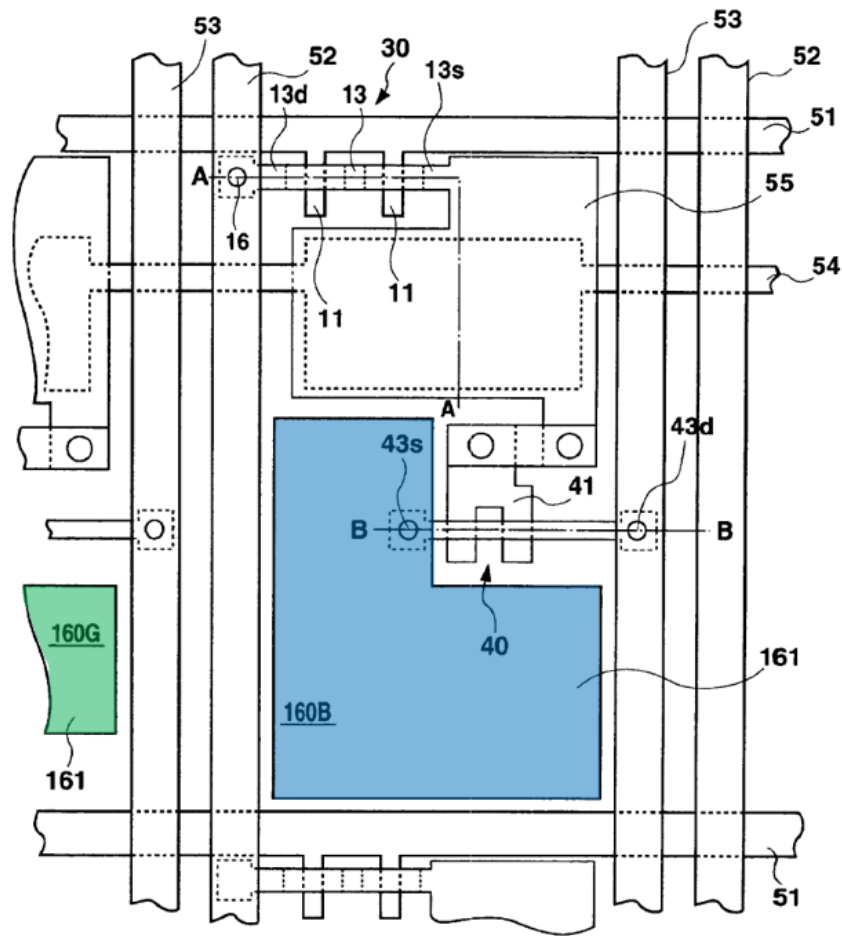


Fig. 5

Id., Fig. 5 (annotated). As shown in Figure 5 above, the blue pixel has an irregular shape due to the space occupied by the TFT 40, which includes the gate 41, source 43s, and drain 43d.

Petitioner fails to show how a POSITA would have had a reasonable expectation of success of applying Yamada's disclosures, which result in pixels that have irregular shapes as discussed above, to Matthies, and how such a combination would result in the structure required by the '803 patent. *See* Ex. 1001, cl. 1

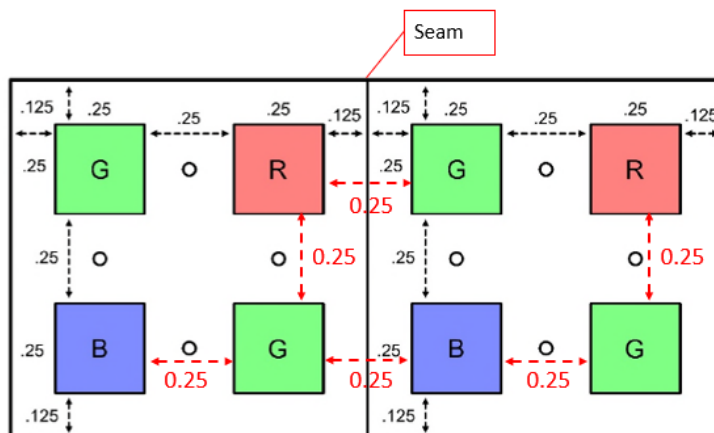
(requiring, among other things, “a first pixel having a center coinciding with a center of a virtual square,” “a second pixel . . . having a center at a first vertex of the virtual square,” “a third pixel . . . having a center at a second vertex neighboring the first vertex of the virtual square”).

Thus, Petitioner does not (and cannot) show that a POSITA would have had a reasonable expectation of success in modifying Matthies based on Yamada in the way that Petitioner suggests, while still satisfying the requirements of the claims.

c. Petitioner Does Not Explain How Differently Sized Pixels Could Be Used In Matthies’ Pixel Geometry, Which Require “Evenly Spaced” Pixels

Likewise, Petitioner does not even attempt to explain how differently sized pixels could be used with Matthies’ pixel geometry. Because the display in Matthies is a large-area display formed of tiles, one of its main concerns is “eliminating the visibility of the seams between tiles.” Ex. 1004 at 2:7–10; *see also id.* at 8:37–39. To achieve this goal, “[t]he tiles are constructed with pixel forming elements evenly spaced up to the edges of the tiles.” *Id.* at 5:47–48; *see also id.* at 8:39–41 (“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 9:23–26 (“The tiled displays described in detail below have an architecture which connects the signals to the pixels without interrupting the continuity of the pixel spacing, even at the edges of

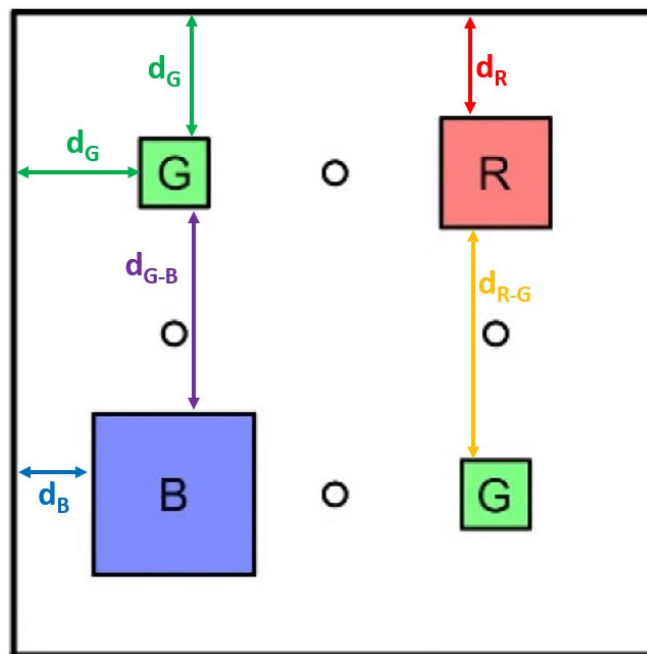
the tiles.”). For example, consider the following two quad pixel structures that are separated by a tile seam:



Pet. at 24 (further annotations in red of Petitioner’s figure). All adjacent pixels are separated by 0.25 times the pitch, whether the spacing is between pixels separated by the tile seam or it is between pixels within a tile.

In Petitioner’s cursory paragraph on “reasonable expectation of success” fully reproduced above, Petitioner simply asserts that “Matthies itself already contemplates that the sizes and space between its pixels can be adjusted.” Pet. at 44 (relying on Matthies at 17:31–37 and 12:9). But Matthies states only that the spaces between the pixels “in the horizontal and vertical directions . . . may be different.” Ex. 1004 at 17:31–33. That is, the space between rows of pixels may be different from the space between columns of pixels. Matthies does not “contemplate” having uneven spaces between the rows or between the columns or having different sized pixels.

On the contrary, if the red, green, and blue pixels were made to all have different sizes with respect to each other as Petitioner proposes, the distance between adjacent pixels would no longer be constant, contrary to Matthies' express disclosures, and the distance between pixels and the edge of the tile would also be different for each color pixel. Using Petitioner's figure depicting its proposed combination, where the red pixels are smaller than the blue pixels and the green pixels are smaller than the red pixels, the space between a green pixel and an adjacent red pixel would be *greater* than the space between a green pixel and an adjacent blue pixel, as illustrated below in annotations to Petitioner's figures. Likewise, there would be *different* distances, not an equal distance, between the edges of each adjacent color pixel and the edge of the tile:



Pet. at 33 (further annotation of Petitioner’s annotated figure). Petitioner’s proposed modification would thus contravene Matthies’ express teachings.

In addition, Matthies describes the areas of its pixels by providing dimensions for just one pixel (d_{SW} and d_{SH}) in the grouping, as can be seen in Matthies’ Figures 8A and 8B. Matthies can do this only because its pixels are all of the same size. Yet Petitioner’s proposal would eliminate this element of Matthies’ design as well.

Therefore, Petitioner’s proposed combination would create unevenly spaced pixels—as to the spacing between pixels separated by a tile seam as well as pixels within a tile, and the spacing between the edges of pixels and the edges of the tile—and frustrate Matthies’ stated goal of “eliminating the visibility of the seams between tiles.” Ex. 1004 at 2:7–10.

2. Petitioner Fails to Identify a Reason to Use a Quad Pixel Design of Matthies, Rather Than Matthies’ Stripe Pattern, in a Combination with Yamada’s Stripe Pattern

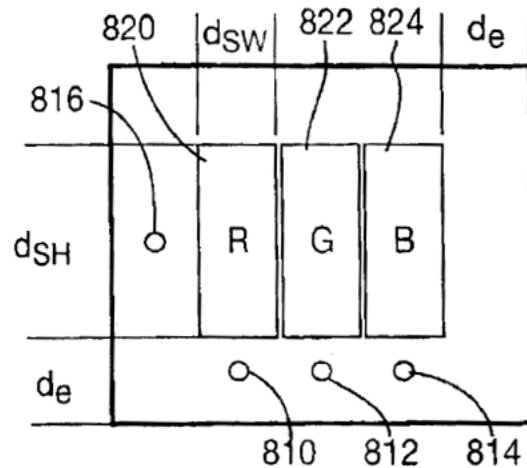
Even assuming *arguendo* that a POSITA would try to combine Matthies with Yamada, the POSITA would not have been motivated to use Matthies’ quad subpixel structure—in which there are two green pixels in addition to a blue pixel and a red pixel (known in the art as an RGBG arrangement)—rather than its RGB triple subpixel structure, for the combination. Yamada’s disclosure focuses on an RGB

triple subpixel structure arranged in a stripe pattern. Ex. 1008, Fig. 4.³ Matthies also discloses embodiments using an RGB triple subpixel structure arranged in a stripe pattern. Ex. 1004 at 16:37–61, Fig. 8A. To the extent that a POSITA considered modifying Matthies in light of Yamada, the natural pixel structure to modify would have been the RGB structure disclosed in Matthies (*e.g.*, in Figure 8A), which is similar to Yamada’s illustrated structure. If applying Yamada’s teaching to Matthies, a POSITA would modify Matthies’ RGB structure by making the green subpixel larger, rather than adding a second subpixel of the same color to increase the color’s luminance. *See* Ex. 1004 at 16:67–17:3. Indeed, in Yamada’s display, red, green, and blue pixels are represented in equal numbers. Yamada’s teaching would have been more compatible with the triple subpixel structure in Figure 8A of Matthies, which includes one each of red, green, and blue subpixels like Yamada.

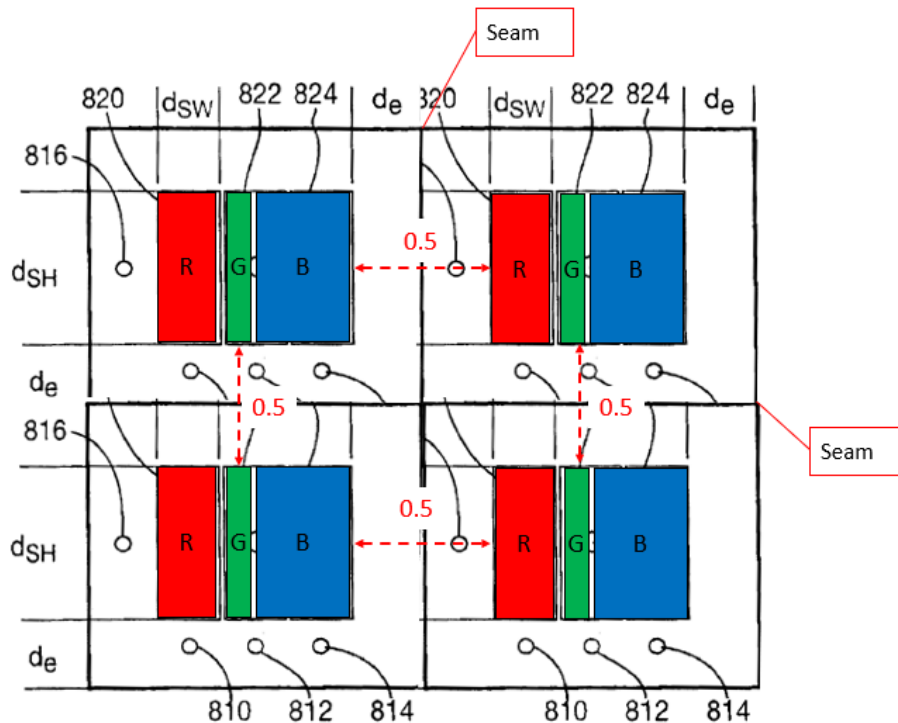
Furthermore, if a POSITA were to make the red and green pixels smaller than the blue pixel as taught by Yamada, Matthies’ RGB structure would have been a more suitable starting point for that modification as well. As discussed above in Section V.A.1.a, in the RGBG structure of Figure 8B, there are pixels for two different colors on each electrode, and changing the size of any given color pixel

³ Yamada states that “the same effect is also obtained in a delta layout and a diagonal layout”; “delta” and “diagonal” are also triple subpixel arrangements having an equal number of red, green, and blue pixels. Ex. 1008 at 12:37–40. Yamada does not disclose or suggest a quad pixel arrangement.

may affect the size of the other color pixel on the same row or column electrode. In contrast, in the RGB structure of Figure 8A, each column electrode contains only one color:



To the extent that Matthies and Yamada could be combined at all, a POSITA would recognize that combining Matthies' RGB structure with Yamada would be more consistent with Matthies' disclosures and avoid certain incompatibilities introduced by Petitioner's proposed modifications. For example, the aperture ratio and the spacing between adjacent pixels separated by a tile seam would remain the same even after changing the width of the column electrodes as shown below.



Ex. 1004, Fig. 8A (annotated using the d_e value from Table 1).

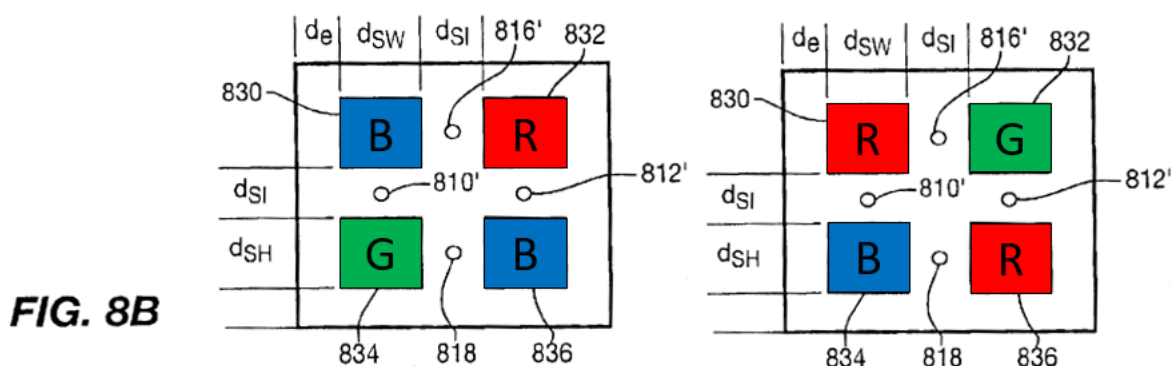
Therefore, even if a POSITA were motivated to combine Matthies and Yamada, Petitioner fails to explain why a POSITA would have been, and a POSITA indeed would not have been, motivated to use Matthies' RGBG quad structure, rather than its RGB triple subpixel structure like Yamada's. With the RGB stripe pattern as the starting point, the claimed virtual square would not form even if Matthies were combined with Yamada.

3. Petitioner Fails to Identify a Reason to Maintain Two Green Pixels in the Quad Pixel Design of Matthies

Even if a POSITA were to combine Matthies' quad subpixel structure with Yamada, there would have been no motivation to maintain the RGBG structure containing two green subpixels. Yamada states that blue electroluminescence (EL)

elements can have “the lowest efficiency among the R, G, and B EL elements” and that the green EL elements can have “the highest emission efficiency.” Ex. 1008 at 8:47–52. For the elements with a lower emission efficiency, “a current larger than that supplied to the other display pixels having a high emission efficiency must be supplied,” causing “the life of those display pixels having a low emission efficiency, in particular, to shorten.” *Id.* at 2:60–67.

Matthies explicitly teaches a solution for such an instance when “the amount of light emitted by the red or blue pixel material may be less than the amount of light emitted by the green pixels.” Ex. 1004 at 17:6–8. In this instance, Matthies states, “the pixels 830 and 836 may both be red or blue pixels,” as shown below, which would “improve the overall brightness of the display.” *Id.* at 17:5–6, 8–10.



Id., Fig. 8B (annotated).

In particular, if the blue pixel has the lowest emission efficiency as Petitioner argues is taught by Yamada, then Matthies directs one to use the quad subpixel structure in which the pixels 830 and 836 are both *blue* pixels (*i.e.*, an RBGB

arrangement) to double the emission area of the least efficient blue pixels. This would improve the overall brightness of the display without necessitating a higher current to be supplied to the blue pixels, and the life of the display would be extended as taught by Yamada.

Petitioner altogether ignores this explicit teaching in Matthies, instead summarily declaring that “[t]he same ‘quad sub-pixel structure’ taught by Matthies would continue to be used (just with re-sized pixels).” Pet. at 32. Petitioner’s expert similarly ignores Matthies’ teachings and posits, without analysis, that “[t]he remainder of Matthies would remain the same, including Matthies’ overall pixel array arrangement. The sub-pixels would still be ordered in the same way” Ex. 1003, ¶ 224. As this reflects, rather than the result of reasoned application of the references’ actual teachings, Petitioner and its expert have engaged in improper hindsight reconstruction. *See Sensonics Inc. v. Aerosonic Corp.*, 81 F.3d 1566, 1570 (Fed. Cir. 1996) (“The invention must be viewed not after the blueprint has been drawn by the inventor, but as it would have been perceived in the state of the art that existed at the time the invention was made.”).

The life of the display will not be extended when the size of the pixel with the lowest emission efficiency—the blue pixel according to Petitioner’s arguments based on Yamada—is kept the same as Petitioner proposes. Therefore, even assuming a POSITA used the quad pixel arrangement of Matthies for a combination

with Yamada, one would not have been motivated to maintain the two green subpixels in the arrangement as Petitioner proposed. Moreover, when the quad pixel structure contains a single green pixel, as in case of the RBGB structure taught by Matthies, a virtual square centered on a green pixel would not be formed.

4. Petitioner Fails to Identify a Reason to Reduce the Areas of the Green and Red Pixels While Maintaining the Area of the Blue Pixel

According to Petitioner, the motivation for a POSITA to apply Yamada's disclosures to Matthies would be to extend the overall life of the display. Pet. at 40. Petitioner then proposes to modify Matthies, allegedly in view of Yamada, by keeping the sizes Matthies' blue pixels unchanged and *reducing* the sizes of the red and green pixels. Yet Petitioner's proposed modification is inconsistent with the very disclosures of Yamada on which it purports to rely, as it would reduce the aperture ratio of the display, reducing the display's brightness, and would not extend the life of the display. A POSITA would have had no reason to modify Matthies in this way.

a. The Proposed Combination Would Not Extend the Life of the Display

First, it would be well understood that reducing the sizes of the green and red pixels while keeping the blue pixels their same size would do nothing to extend the overall life of the display. According to Yamada, a blue OLED pixel may have a low emission efficiency, requiring a larger current to be supplied to the pixel. Ex. 1008 at 2:60–64; 11:11–15. The use of the larger current would shorten the blue pixel's

life. *Id.* at 2:64–67. Yamada’s structure contains equal numbers of red, green, and blue pixels (known in the art as an RGB arrangement). Yamada’s goal of addressing the relatively lower emission efficiency of blue pixels in an RGB structure is achieved by *increasing* the size of the blue pixel. By having a larger light-emitting area for blue light, the amount of current supplied to the blue OLED pixel can be decreased, which tends to lengthen its life. The Petition’s proposed combination would not achieve Yamada’s objective and is also inconsistent with Matthies’ disclosures. Moreover, as discussed above in Section V.A.1.a, a pixel’s emissive area in a PMOLED is determined by the widths of the crossing electrodes, and there is a limited space available to increase the electrode widths to make the blue pixel larger.

Because Petitioner’s proposed combination keeps the blue pixels the same size, it would not reduce the current supplied to the blue pixels, and it would not extend the blue pixels’ life. But not only that, by *reducing* the sizes of the green and red pixel significantly, the proposed combination would require increasing the current supplied to each of those pixels to maintain the level of brightness disclosed in Matthies, which would *shorten* their lives. As a result, the proposed combination may actually shorten, rather than extend, the overall life of the display.

b. A POSITA Would Not Have Been Motivated to Reduce the Area of the Green Pixels

Second, the proposed combination contravenes the express disclosures of Matthies on which Petitioner relies. Matthies discloses, among other pixel structures, a quad subpixel structure containing two green subpixels because “more of the luminance information in a color display is in the green pixels than is in either of the red or blue pixels,” so “the use of two green sub-pixels allows for a brighter display.” Ex. 1004 at 16:67–17:4. Thus, Matthies teaches the benefit of having a structure with green subpixels that, combined, have twice the area of the red and blue subpixels. However, according to Petitioner’s proposed combination, the area of the green subpixels would be a fraction—rather than twice—of the area of the blue or red subpixel. It makes no sense to start from an embodiment of Matthies that doubles the number (and therefore the total emissive area) of the green subpixels to increase brightness, only to negate that feature entirely by cutting the area of the green subpixels by more than half. A POSITA would not have been motivated to reduce the area of the green subpixels, having just increased it to “allow[] for a brighter display.” *Id.* at 17:3–4.

c. The Proposed Combination Would Cause a Large Reduction in the Aperture Ratio

Third, the proposed combination would reduce the aperture ratio below a level that a POSITA would find acceptable. In this field, an aperture ratio is defined as the

ratio of the light-emitting area to the total area. An OLED display with a higher aperture ratio can be driven with a lower current, improving its efficiency and extending its lifetime.

The pixel structure of Figure 8B in Matthies that Petitioner relies on already has a relatively low aperture ratio of 25%. Ex. 1004 at 17:33–37. Making subpixels smaller would only reduce that aperture ratio further. For example, if the sizes of the green pixels and the red pixel were reduced to achieve the green:red:blue pixel area ratio of 1:2.6:5.6 as Petitioner proposes, then the aperture ratio would become 10.3%,⁴ less than half of Matthies’ already low aperture ratio. Although Matthies says “[t]he invention contemplates both larger and smaller pixel apertures,” Ex. 1004 at 17:37–38, a POSITA would have considered a 10.3% aperture ratio, and less than half of its original aperture ratio, to be too low and detrimental to the display’s efficiency and lifetime.

Therefore, a POSITA would not have been motivated to apply Yamada’s teaching to Matthies in the way Petitioner suggests.

⁴ Aperture Ratio of a Blue Subpixel = $25\% / 4 = 6.25\%$. Aperture Ratio of a Red Subpixel = $6.25\% * 2.6 / 5.6 = 2.9\%$. Aperture Ratio of Two Green Subpixels = $6.25\% / 5.6 = 1.1\%$. Total Aperture Ratio = $6.25\% + 2.9\% + 1.1\% = 10.3\%$.

B. Ground 2: Petitioner Fails to Demonstrate a Reasonable Likelihood that Claims 1–4 and 19–21 Are Obvious Over Phan

1. Petitioner Fails to Show that Phan Discloses an Organic Light Emitting Diode (OLED) Display

The claims of the '803 patent require “[a] pixel arrangement structure of *an organic light emitting diode (OLED) display*” and “a plurality of pixels for displaying an image on *the OLED display*.” Ex. 1001, claim 1. Petitioner argues that “Phan explains that its teachings can be employed with various ‘display technologies,’ including ‘Organic Light Emitting Diode (OLED)’ displays.” Pet. at 46. But Petitioner’s reliance on Phan is misplaced. To begin, Petitioner fails to show that the embodiments of Phan on which it relies even disclose an OLED display. The only place where Phan mentions OLED is in the field of invention, where it states that “[t]he invention relates to a display comprising pixels and dots, including but not limited to the following display technologies: Cathode Ray Tube (CRT), Field Emission Display (FED), Vacuum Florescent Display (VFD), Plasma Display Panel (PDP), Liquid Crystal Display (LCD), Light Emitting Diode (LED), Organic Light Emitting Diode (OLED), Polymer Light Emitting Diode (PLED), Electroluminescence (EL), Electronic inks, Surface Emitting Display (SED), Digital Light Processing (DLP), Electro-mechanics, Phototronics, Biotronics and any light sources known or invented in the future as well as a method for controlling the (said) display.” Ex. 1005 at 1:18–29.

Phan’s listing of every conceivable display technology, including “any light sources known or invented in the future,” and reference to “OLED” seventh in that laundry list, does not show that any embodiments in Phan are OLED displays. Phan’s invention relates to “a display comprising pixels and dots.” *Id.* at 1:54–55. Dots are “sources of luminous radiation” emitting red, green, or blue light. *Id.* at 1:59–64. A pixel consists of dots representing “the three basic colours red, green, and blue,” and the light of the dots is “mixed to generate luminous mixed colours.” *Id.* Phan explains that each color dot has a receiver of its own to convert digital information transmitted through a network and that the network preferably is an optical fiber network, indicating that the disclosed display is something other than an OLED. *Id.* at 5:16–20. Moreover, neither Phan nor Petitioner explains how Phan’s embodiments can be combined with an OLED display. Therefore, Petitioner fails to show that the proposed combination based on Phan discloses an OLED display.

2. Petitioner Fails to Show that Phan Discloses a Virtual Square

In addition, the claims of the ’803 patent require “a first pixel having a center coinciding with a center of *a virtual square*.” Ex. 1001, claim 1. Petitioner fails to show that the proposed combination of Phan with Yamada discloses any virtual square. Petitioner proposes combining Phan’s quad pixel arrangement in Figure 11b with the quad pixel display in Figure 12. Pet. at 49. The display in Figure 12 shows that there are spaces between adjacent quad pixels. Even if, for the sake of argument,

one could say Figure 12 Phan disclosed an OLED display as Petitioner alleges (despite the lack of support in Phan), then for Phan's arrangement to work there would need to be space for circuitry such as signal lines and power lines. *See* Ex. 1001 at 3:58–61 (describing various lines formed between pixels). Indeed, Yamada discloses gate signal lines 51, signal lines 52, power lines 53, capacitance electrode lines 54, and capacitance electrodes 55 between adjacent pixels, creating spaces between the pixels:

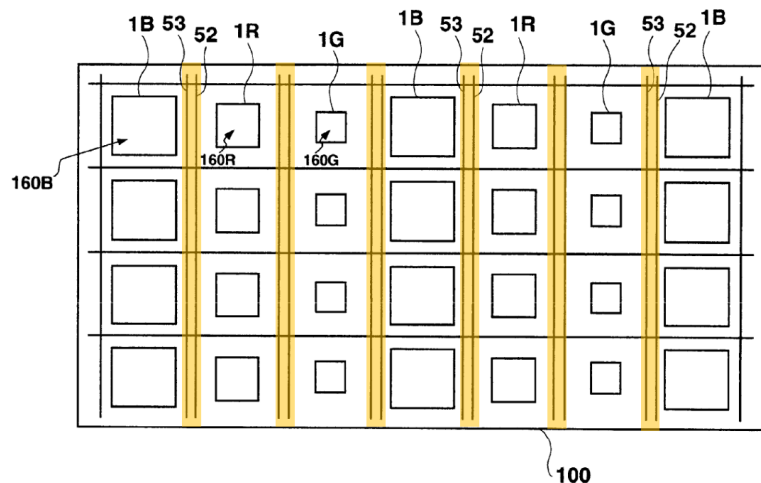


Fig. 4

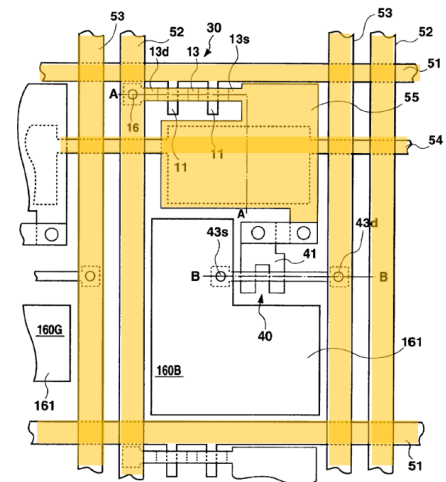
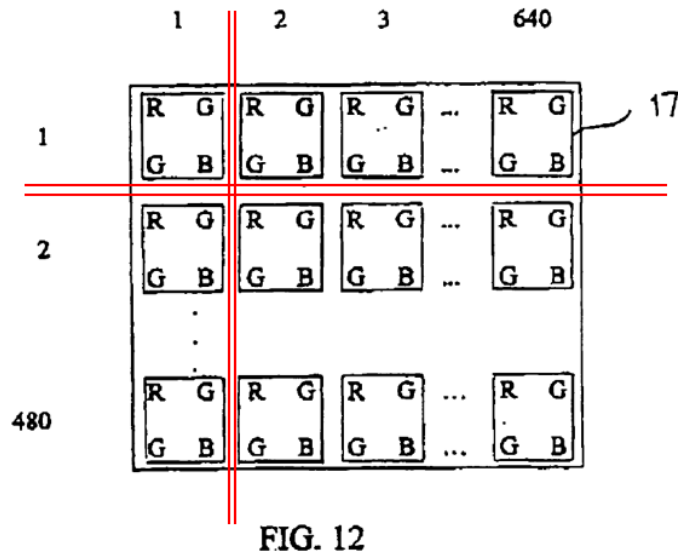


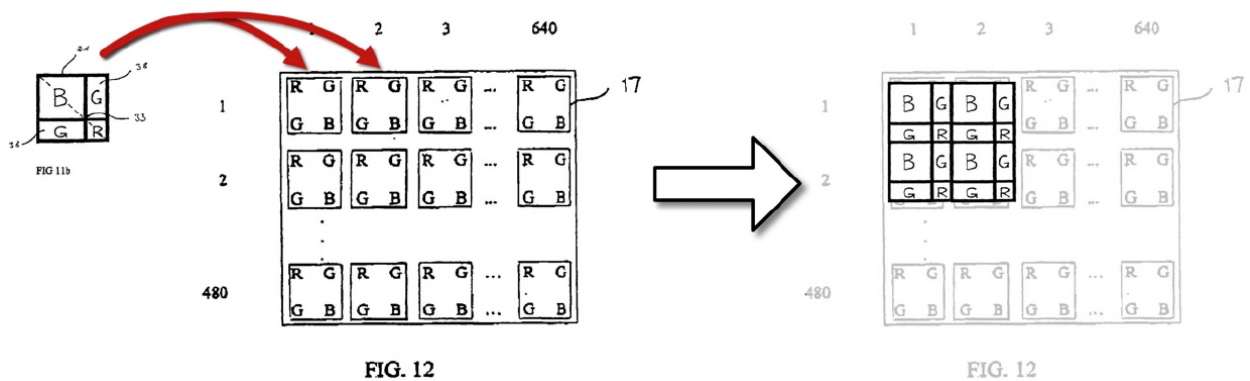
Fig. 5

Ex. 1008, Figs. 4, 5 (annotated), 1:23–33, 6:55–60. Phan's Figure 12 shows spaces between quad pixels where, for instance, signal and/or power lines or other circuitry would apparently need to be present, as shown below:



Ex. 1005, Fig. 12 (annotated).

But, when Petitioner depicts its combination of the quad pixel arrangement of Figure 11b with the display of Figure 12, Petitioner inexplicably changes the arrangement in Phan's figure to remove the gaps between the adjacent quad pixels in Figure 12:



Pet. at 49.

Petitioner offers no justification for changing Phan to remove the gaps between adjacent quad pixels. Petitioner's expert glosses over this critical, and

unexplained, modification to Figure 12 of Phan. Ex. 1003, ¶ 350. Not only that, but two pages later in his declaration, Petitioner's expert directly contradicts the Petition's modified Figure 12 of Phan, asserting that "a POSITA would have understood that when implemented in a display, there would be at least some physical space between to [sic] the dots so as to allow for the required signal lines passing between the dots." *Id.*, ¶ 360. These positions cannot be reconciled; either space between dots is "required" and present or it is not.

If the spaces between the adjacent pixels in the display of Figure 12 are properly maintained when applying the quad pixel arrangement of Figure 11b in the display of Figure 12, then the resulting combination does not exhibit the virtual square arrangement required by the claims of the '803 patent:

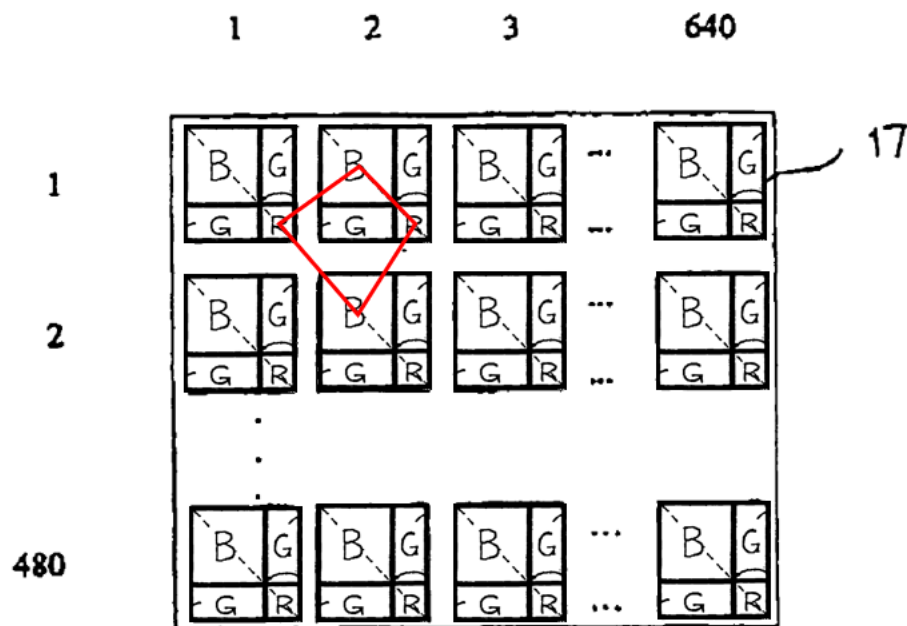


FIG. 12

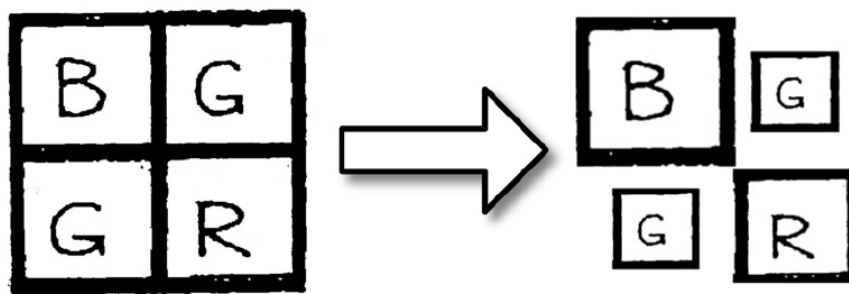
Therefore, Petitioner fails to show that the proposed combination discloses a virtual square.

C. Ground 3: Petitioner Fails to Demonstrate a Reasonable Likelihood that Claim 5 Is Obvious Over Phan and Yamada

Ground 3 only addresses claim 5, which depends from claim 1. Thus, Ground 3 necessarily fails because Ground 2 fails, as discussed above. Nevertheless, the shortcomings of Ground 3 are discussed herein for completeness.

1. Petitioner Fails to Show that that the Phan and Yamada Combination Discloses a Virtual Square

For Ground 3, Petitioner proposes to combine Phan with Yamada to keep Phan's blue dot the same size in Figure 11a, and to make the red dots smaller and the green dots smallest still:



Pet. at 61. Then, Petitioner proposes using this modified pixel in a display matrix like that shown in Figure 12 of Phan. *Id.* at 62. As discussed above in Ground 2, Petitioner fails to show that the combination discloses a virtual square. When Petitioner's modified pixel is used in the display matrix shown in Figure 12, "a

first pixel having a center coinciding with a center of a virtual square” is not formed:

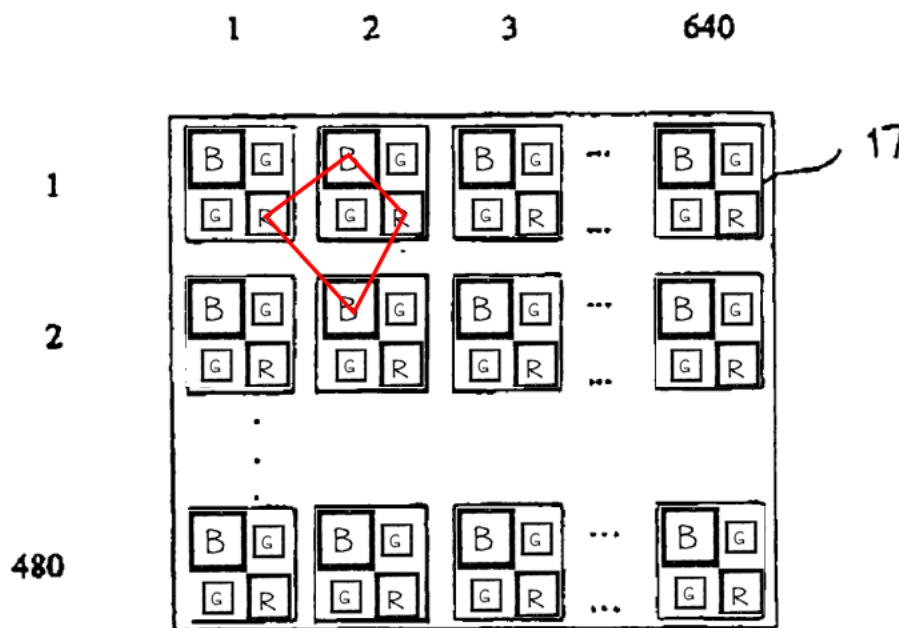


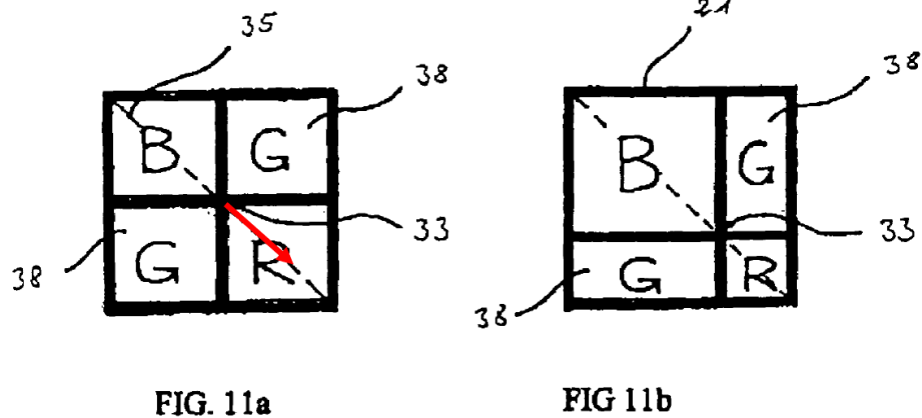
FIG. 12

2. Petitioner Fails to Identify a Motivation to Combine Phan with Yamada

a. Petitioner Fails to Identify a Reason to Reduce the Areas of the Green and Red Pixels While Maintaining the Area of the Blue Pixel

In addition, Petitioner’s proposed combination of reducing the areas of the green and red pixels while maintaining the area of the blue pixel is inconsistent with Phan’s disclosures. First, Phan discloses that the relative sizes of the dots in its square quad pixel can be changed by moving the crosspoint along the diagonal line of the square. Ex. 1005 at 5:51–54. The location of the crosspoint determines the respective sizes of subpixels of the quad pixel. For example, the size of the blue dot

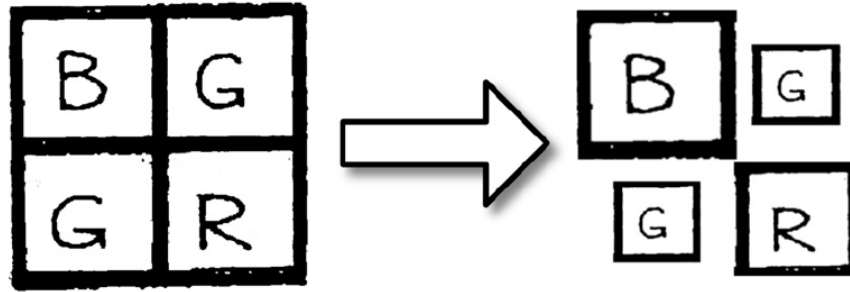
in Figure 11a is increased by moving the crosspoint 33 from center of the pixel along the diagonal line 35 towards the lower-right corner of the pixel to arrive at the structure shown in Figure 11b:



Id., Figs. 11a, 11b.

Accordingly, to increase the blue pixel's size, the sizes of the green and red pixels necessarily decrease, and the blue pixel's size must decrease when the sizes of the green and red pixels increase. Significantly, in the RGBG arrangement, the green pixel's size cannot be made to be smaller than both the red pixel and the blue pixel. Instead, each green pixel always has a size between that of the blue pixel and the red pixel.

Petitioner's proposal of keeping the blue pixel's original size while reducing the sizes of the red and green pixels requires ignoring Phan's disclosure, as shown in Petitioner's drawing below:



Pet. at 61. Petitioner ignores Phan’s teaching about resizing pixels along the diagonal line and breaks up the pixels into an arbitrary structure through hindsight without any support in Phan or Yamada. As discussed in Section V.A.1.b above, using Yamada’s technique of resizing the pixels would create irregularly shaped pixels, rather than square pixels.

Further, Petitioner’s arbitrary addition of empty space between the dots, which Petitioner’s expert conveniently asserts is “required” for placement of the various lines (Ex. 1003, ¶ 379) even though space is already provided between the quad pixels as shown in Figure 12, would further reduce the aperture ratio of the display. In an OLED display, this would lower the display’s brightness or require a higher current to be supplied to the OLED pixels, which would cause the pixels to degrade more quickly and shorten the lifespan of the display.

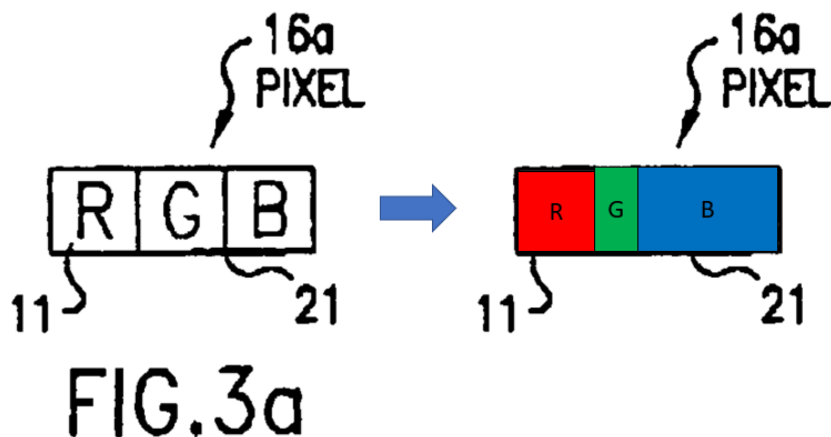
Second, as discussed in Section V.A.4.a above, it would be well understood that reducing the sizes of the green and red pixels while keeping the blue pixels the same size would do nothing to extend the overall life of the display. According to Yamada, the blue pixel can have a low emission efficiency, and in this situation, a

larger current must be supplied to the pixel. Ex. 1008 at 2:60–64; 11:11–15. The use of the larger current would shorten the blue pixel’s life. *Id.* at 2:64–67. As discussed above, Yamada has a structure having an R-G-B stripe arrangement. Yamada’s goal of addressing the relatively lower emission efficiency of blue pixels in an RGB structure would only be achieved by *increasing* the size of the blue pixel to allow the amount of current supplied to the blue pixel to be decreased, which tends to lengthen its life. But Petitioner’s proposed combination would not do that.

The Petition proposes to keep the blue pixels their original size, and to reduce the sizes of the red and blue pixels. A POSITA would have had no reason to make such a modification. Petitioner’s modification would not reduce the current supplied to the blue pixel, and thus would not extend the blue pixel’s life. In fact, by reducing the sizes of the green and red pixel significantly, the proposed combination would require increasing the current supplied to each of those pixels to maintain the level of brightness, which would shorten their lives. As a result, the proposed combination may actually shorten, rather than extend, the overall life of the display. Moreover, Yamada is directed only to extending the life of OLED displays, and a POSITA would not have understood that it applies to the non-OLED displays in Phan. Therefore, a POSITA would not have been motivated to combine Yamada with Phan as Petitioner argues.

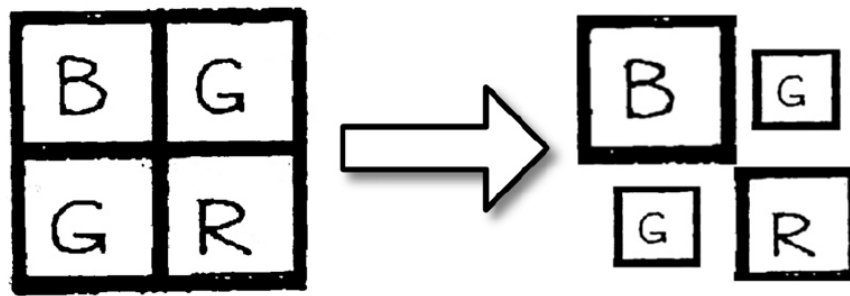
b. Petitioner Fails to Identify a Reason to Use the Quad Pixel Design of Phan, Rather Than Phan's Stripe Pattern, in a Combination with Yamada's Stripe Pattern

Even if assuming *arguendo* that a POSITA would try to combine Phan with Yamada, the POSITA would not have been motivated to use Phan's RGBG quad subpixel structure, rather than its RGB triple subpixel structure, for the combination. Yamada can increase the luminance information of a color display by increasing the corresponding pixel's size rather than increasing the number of pixels. Therefore, according to Yamada's teaching, there is no longer a need to have a quad structure containing two subpixels of the same color to increase the color's luminance. Indeed, Yamada uses an RGB, rather than RGBG, structure arranged in a stripe pattern. Yamada's teaching would have been more compatible with the RGB structures arranged in a stripe pattern in Figures 3a–b of Phan. For example, using the RGB structure in Figure 3a, the sizes of the red, green, and blue dots can be adjusted to achieve the ratio between the sizes of the three color pixels disclosed in Yamada:



Ex. 1005 Fig. 31 (annotated). In contrast, as discussed above in Section V.C.2.a, if the RGBG structure of Figure 11a were used, the red dot cannot be larger than the green dot according to Phan's teaching.

Moreover, even if the green dots could be made smaller than the red dot as Petitioner proposes, this would result in a reduction of the aperture ratio due to the needless creation of spaces between the color dots:



Pet. at 61. As discussed above in Section V.C.2.a, Phan teaches adjusting the sizes of dots in a square quad pixel (or a rectangular quad pixel) without adding any space by moving the crosspoint along the diagonal line, Ex. 1005 at 5:43–46, 51–54, and Petitioner's arbitrary addition of spaces between the dots would reduce the display's aperture ratio. When the RGB structure is used, however, there is no reduction in the aperture ratio, as shown in the annotated Figure 3a shown above.

Therefore, a POSITA would not have been motivated to use Phan's RGBG structure, rather than the RGB structure, when applying Yamada's teaching to Phan.

**c. Petitioner Fails to Identify a Reason to Maintain
Two Green Pixels in the Quad Pixel Design of
Phan**

Even if a POSITA were to combine Phan's quad subpixel structure with Yamada, there was no motivation to maintain two green subpixels in the structure, also referred to as the RGBG structure. Yamada teaches that the blue electroluminescence (EL) elements can have "the lowest efficiency among the R, G, and B EL elements" and that the green EL elements can have "the highest emission efficiency." Ex. 1008 at 8:47–52. For the elements with a lower emission efficiency, "a current larger than that supplied to the other display pixels having a high emission efficiency must be supplied," causing "the life of those display pixels having a low emission efficiency, in particular, to shorten." *Id.* at 2:60–67. A POSITA would have also known that two pixels can be used for the color with a low emission efficiency in a quad pixel structure. *See, e.g.*, Ex. 1004 (Matthies) at 17:5–10.

In particular, if the blue pixel has the lowest emission efficiency, a POSITA would simply use Phan's quad pixel structure that contains two blue pixels, thereby doubling the emission area of the least efficient blue pixel compared to that of the most efficient green pixel. In fact, Phan discloses and illustrates this very quad pixel structure:

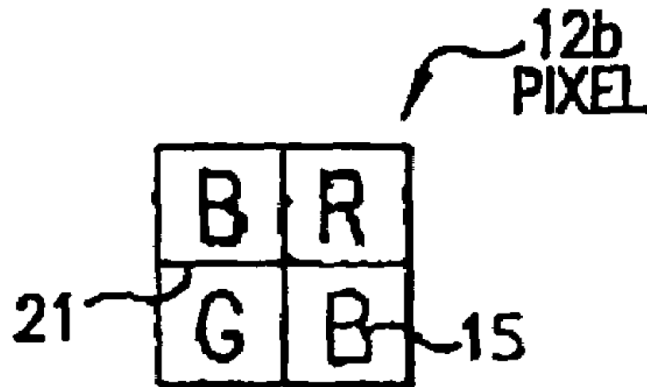


FIG. 1b

Ex. 1005, Fig. 1b.

To the extent that blue pixels had lower efficiency (as is the premise for Petitioner's proposed combination), using this quad pixel structure with two blue pixels would improve the overall brightness of the display without necessitating a higher current supply to the blue pixels, and the life of the display may be extended. In contrast, the life of the display will not be extended when the size of the pixel with the lowest emission efficiency—the blue pixel according to Yamada, under Petitioner's theory—is maintained the same as Petitioner proposes. Therefore, a POSITA would not have been motivated to apply Phan's quad pixel structure with two green pixels in any combination with Yamada. Moreover, the Petition does not argue—nor could it—that a quad pixel arrangement with two blue subpixels would meet the requirements of any claim of the '803 patent. When there is only one green

pixel in the quad pixel structure, there would be no virtual square centered on a green pixel as required by the claims of the '803 patent.

D. Ground 4: Petitioner Fails to Demonstrate a Reasonable Likelihood that Claims 1–5 and 19–21 Are Obvious Over Murai and Yamada

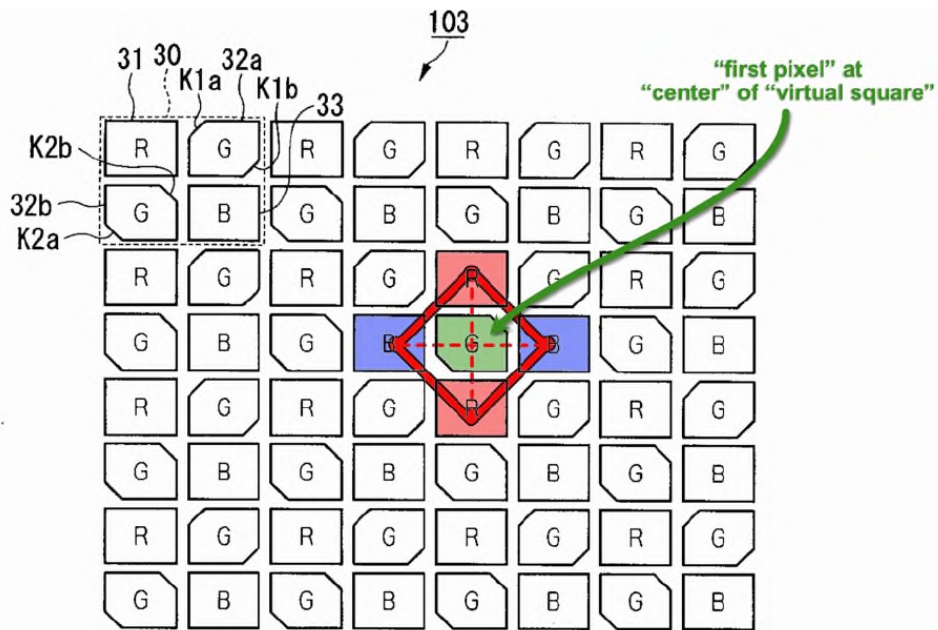
Petitioner argues that “Murai (Ex. 1007) and Yamada (Ex. 1008), when considered in view of the knowledge of a POSITA, render claims 1–5 and 19–21 obvious.” Pet. at 64. But Petitioner fails to show that the proposed combination would meet the “virtual square” limitation of the challenged claims. Further, Petitioner fails to establish that a POSITA would have been motivated combine Murai with Yamada or had a reasonable expectation of success. Murai’s teachings were intended to solve problems in liquid crystal display (LCD) devices, and Yamada’s teachings regarding the efficiency and life of organic emissive layers in OLED displays would not apply to Murai. In addition, Petitioner’s proposed combination would significantly reduce the aperture ratio, which is inconsistent with Murai’s goal of maximizing the aperture ratio and the purpose of Murai’s design. Moreover, like the combination of Matthies and Yamada discussed above, a POSITA would not have been motivated to reduce the areas of the green and red pixels while maintaining the area of the blue pixel; use the quad pixel design rather than the striped pixel design of Murai; or use two green pixels instead of two blue

pixels in the quad pixel design. For each of these independent reasons, Petitioner's arguments fail.

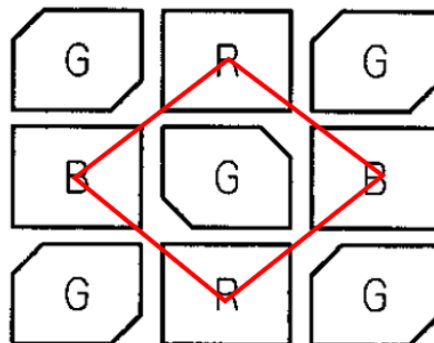
1. Petitioner Fails to Show that the Murai and Yamada Combination Discloses a Virtual Square

For Ground 4, Petitioner relies on a combination of Murai and Yamada, but the combination does not disclose the claimed virtual square. Murai discloses “a unit pixel consisting of four rectangular dots.” Ex. 1007, ¶ [0006]. The “four dots that make up the unit pixel are disposed in a rectangular shape made up of four rectangles.” *Id.* Some of the dots have “cut-off portions wherein at least one corner of the rectangular shape is cut off.” *Id.*, ¶ [0011]. In Murai, “the cut-off portions can prevent dots having the same color (or a similar color) from being adjacent in the diagonal direction of the screen.” *Id.* Murai states that the aperture ratio can be improved by having the cut-off corners. *Id.*, ¶¶ [0010], [0042].

Petitioner argues that “Murai's dots form a ‘virtual square’ with a green dot at its ‘center.’” Pet. at 67. To support its argument, Petitioner provides the following annotated image:



Id. at 68. However, upon closer inspection, the Petition has placed the upper and lower vertices of the “virtual square” deceptively off the centers of the red dots to make a non-square figure look like a square. Even assuming *arguendo* that this figure from Murai is to scale and represents the actual pixel shapes, when the vertices are placed at the centers of the red dots as the claims require, the resulting shape is not a square:



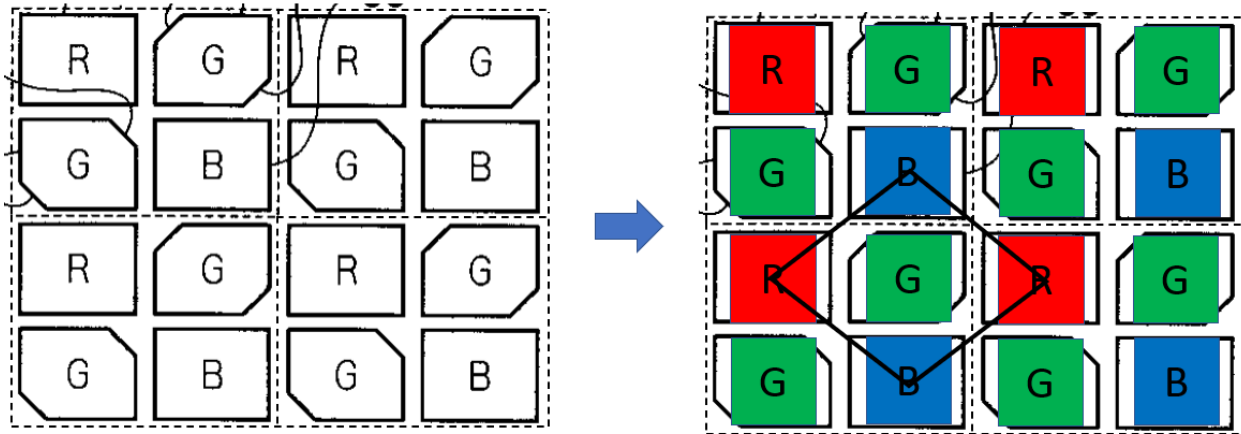
Ex. 1007, Fig. 3 (annotated).

A virtual square simply would not form when rectangular dots are arranged in a grid as shown in Petitioner's drawing reproducing Figure 3 of Murai. The length and the width of a rectangle are necessarily different, unless the rectangle happens to be a square.

Even though Petitioner uses rectangular dots to depict the proposed combination, Petitioner states that Figure 3 provides an example of "the use of a square dot shape, with dots arranged in a grid with a square shape." Pet. at 67. Figure 3 does not. As shown above, Figure 3 uses a rectangular dot shape, with dots arranged in a grid with a rectangular shape. Although Murai states that "[i]t is preferable for the rectangular shape thereof to be a square, but it may also be an oblong rectangle," Ex. 1007, ¶¶ [0017], [0030], the Figure 3 embodiment that Petitioner uses for its proposed combination uses a rectangular dot shape, not a square shape. In fact, there is no figure in Murai that uses a square dot shape, and Petitioner does not provide any reason why a POSITA would have modified the Figure 3 embodiment to have square-shaped dots when combining the embodiment with Yamada.

Moreover, even if the Figure 3 embodiment is assumed to be drawn to scale and to be representative of the actual pixel shapes, and is redrawn with square dots, the virtual square required by the claims still may not be formed. While Murai states that color dots can have a square shape, it does not disclose that the quad pixel

structure (called “unit pixel” in Murai) that contains four of the color dots can be anything other than an oblong rectangle. *Id.*, ¶¶ [0017], [0030]. If the quad pixel structure’s shape is maintained as an oblong rectangle as Murai teaches, then a virtual square would not form even if the individual dots have a square shape:



Id., Fig. 3 (annotated) (dotted rectangles representing quad pixel structures).

Nor does Petitioner argue that a POSITA would have changed the shape of the quad pixel structure of Figure 3 from an oblong rectangle to a square when combining Murai with Yamada. Petitioner states only that “[a]ll of the dots are ‘accurately’ and ‘regularly disposed.’” Pet. at 67 (quoting Ex. 1007, ¶ [0010]). But the quad pixel structure does not have to have a square shape for the dots to be accurately and regularly disposed. Further, even if changing the shapes of the dots to be squares is followed by adjusting the spaces between the dots, a virtual square may still not be formed unless the horizontal and the vertical spaces between the dots are equal in their sizes, but Murai does not state or imply that the horizontal

spaces and the vertical spaces between the dots are equally sized. Indeed, Yamada discloses having different spacings between columns of pixels compared to the spacings between rows of pixels due to the different number of types of power and signal lines running between the pixels in the vertical and horizontal directions:

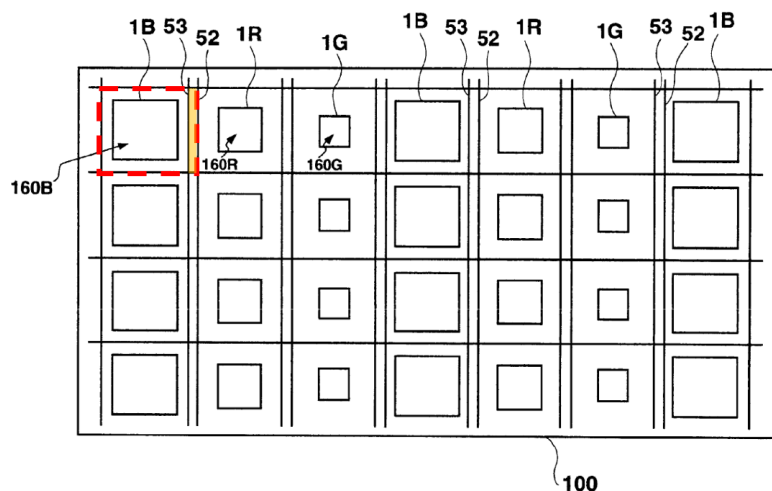


Fig. 4

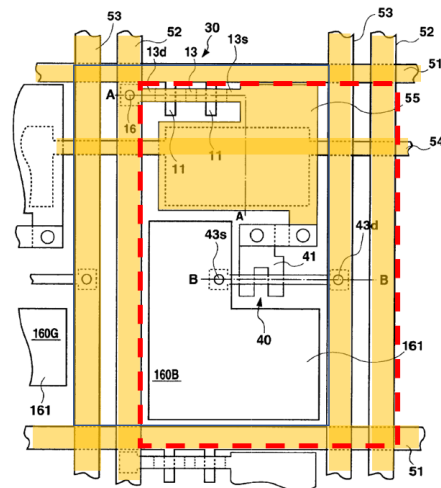


Fig. 5

Ex. 1008, Figs. 4, 5 (annotated), 1:23–33, 6:55–60; *see also* Ex. 1004 (Mathies) at 17:31–33 (“[I]t is contemplated that [the spaces between the pixels in the horizontal and vertical directions] may be different.”).

In addition, the ’803 patent claims require blue pixels to be larger than red pixels, but in Murai all of the red and blue pixels have the same size. *See* Ex. 1007, Fig. 6(a)–(b) (showing red and blue pixels either with no cut-out portions or with matching cut-out portions). As discussed in more detail below, there is no principled way to change the pixel sizes in Murai while being consistent with Murai’s teachings.

Petitioner’s bare assertion that a POSITA would have changed the sizes while creating a virtual square is unsupported and implausible.

Therefore, Petitioner fails to show that the proposed combination discloses a virtual square.

2. Petitioner Fails to Identify a Motivation to Combine Murai with Yamada

a. Petitioner Fails to Identify a Reason to Reduce the Area of Any Pixel in Murai

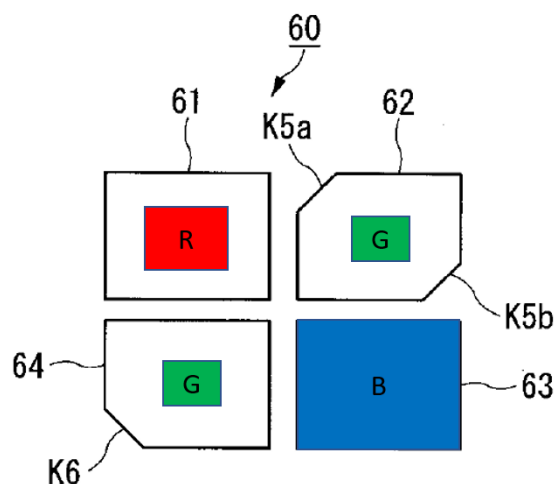
As an initial matter, Murai discloses problems associated with liquid crystal display (LCD) devices and means for solving the problems. Ex. 1007, ¶ [0002]–[0014].⁵ Unlike an OLED display, LCDs do not contain organic emissive layers. Instead, LCDs contain filters that are used in conjunction with backlighting to produce colored images. Accordingly, Yamada’s teachings regarding the efficiency and the life of organic emissive layers do not apply to Murai, and a POSITA would not have been motivated to reduce Murai’s pixel sizes based on Yamada.

Moreover, in Murai, a cutout is created in one or more corners of one or more rectangular dots. Petitioner proposes a combination of Murai and Yamada in which the blue dots have no cutout, red dots have two smaller cutouts, and green dots have

⁵ Although Murai states that its invention “can be applied to . . . organic EL display devices,” it does not explain how its solutions for LCD devices can be used with OLED display. Ex. 1007, ¶ [0058].

two larger cutouts. Pet. at 74. Petitioner claims, without citation or support, that “Murai also teaches that its dots can have different sizes.” Pet. at 18. Not so. Murai merely suggest that the position of the cut-off portion of the dots can vary. Ex. 1007, ¶ [0012] (“[I]t is preferable in the color image display device of the present invention for the position of the cut-off portion of the first auxiliary dot and the position of the cut-off portion of the second auxiliary dot to be different.”). As discussed above, Murai only teaches having cut-off corners and is silent on the effect of the cut-off corners on the sizes of the dots. The purpose of the cutouts in Murai is not to reduce the sizes of the dots. It is to prevent dots having the same color (or a similar color) from being adjacent in the diagonal direction to avoid streaks in that direction. *Id.*, ¶ [0011]. The cut-outs are present either on only the green dots (*id.*, Figs 3, 4, 6(a)) or on all of the dots (*id.*, Fig. 6(b)).

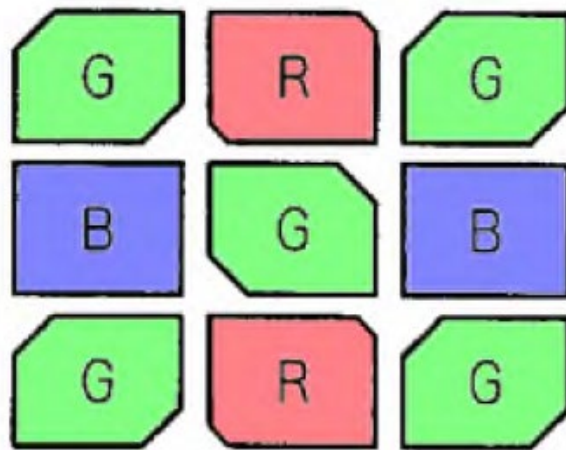
Modifying Murai in view of Yamada as Petitioner suggests would negate the reason for these cutouts and render the purported invention of Murai meaningless. As Petitioner notes in its Ground 1, Yamada teaches the emissive area ratio of 1:2.6:5.6 between the green, red, and blue pixels, and Yamada additionally discloses the ratio of 1:14.2:35. Pet. at 32; Ex. 1008 at 11:8–10, 11:34–39. If either ratio were applied to Murai, then the red dots and the green dots would be greatly separated from other dots as shown below, eliminating any need for the very cut-out portions that are at the heart of Murai.



Ex. 1007, Fig. 6(a) (annotated). In other words, Murai’s entire purpose for cutting off corners to prevent dots having the same color (or a similar color) from being adjacent in the diagonal direction would be nullified. In addition, Murai explains that the purpose of the invention is so that “the overall aperture ratio can be improved.” Ex. 1007, ¶ [0042]. The large cutouts that have to be made to apply Yamada’s emissive area ratio to Murai would be counter to that purpose. Further, as discussed in Section V.A.1.b above, using Yamada’s technique of resizing the pixels would create irregularly shaped pixels, rather than square or rectangular pixels. There is no principled reason or basis in Murai or Yamada to cut off corners from green and red pixels as Petitioner asserts.

Petitioner’s proposed modification of Murai includes adding small cutouts to the red dots, allegedly based on Yamada’s disclosures. Pet. at 74. But because the sizes of the emissive areas remain largely unchanged, Yamada’s goal of achieving a balanced pixel luminance would not be achieved. Instead, the only rationale for the

modification Petitioner advances, reproduced below, is that Petitioner is attempting through hindsight to adjust Murai's figures to meet claim limitations of the '803 patent, with no justification to be found in the actual disclosures of Yamada or Murai:



Id.

Murai's display, whose pixel corners are cut off to increase the aperture ratio in a display, packing pixels as closely together as possible, is fundamentally incompatible with Petitioner's proposed modifications that are purportedly based on Yamada and that *reduce* the aperture ratio of the display. The purposes of the two references cannot both be achieved by their combination, and a POSITA would not have been motivated to combine them. Further, a POSITA would have had no reasonable expectation of success in such a combination.

b. Petitioner Fails to Identify a Reason to Reduce the Areas of the Green and Red Pixels While Maintaining the Area of the Blue Pixel

Petitioner argues that a POSITA would have been motivated to apply Yamada's teaching to Murai to extend the overall life of the display. To achieve this goal, Petitioner proposes a combination in which the original size of Murai's blue pixel is kept and the sizes of the red and green pixels are reduced. Pet. at 74. However, Petitioner's proposal, which entails significantly *reducing* the aperture ratio of the display if Yamada's emissive area ratio were applied to Murai, is incompatible with the very purpose of Murai's design, which Murai explains is that "the overall aperture ratio can be improved." Ex. 1007, ¶ [0042].

Further, as discussed in Section V.A.4.a above, it would be well understood that reducing the sizes of the green and red pixels while keeping the blue pixels their same size would do nothing to extend the overall life of the display. According to Petitioner's theory of Yamada, a blue OLED pixel has a low emission efficiency, requiring a larger current to be supplied to the pixel. Ex. 1008 at 2:60–64; 11:11–15. The use of the larger current shortens the blue pixel's life. *Id.* at 2:64–67. As discussed above, Yamada has a structure having an R-G-B arrangement. Yamada's goal of addressing the relatively lower emission efficiency of blue pixels in an RGB structure would only be achieved by *increasing* the size of the blue pixel. By having

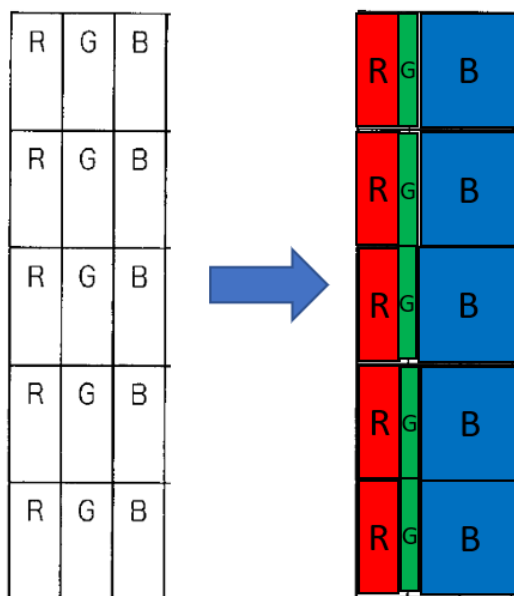
a larger light-emitting area for blue light, the amount of current supplied to the blue pixel can be decreased, which tends to lengthen its life.

Because the proposed combination maintains the blue pixels' original size, it would not reduce the current supplied to the blue pixel. Petitioner's proposed combination therefore would not extend the blue pixel's life. In fact, by reducing the sizes of the green and red pixel significantly, the proposed combination would require increasing the current supplied to each of those pixels to maintain the level of brightness, which would shorten their lives. As a result, assuming *arguendo* that Murai's figure may be applied to an OLED rather than an LCD design, the proposed combination may actually shorten, and certainly would not extend, the overall life of the display. Therefore, a POSITA would not have been motivated to apply Yamada's teaching to Murai.

c. Petitioner Fails to Identify a Reason to Use the Quad Pixel Design of Murai, Rather Than Murai's Stripe Pattern, in a Combination with Yamada's Stripe Pattern

Even assuming *arguendo* that a POSITA would combine Murai with Yamada, the POSITA would not have been motivated to use Murai's RGBG quad subpixel structure, rather than its RGB triple subpixel structure, for the combination. Yamada teaches increasing the luminance information of a color display by increasing the corresponding pixel's size rather than increasing the number of pixels. Therefore, according to Yamada's teaching, there is no longer a need to have a quad structure

containing two subpixels of the same color to increase the color's luminance. Indeed, Yamada's display uses an RGB structure arranged in a stripe pattern. Yamada's teaching would have been more compatible with the triple subpixel structures in Figure 7 of Murai, which uses RGB structures arranged in a stripe pattern like Yamada. For example, Figure 7's RGB structure can be modified to provide differently sized red, green, and blue dots to achieve the ratio taught by Yamada without sacrificing the aperture ratio as shown below:



Ex. 1007, Fig. 7 (annotated).

As with the other Grounds, Petitioner fails to explain why a POSITA would have started from the RGBG quad pixel structure and further fails to explain why a POSITA would not have used the more suitable RGB pixel structure in light of Yamada's teachings. Therefore, a POSITA would not have been motivated to use

Murai's RGBG structure, rather than the RGB structure, when applying Yamada's teaching to Murai.

d. Petitioner Fails to Identify a Reason to Maintain Two Green Pixels in the Quad Pixel Design of Murai

Even if a POSITA were to combine Murai's quad subpixel structure with Yamada, there was no motivation to maintain two green subpixels in the structure. Yamada states that blue electroluminescence (EL) elements can have "the lowest efficiency among the R, G, and B EL elements" and that the green EL elements can have "the highest emission efficiency." Ex. 1008 at 8:47–52. For the elements with a lower emission efficiency, "a current larger than that supplied to the other display pixels having a high emission efficiency must be supplied," causing "the life of those display pixels having a low emission efficiency, in particular, to shorten." *Id.* at 2:60–67. A POSITA would have also known that two pixels can be used for the color with a low emission efficiency in a quad pixel structure. *See, e.g.*, Ex. 1004 (Matthies) at 17:5–10.

In particular, if the blue pixel has the lowest emission efficiency, a POSITA would make two pixels in Murai's quad pixel structure be blue pixels, doubling the emission area of the blue pixels. This would improve the overall brightness of the display without necessitating a higher current supply to the blue pixels, and the life of the display would be extended as was a goal of Yamada. In contrast, the life of

the display will not be extended when the size of the pixel with the lowest emission efficiency—the blue pixel according to Yamada—is maintained the same as Petitioner proposes. Therefore, a POSITA would not have been motivated to use a quad pixel structure with two green pixels if Murai were combined with Yamada. Further, where a quad pixel structure contains two blue pixels and one green pixel, there would be no virtual square centered on a green pixel as required by the claims of the '803 patent.

VI. Conclusion

For all of the foregoing reasons, Patent Owner respectfully submits that institution should be denied.

Date: October 10, 2023

Respectfully submitted,

By /Scott C. Weidenfeller/

David A. Garr

Registration No.: 74,932

Scott C. Weidenfeller

Registration No.: 54,531

Counsel for Patent Owner

CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), I certify that the present paper contains 13,157 words based on the word count indicated by the word-processing program used to generate the paper and excluding those portions exempted by 37 C.F.R. §§ 42.24(a) and (b).

Date: October 10, 2023

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Registration No.: 54,531

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6, I hereby certify that the foregoing Patent Owner's Preliminary Response and accompanying exhibits were served by electronic mail on the following counsel of record for petitioner:

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