

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 IPR2023-01075
U.S. Patent No. 11,594,578

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
Ex. 2004	U.S. Patent No. 6,867,549 to Cok et al.

I. Introduction

U.S. Patent No. 11,594,578 B2 (the “’578 patent”) is directed to innovative arrangements and structures of pixels for organic light emitting diode (“OLED”) displays. In OLED displays, organic light-emitting layers are formed through deposition processes that present design and manufacturing challenges. For example, the ’578 patent explains 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 1:46–50. Further, the organic materials used to emit different color light are susceptible to deterioration, and at different rates, including based on the level of current driven through them. *See, e.g., id.* at 7:35–38. At the same time, the number, size, and arrangement of OLED pixels impacts the brightness, image quality, and lifetime of an OLED display, among other attributes.

The ’578 patent’s inventive arrangements of blue OLED pixels, red OLED pixels, and green OLED pixels overcome the design and manufacturing challenges associated with organic light emitting layers. *See, e.g., id.* at 7:13–42. For example, 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 ’578 patent employ a greater number of green pixels than blue and red pixels. The ’578

patent spaces and arranges the green, red, and blue pixels in particular ways, and uses particular shapes for pixels, as illustrated in, for example, Figure 5 of the '578 patent to form arrangement structures that improve the aperture ratio of the display (the relative area of the light-emitting regions of the display to non-light-emitting regions¹), the brightness, and the image quality. At the same time, the pixels are spaced sufficiently to allow for reliable deposition of the organic light emitting material and to improve the lifespan of the display. *See, e.g., id.* at 5:26–36, 6:50–60 (“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).

Petitioner’s challenges to the '578 patent all rely on a proposed combination of two references, Matthies and Yamada. A person of ordinary skill in the art (“POSITA”) would have had no reason to combine these references—let alone in the particular way in which Petitioner argues—given incompatibilities in their technologies. The Petition’s Ground 1 is based on this combination of Matthies and Yamada, while Ground 2 is based on the combination of Matthies and Yamada with

¹ 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 4:1–6.

a further reference, Hong, that is itself inconsistent with Petitioner's theories. These grounds lack merit.

Petitioner's proposed combinations of Matthies and Yamada are all constructed on the flawed premise that a POSITA would want to **reduce** the aperture ratio (and hence brightness and image quality) of an OLED display by shrinking the size of certain pixels, which has no basis in the prior art. Moreover, Petitioner fails to explain why the references would have been combined in the manner it asserts, proposing pixel arrangement structure inconsistent with the references' disclosures.

Petitioner's arguments are also internally inconsistent. To take an example, for most claims, including claim 1, Petitioner asserts that a POSITA would have been motivated by Yamada to have the blue pixels in Matthies be the largest pixels (by reducing the sizes of Matthies' red and green pixels). *See, e.g.,* Pet. at 36–40. Yet to challenge claim 5 of the '578 patent, which depends from claim 1, Petitioner argues that in combining Matthies with Yamada a POSITA would keep the blue and red pixels in Matthies **the same size** (but, for some unexplained reason, modify the green pixel to be smaller). *See Id.* at 44–46. Petitioner cannot have it both ways. Indeed, Petitioner's arguments fail to address and remain faithful to the disclosures of the references and, instead, attempt to reconstruct the inventions of the '578 patent through hindsight starting from the inventions themselves.

Petitioner attempts to combine Matthies, which discloses a large-area tiled display using a passive matrix OLED (PMOLED), 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 at least two reasons. *First*, passive and active matrix OLED technologies operate in materially different ways that render Petitioner's proposed combination unfeasible. *Second*, Matthies' large-area tiled display—which is created by connecting multiple displays (“tiles”) that each present a separate sub-image that together form a full image—expressly requires even spacing between the pixels within a particular tile. It also requires even spacing between the pixels and the edges of the tiles so that the seams between the tiles do not become visible to a viewer. Yet, in the face of Matthies' teaching requiring uniform spacing of pixels, Petitioner proposes a hindsight-driven 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 an RGB pixel structure where a single red pixel, a single green pixel, and a single blue pixel are aligned to form a stripe pattern. If attempting to combine Matthies with Yamada, a POSITA would (if anything) have looked to the similar RGB stripe pattern disclosed in Matthies. Instead, Petitioner cherry-picks a specific quad pixel structure from

Matthies that contains two green pixels, a blue pixel, and a red pixel, instead of looking to Matthies' stripe embodiment that would match Yamada's disclosure and offer benefits that the quad pixel structure does not.

Moreover, according to Petitioner, Yamada teaches that a blue OLED pixel has a low emission efficiency (Pet. at 18 (quoting Ex. 1005 at 8:47–52)) and therefore should be made larger. But instead of doing so, Petitioner inexplicably keeps the blue pixel the same size and shrinks the green and red pixels. Petitioner does so despite Matthies' explicit teaching that, where the blue pixel is inefficient, 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). Petitioner does not successfully explain why a POSITA would have been motivated to keep the blue pixel the same size and to decrease the size of the green and red pixels, which would decrease the aperture ratio below Matthies' already low 25% aperture ratio and shorten the life of the display, with no corresponding benefit. A POSITA therefore would not have been motivated to make Petitioner's combination of Matthies and Yamada.

The Petition has still further failings regarding claims 41, 44, and 52, which require the green pixel to have "elongated" sides or edges. Petitioner argues that "Matthies teaches that its display can employ rectangular shaped sub-pixels." Pet. at 60. However, Matthies uses rectangular shaped pixels only for its *RGB stripe*

patterned pixel structure, not for its quad pixel design, but Petitioner does not suggest that a POSITA would apply this modification to Matthies' stripe design (which would not meet numerous requirements of the '578 patent's claims). Ex. 1004 at 16:49–61, 25:46–54, Fig. 8A. Matthies provides no example where rectangular shaped sub-pixels are used in a quad pixel structure, *id.* at 17:16–29, 25:46–54, Fig. 8B, and Petitioner offers no reason that a POSITA would use a rectangular pixel with Matthies' quad pixel structure, much less with a reasonable expectation of success in Matthies' PMOLED tile design in which the size of pixels is based on the sizes of column and row electrodes and the presence of vias.

Moreover, Petitioner does not show that the limitations of claims 41, 44, and 52 would be met even if rectangular pixels were used. Changing the pixel shape from a square to a rectangle would alter the distances between the pixels. Petitioner does not explain how the combination, after the shape is changed, would even satisfy the claim limitations regarding spacing between pixels.

Regarding Ground 2 based on Matthies, Yamada, and Hong, the combination is deficient not only for the lack of a motivation to combine Matthies and Yamada as discussed above, but also for the further lack of any motivation to combine those two references with Hong, much less in the way Petitioner asserts. Petitioner argues that a POSITA would have been motivated to apply Hong's elongated pixels with truncated corners to Matthies and Yamada. However, Petitioner fails to explain why

a POSITA would purportedly have been motivated to use Hong's elongated pixels in Matthies' quad pixel structure. Nor could Petitioner, as the reason for Hong's elongated pixels with truncated corners was to *increase* the distance between the nearest pixels, yet in Petitioner's combination the spacing between nearest pixels is unchanged (as the shortest distances are between top/bottom or side edges of adjacent pixels, not the corners that Petitioner truncates). Indeed, Petitioner's proposal would reduce the distance between certain adjacent pixels, which is directly contrary to Hong's goal.

Petitioner also disregards the incompatibility between its proposed Matthies-Yamada combination and the disclosures of Hong. Hong teaches that its truncated corners allow pixels in RGB patterns where each color pixel has substantially the same area to be closely situated to form a high aperture ratio display without causing a "shadowing effect," in which overlapping pixel regions inadvertently affect the colors emitted by the respective pixels. Ex. 1011, ¶¶ [0010]–[0013]. But Matthies provides a low aperture ratio display, and Petitioner's proposed combination of Matthies and Yamada would substantially reduce the already low aperture ratio of Matthies. Further, Petitioner's proposed combination uses a quad pixel arrangement in which pixels have different sizes, while Hong is directed to solving a problem with RGB arrangements in which the pixels are all of substantially the same size.

There would have been no reason to apply Hong's truncated corners to such a design, as they would be pointless and fail to serve the purpose that Hong ascribes to them.

In addition, like with claims 41, 44, and 52 in Ground 1, Petitioner fails to account for the changed distances between the pixels after applying Hong's elongated pixels with truncated corners to Matthies and Yamada, and wholly fails to show that the Ground 2 combination would even meet the claim limitations regarding spacing between pixels, as discussed below.

The petition should be denied.

II. The '578 Patent

As discussed above, to address manufacturing challenges for OLED displays associated with the deposition of organic light-emitting layers, the '578 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 1:62–2:3, 5:30–36, 6:46–60, 7:27–43, 8:10–16, 8:53–59. The arrangement uses more green pixels than red and blue pixels, and it 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 '578 patent offsets the green pixels, arranged in lines, from the blue pixels, the red pixels, or both. The arrangements further form the red, green, and blue pixels in particular

patterns with specified spacings, and in particular shapes and/or sizes. *Id.* at 1:62–3:4.

Claim 1 of the '578 patent recites:

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

a plurality of first pixels;

a plurality of second pixels; and

a plurality of third pixels,

wherein the OLED display comprises a pixel defining layer defining areas of the first pixels, the second pixels, and the third pixels,

wherein the first pixels, the second pixels, and the third pixels are configured to emit different color lights,

wherein the first pixels are arranged in first sets extending along a first direction to form respective first lines,

wherein the second pixels and the third pixels are alternately arranged in second sets extending along the first direction to form respective second lines parallel to the first lines,

wherein one of the second lines passes through centers of the second pixels and the third pixels in a corresponding one of the second sets and passes between the first pixels in corresponding adjacent ones of the first sets,

wherein the first lines and the second lines are alternately arranged,

wherein the first pixels are also arranged in third sets extending along a second direction that is perpendicular to the first direction to form respective third lines,

wherein the second pixels and the third pixels are also alternately arranged in fourth sets extending along the second direction to form respective fourth lines that are parallel to the third lines,

wherein the third lines and the fourth lines are alternately arranged,

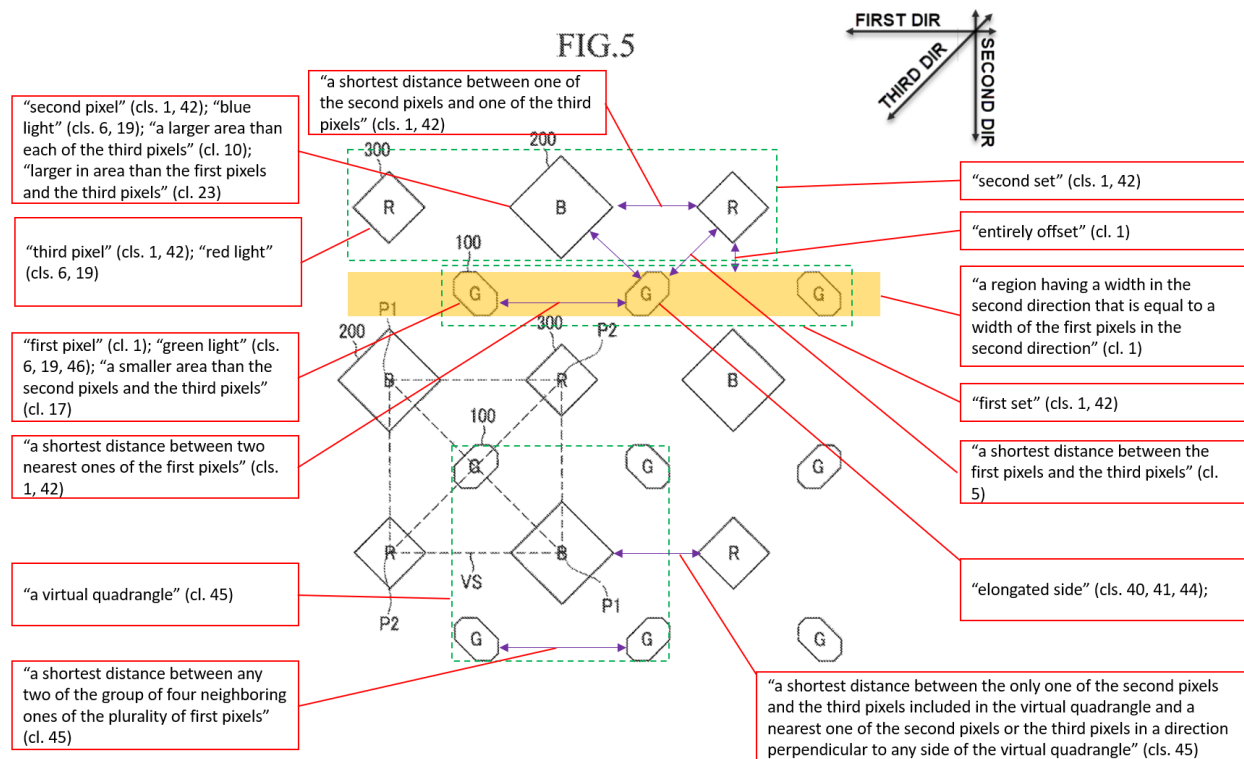
wherein the first pixels and either the second pixels or the third pixels are alternately arranged along a third direction, which crosses the first direction and the second direction,

wherein a region having a width in the second direction that is equal to a width of the first pixels in the second direction, extending parallel to the first direction, and completely overlapping a row of the first pixels extending in the first direction, is entirely offset in the second direction from at least one of the second pixels or the third pixels in at least one of rows of the second pixels and the third pixels adjacent to the row of the first pixels, and

wherein a shortest distance between two nearest ones of the first pixels in one of the first sets is greater than a shortest distance between one of the second pixels and one of the third pixels that are nearest each other in one of the second sets.

The '578 patent explains, with reference to Figure 5, that in this structure, “the neighboring first pixels 100 have a octagonal shape and are symmetrical to each other, while the second pixels 200 have a larger area than the third pixels 300” and “[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.” Ex. 1001 at 8:44–52.

Figure 5 of the '578 patent is reproduced below with annotations to illustrate key claim limitations:



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 ’578 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 ’578 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 '578 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 1–6, 10, 12, 17–19, 21–23, 41–42, 44–47, and 52 Are Obvious Over Matthies and Yamada

Petitioner argues that the combination of “Matthies (Ex. 1004) and Yamada (Ex. 1005), when considered in view of the knowledge of a POSITA, render claims 1–6, 10, 12, 17–19, 21–23, 41–42, 44–47, and 52 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 display 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)² at 7:33–35 (explaining that “it is possible to create very large (wall-sized) display panels, by tiling individual display devices”).

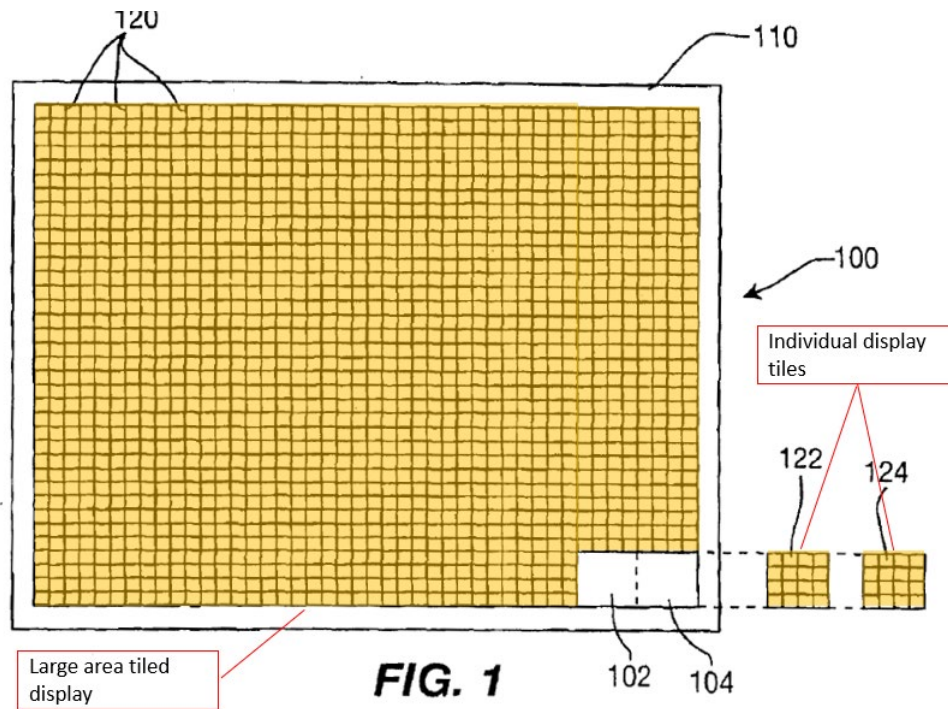
As Matthies explains:

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, within [sic] ½ 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.

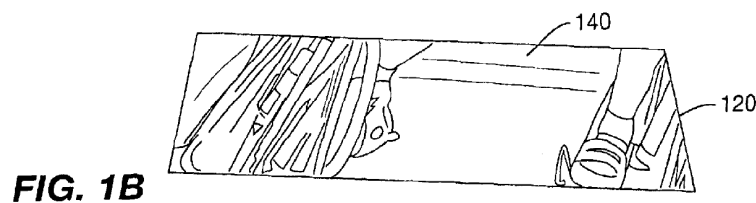
To this end, Matthies discloses a tile structure comprising a passive matrix OLED display, which can be used to create a large area display, as shown below in Figure 1.

² 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.



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.”).³ 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.

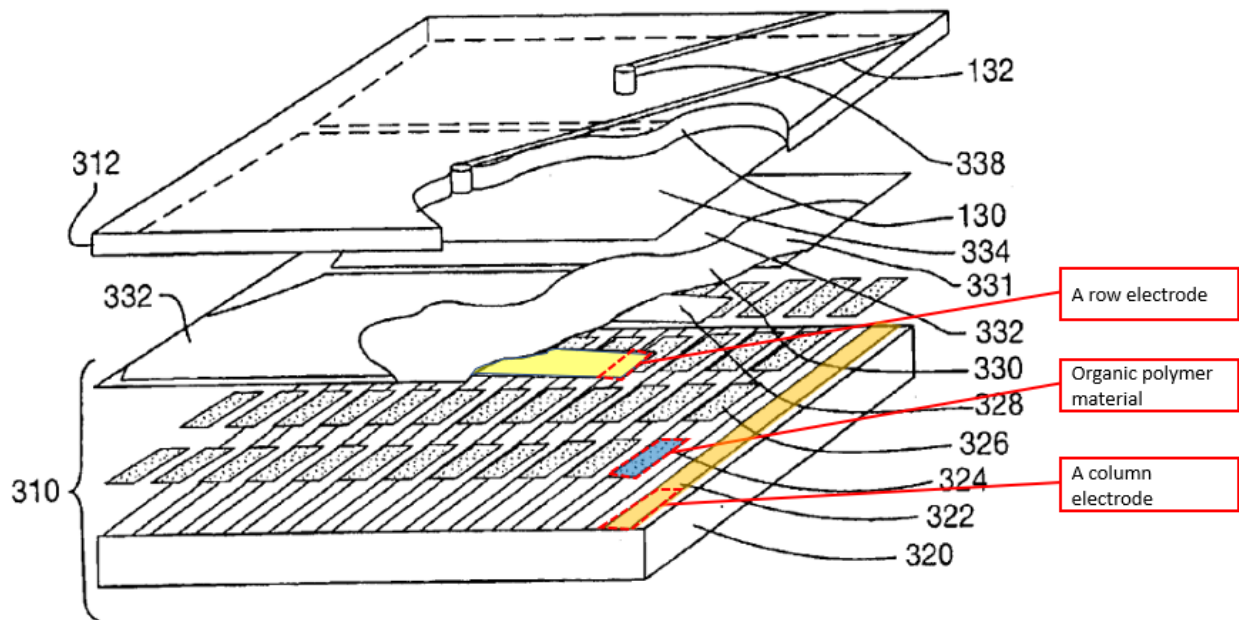


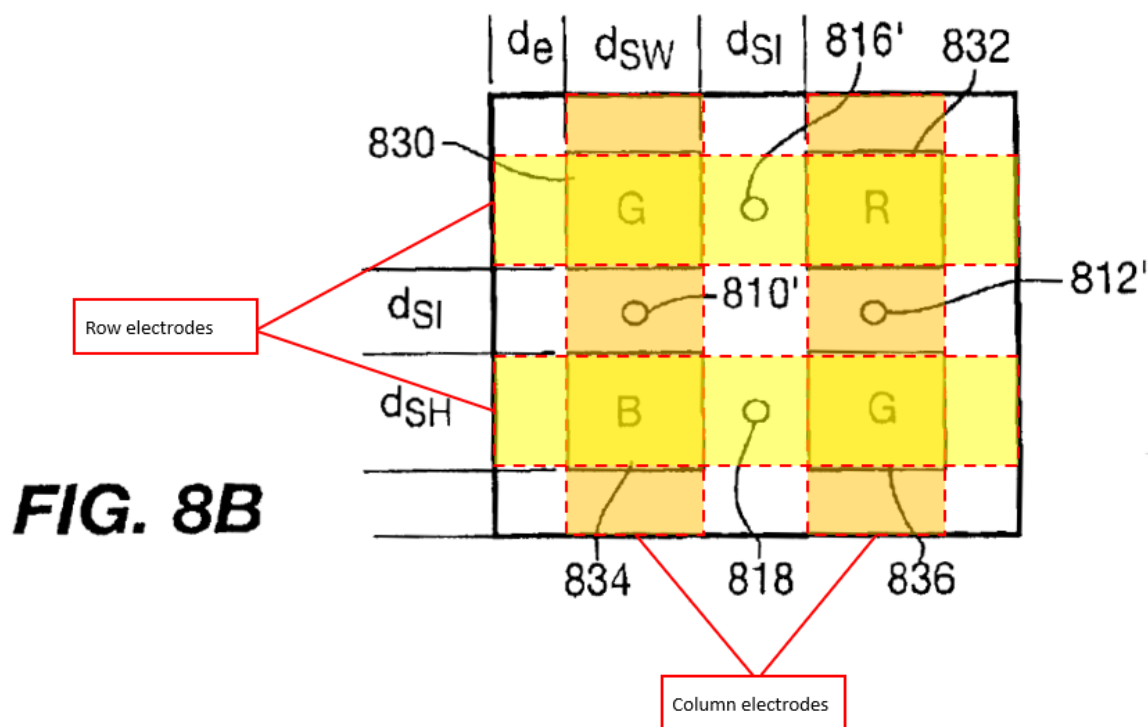
FIG. 3

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.*,

³ 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.

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.

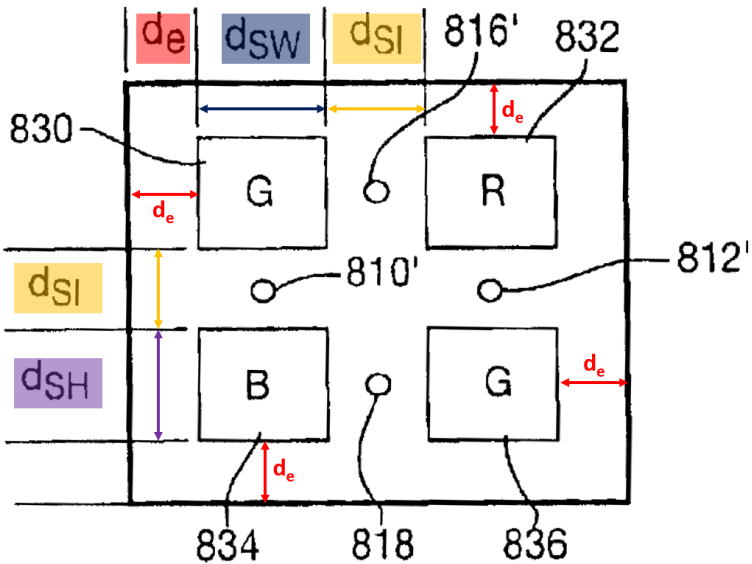


Id., Fig. 8B (annotated). Each of the electrodes is connected to the electronics section by a via, *id.* at 17:13–16, and the voltage difference between the column electrode and the row electrode causes the pixel at their crossing to emit light.

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:

FIG. 8B



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. 1005 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:

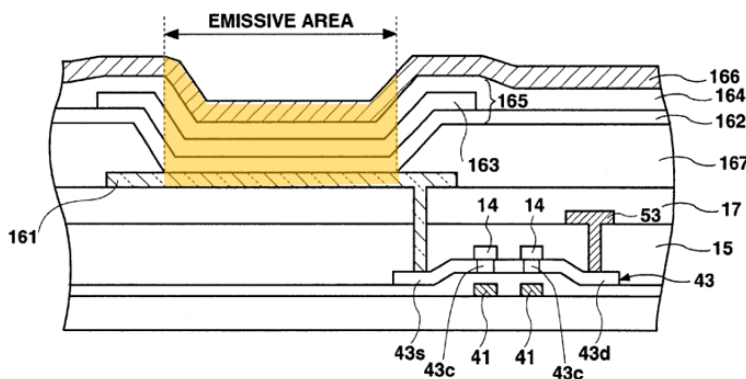


Fig. 6B

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 69–74, 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 74–75.

Petitioner has the burden of showing reasonable expectation of success. *See Intelligent Bio-Systems, Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367–68 (Fed. Cir. 2016) (“It was [Petitioner]’s burden to demonstrate both ‘that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so.’”); *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 reasonable expectation of success. (*See id.*, ¶¶ 437–446.) Again, it was routine in the art to resize OLED pixels to improve display lifetime. (*Id.*, ¶¶ 438–439.) Indeed, Matthies itself already contemplates that the sizes of and space between its pixels can adjusted [sic]. (*See, 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, ¶ 440–441.) 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. 1005, 12:37–40.) This would have further motivated application of Yamada’s teachings and emphasized to a POSITA that combination would be successful. (Ex. 1003, ¶¶ 442–444.) Finally, both Matthies and Yamada relate to pixel designs intended for use with OLED displays. (*Id.*, ¶ 445–446.) 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 74–75.

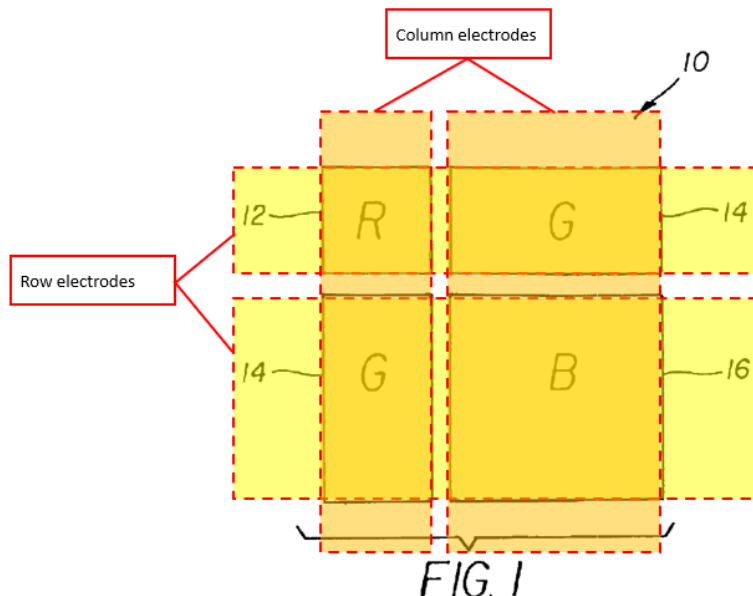
This paragraph fails to explain why or how a POSITA would have had a reasonable expectation of success. The first half of the paragraph builds up to a conclusion that “a POSITA would have considered application Yamada [sic] to amount to nothing more than the use of known [sic] design option . . . to solve a known prior art problem.” *Id.* at 75. 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, ¶ 438 (cited

by Pet. at 74). For this statement, the expert appears to rely on the existence of two *other* OLED displays that include non-uniform pixel sizes. Ex. 1003, ¶¶ 434–435 (citing Exs. 1011 [sic], 1015 [sic]).⁴ 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.

⁴ It appears that the expert is referring Ex. 1006 (Smith) and U.S. Patent No. 6,867,549 (Cok). *See Minyang BOE Optoelectronics Tech. Co. Ltd. v. Samsung Display Co., Ltd.*, IPR2023-00987, Ex. 1003, ¶¶ 306–307. This Cok reference is not on Petitioner’s exhibit list. *See* Pet. at iv (listing a different Cok reference “U.S. Patent No. 7,250,722”). In this preliminary response, U.S. Patent No. 6,867,549 is cited as Ex. 2004.

This problem is acutely illustrated by the display structure of Exhibit 2004 (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. 2004, 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.

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:

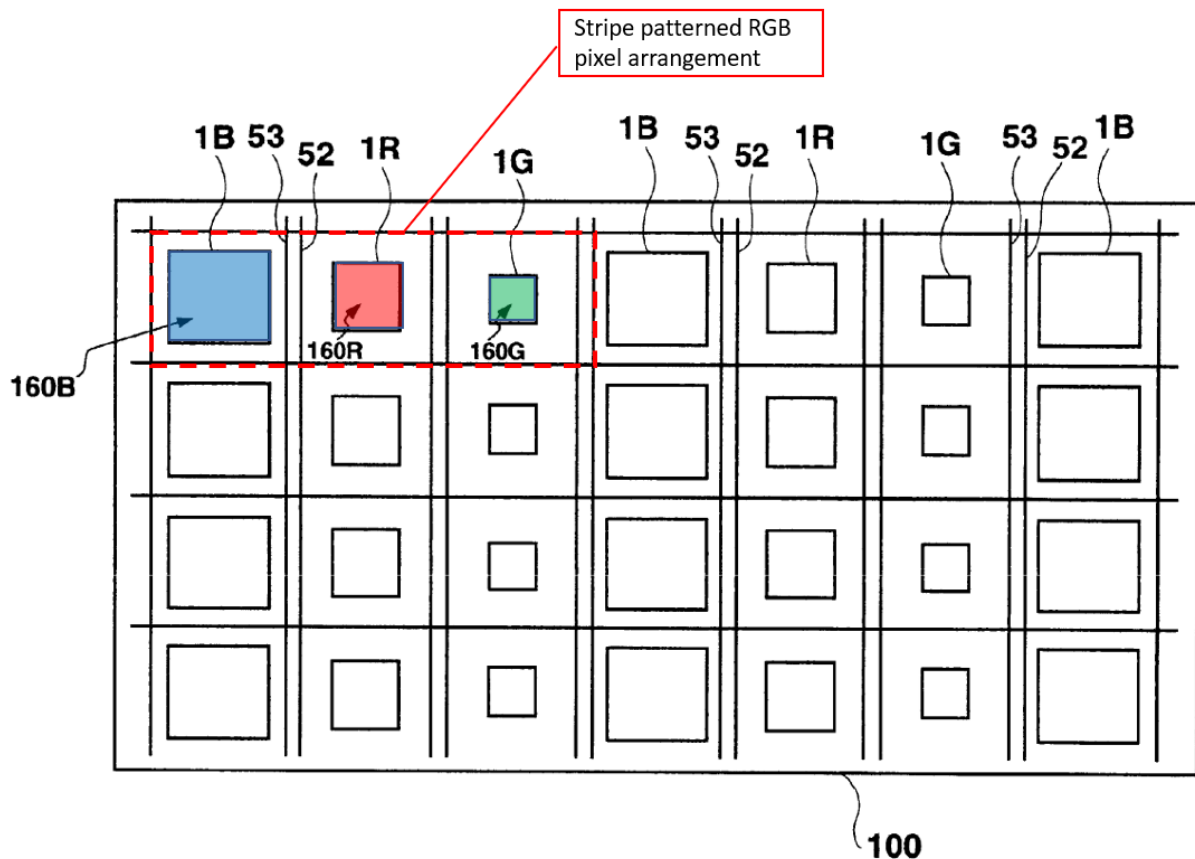


Fig. 4

Ex. 1005, 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 id.* 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:

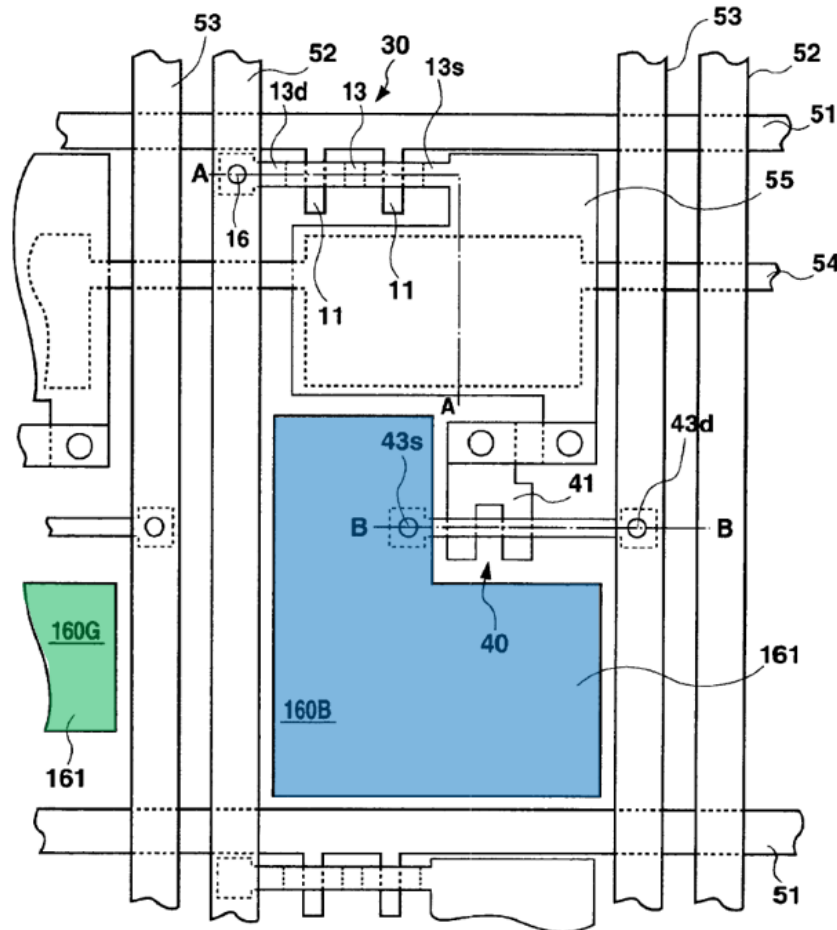


Fig. 5

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.

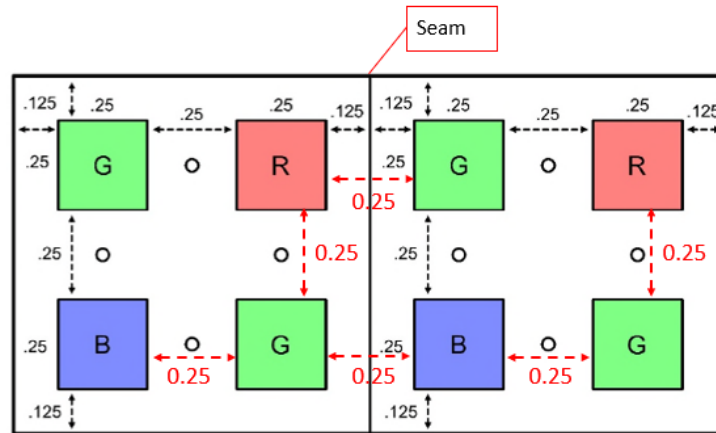
Petitioner fails to show how a POSITA would have had a reasonable expectation of success of applying Yamada’s disclosures, which result in pixels that have irregular shapes as discussed above, to Matthies, and how such a combination would result in the structure required by the ’578 patent. *See, e.g.*, Ex. 1001, cl. 1 (requiring, among other things, that “one of the second lines passes through centers of the second pixels and the third pixels”).

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:

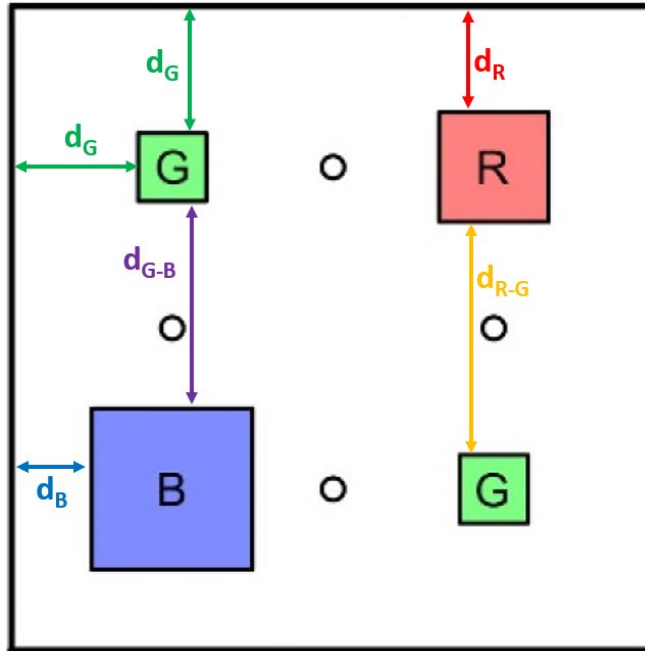


Pet. at 30 (further annotations in red of Petitioner’s figure). All adjacent pixels are separated by 0.25 times the pitch, whether the spacing is between pixels separated by the tile seam or it is between pixels within a tile.

In Petitioner’s cursory paragraph on “reasonable expectation of success” fully reproduced above, Petitioner simply asserts that “Matthies itself already contemplates that the sizes of and space between its pixels can adjusted [sic].” Pet. at 74 (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 39 (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.

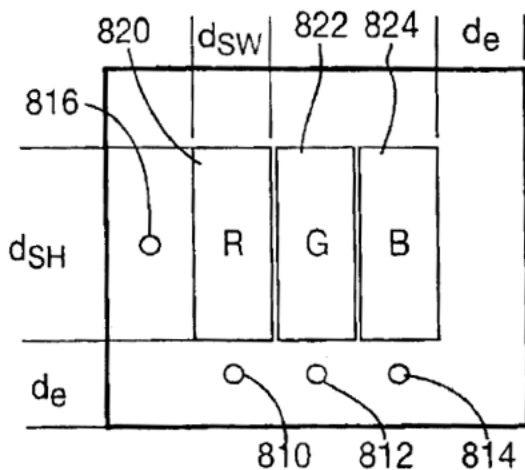
2. Petitioner Fails to Identify a Reason to Use a Quad Pixel Design of Matthies, Rather Than Matthies’ Stripe Pattern, in a Combination with Yamada’s Stripe Pattern

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. 1005, Fig. 4.⁵ 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,

⁵ 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. 1005 at 12:37–40. Yamada does not disclose or suggest a quad pixel arrangement.

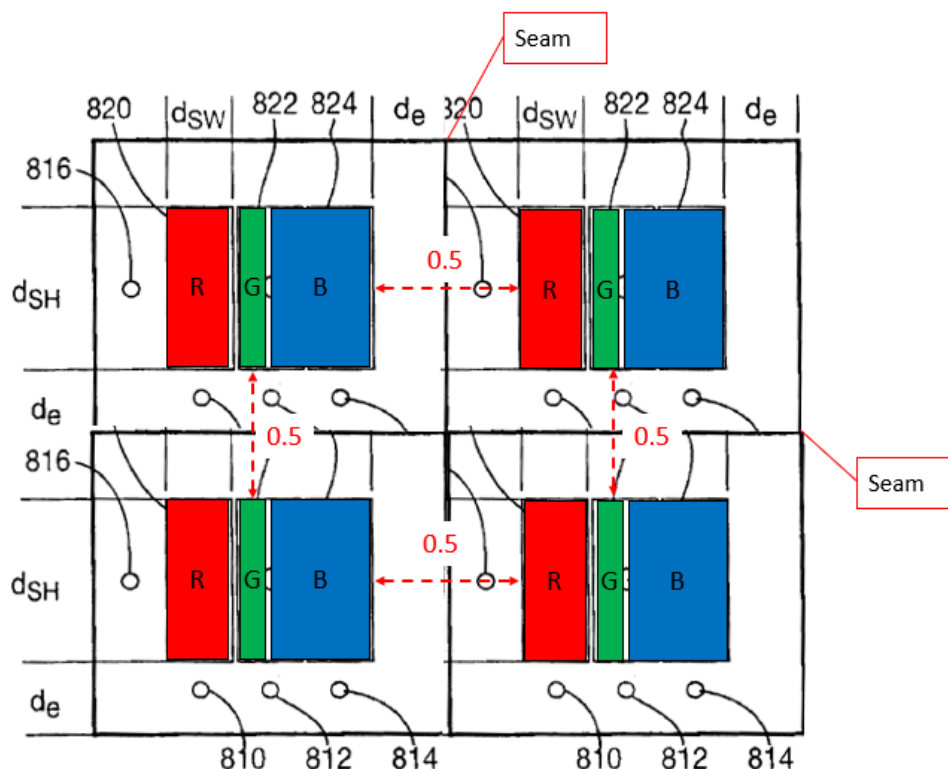
and blue pixels are represented in equal numbers. Yamada's teaching would have been more compatible with the triple subpixel structure in Figure 8A of Matthies, which includes one each of red, green, and blue subpixels like Yamada.

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 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.



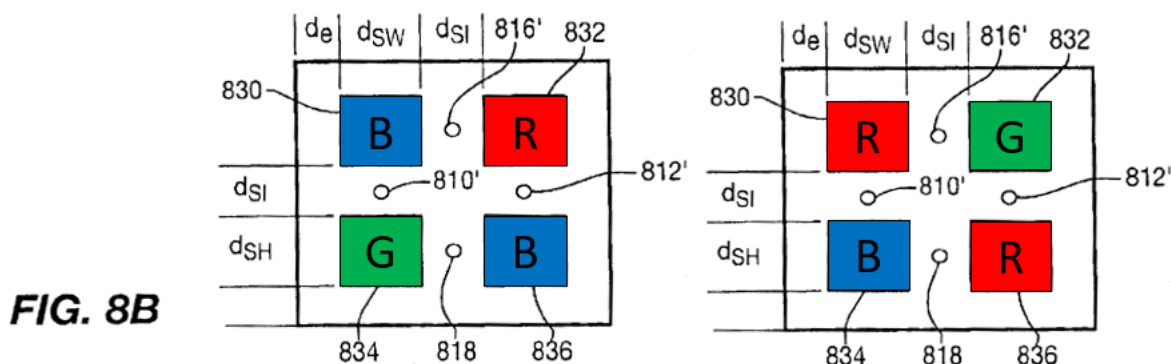
Ex. 1004, Fig. 8A (annotated using the d_e value from Table 1).

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 patterns 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. 1005 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 38. 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, ¶ 243. 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, the claimed patterns 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 70. Petitioner then proposes to modify Matthies, allegedly in view of Yamada, by keeping the sizes of 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. 1005 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%,⁶ less than half of Matthies’ already low aperture ratio. Although Matthies

⁶ 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%.

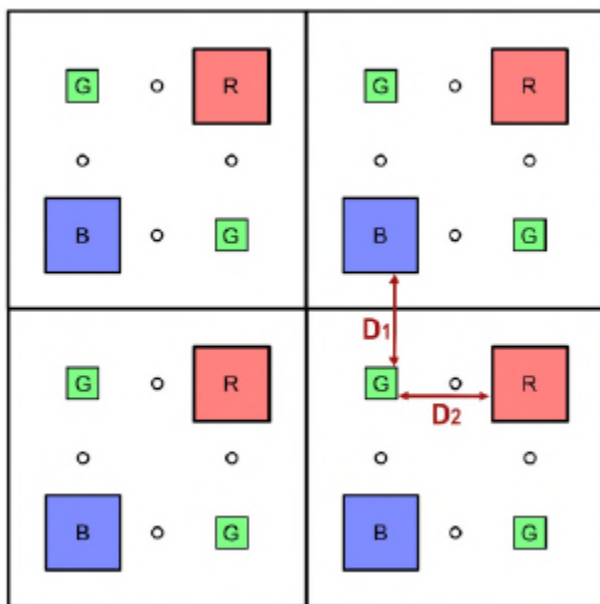
says “[t]he invention contemplates both larger and smaller pixel apertures,” Ex. 1004 at 17:37–38, a POSITA would not have been motivated to use an aperture ratio as small as 10.3%.

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

5. Petitioner Is Forced to Rely on Inconsistent Arguments in Its Attempt to Establish That Claim 5 Would Have Been Obvious

In addition to the above deficiencies, Petitioner’s argument regarding dependent claim 5 cannot be reconciled with its arguments for claim 1, on which claim 5 depends. Claim 5 requires that “a shortest distance between the first pixels and the second pixels, and a shortest distance between the first pixels and the third pixels, are a same first length.” Ex. 1001, cl. 5. This limitation is not met by the combination that Petitioner proposes for claim 1.

Recognizing that its proposed combination does not meet the requirements of claim 5, to argue that the additional claim limitation is met, Petitioner draws the following figure for claim 5, arguing that the blue pixel and the red pixel have the *same size* and the distances D_1 and D_2 are therefore equal:



Pet. at 45.

However, this assertion that the blue pixel and the red pixel would have had the same size is at odds with the remainder of Petitioner’s arguments, including Petitioner’s purported basis for combining Matthies with Yamada, that a POSITA would have allegedly understood from Yamada that the area of the blue pixels should be larger than both the red pixels and the green pixels. Addressing claim 1, Petitioner argues that “a POSITA 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.” *Id.* at 38. Petitioner likewise asserts that “following Yamada, a POSITA would have

considered it obvious to make Matthies' blue sub-pixels largest, its red sub-pixels intermediately sized, and its green sub-pixels smallest." *Id.* at 40.

Moreover, in connection with claim 10, Petitioner further asserts that "following Yamada's teachings, a POSITA would have re-sized Matthies' sub-pixels such that the 'second pixels' (blue sub-pixels) have a '**larger area**' than both the intermediately sized 'third pixels' (the red sub-pixels) and the smallest 'first pixels' (the green sub-pixels)." *Id.* at 47. Likewise with claim 17: "following Yamada's teachings, a POSITA would have re-sized Matthies' sub-pixels such that the '**first pixels**' (green sub-pixels) have a '**smaller area**' than both the intermediately sized '**third pixels**' (the red sub-pixels) and the largest '**second pixels**' (the blue sub-pixels)." *Id.* at 47–48.

And Petitioner asserts with respect to claim 21 that "following Yamada's teachings, a POSITA would have considered it obvious to re-size Matthies' sub-pixels such that the 'second pixels' (blue sub-pixels) are largest and the 'third pixels' (the red sub-pixels) have an intermediate '**different . . . size.**'" *Id.* at 51. So, too, with claim 41, Petitioner argues: "following Yamada's teachings, a POSITA would have considered it obvious to re-size Matthies' sub-pixels such that 'second pixels' (blue sub-pixels) are largest, its 'third pixels' (the red sub-pixels) have an intermediate size, and its 'first pixels' (the green sub-pixels) are smallest." *Id.* at 60–61. All those claims, like claim 5, depend on claim 1.

Petitioner, however, contradicts all those assertions in its argument for claim 5 because it is plain that the claim is *not* met even under a combination that follows Petitioner's logic (which, as discussed, is itself flawed for numerous reasons). Petitioner's assertion that a POSITA would "mak[e] the green sub-pixels smaller *and the red and blue pixels equally sized*," *id.* at 45 (emphasis added), is unsupported and contrary to Petitioner's own arguments. Petitioner has identified no reason why a POSITA would modify Matthies to make smaller green pixels and, at the same time, keep the red and blue pixels the same size.

Petitioner cannot have it both ways. Petitioner cannot rely on Yamada as the basis for its proposed combination under a theory that Yamada taught making the area of blue OLED pixels larger than that of both red pixels and green pixels, and then argue that in making such a combination a POSITA would have kept the blue and red pixels *the same size*. If anything, the clear and fundamental contradiction between Petitioner's argument for claim 5 and its arguments for the other claims lays bare that the Petition is not explaining what a POSITA would have done or had reason to do, but instead is engaged in a hindsight-based effort to reconstruct the inventions of the '578 patent.

In addition, Petitioner fails to explain how its proposed modification would meet all of the requirements of dependent claim 5, which include the limitations of independent claim 1. Petitioner relies on one proposed modification to Matthies for

claim 1 (in which blue pixels are largest, red are made smaller, and green are made smaller still), but a *different* modification to Matthies (in which the blue and red pixels are made the same size) for the additional limitations of dependent claim 5. Claim 5 must be read as a whole, incorporating the limitations stated in claim 1 as well as the additional limitations recited in claim 5. Petitioner cannot rely on one structure to meet claim 1 (with differently-sized blue and red pixels), and then a different structure (with same-sized blue and red pixels) to meet the additional limitation of dependent claim 5.

6. Petitioner Offers No Reason to Use the “Elongated” Sides or Edges Required by Claims 41, 44, and 52, and Does Not Demonstrate that Key Limitations Would Be Met Even If “Elongated” Sides or Edges Were Used

Claims 41, 44, and 52 require the first pixel to have “elongated” sides or edges. Petitioner asserts that Matthies and Yamada indicate that non-square pixels “can” be used, as required by claim 41, and asserts that “[i]n particular, Matthies teaches that its display can employ rectangular shaped sub-pixels.” Pet. at 60. But Matthies uses rectangular shaped pixels only for its RGB stripe patterned pixel structure. Ex. 1004 at 16:49–61, 25:46–54, Fig. 8A. Matthies does not describe or depict using rectangular shaped sub-pixels in a quad pixel structure. *Id.* at 17:16–29, 25:46–54, Fig. 8B.

Petitioner offers no reason that a POSITA would use a rectangular pixel with Matthies' quad pixel structure, apart from a throwaway assertion that it would "be a routine, obvious design choice." Pet. at 60; *Cutsforth, Inc. v. MotivePower, Inc.*, 636 F. App'x. 575, 578 (Fed. Cir. 2016) (non-precedential) ("Merely stating that a particular placement of an element is a design choice does not make it obvious."). Petitioner does not even attempt to show how non-square pixels would be used, as required by claim 41, instead relying solely on a figure with square pixels and a bare, unsupported assertion that the relative distances between those square pixels "would continue to be the case even if Matthies' sub-pixels were formed with an elongated, rectangular shape." *Id.* at 61.

In addition, Petitioner wholly fails to explain how pixels modified in the way it argues would meet all of the requirements of dependent claim 41, which include not only the additional limitations stated in claim 41 but also the limitations of independent claim 1, from which it depends. Petitioner does not explain how a structure with such elongated pixels would meet the requirement of claim 1 that "a region having a width in the second direction that is equal to a width of the first pixels in the second direction . . . and completely overlapping a row of the first pixels extending in the first direction, is entirely offset in the second direction from at least one of the second pixels or the third pixels." Ex. 1001, cl. 1. Nor does Petitioner explain how in such a structure the "shortest distance between two nearest ones of

the first pixels in one of the first sets is greater than a shortest distance between one of the second pixels and one of the third pixels that are nearest each other in one of the second sets,” as also required by claim 1. *Id.* Yet these are both crucial requirements of the pixel arrangement structures of claim 1.

In short, Petitioner has made no analysis of claim 41 as a whole, and no showing that the modification it proposes would meet *all* of the limitations of claim 41—that is, all of the limitations of claim 1 as well as the specific additional limitations stated in dependent claim 41.

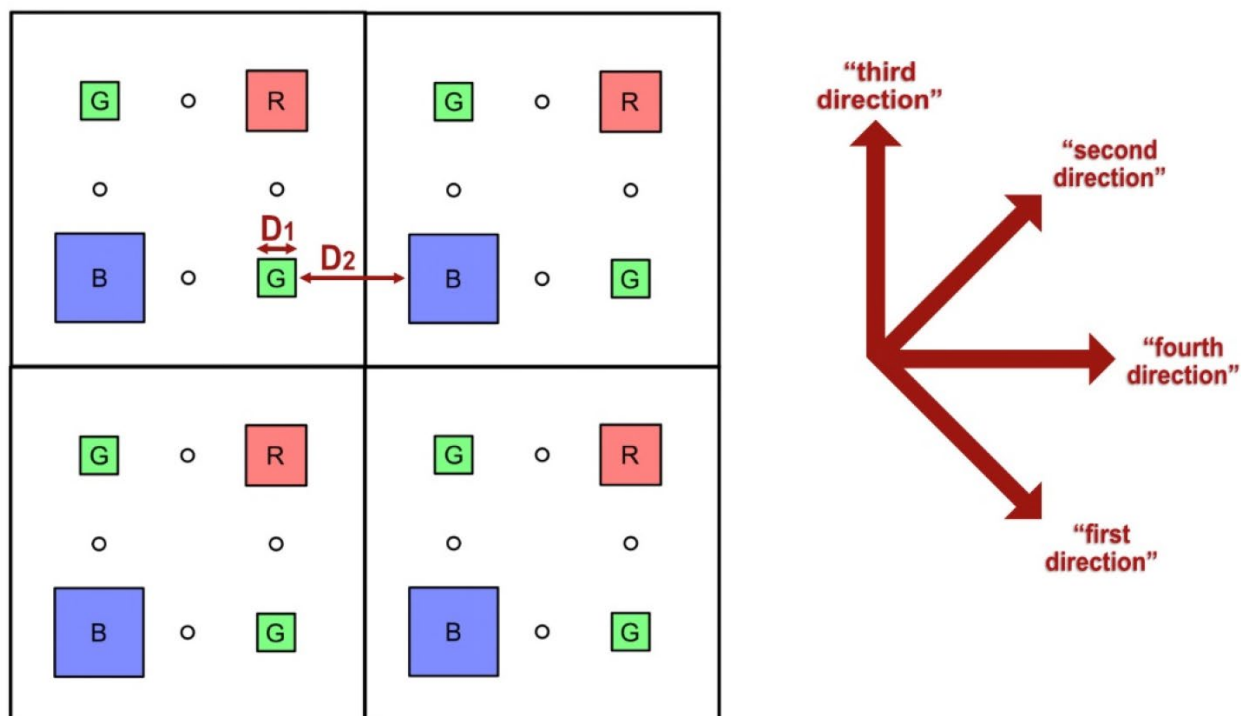
Petitioner’s arguments for dependent claims 44 and 52 are defective for all of the same reasons. For both of these claims, Petitioner simply points back to its flawed analysis of claim 41, and fails to show how the structure it proposes for these claims would meet the limitations of the independent claims from which they depend. Pet. at 64, 68–69. For dependent claim 44, which depends from independent claim 42, Petitioner makes no showing of how the modified structure it advances for claim 44 would meet all of the limitations of independent claim 42. *Id.* at 64. And for dependent claim 52, which depends from claim 45, Petitioner makes no showing of how the modified structure it advances for claim 52 would meet all of the limitations of independent claim 45. *Id.* at 68–69.

Therefore, Petitioner’s arguments for claims 41, 44, and 52 fail for these additional reasons as well.

7. Petitioner Offers No Reason to Elongate the First Pixels' Edges in a First Direction or a Second Direction as Required by Claim 52

Claim 52 requires a first pixel having “two parallel edges that are elongated in a first direction or a second direction crossing the first direction.” Ex. 1001, cl. 52. Petitioner does not provide any independent analysis to show that its proposed combination of Matthies and Yamada meets this claim limitation. Pet. at 68–69. Instead, it relies on its analysis of claim 41, stating that “[t]his limitation is substantively the same as that required by claim 41.” *Id.*

But claim 41 includes no limitation on the direction of the first pixel's elongation. It requires that “a shortest distance between two elongated sides of one of the first pixels is less than a shortest distance between the one of the first pixels and a nearest one of the second pixels in the third direction or a fourth direction crossing the third direction.” Ex. 1001, cl. 41. To show that the proposed combination meets this limitation of claim 41, Petitioner shows the following figure:



Pet. at 61.

In this figure, the alleged “shortest distance between two elongated sides” of the first pixel is D_1 . *Id.* Petitioner’s figure shows that D_1 is the distance between the two sides of the green pixel that extend along the ***third direction***. Even if these two sides were to be elongated, it would not produce two parallel edges that are elongated in “a first direction” or “a second direction” as claim 52 requires. Indeed, Petitioner’s figure shown above does not contain any pixel edge (elongated or not) that extends along the first direction or the second direction (which would be diagonal with respect to the quad pixel structure). Moreover, neither Matthies nor Yamada provides any pixel arrangement (whether a quad pixel structure or a triple striped

structure) in which a pixel is elongated in a direction diagonal with respect to the arrangement.

Therefore, Petitioner has not shown that its proposed combination meets the additional limitation of claim 52.

B. Ground 2: Petitioner Fails to Demonstrate a Reasonable Likelihood that Claims 40, 43, 45–47, and 51–52 Are Obvious Over Matthies, Yamada, and Hong

As discussed above in Ground 1, Petitioner fails to identify a motivation to combine Matthies with Yamada. Its proposal to combine those two references with Hong fails for the same reasons. In addition, Petitioner fails to identify a motivation to combine those two references with Hong, which is directed toward a different type of pixel arrangement whose features would be inapplicable to Petitioner’s proposed combination and whose disclosures are inconsistent with Petitioner’s proposal.

Hong is directed to an RGB structure in which the red, green, and blue pixels are equally sized and arranged in a “zigzag” pattern. *See, e.g.*, Ex. 1011, Abstract, ¶¶ [0015]–[0016], [0048], [0060]. As Figures 5 and 8 of Hong illustrate, the shortest distance between adjacent pixels in this zigzag pattern is in the diagonal direction (d1 in Figure 5):

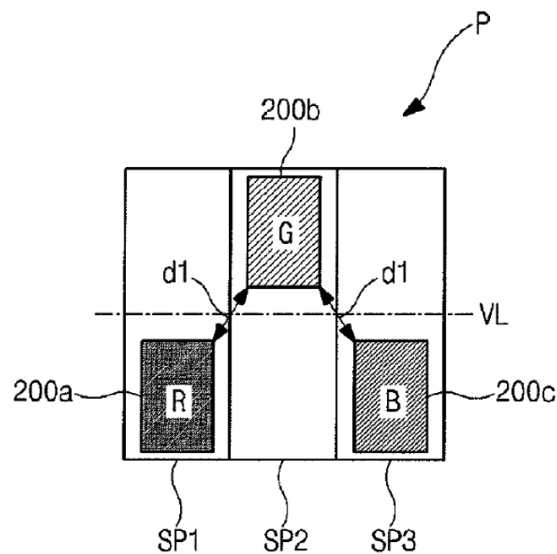


FIG. 5

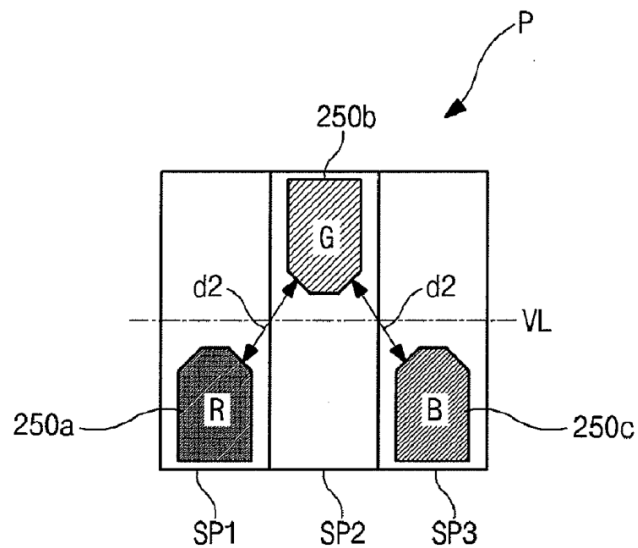


FIG. 8

Id., Figs. 5, 8. Hong's goal is to increase the aperture ratio in its RGB arrangement by using this zigzag pattern to avoid a shadowing effect that the proximity of pixels in such an arrangement can cause. *See, e.g., id.* ¶¶ [0011], [0044]. Hong discloses that the arrangement in Figure 8 further addresses the potential shadowing effect by truncating the corners of the pixels to increase the distance between the pixels from $d1$ to $d2$. *Id.* ¶¶ [0047]–[0048], [0060]–[0061]. This allows the pixels 250a, 250b, and 250c to have “a further enlarged area” and results in an increase in the light-emitting area of the pixels overall, *see, e.g., id.* ¶¶ [0057], [0061], consistent with Hong's teaching that pixel areas in RGB designs should be enlarged to increase the aperture ratio.

Petitioner thus fails to provide a reason to combine Hong with its proposed combination of Matthies and Yamada, let alone with a reasonable expectation of

success. To the contrary, Petitioner’s proposed combination of Matthies and Yamada is fundamentally inconsistent with Hong.

In addition, as further discussed below, Petitioner’s proposed combination is not only unsupported by and at odds with Matthies, Yamada, and Hong, but Petitioner has also failed to show that this combination would meet all the limitations of claims 40, 43, 45–47, and 51–52.

1. Petitioner Fails to Identify a Reason to Modify Matthies to Use Elongated Pixels with Truncated Corners

Initially, Petitioner fails to identify a motivation to combine Matthies and Yamada with Hong to change Matthies’ square pixels into Hong’s elongated ones. Petitioner argues that “Matthies itself already contemplates the use of various different pixel shapes, including elongated pixels.” Pet. at 82 (citing Ex. 1004 at 8:50–52, 25:47–54, Figs. 3, 8A, 9 of Matthies). However, Petitioner offers no reason that a POSITA would use an elongated pixel with Matthies’ quad pixel structure when Matthies uses elongated shaped pixels only for its RGB stripe pixel structure. Ex. 1004 at 16:49–61, 25:46–54, Fig. 8A. Matthies provides no example where elongated sub-pixels are used in a quad pixel structure. *Id.* at 17:16–29, 25:46–54, Fig. 8B. The portions of Matthies that Petitioner cites do not show or suggest elongated pixels being used in a quad pixel structure. Ex. 1004 at 8:50–52 (discussing the shapes of *tiles*, not pixels), 25:47–54 (showing that square pixels are

used in a quad pixel structure and elongated pixels are used in a triple pixel structure), Figs 3 and 9 (illustrating generally how electrical connections are made to form pixels and not specifically in a quad pixel structure), 8A (showing that elongated pixels are used in a triple pixel structure). Matthies describes its quad pixel structure based on the symmetry of square pixels, which takes into account the constraints in Matthies' PMOLED, tiled design based on the electrodes and vias required to operate the pixels. *See* Section V.A.1.a, *supra*. To the extent that a POSITA were to use elongated pixels consistent with Matthies, it would have been in an RGB stripe arrangement (as in Matthies' Figure 8A and in Yamada), not a quad pixel arrangement.

In addition, Petitioner also asserts that Hong itself explains that “forming pixels with ‘truncated’ corners improves ‘aperture ratio’” and that this pixel shape improves resolution by “minimizing the ‘shadowing effect’ that can otherwise arise from closely situated pixels.” Pet. at 82–83. However, Petitioner neglects that the improvement in the aperture ratio and the shadowing effect in Hong result from allowing the pixels to have “a further enlarged area” because the truncated corners allow adjacent pixels to maintain a certain distance from each other in the diagonal direction, as illustrated in Figure 8 and its comparison to Figure 5. Ex. 1011, ¶ [0061]:

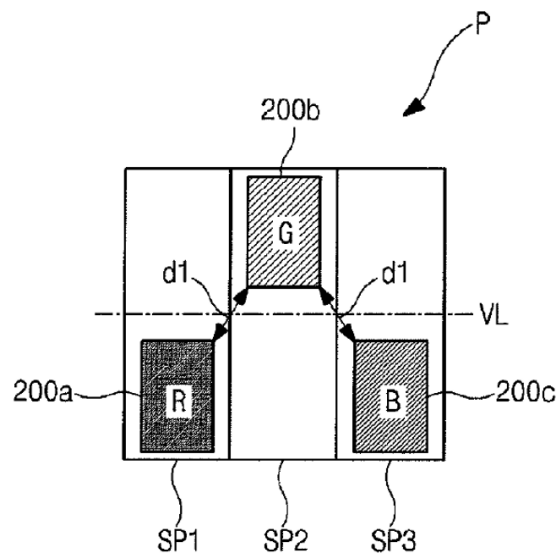


FIG. 5

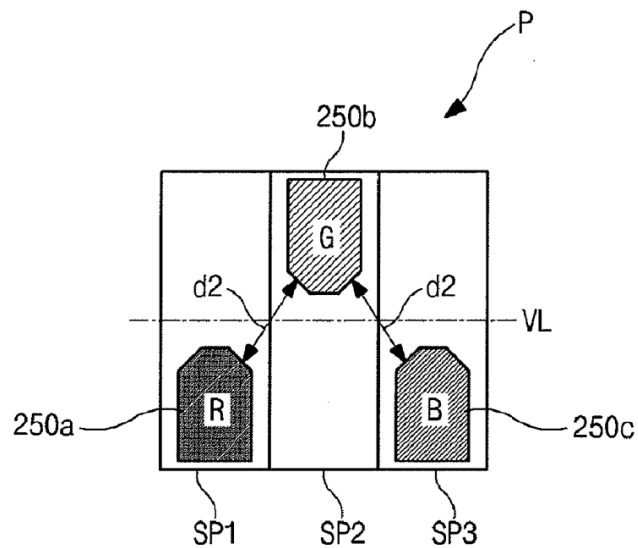
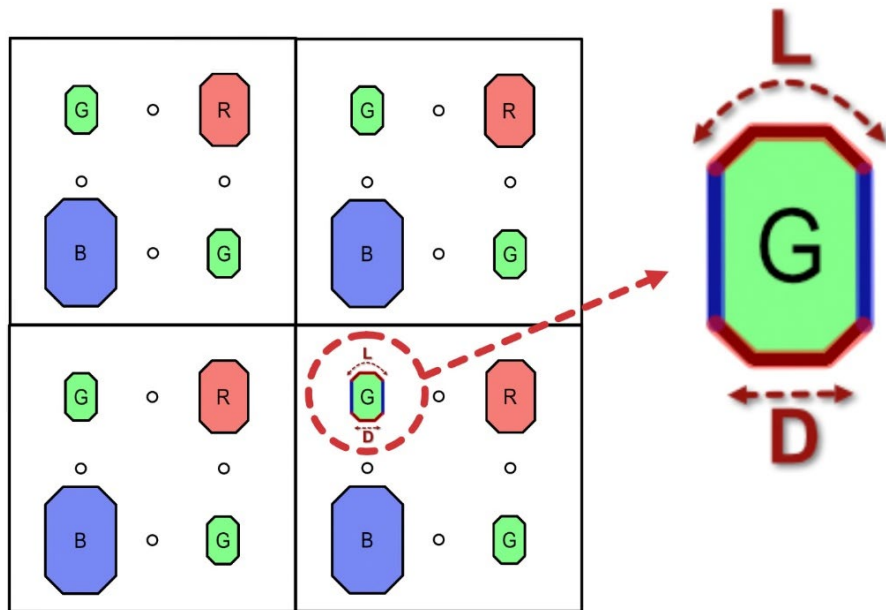


FIG. 8

Id., Figs. 5, 8. It is the proximity of the pixels in the diagonal direction that is Hong's reason for truncating the corners of the pixels, to increase the distance between the pixels from $d1$ to $d2$, as shown in Figure 8 above. Ex. 1011, ¶¶ [0060]–[0061]. Simply truncating corners would not improve aperture ratio; indeed, it would reduce aperture ratio by adding non-display space between adjacent pixels, which is contrary to Hong's goals.

In Petitioner's proposed combination, however, truncated corners provide no such benefit. As can be seen in Petitioner's drawing, the pixels are closest not in the diagonal directions, but rather are closest between their top/bottom or left/right edges.



Pet. at 80. Petitioner's truncating of corners does not increase the separation between adjacent pixels; it simply reduces the area of the pixels for no reason. Nothing in Hong would suggest or motivate such an alteration. Petitioner ignores the context and purpose of Hong's design and proposes altering an unrelated structure in a way that has no basis or support in Hong. Simply put, there would have been no reason for a POSITA to start with Petitioner's structure allegedly based on Matthies and Yamada, to elongate pixels in the way Petitioner does, and then to truncate their corners as Petitioner proposes.

There are also additional reasons why Petitioner's proposal is inconsistent with Hong. Petitioner bases its proposal on Matthies, which provides a low aperture ratio PMOLED display, and Petitioner's base combination further reduces the aperture ratio by shrinking the red and green pixels in Matthies allegedly based on

Yamada. Hong would have no application to such a design, as there is no indication that the shadowing effect being addressed by Hong would be an issue with Matthies. Moreover, if Matthies were combined with Yamada as Petitioner proposes, which Petitioner alleges results in the substantial shrinkage of the red and green pixels, this further reduction in the sizes of the green and red pixels would cause the gaps between the pixels to increase even further, obviating the need for a POSITA to further modify the resulting design with Hong's truncated corners.

Further, even if a POSITA were to address any shadowing effect in the combination of Matthies and Yamada, the POSITA would not have elongated the pixels as Petitioner asserts or truncated the pixel corners in the diagonal direction. As shown in Petitioner's figure above depicting its proposed combination, according to Hong any shadowing effect would be more likely to occur in the vertical direction due to the proximity of the pixels in that direction compared to the diagonal direction. However, Petitioner's proposed combination reduces the vertical spacing from its base combination by elongating the pixels in that direction, reducing their separation. Then, Petitioner proposes needlessly truncating the pixels in the diagonal direction even though the pixels are relatively distant from each other in that direction.

Simply stated, Hong's disclosures of increasing spacing between pixels in a zigzag RGB arrangement are not applicable to Petitioner's proposed combination of Matthies and Yamada with the quad pixel arrangement Petitioner has proposed.

Therefore, a POSITA combining Matthies and Yamada would have had no reason elongate pixels or truncate corners of pixels as Petitioner proposes.

Petitioner throws in an argument that the truncated corners were desirable as they were “easier to manufacture than square pixels.” Pet. at 82 (citing Ex. 1006 (Smith), ¶ [0064]). But Smith’s disclosure regarding manufacturability relates to an inkjet printing method for depositing a light-emissive layer, and has no relationship to the manufacturing process in Matthies where the OLED materials are “preferably conjugated polymer materials that are applied by thick film processes” or the manufacturing process in Hong where organic material is deposited through a shadow mask. Ex. 1004 at 6:41–45; Ex. 1011, ¶¶ [0009], [0073], [0077].

Moreover, none of the references cited by Petitioner provides any teaching on the relative dimensions of the length, width, and truncated corners to use in general, let alone when specifically reducing the areas of the green and red pixels as proposed by Petitioner. Therefore, a POSITA would not have been motivated to combine Matthies and Yamada and Hong in the way Petitioner proposes (other than via hindsight).

Finally, Petitioner does not even bother to attempt to establish a reasonable expectation of success with the combination of the three references, instead calling pixel shape a “triviality.” Pet. at 76. But Petitioner bears the burden of showing a reasonable expectation of success, in addition to a motivation to combine. *Intelligent*

Bio-Systems, Inc. v. Illumina Cambridge Ltd., 821 F.3d 1359, 1367–68 (Fed. Cir. 2016). Having failed to carry that burden, Petitioner’s arguments regarding Ground 2 cannot succeed.

2. Petitioner Fails to Show that Key Limitations Are Met After Matthies and Yamada Are Further Combined with Hong

Petitioner’s Ground 2 fails for the additional reason that Petitioner makes no showing that its modification to use elongated pixels would meet all of the limitations of independent claims 1, 42, and 45, on which the challenged claims depend. The claims that Petitioner challenges in Ground 2 (claims 40, 43, 45–47, and 51–52) contain limitations on spacings of and distances between specific pixels that would change if a square pixel were elongated in one direction and truncated in other ways as Petitioner asserts. However, Petitioner never shows that a pixel arrangement having the elongations and truncations Petitioner proposes would meet all of the requirements found in the independent claims from which claims 40, 43, 45–47, and 51–52 depend.⁷ Pet. at 76–82. Petitioner thus fails to analyze each dependent claim (and independent claim 45) as a whole, and only analyzes the limitations of the independent claims based on a proposed combination of Matthies

⁷ Although claim 45 is an independent claim, Petitioner’s argument regarding the claim in Ground 3 suffers from the same defect. Petitioner does not show that the proposed combination for Ground 3 meets all of the claim’s limitations, and instead relies on Petitioner’s analysis for Ground 2 for many of the limitations.

and Yamada in which the pixels all have square shapes. Petitioner does not provide any analysis as to whether these limitations are met after combining further with Hong, as it must.

For example, claim 1 (on which claim 40 depends), claim 42 (on which claim 43 depends), and claim 45 (on which claims 46, 47, 51, 52 depend) require the shortest distance between the first pixels to be greater than the shortest distance between the second and third pixels. Claim 1, on which claim 40 depends, recites:

wherein a shortest distance between two nearest ones of the first pixels in one of the first sets is greater than a shortest distance between one of the second pixels and one of the third pixels that are nearest each other in one of the second sets.

Ex. 1001, cl. 1. Claim 42, on which claim 43 depends, recites:

wherein a shortest distance between two nearest ones of the first pixels in one of the first sets is greater than a shortest distance between one of the second pixels and one of the third pixels that are nearest each other in one of the second sets.

Id., cl. 42. Claim 45, on which claims 46, 47, 51, and 52 depend, recites:

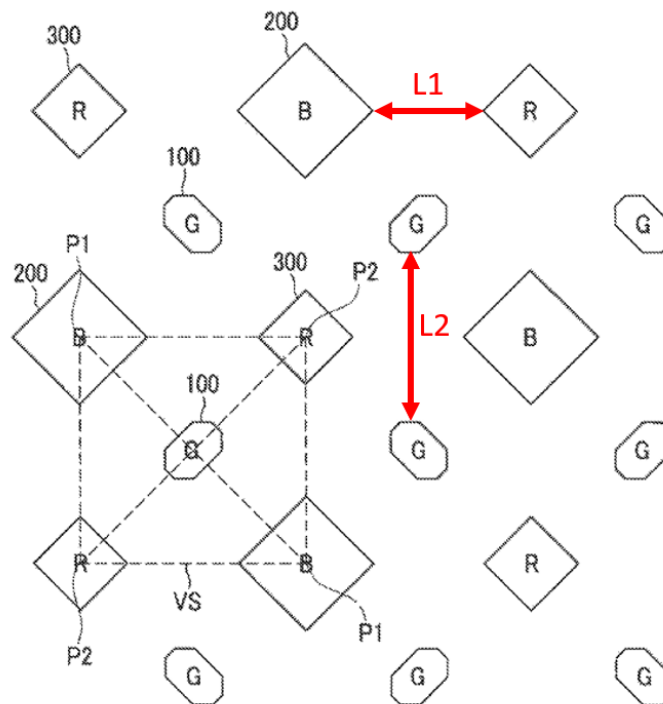
wherein a shortest distance between any two of the group of four neighboring ones of the plurality of first pixels is greater than a shortest distance between the only one of the second pixels and the third pixels included in the virtual quadrangle and a nearest one of the second pixels or the third pixels in a direction perpendicular to any side of the virtual quadrangle.

Id., cl. 45.

For these claims, since the first pixel is green, the second pixel is blue, and the third pixel is red, the shortest distance between neighboring two green pixels

(annotated as L2 in Fig. 5 reproduced below) must be greater than the shortest distance between a blue and red pixel that are nearest each other to meet these claim limitations (annotated as L1 below), as shown below.

FIG.5



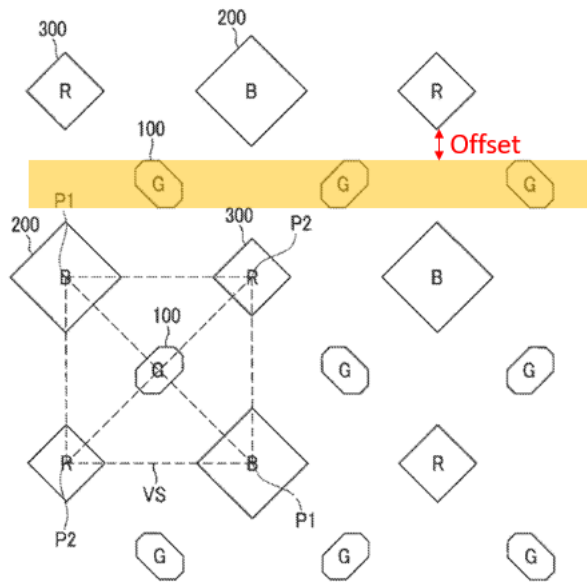
Id., Fig. 5 (annotated).

In addition, claim 1 requires that a region containing first pixels is “entirely offset” from one of the second pixels or one of the third pixels:

wherein a region having a width in the second direction that is equal to a width of the first pixels in the second direction, extending parallel to the first direction, and completely overlapping a row of the first pixels extending in the first direction, is entirely offset in the second direction from at least one of the second pixels or the third pixels in at least one of rows of the second pixels and the third pixels adjacent to the row of the first pixels.

Id., claim 1. Figure 5 from the '578 patent, annotated below, shows the region containing first pixels (*i.e.*, green) is “entirely offset” from a third pixel (*i.e.*, red):

FIG.5



Id., Fig. 5 (annotated).

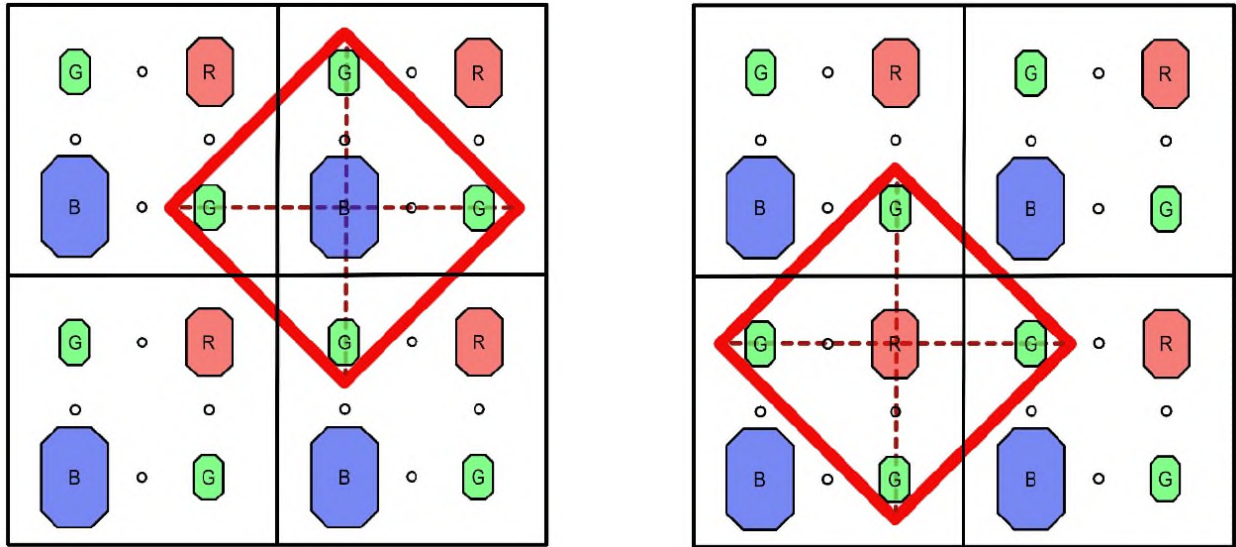
Petitioner does not make any showing that these limitations of claim 1, 42, or 45 are met by a design in which the square pixels in Yamada are elongated and truncated (allegedly according to Hong). Indeed, Petitioner wholly fails to provide any analysis as to whether the above limitations are met in its proposed modification with Hong.

Further, claim 45 contains the following limitation on all portions of the neighboring second pixels and third pixels being outside of a virtual quadrangle:

wherein only one of the second pixels and the third pixels is included in a virtual quadrangle containing outer edges comprising some of

the edges of a group of four neighboring ones of the plurality of first pixels, all portions of all others of the second pixels and the third pixels being outside of the virtual quadrangle.

Id., 1001, cl. 45. As for this claim limitation, Petitioner provides the following annotated figures:



Pet. at 81. Even though Petitioner's images above seem to show that the neighboring second pixels (blue) and third pixels (red) are outside the quadrangle, Petitioner does not state whether that is the case. Moreover, Petitioner does not provide any reasoning as to why Petitioner chose the specific dimensions of the length, width, and truncated corners of the pixels it included in the images.

All of the limitations discussed above can be affected by how the square pixels in Matthies are elongated and truncated when being combined with Hong. Petitioner has failed to demonstrate that the limitations would have been met even if a POSITA would have combined Matthies, Yamada, and Hong.

3. Petitioner Offers No Reason to Elongate the First Pixels' Edges in a First Direction or a Second Direction as Required by Claims 51 and 52

As discussed above in Section V.A.7, claim 52 requires a first pixel having “two parallel edges that are elongated in a first direction or a second direction crossing the first direction.” Ex. 1001, cl. 52. Similarly, claim 51 requires that “two parallel edges from among the edges of each of the first pixels are elongated in a first direction or a second direction crossing the first direction.” *Id.*, cl. 51. Petitioner fails to show that its proposed combination of Matthies, Yamada, and Hong meets this requirement.

As for claim 51, Petitioner merely argues that “[t]hese limitations are also substantively the same as those required by claim 40.” Pet. at 82. But if anything, claim 40’s requirement on the elongation direction of the first pixel’s edges is antithetical to claim 51’s. Claim 40 requires that “each of the first pixels has two elongated sides that are elongated in the *third direction* or a *fourth direction* crossing the third direction and *different from the first and second directions*.” Ex. 1001, cl. 40 (emphasis added). Petitioner argues that its proposed combination meets this limitation because “when Matthies employs an array of elongated sub-pixels . . . , it orients these pixels with their ‘elongated sides’ in the ‘*third direction*’ (up and down on Matthies’ display),” Pet. at 77, and shows the following figure:

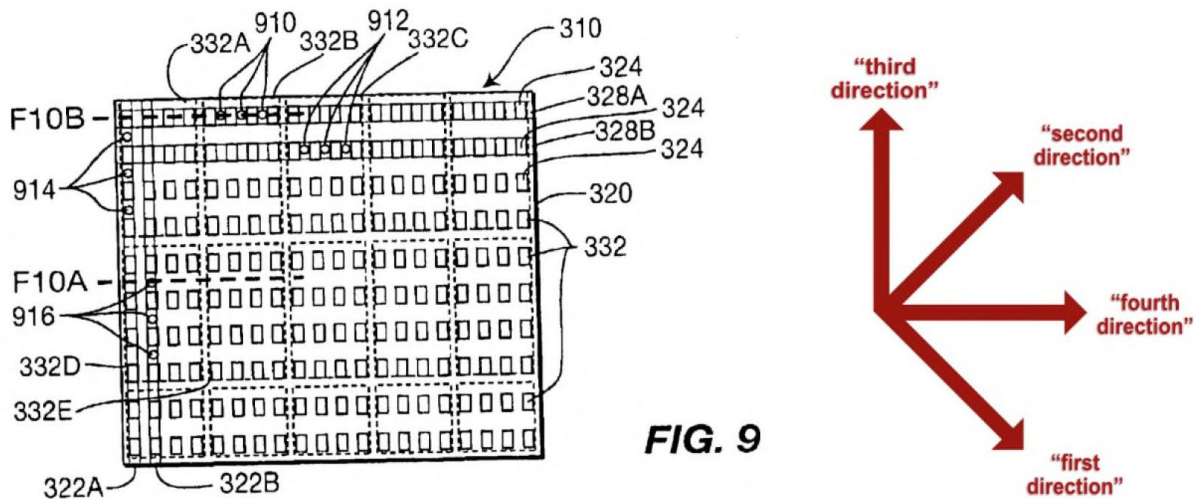
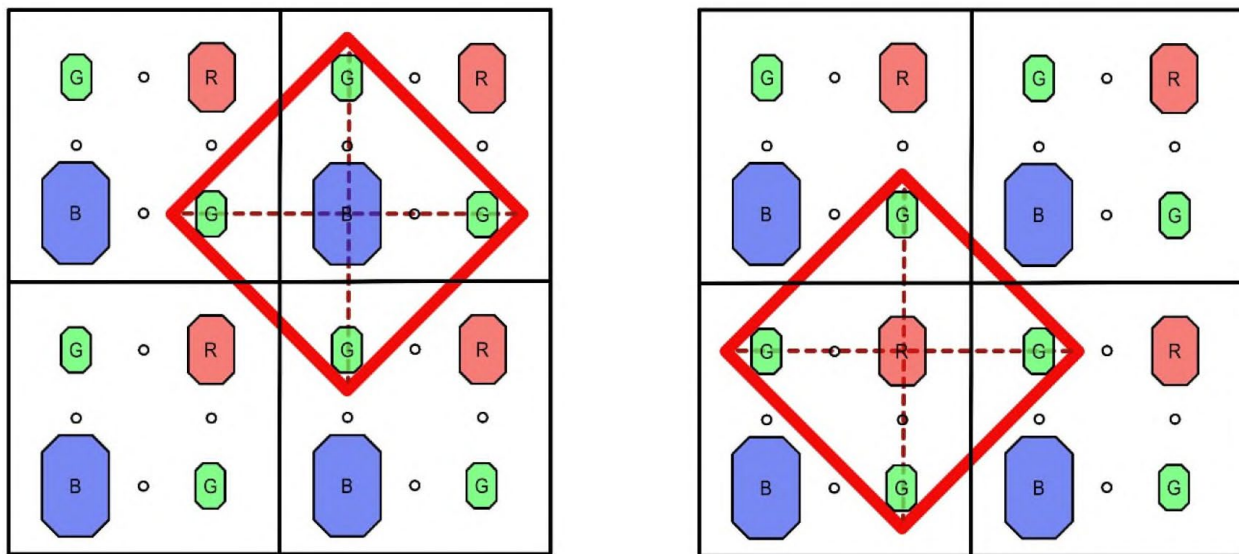


FIG. 9

Id. at 78. If the proposed combination meets claim 40’s requirement of having the first pixel’s sides elongated in a direction “different from the first and second directions,” as Petitioner argues, the combination cannot at the same time meet claim 51’s requirement wherein the pixel edges are “elongated in a first direction or a second direction.” *See* Ex. 1001, cls. 40, 51.

Petitioner does not fare any better in its attempt to show that its proposed combination of Matthies, Yamada, and Hong meets the requirement of claim 52. For claim 52, rather than relying on claim 40 as it did for claim 51, Petitioner provides a new drawing that purportedly shows that the proposed combination meets claim 52’s limitations:



Pet. a 81. Petitioner does not explain how this figure shows that the proposed combination's green pixel has two parallel edges "elongated in a first direction or a second direction." *Id.* Nor can it. Consistent with claim 40 discussed above, the figure shows that the green pixel's edges are elongated in the ***third direction***.

Therefore, Petitioner has not shown that its proposed combination meets the limitations of claims 51 and 52.

VI. Conclusion

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

Date: October 12, 2023

Respectfully submitted,

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CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), I certify that the present paper contains 13,035 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 12, 2023

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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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