

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

v.

SAMSUNG DISPLAY CO., LTD.,
Patent Owner.

IPR2023-01075
Patent 11,594,578 B2

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

McMILLIN, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

Mianyang BOE Optoelectronics Technology Co., Ltd.; Wuhan China Star Optoelectronics Semiconductor Display Technology Co., Ltd.; Tianma Microelectronics Co. Ltd.; and Visionox Technology, Inc. (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting an *inter partes* review of claims 1–6, 10, 12, 17–19, 21–23, 40–47, 51, and 52 (“the challenged claims”) of U.S. Patent No. 11,594,578 B2 (Ex. 1001, “the ’578 patent”). Samsung Display Co., Ltd. (“Patent Owner”) filed a Preliminary Response (Paper 9, “Prelim. Resp.”).

We have authority to determine whether to institute an *inter partes* review. *See* 35 U.S.C. § 314 (2018); 37 C.F.R. § 42.4(a) (2022). Under 35 U.S.C. § 314(a), we may not authorize an *inter partes* review unless the information in the petition and the preliminary response “shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” For the reasons that follow, we institute an *inter partes* review as to claims 1–6, 10, 12, 17–19, 21–23, 40–47, 51, and 52 of the ’578 patent on all grounds of unpatentability presented.

I. BACKGROUND

A. *Real Parties-in-Interest*

Petitioner identifies Mianyang BOE Optoelectronics Technology Co., Ltd.; Wuhan China Star Optoelectronics Semiconductor Display Technology Co., Ltd.; Tianma Microelectronics Co. Ltd.; and Visionox Technology, Inc. and their subsidiaries as the real parties-in-interest. Pet. 3–4. Patent Owner identifies Samsung Display Co., Ltd., as the real party-in-interest. Paper 6, 2.

B. Related Matters

The parties identify the following proceedings related to the '578 patent (Pet. 4; Paper 6, 2):¹

Certain Active Matrix Organic Light-Emitting Diode Display Panels And Modules For Mobile Devices, And Components Thereof, Inv.

No. 337-TA-1351 (USITC); and

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

C. The '578 Patent

The '578 patent is directed to “a pixel arrangement structure of an organic light emitting diode (OLED) display.” Ex. 1001, 1:22–23. The '578 patent indicates that “[a]n organic emission layer included in the pixel of an OLED display may be deposited and formed by using a mask such as a fine metal mask (FMM).” *Id.* at 1:46–48. The '578 patent notes, however, that “[w]hen reducing a gap between the neighboring pixels to obtain a high aperture ratio of the pixel, deposition reliability may be deteriorated,” but “[o]n the other hand, when increasing the gap between the pixels to improve the deposition reliability, the aperture ratio of the pixel may be deteriorated.” *Id.* at 1:48–53. The '578 patent also indicates that pixels of certain colors may have different lifespans from other pixels, and that the pixel arrangement structure of the OLED display may provide improved life span. *Id.* at 7:35–42.

¹ The '578 patent is based on a continuation of an application that issued as U.S. Patent No. 10,854,683 (challenged in IPR2023-00988) and which in turn is based on a continuation of an application that issued as U.S. Patent No. 9,818,803 (challenged in IPR2023-00987). Ex. 1001, code (63).

The '578 patent indicates that an exemplary embodiment “provides a pixel arrangement structure for an OLED display having an improved aperture ratio of a pixel while efficiently setting up a gap between the pixels.” Ex. 1001, 1:66–2:3.

Figure 1 of the '578 patent is reproduced below.

FIG.1

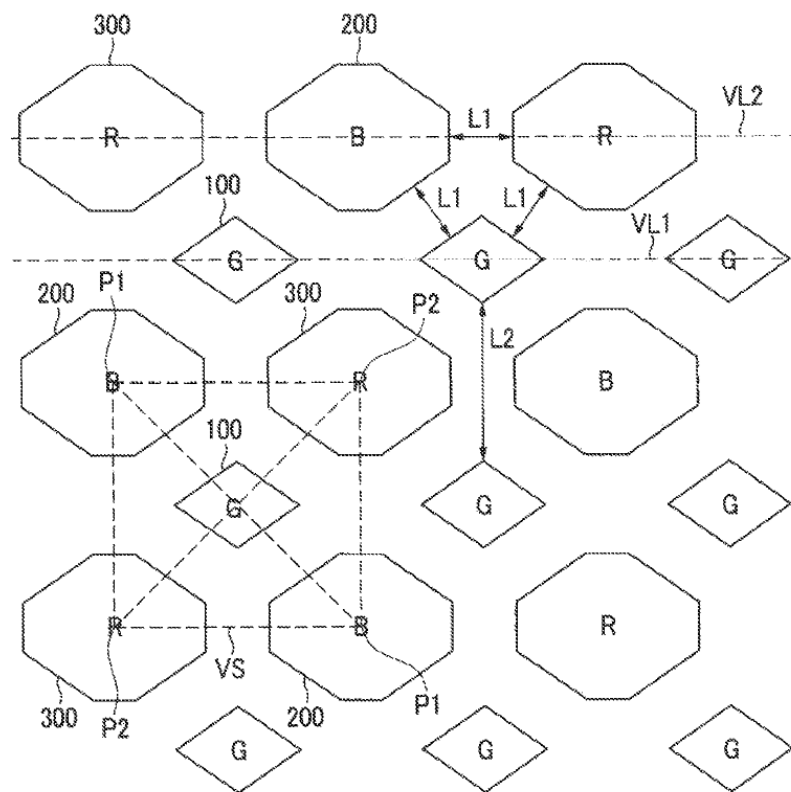


Figure 1 depicts “a view of a pixel arrangement structure of an OLED display.” Ex. 1001, 3:8–9. “[T]he pixel arrangement structure of the OLED display includes a plurality of first pixels 100, a plurality of second pixels 200, and a plurality of third pixels 300,” which respectively emit green, blue, and red light. *Id.* at 3:62–65, 4:23–24, 4:40–41, 4:53–54.

According to the '578 patent, “each of the first pixels 100 has a smaller area than neighboring second pixels 200 and third pixels 300, and has a quadrilateral (i.e., four-sided) shape.” Ex. 1001, 4:14–17. “The second pixels 200 are arranged diagonally with respect to the first pixels 100, such as at first vertices P1 along one diagonal of a virtual square VS having one of the first pixels 100 as a center point (or center) of the virtual square VS.” *Id.* at 4:24–28. “In a similar fashion, the third pixels 300 are arranged diagonally with respect to the first pixels 100, such as at second vertices P2 along the other diagonal of the virtual square VS.” *Id.* at 4:28–31.

The '578 patent states that, “[e]ach of the third pixels 300 has a larger area than the neighboring first pixel 100 and the same area as each of the second pixels 200.” Ex. 1001, 4:46–48. The '578 patent also indicates that “by enclosing each of the first pixels 100 by a pair of the second pixels 200 and a pair of the third pixels 300, the aperture ratio of the first pixels 100, the second pixels 200, and the third pixels 300 may be improved.” *Id.* at 5:30–33.

The '578 patent further states that

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

Ex. 1001, 5:19–29.

Figure 2 of the '578 patent is reproduced below.

FIG.2

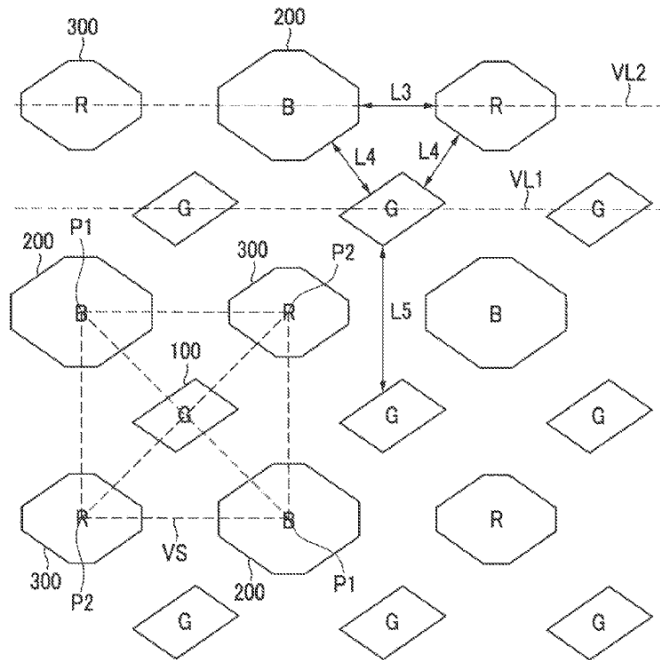


Figure 2 depicts “a view of a pixel arrangement structure of an OLED display.” Ex. 1001, 3:10–11. In Figure 2, “[t]he plurality of first pixels 100 have the same quadrilateral shape (e.g., a parallelogram)” and “the second pixels 200 have a larger area than the third pixels 300.” *Id.* at 6:11–13. According to the '578 patent, because “the second pixels 200 that emit blue have the shortest life span,” “the second pixels 200 have a larger area than the third pixels 300, thereby suppressing the deterioration of the life span of the OLED display.” *Id.* at 6:54–59.

Figure 5 of the '578 patent is reproduced below.

FIG.5

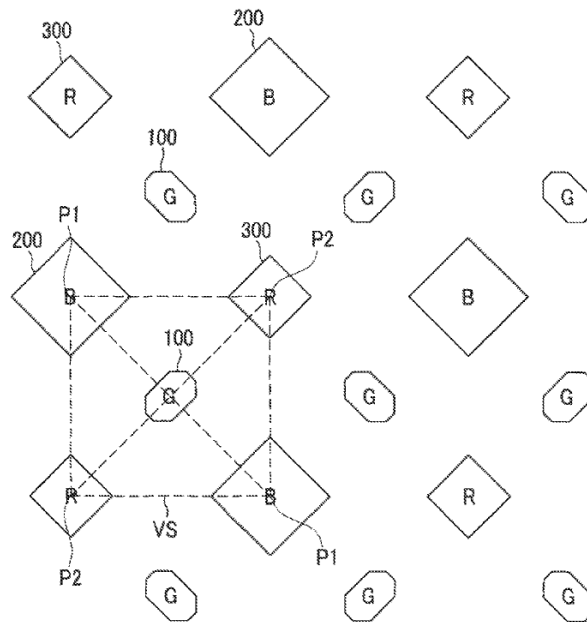


Figure 5 depicts “a view of a pixel arrangement structure of an OLED display.” Ex. 1001, 3:19–20. According to the '578 patent, “the neighboring first pixels 100 have a octagonal shape and are symmetrical to each other, while the second pixels 200 have a larger area than the third pixels 300.” *Id.* at 8:44–47. The '578 patent states that “[t]his results in improved deposition reliability in the deposition process using the fine metal mask to form the green, blue, and red organic emission layers respectively included in the first pixels 100, the second pixels 200, and the third pixels 300.” *Id.* at 8:47–51.

The application that led to the '578 patent was filed on July 8, 2019, and claims priority to, *inter alia*, a Korean application that was filed on March 6, 2012 (i.e., the earliest possible effective filing date). Ex. 1001,

codes (22), (30). We apply the March 6, 2012, date for qualifying the asserted references as prior art.

D. Illustrative Claim

Of the challenged claims, claims 1, 42, and 45 are independent. Claims 2–6, 10, 12, 17–19, 21–23, 40, 41, 43, 44, 46, 47, 51, and 52, directly or indirectly, depend from one of claims 1, 42, and 45. Claim 1 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.

Ex. 1001, 8:63–9:26.

E. Cited Art

Petitioner relies on the following references:

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

U.S. Patent No. 6,366,025 B1, filed Feb. 24, 2000, issued Apr. 2, 2002 (Ex. 1005, “Yamada”); and

U.S. Patent Application Publication No. 2011/0234550 A1, filed Aug. 13, 2010, published Sep. 29, 2011 (Ex. 1011, “Hong”).

F. Asserted Grounds

Petitioner challenges claims 1–6, 10, 12, 17–19, 21–23, 40–47, 51, and 52 of the ’578 patent based on the following grounds (Pet. 6):

Claims Challenged	35 U.S.C. §	References
1–6, 10, 12, 17–19, 21–23, 41, 42, 44, 47, 52	103(a) ²	Matthies, Yamada
40, 43, 45–47, 51, 52	103(a)	Matthies, Yamada, Hong

Petitioner filed a Declaration of P. Morgan Pattison, Ph.D. (Ex. 1003) in support of its Petition. Patent Owner did not submit any testimony in support of its arguments, so the testimony of Dr. Pattison is unrebutted at this stage.

II. ANALYSIS

We consider Petitioner’s asserted grounds and Patent Owner’s arguments to determine whether Petitioner has met the reasonable likelihood standard for institution under 35 U.S.C. § 314(a).

A. Legal Standards

A claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. *See KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007).

² The Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112-29, 125 Stat. 284, 287–88 (2011), amended 35 U.S.C. §§ 102 and 103. Because the ’578 patent claims priority to an application filed before March 16, 2013 (the effective date of the relevant amendments), the pre-AIA versions of §§ 102 and 103 apply.

The question of obviousness is resolved on the basis of underlying factual determinations, including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) where in evidence, so-called secondary considerations.³ *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). We also recognize that prior art references must be “considered together with the knowledge of one of ordinary skill in the pertinent art.” *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994) (citing *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)).

B. Level of Ordinary Skill in the Art

Citing testimony from Dr. Pattison, Petitioner contends a person of ordinary skill in the art “would have had a degree in electrical engineering, materials science, physics, or a similar discipline, along with 2 years of professional experience working with display design, including OLED displays, or an equivalent level of skill, knowledge, and experience.” Pet. 10 (citing Ex. 1003 ¶¶ 37–40). Petitioner further notes that such a person of ordinary skill in the art “would have been aware of and generally knowledgeable about OLED materials, and display pixel design, layout, and operation. *Id.* (citing Ex. 1003 ¶ 40). Patent Owner does not dispute Petitioner’s proposed level of ordinary skill in the art at this time, noting that “[f]or purposes of this Preliminary Response, Patent Owner does not believe it is necessary to define the level of ordinary skill in the art.” Prelim. Resp. 12.

³ The present record does not include any evidence of secondary considerations of nonobviousness.

For purposes of this Decision, we adopt Petitioner’s definition of the level of ordinary skill in the art.⁴ It is supported by the testimony of Dr. Pattison and not disputed by Patent Owner. Further, it appears consistent with what is reflected by the content of the applied prior art references. *Cf. Okajima v. Bourdeau*, 261 F.3d 1350, 1354–55 (Fed. Cir. 2001) (the applied prior art may reflect an appropriate level of skill).

C. Claim Interpretation

In an *inter partes* review, we construe claims using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. [§] 282(b), including construing the claim in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.

37 C.F.R. § 42.100(b). Accordingly, our claim construction standard is the same as that of a district court. *See id.* Under the standard applied by district courts, claim terms are generally given their plain and ordinary meaning, as would have been understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005) (en banc). “There are only two exceptions to this general rule: 1) when a patentee sets out a definition and acts as his own lexicographer, or 2) when the patentee disavows the full scope of a claim term either in the

⁴ No matter how designated in this Decision, any determination (except our decision to institute trial) is preliminary and non-binding. We wish to have the full record as developed during trial before rendering any binding determination, finding, or conclusion.

specification or during prosecution.” *Thorner v. Sony Comput. Entm’t Am. LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012).

Petitioner states that “[i]n the related ITC action involving the ’578 patent, Patent Owner and the Staff proposed constructions for certain claim terms that did not meaningfully depart from the claim language,” and that “[f]or purposes of this petition, Petitioner adopts these constructions.” Pet. 13 (citing Ex. 1003 ¶¶ 83–88; Ex. 1010). Patent Owner points out that “the Administrative Law Judge in the related ITC Investigation No. 337-TA-1351 issued a claim construction order” (Prelim. Resp. 11 (citing Ex. 2001)), but also states that “[t]he order did not adopt any claim constructions for the ’578 patent that Patent Owner believes are pertinent to this Preliminary Response” (Paper 10 (Errata to Patent Owner’s Preliminary Response), 2). Patent Owner further states that “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.” *Id.* (citing Ex. 2002). Patent Owner indicates however that, for the purposes of its Preliminary Response, it “does not believe that any specialized constructions are necessary,” and that “[t]he Petition fails to establish a reasonable likelihood of prevailing under any claim interpretation.” *Id.*

For purposes of this Decision, we determine that no aspects of the challenged claims require explicit construction.⁵ *See, e.g., Realtime Data,*

⁵ If either party contends that explicit claim construction is necessary in order to make a final determination whether or not any challenged claim is unpatentable based on the arguments and evidence presented, it should clearly explain why during trial and provide a clear and unambiguous construction with supporting evidence including specifically identifying the challenges, claims, and limitations to which the construction is necessary.

LLC v. Iancu, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

D. Obviousness Ground Based on Matthies and Yamada

Petitioner contends that claims 1–6, 10, 12, 17–19, 21–23, 41, 42, 44–47, and 52 would have been obvious in view of a combination of teachings of Matthies and Yamada. Pet. 19–75. Patent Owner opposes institution on this ground. Prelim. Resp. 12–49.

We provide summaries of Matthies and Yamada and then analyze the arguments and evidence of the parties relating to this ground.

I. Matthies

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

Figure 1 of Matthies is reproduced below.

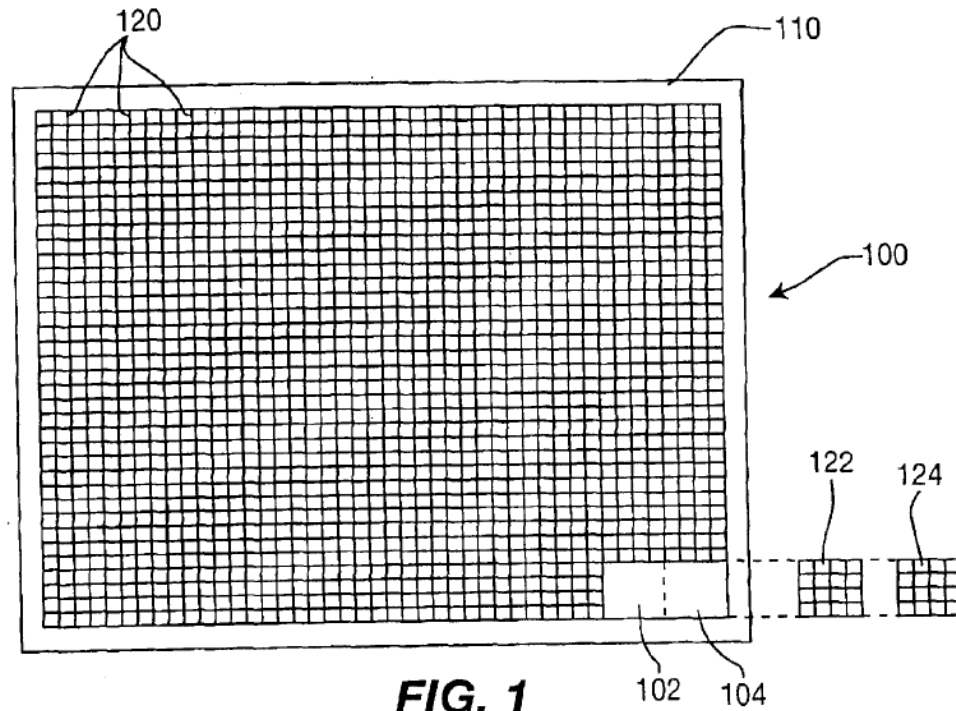


Figure 1 depicts “a front plan drawing of a large area display device from which two tiles have been removed.” Ex. 1004, 3:49–50. According to Matthies, “display 100 is a tiled display in which emissive or reflective elements, on which the image pixels are formed, are built as relatively small arrays on tiles 120 and assembled into a frame to produce the large-area display having a large number of pixel forming elements.” *Id.* at 5:38–42. Matthies indicates that “[a]lthough the display 100 is shown as being formed from tiles having 16 pixel forming elements in a four by four array, it is contemplated that each tile may include many more pixels.” *Id.* at 5:56–59.

Matthies states that in an exemplary embodiment, “the pixel forming elements are made from an organic light emitting diode (OLED) material.” Ex. 1004, 6:17–19. According to Matthies, “[t]he active portion . . . of the pixels occupies only about 1/4 of the total pixel area.” *Id.* at 15:67–16:1.

Matthies indicates that “this spacing of the pixels leaves room along the edges of the display for the vias . . . to connect to the row and column electrodes of the pixel without interfering with the regular spacing of the pixels across tile boundaries.” *Id.* at 16:5–9.

Figure 7 of Matthies is reproduced below.

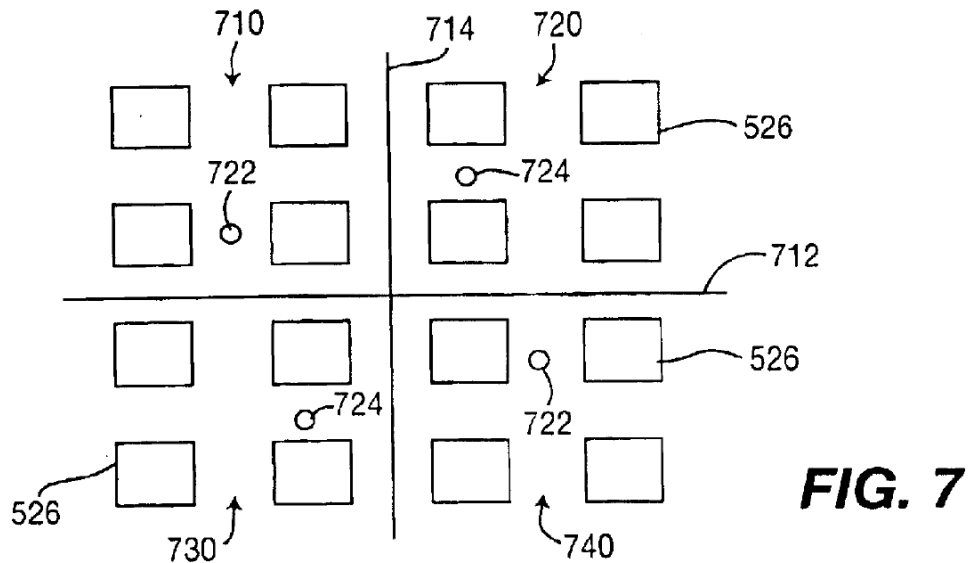


Figure 7 depicts “a pixel diagram which shows an exemplary pixel layout for portions of four tiles.” Ex. 1004, 4:6–7. “In the layout shown in FIG. 7, the active portions 526 of the pixels are centered in their respective pixel regions and the vias which connect the row and column electrodes of the display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

Figure 8B of Matthies is reproduced below.

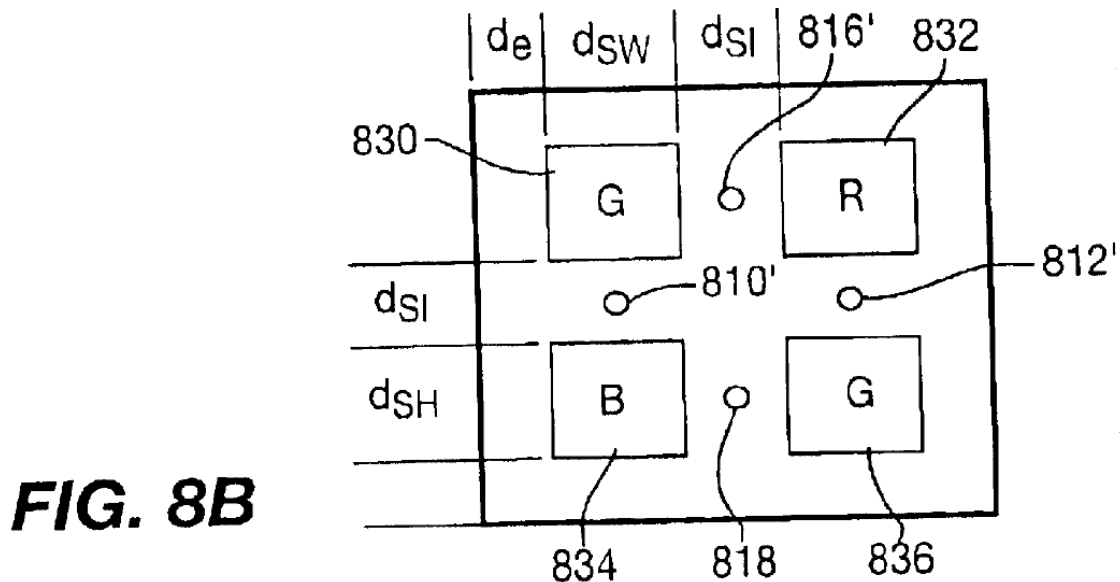


Figure 8B depicts “a front-plan view of an alternative single color pixel structure which includes separate sub-pixels.” Ex. 1004, 4:12–13. According to Matthies, Figure 8B illustrates a “color pixel structure” that “includes four sub-pixel elements, 830, 832, 834 and 836.” *Id.* at 16:62–64. “Two of these sub-pixel elements, 830 and 836 emit green light when stimulated while the other two pixel elements, 832 and 834 emit red and blue light, respectively.” *Id.* at 16:64–66. Matthies indicates that “[t]his structure is known as a quad sub-pixel structure.” *Id.* at 16:67. According to Matthies, “[t]he geometry of the quad sub-pixel structure is defined by the dimensions d_{SH} , the height of the sub-pixel, d_{SW} , the width of the sub-pixel, d_e , the distance from the active sub-pixel areas to the edge of the pixel area, and d_{SI} , the distance between adjacent sub-pixels.” *Id.* at 17:16–20.

Matthies teaches that a “tile may also include circuitry which automatically adjusts the pixel brightness to compensate for aging of the display material,” such as a “small light sensor over one or more pixel positions which continually monitors the brightness of that pixel and adjusts

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

Matthies issued May 24, 2005,⁶ (Ex. 1004, code (45)) and Petitioner contends that Matthies qualifies as prior art under 35 U.S.C. § 102(b). Pet. 14. Patent Owner does not contest the prior art status of Matthies. *See generally* Prelim. Resp. We determine that Matthies qualifies as prior art under 35 U.S.C. § 102(b), because Matthies’ issue date of May 24, 2005, is more than one year before the earliest claimed priority date for the ’578 patent, which is March 6, 2012. Ex. 1001, code (30); Ex. 1004, code (45).

2. *Yamada*

Yamada is a U.S. patent related to an “electroluminescence (EL) display apparatus.” Ex. 1005, 1:6–7. Yamada discusses an “EL display apparatus” including “emissive regions 1B, 1R, and 1G for the display pixel of the respective color . . . arranged in a matrix configuration.” *Id.*

⁶ The Petition incorrectly states that Matthies issued on May 23, 2005, when it actually issued one day later on May 24, 2005. Pet. 11; Ex. 1004, code (45). This does not affect whether Matthies qualifies as prior art.

at 2:55–60. Yamada indicates that “the emission efficiency of the emissive layer for emitting light of various colors differs with each color.” *Id.*

at 2:53–54. According to Yamada, when the pixels “all have identical emissive areas in size,” “in order to obtain the same luminance at the display pixels having a low emission efficiency, a current larger than that supplied to the other display pixels having a high emission efficiency must be supplied.”

Id. at 2:55–64. Yamada teaches that “[t]his causes the life of those display pixels having a low emission efficiency, in particular, to shorten, and also possibly causes the life of the EL display apparatus to shorten.” *Id.*

at 2:64–67.

Yamada purports to improve upon these aspects of EL displays by way of “a color display device, in which a display pixel having an emissive element is provided for every color, wherein the emissive area of the display pixel of any one color, among the display pixels of various colors, is different in size from the emissive area of the display pixel of another color.” Ex. 1005, 3:17–22. According to Yamada,

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

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

Figure 4 of Yamada is reproduced below.

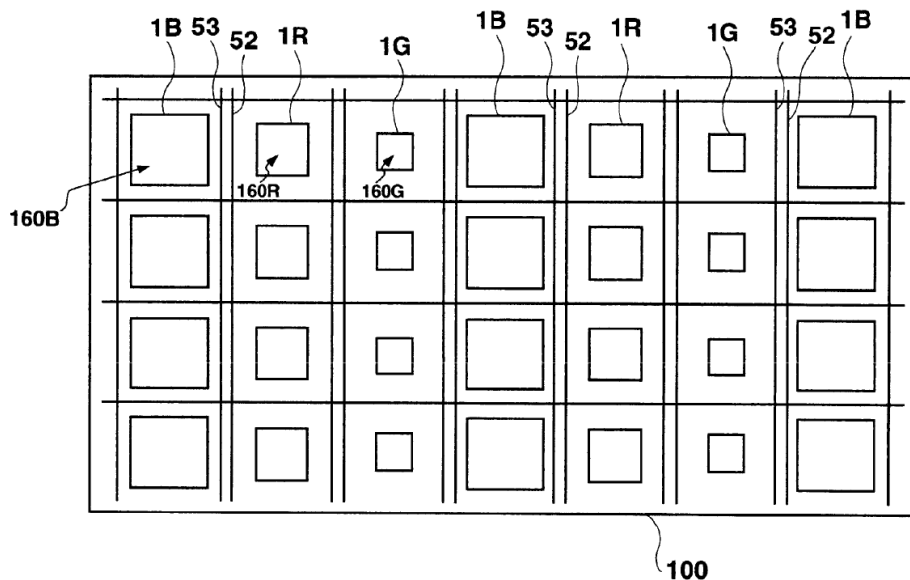


Fig. 4

Figure 4 depicts a “conceptual diagram showing emissive region areas of the EL display apparatus.” Ex. 1005, 6:24–25. According to Yamada, Figure 4 “is a top plan view of an EL display apparatus 100” representing “a case where the respective display pixels emit red (R), green (G), and blue (B) light.” *Id.* at 6:49–52. “[I]n the case of FIG. 4, the emissive area of the green display pixel 1G is provided as the smallest,” while “[e]missive regions 1R and 1B of the other colors are formed with a larger area than that of emissive region 1G.” *Id.* at 7:6–10. Yamada indicates that while in Figure 4 the “[a]rea of green emissive region 1G<area of red emissive region 1R<area of blue emissive region 1B,” “the order in size of the emission region areas is not fixed at the above-mentioned green<red<blue, but is determined by the emission efficiency of the emissive materials that are used.” *Id.* at 7:10–19.

Yamada issued April 2, 2002, (Ex. 1005, code (45)) and Petitioner contends that Yamada qualifies as prior art under 35 U.S.C. § 102(b).

Pet. 17. Patent Owner does not contest the prior art status of Yamada. *See generally* Prelim. Resp. We determine that Yamada qualifies as prior art under 35 U.S.C. § 102(b), because Yamada’s issue date of April 2, 2002, is more than one year before the earliest claimed priority date of the ’578 patent, which is March 6, 2012. Ex. 1001, code (30); Ex. 1005, code (45).

3. *Claim 1*

The Petition provides an element-by-element mapping of claim 1 to teachings in Matthies and Yamada (Pet. 20–41) and articulates reasoning to combine the relevant teachings of Matthies and Yamada (*id.* at 69–75). Patent Owner does not dispute the showing in the Petition that the combination of Matthies and Yamada teaches all the limitations recited in claim 1. *See generally* Prelim. Resp. Patent Owner does dispute Petitioner’s showing as to motivation to combine the relevant teachings of Matthies and Yamada. *See id.* at 12–40.

We analyze the showing in the Petition for claim 1⁷ and the reasoning for combining the teachings of the cited art. Then, we consider Patent Owner’s contrary arguments and contentions.

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

Petitioner does not take a position as to whether the preamble of claim 1 is limiting, but does contend that Matthies teaches it. Pet. 20 (“To the extent this preamble language is limiting, Matthies teaches it.”). The Petition states:

⁷ We adopt the parsing of claim 1 in the Petition for ease of reference, understanding, and consistency.

Matthies discloses a tiled “electronic display device.” (Ex. 1004, 1:8-10.) The display can be an “OLED ... display” that includes OLED “pixel forming elements.” (*Id.*, 5:29-30; 6:18-22, 16:40-43; *see also id.*, 3:6-7)

Matthies also discusses how the pixels making up its display device are arranged. In particular, the display includes “tiles ... constructed with” “evenly spaced” “pixel forming elements.” (*Id.*, 5:47-53.) In one example, a “display 100” is “formed from tiles having 16 pixel forming elements in a four by four array.” (*Id.*, 5:56-61; *see also id.*, Fig. 1; Ex. 1003, ¶¶ 131-137.)

Id. Petitioner’s contention that Matthies teaches the preamble of claim 1 is supported by the cited passages. *See id.* (citing Ex. 1003 ¶¶ 131–137; Ex. 1004, 1:8–10, 3:6–7, 5:29–30, 5:47–53, 5:56–61, 6:18–22, 16:40–43, Fig. 1). At least at this stage, we need not determine whether the preamble is limiting (*see Realtime Data* at 1375), because we determine that Petitioner’s showing is sufficient for institution.

a plurality of first pixels; a plurality of second pixels; and a plurality of third pixels,

Petitioner relies on Matthies as teaching these three limitations. *See* Pet. 20–22 (citing Ex. 1003 ¶¶ 138–152; Ex. 1004, code (57) (Abstract), 2:35–37, 2:58–63, 5:54–61, 9:10–13, 13:1–2, 16:38–44, 16:62–17:4, Figs. 1, 2, 8B). The Petition states:

Matthies teaches a “tiled display” device that includes a multitude of “picture element[s]” or “pixels.” (Ex. 1004, Abstract; *see also id.*, 2:35-37 (referencing a “display” with “picture element[s]” or “pixels”).) In one embodiment, the display pixels can be formed from “red (R) ..., green (G) ... and blue (B)” OLED “sub-pixels.” (Ex. 1004, 16:40-44; 13:1-2.)

* * *

The ’578 patent, the “term pixel refers to a minimum unit for displaying images.” (Ex. 1001, 1:39-40; 3:65-67.) Matthies

display includes this claimed “*plurality*” of “*pixels*” (its colored sub-pixels). (Ex. 1003, ¶¶ 138-145.)

* * *

In sum, Matthies teaches colored displays made from green, blue, red sub-pixels arranged into tiles. The green sub-pixels are the claimed “*first pixels*,” while the blue and red sub-pixels are respectively the “*second pixels*” and “*third pixels*.” (*Id.*, ¶ 152.)

Id. Petitioner’s contention that Matthies teaches these limitations of claim 1 is supported by the cited passages. We determine that Petitioner’s showing is sufficient for institution.

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

Petitioner contends that Matthies teaches this limitation.

Pet. 23–26 (citing Ex. 1003 ¶¶ 157–179; Ex. 1004, 5:47–48, 5:56–61, 6:6–7, 6:18–22, 6:37–38, 12:62–65, 13:1–5, 13:10–14, 13:16–21, 15:67–16:2, Figs. 3, 9, 10B). The Petition states:

Matthies . . . provides . . . detail regarding the layers making up its display, including those responsible for defining the shape of and area occupied by its sub-pixels. In particular, “column electrodes 322” are first applied to a “front plate 320.” (*Id.*, 12:62-65.) Then, the “OLED materials 324 and 326” that “define the active area of the pixel” are “deposited on top of the column electrodes.” (*Id.*, 13:1-5.) The “active portions” are shaped such that they “occupy only about ¼ of the total pixel area” so as to “define[] a pixel aperture of approximately 25%.” (*id.*, 15:67-16:2; *see also id.*, 13:11-14 (again explaining that the “display materials 324 and 326” are formed so as to “occupy only a portion . . . of the pixel area”).) This is then followed by “row electrodes 328.” (*Id.*, 13:10-11.) The electrodes and active materials are then covered by “an

insulating layer 330” that “protect the display materials.” (*Id.*, 13:16-21.)

Id. at 24 (alteration in original). Petitioner also contends that “a POSITA [person of ordinary skill in the art] would have considered the layer including and around Matthies’ shaped active areas 324/326 to be the claimed ‘*pixel defining layer*’” and “[t]his layer is responsible for defining the shape of, and thus also the ‘*area*’ occupied by, the various sub-pixels making up Matthies’ display.” *Id.* at 26 (citing Ex. 1003 ¶¶ 178–179).

Petitioner’s contention that this limitation is taught by the cited art is supported by the cited passages of Matthies. We determine that Petitioner’s showing is sufficient for institution.

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

The Petition states, “Matthies[’] display includes red, green, and blue sub-pixels” and “[r]ed, green, and blue are ‘*different color lights*.’” Pet. 26 (citing Ex. 1003 ¶¶ 180–182; Ex. 1004, 13:1-2; 16:40-44; 16:62-17:4; Fig. 8B). We find preliminarily that Matthies teaches these limitations and determine that Petitioner’s showing is sufficient for institution.

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,

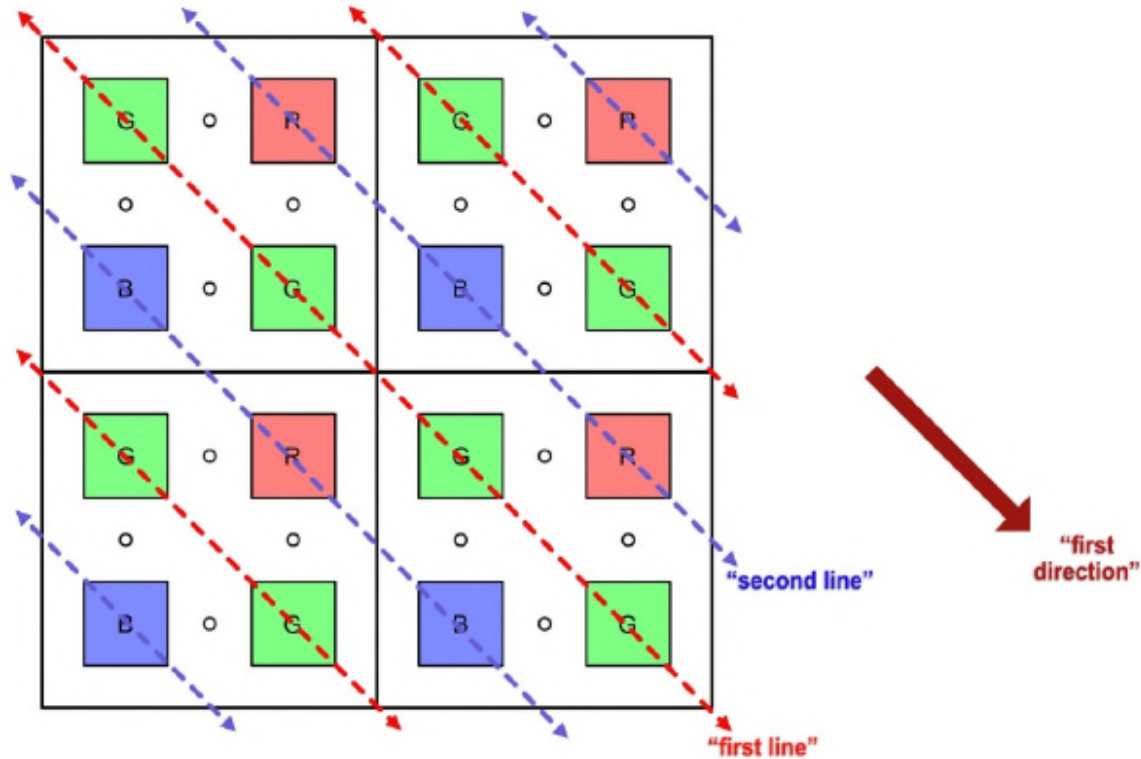
wherein the first lines and the second lines are alternately arranged,

Petitioner groups together “[t]his . . . first of a series of interrelated limitations that dictate the pixel geometry required by claim 1 . . . because they all relate to how the claimed pixels are organized in a so-called ‘**first direction**.’” Pet. 27. Petitioner relies on Matthies as teachings all the elements of these four limitations. *See id.* (“Matthies teaches what these limitations require.”) (citing Ex. 1003 ¶¶ 184–214; Ex. 1004, 1:56–65, 2:35–40, 2:46–47, 5:36–63, 8:48–50, 13:11–14, 15:67–16:2, 16:21–30, 16:40–41, 16:53–55, 16:62–67, 17:10–29, 17:31–33, Figs. 1, 7, 8B, Table 2).

The Petition states:

A display formed using Matthies “quad sub-pixel structure” includes “first,” “second,” and “third” pixels be arranged in two “**sets**” (one including the “first” pixels and the other including the “second” and “third” pixels) with “**alternat[ing]**” “**parallel**” “**lines**” in a “**first direction**” passing through the “**centers**” of the pixels as this limitation requires. . . . Matthies’ “first pixels” (the green sub-pixels) form “**first sets**” with “**first lines**” (red) passing through the sub-pixel centers. Matthies’ “second” and “third pixels” (the red and blue sub-pixels) alternate with each other to form “**second sets**” with “**second lines**” (blue) parallel to the “first lines” passing through the sub-pixel centers. The lines are parallel because—per Matthies’ Table 2 example pixel size and spacing values—the pixels are square and evenly spaced apart. The lines all proceed in the same “**first direction**.”

Id. at 31 (footnote omitted). The Petition includes a demonstrative figure (based on Figures 1, 7, and 8B of Matthies (*see id.* at 28–30)), reproduced below, to illustrate this description of the teachings from Matthies related to these limitations.



Pet. 31 (citing Ex. 1003 ¶¶ 208–214). This demonstrative figure depicts Petitioner’s conception of how Matthies teaches the arrangement of the pixels in the manner recited in these four limitations. We are persuaded preliminarily by Petitioner’s showing that the cited passages in Matthies teach these four limitations and determine that it is sufficient for institution.

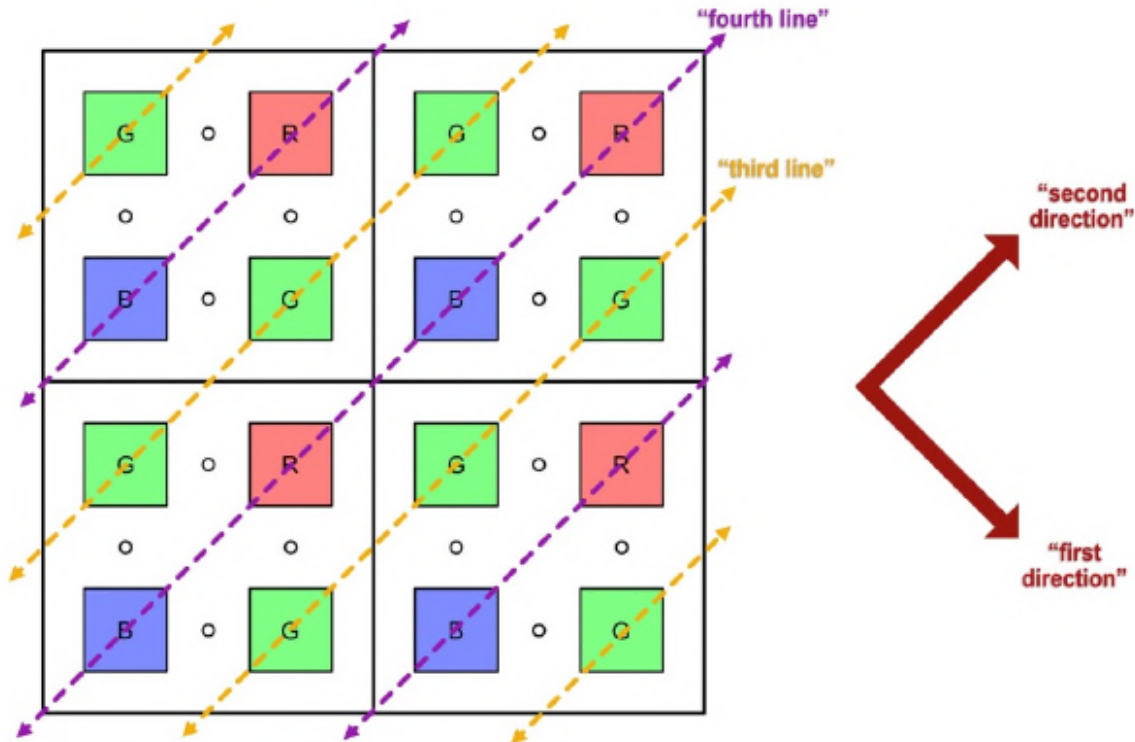
wherein the first pixels are also arranged in third sets extending along a second direction that is perpendicular to the first direction to form respective third lines,

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,

Petitioner relies on Matthies for teaching all the elements of these three limitations. Pet. 33–34 (citing Ex. 1003 ¶¶ 215–221). With regard to

grouping these limitations together, the Petition states: “These limitations also relate to pixel geometry. They have been grouped together because they all relate to how the claimed pixels are organized in a so-called ‘*second direction*.’” *Id.* at 33. The Petition includes the following demonstrative figure to illustrate that Matthies teaches what these limitations require:



Id. at 34 (citing Ex. 1003 ¶¶ 215–221). This demonstrative figure depicts Petitioner’s conception of how Matthies teaches the arrangement of pixels recited in these three limitations. In describing this demonstrative figure, the Petition states:

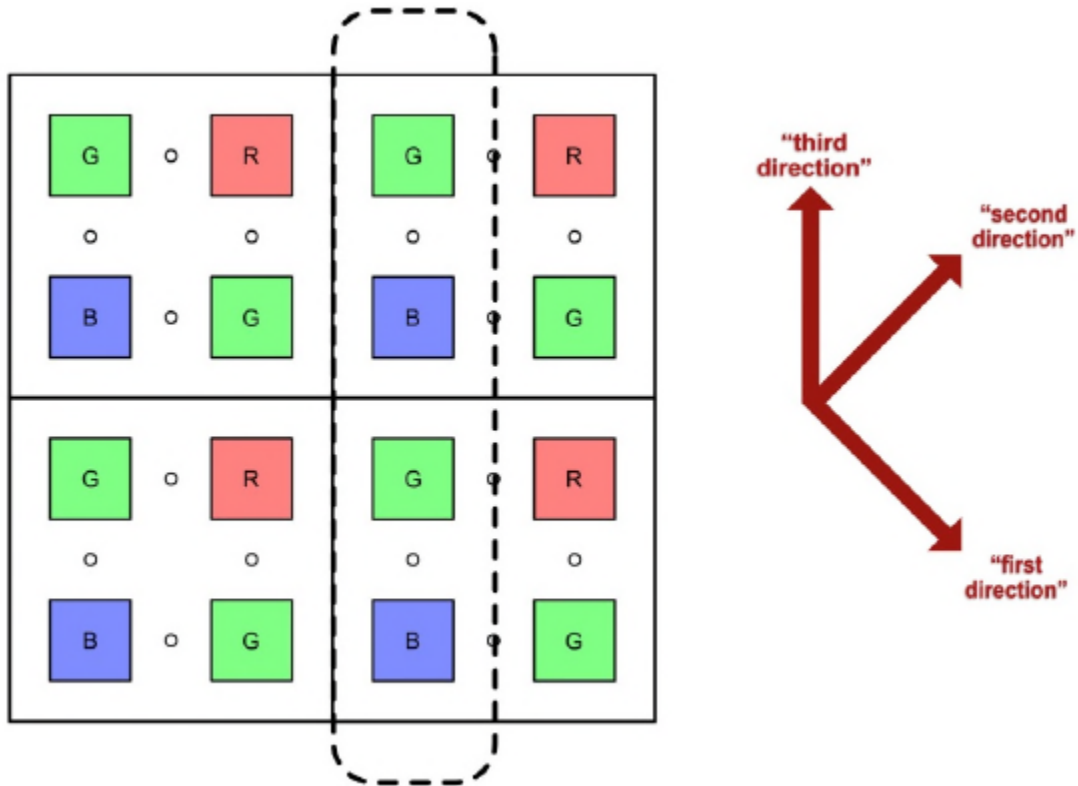
A display formed using Matthies “quad sub-pixel structure” also includes the additional “*sets*” located along “*alternat[ing]*” “*parallel*” “*third ... and ... fourth lines*” in a “*second direction*” these limitations require. In particular, Matthies’ “first pixels” (the green sub-pixels) form “*third sets*” with “*third lines*” (orange) passing through the sub-pixel centers. Due to Matthies’ use of equally sized square sub-pixels arranged in a repeating, square matrix (as dictated by the

example pixel size and spacing values in Table 2), this set is oriented in a “***second direction***” that is at a right angle or “***perpendicular***” to the “first direction.” Moreover, Matthies’ “second” and “third pixels” (the red and blue sub-pixels) alternate to form “***fourth sets***” with “fourth lines” (purple [sic]) parallel to the “third lines” passing through the pixel centers.

Id. at 33. We are persuaded preliminarily by Petitioner’s showing that Matthies teaches these three limitations and determine that it is sufficient for institution.

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,

Petitioner relies on Matthies for teaching this limitation. Pet. 35–35 (citing Ex. 1003 ¶¶ 222–225). The Petition includes the following demonstrative figure to illustrate that Matthies teaches what this limitation requires:



Id. at 35 (citing Ex. 1003 ¶¶ 222–225). This demonstrative figure depicts Petitioner’s conception of how Matthies teaches the arrangement of pixels recited in this limitation. With regard to this demonstrative figure, the Petition states: “Matthies’ ‘first’ and ‘second pixels’ (the green and blue sub-pixels outlined with a black dashed box) are ‘**alternatively arranged**’ in a ‘third direction’ (up and down). This ‘third direction’ ‘crosses’ both the ‘first’ and ‘second direction[s].’” *Id.* at 34 (alteration in original). We are persuaded preliminarily by Petitioner’s showing that Matthies teaches this limitation and determine that it is sufficient for institution.

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

For this limitation, Petitioner relies on a combination of the teachings of Matthies and Yamada. Pet. 35–40 (citing Ex. 1003 ¶¶ 226–250; Ex. 1004, 2:46–47, 13:11–14, 15:67–16:2, 16:22–25, 16:62–17:33, 17:36–38, 19:9–10; Ex. 1005, 1:6–10, 1:24–54, 2:53–60, 3:16–27, 3:38–44, 3:51–57, 6:44–7:12, 8:19–28, 8:47–52, 10:52–55, 10:57–60, 11:4–15, 12:37–40, Figs. 3, 4).

With regard to Matthies and this limitation, the Petition states:

Because Matthies’ sub-pixels have equal size, and the space between sub-pixels is equal to the sub-pixel height and width, the “**region**” defined by the “**width**” of Matthies’ green pixels . . . in “the second direction” will not overlap with and is instead “**entirely offset**” from the red or green sub-pixels.

* * *

While there is no overlap, the “region” surrounding Matthies green sub-pixels does abut Matthies’ red and blue sub-pixels. Again, this is the result of Matthies use of equally sized sub-pixels, with sub-pixel spacing equal to the sub-pixel height and width. (*See, e.g.*, Ex. 1004, 16:62–17:29.) This, however, is not the extent of what Matthies teaches. In particular, Matthies explains that it also “contemplates both larger and smaller pixel apertures.” (*Id.*, 17:36–38.) Further, Matthies explains that the sub-pixel spacing can also be “different.” (*Id.*, 17:31–33; *see also id.*, 19:9–10 (referencing the use of “different pixel pitches”).) If the green sub-pixels are resized to be smaller, then the “region” surrounding the sub-pixels would not overlap and would not even abut any red or blue sub-pixel. (Ex. 1003, ¶¶ 229–232)

Id. at 35–36. With regard to Yamada and this limitation, the Petition states:

Yamada provides an example of an array of red, green, and blue pixels that are differently sized and have different amounts of pixel-to-pixel spacing. Like Matthies, Yamada relates to an “electroluminescent display apparatus.” (Ex. 1005,

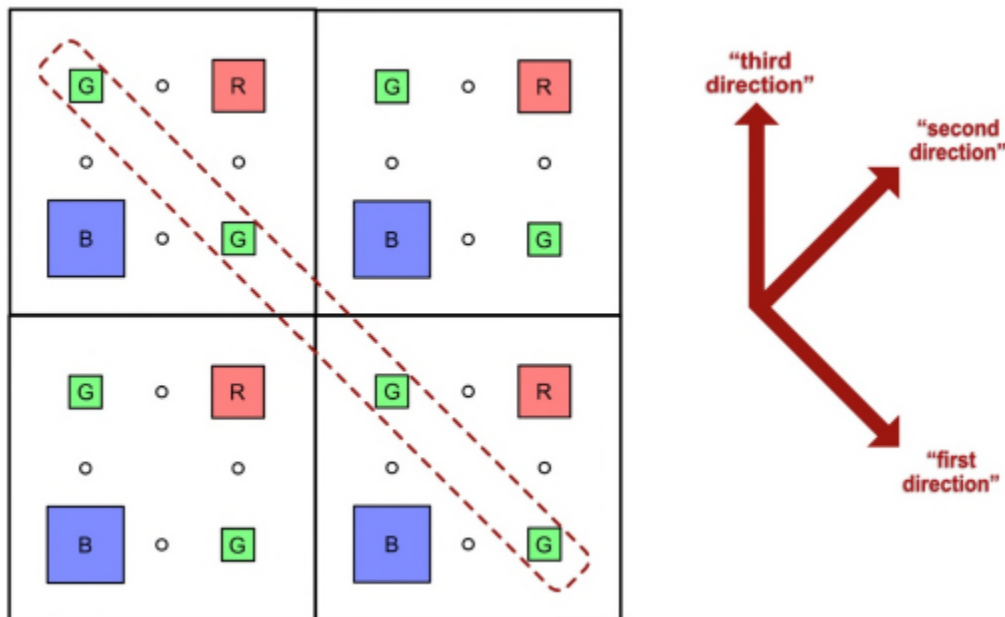
1:6-10.) Also like Matthies, Yamada explains that such a display includes red, blue, and green “pixel[s] ... arranged in a matrix configuration.” (*Id.*, 2:55-60; *see also id.*, 6:44-7:2.) In such a display, the different colors’ “emission layer[s]” have different “emission efficienc[ies].” (*Id.*, 2:53-54.) To account for this, Yamada does not make pixels the same size and instead re-sizes them “in accordance with ... emission efficiency.” (*Id.*, 2:55-60, 3:16-27.) The “emissive element of a color with the highest emission efficiency” is made “smaller,” while the “emissive element of a color with the lowest emission efficiency” is made “larger.” (*Id.*, 3:38-44, 3:51-57.) Yamada explains that in a typical OLED display, the “green pixel” has the highest efficiency and is thus made smallest, while the “blue pixel” has the lowest efficiency and is made largest. (*Id.*, 7:3-12, 8:19-28; 8:47-52; 10:52-55; 11:4-15.) Figures 3 and 4 of Yamada exemplify how a display array is to be modified using this relative sizing. The blue pixel’s size remains the same, while size of the red and green pixels is reduced. The same pixel spacing continues to be used, with the pixels centered on the same locations, so that the intervening signal lines 51, 52, and 53 remain in place . . . (*Id.*, Fig. 4; *see also id.*, 1:24-54 (discussing a “pixel ... formed in a region surrounded by gate signal lines 51 and drain signal lines 52”).) Yamada also provides a numerical example where the green:red:blue pixel area ratio is set to 1:2.6:5.6. (*See id.*, 11:8-10.) When square pixels are used, the pixels will have side length ratios of 1:1.6:2.4. (Ex. 1003, ¶¶ 233-241.) While Yamada’s figures show red, green, and blue pixels arrange in same-color columns, it explains that its teachings apply equally to other pixel “arrangement[s]” and “layouts.” (Ex. 1005, 12:37-40.)

Id. at 36–38 (alteration in original). Petitioner contends that a skilled artisan would have combined these teachings of Matthies and Yamada in the following manner:

Following these teachings, rather than making all the sub-pixels all the same size, 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. The same “quad sub-pixel structure” with two green sub-pixels, one red sub-pixel, and one blue sub pixel arranged in a repeating square matrix taught by Matthies would continue to be used, just with re-sized pixels. (Ex. 1003, ¶¶ 242-243.)

Id. at 38. The Petition includes the following demonstrative figure to illustrate that the combination of Matthies and Yamada teaches what this limitation requires:



Id. at 40 (citing Ex. 1003 ¶¶ 249–250). This demonstrative figure depicts Petitioner’s conception of how the combination of Matthies and Yamada teaches the arrangement of pixels recited in this limitation. The Petition states:

The . . . demonstrative—again drawn to scale—applies Yamada’s example green:red:blue pixel area ratio of 1:2.6:5.6 to Matthies’ “quad sub-pixel structure.” Per Yamada, the blue pixel has kept its original size. The other pixels have been reduced in size in accordance with Yamada’s example ratio.

The same regular sub-pixel spacing taught by Matthies continues to be employed. Each pixel is still “centered in the pixel area” as Matthies teaches. (Ex. 1004, 2:46-47, 16:22-25, 16:62-17:30.) And, consistent with Matthies, it continues to be the case that no pixel occupies more than “ $\frac{1}{4}$ of the total pixel area.” (*Id.*, 15:67-16:2; *see also id.*, 13:11-14.)

* * *

When modified following Yamada, Matthies teaches exactly what this limitation requires. Because the green sub-pixels are smaller, the “region” surrounding those pixels is “*entirely offset*” from and does not touch the red and blue sub-pixels.

* * *

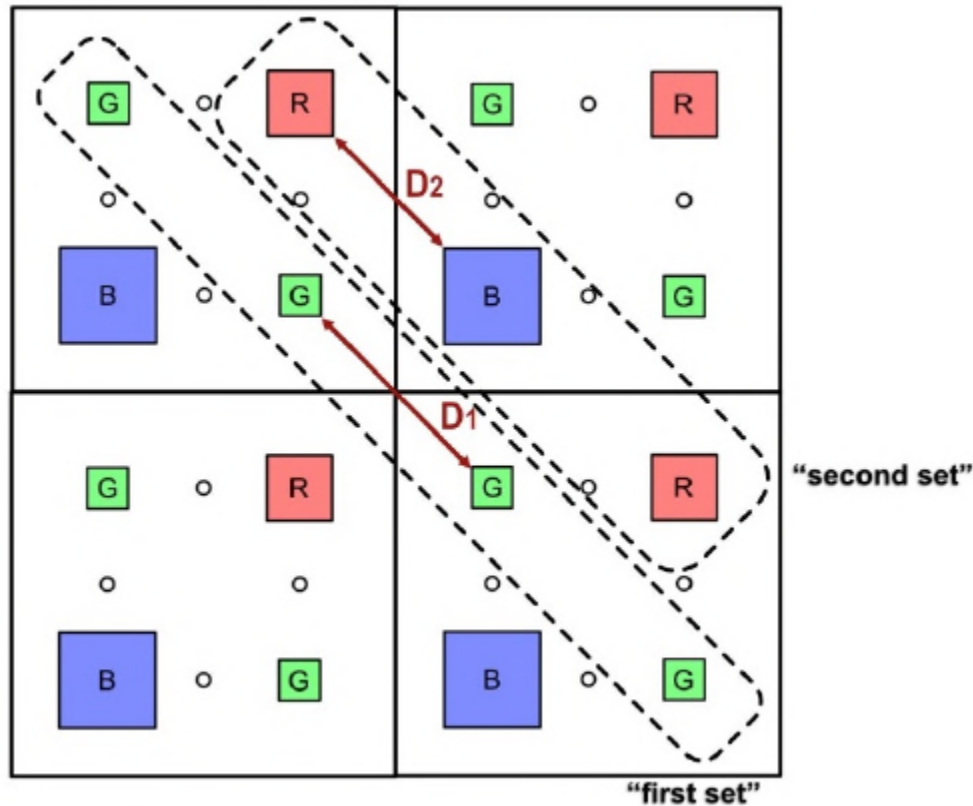
Yamada also teaches other pixel sizing arrangements besides the “green<red<blue” arrangement discussed above, including one where the pixels are sized “green<red $\equiv$ blue.” (Ex. 1005, 10:57-60.) Because the green sub-pixels are still smaller in this arrangement, the “region” surrounding those sub-pixels will also be “entirely offset” from the red and blue sub-pixels. (Ex. 1003, ¶ 250.)

Id. at 38–40. Although Patent Owner disputes Petitioner’s rationale for combining Yamada with Matthies (as discussed below), Patent Owner does not dispute Petitioner’s analysis for this limitation. We are persuaded preliminarily by Petitioner’s showing that the cited passages in Matthies and Yamada teach this limitation and determine that it is sufficient for institution.

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.

For this limitation, Petitioner relies on a combination of the teachings of Matties and Yamada. Pet. 40–41 (citing Ex. 1003 ¶¶ 251–255). The

Petition includes the following demonstrative figure to illustrate that Matthies and Yamada teach what this limitation requires:



Id. at 41 (citing Ex. 1003 ¶¶ 251–255). This demonstrative figure depicts Petitioner’s conception of how the combination of Matthies and Yamada teaches the arrangement of pixels recited in this limitation. With regard to this demonstrative figure and this limitation, the Petition states:

Again, 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. When Matthies’ display is implemented in this manner, it teaches what this limitation requires. Because the green sub-pixels are smaller than the red and blue sub-pixels, the “*shortest distance*” (D1) between the green sub-pixels in a “first set” will be “*greater*” than another “*shortest distance*” (D2) between blue and red sub-pixels in a “second set.”

Id. at 40–41. Although Patent Owner disputes Petitioner’s rationale for combining Yamada with Matthies (as discussed below), Patent Owner does not dispute Petitioner’s analysis for this limitation. We are persuaded preliminarily by Petitioner’s showing that the cited passages in Matthies and Yamada teach this limitation and determine that it is sufficient for institution.

Notwithstanding Patent Owner’s arguments against Petitioner’s rationale for combining Yamada with Matthies, discussed below, we determine that the Petition establishes that there is a reasonable likelihood that Petitioner will prevail in showing that the combination of Matthies and Yamada teaches all the limitations of claim 1.

Motivation to Combine Matthies and Yamada

Petitioner contends that a skilled artisan would have been motivated to combine the relevant teachings of Matthies and Yamada with a reasonable expectation of success. Pet. 69–75. Petitioner contends that “[a] POSITA would have considered it obvious and would have been motivated to apply Yamada’s teaching to Matthies.” *Id.* at 69 (citing Ex. 1003 ¶¶ 395–436). The specific teaching from Yamada that Petitioner relies on is “that the pixels with lower emission efficiencies (blue) should be made larger than pixels with higher emission efficiencies (green)” (*id.* at 70 (citing Ex. 1005, 3:38–44, 3:51–57; 7:3–12, 8:19–28; 8:47–52, Figs. 4, 9)) and, “[a]pplying Yamada’s teachings and re-sizing the pixels in accordance with their emission efficiencies—the blue pixels would be largest, the red would have an intermediate size, and the green the smallest—would allow each pixel to be supplied with a similar current increasing the display’s life” (*id.* at 71

(citing Ex. 1003 ¶ 410)). Petitioner contends that a skilled artisan would have “a strong motivation to apply Yamada to Matthies” (*id.* at 70) because

[T]he pixels have different sizes, luminance can be balanced while supplying each of the pixels with similar amounts of current or power. . . . This avoids the deterioration problem experienced in prior art OLED displays with same-sized pixels and “extend[s] the life of the display device. . . .” As an added benefit, the overall display design becomes “simplified” and “extremely easy to control” as each pixel is supplied with “the same amount of power.” (*Id.* (citing Ex. 1003 ¶¶ 396–401; Ex. 1005, 3:64–65, 4:5–14, 4:57–5:8. 5:41–49, 10:61–11:3) (alteration in original)).

Applying Yamada’s teachings [to Matthies] and re-sizing the pixels in accordance with their emission efficiencies—the blue pixels would be largest, the red would have an intermediate size, and the green the smallest—would allow each pixel to be supplied with a similar current increasing the display’s life.” (*Id.* at 71 (citing Ex. 1003 ¶¶ 408–410)).

Further, not only would the life of Matthies’ display be improved after applying Yamada, but a POSITA would have recognized that its design would be simplified. (*Id.*)

A POSITA would have recognized that Yamada is able to achieve a similar effect—more balanced luminance and reduced aging effects—without the need for all the extra structure referenced in Matthies. . . . This would have simplified Matthies’ design and would have simplified Matthies’ design and would have further motivated application of Yamada to Matthies. . . . It is also consistent with Matthies own expressed goal of “reduc[ing] manufacturing costs.” (*Id.* at 72 (citing Ex. 1003 ¶¶ 411–417; Ex. 1004, 1:64–65) (alteration in original)).

Matthies itself repeatedly recognizes that OLED pixels are subject to “aging” and “decay. . . .” While it proposes a number of methods to address these deleterious effects, it also explains

that “other methods” can also be used “either as a check or to augment the performance. . . . This would have motivated a POSITA to consider applying other known methods for addressing OLED pixel aging and display, including that set forth in Yamada. . . . Bolstering this, Matthies explains that the “geometry of the pixels” plays a role in the “rate of decay,” and suggests that “suitable adjustments may be readily determined by one skilled in the art of designing OLED displays by monitoring the performance of an exemplary pixel over time. . . . A POSITA would have considered this an invitation to apply the different pixel geometries set forth in Yamada to address the aging and decay problems Matthies references. (*Id.* at 72–73 (citing Ex. 1003 ¶¶ 418–422; Ex. 1004, 11:47–49, 11:54–60, 12:3–16, 12:41–47)).

Yamada’s design—in particular, its use of larger blue pixels and smaller green pixels—is also referenced repeatedly in the prior art. . . . The fact that both the problem Yamada addresses and the solution it proposes were well-known as the ’578 patent’s filing would have further motivated its application to Matthies. (*Id.* at 73 (citing Ex. 1003 ¶¶ 432–436; Ex. 1006 ¶ 62; Ex. 1008, 1:63–67)).

[A] POSITA would have recognized that applying Yamada’s teachings would have provided Matthies with greater design flexibility. . . . This would also have motivated combination. (*Id.* at 73 (citing Ex. 1003 ¶ 423)).

Reducing the size of the more luminant green and red pixels, while leaving the blue pixels at their existing $\frac{1}{4}$ of total pixel area size, would create additional space for Matthies’ vias. (*Id.* at 74 (citing Ex. 1003 ¶¶ 424–425)).

Petitioner summarizes its showing on motivation to combine in the following way:

“[W]hen a patent simply arranges old elements with each performing the same function it had been known to perform and yields no more than one would expect from such an

arrangement, the combination is obvious.” *KSR Int’l Co. v. Teleflex Inc.*, 550 US 398, 406 (2007). This is all the ’578 patent does here. (Ex. 1003, ¶¶ 426-428.) Matthies teaches an improved OLED display that is tiled (and thus can be made large), is easier to manufacture, and has improved performance (*See, e.g.*, Ex. 1004, 1:56-65; 2:35-40; 2:62-65.) Yamada teaches an OLED display with improved life. (*E.g.*, Ex. 1005, Abstract, 3:11-16.) The combined display of Matthies and Yamada would continue to exhibit these very same benefits and advantages. (Ex. 1003, ¶¶ 429-431.)

Id. at 74. With regard to reasonable expectation of success, the Petition states:

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 be adjusted. (*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 to amount to nothing more than the use of known 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.*)

Id. at 74–75 (alterations in original).

Patent Owner’s Arguments

Patent Owner argues that Petitioner has failed to establish that a skilled artisan would have been motivated to combine the relevant teachings of Matthies and Yamada. Prelim. Resp. 12–40. Patent Owner summarizes its arguments as follows:

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.

Id. at 12–13. We shall consider these arguments as explained and elaborated on by Patent Owner. *See id.* at 13–40. In summary, for the reasons discussed below, we determine that these arguments do not undermine Petitioner’s showing on motivation to combine and reasonable expectation of success.

Patent Owner first argues that “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” and “the two references are incompatible in material respects and, further, Petitioner’s proposed modifications are inconsistent with the disclosures of these references.” Prelim. Resp. 13. With regard to Matthies, Patent Owner argues that the disclosed displays relied on by Petitioner are passive matrix OLED (PMOLED) displays with equal spaces between the pixels and a uniform distance between the outermost sides of each pixel and the edge of the tile. *Id.* at 14–19 (citing Ex. 1004, 6:19–21, 6:22–23, 10:21–23, 10:31–33, 17:13–20, Figs. 1, 1B, 3, 8B, Table 2). With regard to Yamada, Patent Owner argues that the disclosed displays relied on by Petitioner are active matrix OLED (AMOLED) displays with differently-sized pixels. *Id.* at 19–20 (citing Ex. 1005, 1:6–9, 10:39–44, Fig. 6B). Patent Owner contends that “Petitioner all but ignores the differences between the PMOLED in Matthies and the AMOLED in Yamada” in arguing “as to why a POSITA may have wanted to resize Matthies’ pixels in view of Yamada.” *Id.* at 20. Patent Owner argues that “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.” *Id.* at 23.

Petitioner has put forth unrebutted testimony from Dr. Pattison that an ordinarily skilled artisan “would . . . have had a more than reasonable expectation of success” and “it was routine in the art to resize OLED pixels to improve display lifetime.” Pet. 74 (citing Ex. 1003 ¶¶ 437–439). And Dr. Pattison testifies that a skilled artisan would have considered application of

Yamada’s teachings regarding pixel size “to amount to nothing more than the use of [a] known design option—that Matthies itself already allows for—to solve a known prior art problem.” *Id.* at 75 (citing Ex. 1003 ¶¶ 440–441; Ex. 1004, 12:9, 12:41–46, 17:31–37). Dr. Pattison further testifies that “both Matthies and Yamada relate to pixels designs intended for use with OLED displays” and “[t]his similarity in purpose would have given a POSITA yet another reason to believe that the references’ teachings would be successfully used together.” *Id.* (citing Ex. 1003 ¶¶ 445–446). Patent Owner’s positions, though extensively supported with citations to the underlying record, amount to attorney argument.⁸ *See* Prelim. Resp. 13–30. Petitioner’s contentions are well-supported and reasonable. At this stage and on this record, we determine that Petitioner’s position is better supported, has more merit, and is sufficient for institution.⁹

Patent Owner also argues that “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” (Prelim. Resp. 31 (emphasis omitted)); “Petitioner Fails to Identify a Reason to Maintain Two Green Pixels in the Quad Pixel Design of Matthies” (*id.* at 34 (emphasis omitted)); and “Petitioner Fails to Identify a Reason to Reduce the Areas of

⁸ *See Gemtron Corp. v. Saint-Gobain Corp.*, 572 F.3d 1371, 1380 (Fed. Cir. 2009) (“[U]nsworn attorney argument . . . is not evidence and cannot rebut . . . other admitted evidence.”).

⁹ Notwithstanding our preliminary determination, we look forward to the parties further developing the record at trial on the potential incompatibilities in Petitioner’s combination, including the differences between PMOLED and AMOLED technologies and any differences in pixel geometry between Matthies and Yamada. We will be better able to decide these issues with a fully developed record.

the Green and Red Pixels While Maintaining the Area of the Blue Pixel (*id.* at 36 (emphasis omitted)). The Preliminary Response states:

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. 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.

Id. at 31–32 (footnote omitted). However, as discussed above with regard to the element-by-element analysis of Petitioner's showing as to claim 1, Petitioner's contentions as to the use of two green pixels in the quad pixel design of Matthies are supported by cited teachings in Matthies (*see, e.g.*, Ex. 1004, Fig. 8B) and the proposed modifications to Matthies by resizing the pixels based on emission efficiency are supported by cited teachings of Yamada (*see* Ex. 1005, 7:3–12, 8:19–28, 8:47–52, 10:52–55,; 11:4–15) and the testimony of Dr. Pattison (*see* Ex. 1003 ¶¶ 226–250). Patent Owner's

positions amount to attorney argument. *See* Prelim. Resp. 31–36. Again, at this stage and on this record, we determine that Petitioner’s position is better supported, has more merit, and is sufficient for institution.¹⁰

Notwithstanding Patent Owner’s arguments to the contrary, we determine that Petitioner has sufficiently shown a motivation to combine the relevant teachings of Matthies and Yamada with a reasonable expectation of success.

Summary as to Claim 1

Petitioner has sufficiently shown for purposes of institution that the combination of Matthies and Yamada teaches all the limitations of claim 1 and has sufficiently articulated well-supported reasoning as to why a skilled artisan would have been motivated to combine the teachings of Matthies and Yamada as set forth in claim 1. We determine that there is a reasonable likelihood that Petitioner will prevail in establishing the unpatentability of challenged claim 1 of the ’578 patent. Accordingly, we institute *inter partes* review of all the challenged claims and on both grounds presented in the Petition. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348 (2018) (holding that the Board may not institute review on fewer than all claims challenged in the petition); 37 C.F.R. § 42.108(a) (2023) (“When instituting *inter partes* review, the Board will authorize the review to proceed on all of the challenged claims and on all grounds of unpatentability asserted for each claim.”).

¹⁰ Notwithstanding this preliminary determination, we look forward to the parties developing this issue during trial and feel that evaluating Petitioner’s resizing of pixels in Matthies’ quad pixel design based on emission efficiency as taught by Yamada would be best decided in the context of a fully developed record.

4. *Claims 2–6, 10, 12, 17–19, 21–23, 41, 42, 44, 47, 52*

Petitioner also challenges claims 2–6, 10, 12, 17–19, 21–23, 41, 42, 44, 47, and 52 of the '578 patent as unpatentable in view of a combination of the teachings of Matthies and Yamada. Pet. 6, 41–75. Petitioner presents an element-by-element mapping of the limitations of these claims to the relevant teachings of Matthies and Yamada and articulates reasons why a skilled artisan would have been motivated to combine these teachings as set forth in claims 2–6, 10, 12, 17–19, 21–23, 41, 42, 44, 47, and 52. *Id.*

For claims 2–4, 6, 10, 12, 17–19, 21–23, 42, and 47, Patent Owner relies on its arguments as to the rationale for the combination as discussed above (*see* Prelim. Resp. 12–40), but does not dispute Petitioner's showing that the cited art teaches all the limitations set forth in these claims (*see generally id.*). After considering the Petitioner's showing and for the reasons discussed above with regard to claim 1 and Patent Owner's arguments, we determine that Petitioner has sufficiently shown for purposes of institution a reasonable likelihood of prevailing in establishing the unpatentability of claims 2–4, 6, 10, 12, 17–19, 21–23, 42, and 47 of the '578 patent in view of a combination of the teachings of Matthies and Yamada.

Patent Owner sets forth additional arguments related specifically to claims 5, 41, 44, and 52 (*see id.* at 40–49). These claims recite additional limitations not present in claim 1 that are particularly related to relative distance between pixels. *See* Ex. 1001, 9:66–10:2, 13:36–41, 14:33–37, 15:27–35. Petitioner supports its showings as to claims 5, 41, 44, and 52 with citations to Matthies and Yamada. *See* Pet. 44–46, 59–60, 64, 68–69. Petitioner also supports these showings with the testimony of Dr. Pattison

that the additional limitations would have been “a routine, obvious design choice.” *Id.* at 46 (showing for claim 5 citing Ex. 1003 ¶ 277), 60 (showing for claim 41 citing Ex. 1003 ¶ 339), 64 (showing for claim 44 relying on showing for claim 41), 68–69 (showing for claim 52 relying on showing for claim 41). At this stage, Petitioner’s contentions are supported by Dr. Pattison’s testimony, whereas Patent Owner’s positions amount to attorney argument. As we are instituting trial as to all the challenged claims based on the showing as to claim 1, we feel that evaluating Petitioner’s showing with regard to these claims and their limitations related to the relative distance between pixels would be best accomplished in the context of a fully developed trial record.

E. Obviousness Ground Based on Matthies, Yamada, and Hong

Petitioner contends that claims 40, 43, 45-47, 51, and 52 would have been obvious over Matthies, Yamada, and Hong. Pet. 75–83. Patent Owner argues to the contrary. Prelim. Resp. 49–64.

1. Hong

Hong is a U.S. patent application publication directed to an “organic electroluminescent display (ELD) device” in which “aperture ratio and resolution are improved due to an arrangement of organic patterns in sub-pixel regions.” Ex. 1011 ¶ 3. Hong discloses each of first, second, and third organic patterns having a rectangular shape with two truncated corners. *Id.* ¶ 61. According to Hong, this allows the organic patterns to be made larger and “[a]s a result, an aperture ratio is . . . improved.” *Id.*

Petitioner notes that Hong published September 29, 2011 and was filed in the U.S. on August 13, 2010, and contends that Hong qualifies as prior art under 35 U.S.C. §§ 102(a) and (e). Pet. 18. Patent Owner does not

contest the prior art status of Hong. *See generally* Prelim. Resp. We determine that Hong qualifies as prior art under 35 U.S.C. §§ 102(a) and (e), because both Hong's filing date and publication date were before the earliest claimed priority date of the '578 patent, which is March 6, 2012. Ex. 1001, code (30); Ex. 1011, codes (22), (43).

2. Discussion

Claims 40, 43, 45–47, 51, and 52 recite additional limitations relating to the geometry of the pixels. For example, claim 40 recites:

40. The pixel arrangement structure of claim 1, wherein 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, and two connection portions that connect the two elongated sides to each other at respective ends, and wherein at least one of the two connection portions has a length that is greater than a shortest distance between the two elongated sides.

Ex. 1001, 13:26–35. The Petition provides an element-by-element mapping of the limitations of these claims to Matthies, Yamada, and Hong. *See* Pet. 76–82. Petitioner relies on Hong for its teaching of the use of elongated pixels with truncated corners in an OLED display. *See, e.g., id.* at 78 (citing Ex. 1006 ¶ 61, Fig. 9). With regard to motivation to combine the relevant teachings of Matthies, Yamada, and Hong, the Petition states:

A POSITA would have considered it obvious to employ an elongated, octagonal pixel with Matthies and Yamada. ([Ex. 1003] ¶ 479.) Again, Matthies itself already contemplates the use of various different pixel shapes, including elongated pixels. (*See* Ex. 1004, 8:50-52; 25:47-54; Fig. 3; Fig. 8A; Fig. 9.) So does Yamada. (Ex. 1005, 12:32-36.) And, many different types of pixel shapes were known and in routine use as of the '578 patent's filing. (Ex. 1003, ¶ 480-484.) A POSITA

would have considered the use of one pixel shape versus another to be nothing more than a routine, obvious design choice. (*Id.*, ¶ 483.) All pixel shapes capable of accommodating the inter-pixel electrical connections would have been considered. (*Id.*, ¶ 484.) And, while other shapes would also have been obvious to use, a POSITA would have considered the use of octagonal pixels with cut-off or truncated corners particularly desirable as they were known to “provide[] a good aperture ratio” and were easier to manufacture than square pixels. (*E.g.*, Ex. 1006, ¶ [0064].) Indeed, Hong itself says this, explaining that forming pixels with “truncated” corners improves “aperture ratio.” (*Id.*, ¶¶ [0003], [0011], [0061]-[0062].) Moreover, as another added benefit, this pixel shape also serves to “improve[]” “resolution” by minimizing the “shadowing effect” that can otherwise arise from closely situated pixels. (*Id.*, ¶¶ [0003], [0036], [0044], [0049], [0062].) This would further motivate use of this shape with Matthies and Yamada. (Ex. 1003, ¶¶ 485-490.)

Id. at 82–83. Thus, Petitioner articulates several benefits allegedly achieved by combining the relevant teachings of the cited art. *Id.* And, based on testimony by Dr. Pattison (Ex. 1003 ¶¶ 456, 483), Petitioner contends that the additional pixel geometry recited in these claims would have been a routine, obvious design choice. *See id.* at 77 (“A POSITA would have considered what this claim requires to be nothing more than a routine and obvious design choice.”), 82 (“A POSITA would have considered the use of one pixel shape versus another to be nothing more than a routine, obvious design choice.”).

Patent Owner again argues that there is no motivation to combine (*see* Prelim. Resp. 49–64) and contends that, “Petitioner fails to identify a motivation to combine [Matthies and Yamada] 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” (*id.* at 49). However, as shown above, Petitioner does articulate a motivation to combine Matthies, Yamada, and Hong. *See* Pet. 82–83. And, here again, at this stage, Petitioner’s contentions are supported by Dr. Pattison’s testimony, whereas Patent Owner’s positions amount to attorney argument. As we are instituting trial as to all the challenged claims based on the showing as to claim 1, we feel that evaluating Petitioner’s showing with regard to these claims and their limitations related to the geometry of the pixels would be best accomplished in the context of a fully developed trial record.

III. CONCLUSION

After considering the evidence and arguments presented in the current record, we determine that Petitioner has demonstrated a reasonable likelihood that it would prevail with respect to at least one of the claims challenged in the Petition. Accordingly, we institute an *inter partes* review on all of the challenged claims and all grounds presented in the Petition. At this stage of the proceeding, we have not made a final determination as to the patentability of any challenged claim.

IV. ORDER

Accordingly, it is

ORDERED that pursuant to 35 U.S.C. § 314, *inter partes* review is instituted as to claims 1–6, 10, 12, 17–19, 21–23, 40–47, 51, and 52 of the ’578 patent with respect to all grounds of unpatentability presented in the Petition; and

FURTHER ORDERED that *inter partes* review is commenced on the entry date of this Order, and pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial.

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