

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

**BOE Technology Group Co., Ltd.
Petitioner**

v.

**Optronic Sciences LLC
Patent Owner**

Inter Partes Review No.: IPR2024-01131

**PETITION FOR INTER PARTES REVIEW OF U.S. PATENT NO.
7,226,801 UNDER 35 U.S.C. §§ 311-319 AND 37 C.F.R. §§ 42.1-100, ET SEQ**

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INDEX OF EXHIBITS

Exhibit No.	Description
1001	U.S. Pat. No. 7,226,801 (“the 801 Patent”)
1002	File History of 7,226,801
1003	Declaration of Dr. Dean Neikirk
1004	Curriculum Vitae of Dr. Dean Neikirk
1005	U.S. Patent No. 7,538,488 (“Kwak”)
1006	Chinese Patent Publication CN 1538212A (“Zhang”)
1007	U.S. Patent No. 6,406,636 (“Vaganov”)
1008	U.S. Patent Publication 2003/0076452 (“Kim”)
1009	U.S. Patent No. 7,446,336 (“Yamazaki”)
1010	U.S. Patent Publication 2003/0209726 (“Shigeno”)
1011	U.S. Patent No. 7,786,496 (“Yamazaki 496”)
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1014	U.S. Patent No. 6,734,935 (“Kim 935”)
1015	U.S. Patent No. 7,538,039 (“Sasagawa”)
1016	U.S. Patent No. 6,011,608 (“Tanaka”)
1017	U.S. Patent No. 7,342,619 (“Arakawa”)
1018	U.S. Patent No. 8,076,782 (“Asai”)
1019	U.S. Patent No. 7,696,100 (“Maekawa”)

CHART OF CLAIM LANGUAGE	
1pre	A method for forming a sealant region pattern of a liquid crystal display, comprising:
1a	providing a first substrate and a second substrate opposite thereto;
1b	forming a predetermined material layer on the first substrate; and
1c	forming an organic material pattern layer having a saw tooth opening on the predetermined material layer to expose the surface of the predetermined material layer underneath, wherein the surface of the predetermined material layer and the sidewall of the organic material pattern layer form a predetermined angle.
2	The method of claim 1, wherein the predetermined angle is less than about 60 degree.
3	The method of claim 1, wherein the predetermined angle ranges from about 20 degree to about 30 degree.
4	The method of claim 1, wherein the predetermined material layer comprises a passivation layer.
5	The method of claim 1, wherein the predetermined material layer comprises a metal electrode layer.
6a	The method of claim 1, wherein formation of the organic material pattern layer comprises: forming an organic material layer on the predetermined material layer; and patterning the organic material layer to form the saw tooth opening therein;
6b	wherein the organic material pattern layer comprises a plurality of segments adjacent to the saw tooth opening, and the respective height of the plurality segments gradually increases with respect to the distance from the saw tooth opening.
8	The method of claim 6, wherein the organic material layer comprises polymethyl methacrylate (PMMA) or photosensitive-methylsilsequiazane (PS-MSZ).
9pre	A sealant region pattern for a liquid crystal display, comprising:
9a	a first substrate and a second substrate opposite thereto;
9b	a predetermined material layer formed on the first substrate; and
9c	an organic material pattern layer having a saw tooth opening formed on the predetermined material layer to expose the surface of the predetermined material layer underneath, wherein the surface of the predetermined material layer and the sidewall of the organic material pattern layer form a predetermined angle.

10	The sealant region of claim 9, wherein the predetermined angle is less than about 60 degree.
11	The sealant region of claim 9, wherein the predetermined angle ranges from about 20 degree to about 30 degree
12	The sealant region of claim 9, wherein the predetermined material layer comprises a passivation layer.
13	The sealant region of claim 9, wherein the predetermined material layer comprises a metal electrode layer.
14	The sealant region of claim 9, wherein the organic material layer comprises polymethyl methacrylate (PMMA) or photosensitive-methylsilsesquiazane (PS-MSZ).

I. INTRODUCTION

BOE Technology Group Co. Ltd. (“Petitioner”) requests *inter partes* review of claims 1-6 and 8-14 (“Challenged Claims”) of U.S. Patent No. 7,226,801 (“’801 patent,” EX1001), owned by Optronic Sciences LLP (“PO”), pursuant to 35 U.S.C. §§311–19 and 37 C.F.R. §42.100.

II. STATEMENT OF PRECISE RELIEF REQUESTED

In accordance with 35 U.S.C. § 311, Petitioner requests cancellation of claims 1-6 and 8-14 of the ’801 patent in view of the following grounds:

Ground	Claims	Stat. Basis	Prior Art
1	9	35 U.S.C. § 102	Kwak
2	1-6, 8-14	35 U.S.C. § 103	Kwak
3	2, 3, 6, 10, 11	35 U.S.C. § 103	Kwak, Vaganov
4	2, 3, 6, 8, 10, 11, 14	35 U.S.C. § 103	Kwak, Kim
5	2, 3, 6, 10, 11	35 U.S.C. § 103	Kwak, Yamazaki
6	1-6, 9-13	35 U.S.C. § 103	Zhang
7	2, 3, 6, 10, 11	35 U.S.C. § 103	Zhang, Vaganov
8	2, 3, 6, 10, 11	35 U.S.C. § 103	Zhang, Yamazaki

This Petition is supported by the declaration of Dr. Dean Neikirk. EX1003.

III. THE 801 PATENT

A. Overview of the 801 Patent

The ’801 patent discloses methods for implementing a sealant region in liquid crystal displays. EX1003, ¶¶38-42. It discloses a first substrate, a

predetermined material layer, an organic material pattern layer, and a second substrate. EX1001 Fig. 1C. The '801 patent describes creating an opening in the organic layer to expose the underlying predetermined material layer, wherein the sidewalls of the opening form a predetermined angle and the opening is formed in a sawtooth pattern. *Id.* Figs. 1A, 1B, 2A.

B. Overview of the 801 patent's File History

On June 27, 2005, PO filed TW 94121405A. EX1001, cover.

On December 28, 2005, PO filed U.S. Appl. No. 11/319,839. *Id.*

On October 6, 2006, a non-final rejection issued. EX1002, 26-29.

On January 5, 2007, PO responded. EX1002, 17-23.

On April 3, 2007, a notice of allowance issued.

C. Person of Ordinary Skill in the Art

A person of ordinary skill in the art ("POSITA") at the time of the alleged invention of the '801 patent June 27, 2005 would have had a Bachelors' degree in electrical or mechanical engineering or a comparable field of study, plus approximately two to three years of professional experience with electronic and optoelectronic device design or other relevant industry experience. Additional graduate education could substitute for professional experience, and significant experience in the field could substitute for formal education. EX1003, ¶¶34-37.

D. Claim Construction Under 37 C.F.R. § 42.104(b)(3)

The Challenged Claims are interpreted using the same claim construction standard that is used to construe the claim in a civil action in federal district court. 37 C.F.R. § 42.100(b).

The prior art asserted herein discloses the challenged claims within the indisputable scope of the claims, and the Board need not construe the outer bounds of the claims as part of these proceedings. All claim terms should be construed according to their plain and ordinary meaning to a POSITA at the time of the '801 patent. The district court may have to address other bounds of the claims in addressing infringement. *See, e.g., Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

1. “a predetermined angle” (all claims)

“Predetermined angle” is entitled to its full breadth and is not limited to any particular range of angles. EX1003, ¶¶50-54. The ordinary meaning of “predetermined angle” is not limited to any particular range of angles. Certain dependent claims claim a limited range of predetermined angles, confirming the term “predetermined angle” by itself is not so limited. *See* EX1001, claims 2 and 10 (“less than about 60 degree”), claims 3 and 11 (“ranges from about 20 degree to about 30 degree”), claim 6 (increasing segment height). This is consistent with the

specification's numerous uses of the term “predetermined,” including describing a “predetermined material layer” and then providing specific materials the layer may comprise. *Id.*, 2:46-55 (the predetermined material layer may comprise a “silicon nitride layer,” “silicon oxynitride, silicon oxide, organic dielectric layer, or a combination thereof”), 2:27-30 (same). In addition to angles and material layers, the specification also refers to “a predetermined pattern” (*Id.*, 2:56-65) and “a predetermined sealant” (*Id.*, 3:22-26) in the same manner.

The specification states that certain advantages cannot be achieved by predetermined angles in excess of 60° (*id.*, 2:37-40), and discloses various ranges of angles. *Id.*, 3:15-21. But the disclosed advantages are not claimed—only a subset of the disclosed examples are claimed by certain dependent claims—and these statements do not otherwise rise to the level of definition or disclaimer. The prosecution history is silent on this issue.

IV. OVERVIEW OF THE PRIOR ART

A. EX1005 – Kwak

U.S. Patent No. 7,446,336 (“Kwak”) was filed on 2/4/2005 and was granted on 5/26/2009. Kwak is prior art at least under 35 U.S.C. §§ 102(e).

Kwak is directed to improving “sealing function” and reducing “degradation caused by moisture.” EX1005, 2:53-56, 1:15-18; EX1003, ¶¶55-57. Kwak explains adhesion can be improved by implementing holes that extend through the organic

protective layer to the underlying inorganic layer. These opening would allow the sealant to contact both the inorganic and organic layers and “compensate[] for any weakness in the adhesion between the sealant 810 . . . and the protection layer 180 . . .” EX1005, 9:58-10:4; *see also id.* 2:53-56. Kwak also explains that increasing the contact area with the sealant improves the seal strength. *Id.*, 9:1-12, 9:58-10:4. Increasing the depth of the openings “increases [] the adhesive strength between the [substrates].” EX1005, 10:50-53, Figs. 3A-C. Kwak’s holes 811 would “enhance[] protection against moisture infiltration.” *Id.* at 11:46-53. Kwak recognized that angled openings in the sealant region would increase the contact area between the sealant and the various layers, thus increasing the bond strength. *See id.* EX1003, ¶¶56-57. The angled openings also improve reliability by preventing moisture infiltration.

B. EX1006 – Zhang

Chinese Patent No. CN1538212A (“Zhang”) was filed on 10/22/2003 and published on 10/20/2004. Zhang is prior art at least under 35 U.S.C. § 102(a).

Zhang teaches a liquid crystal “display panel frame adhesive structure with superior bonding strength.” EX1006, 4; EX1003, ¶¶58-68. Figures 1A-B depict a “conventional liquid crystal display panel” and Figures 2A-B depict “a conventional reflective liquid crystal display panel.” EX1006, 4-5, 8. Figure 1A

depicts a frame adhesive area 140 that is uniform around the periphery of the display. EX1006, 4, Fig. 1A.

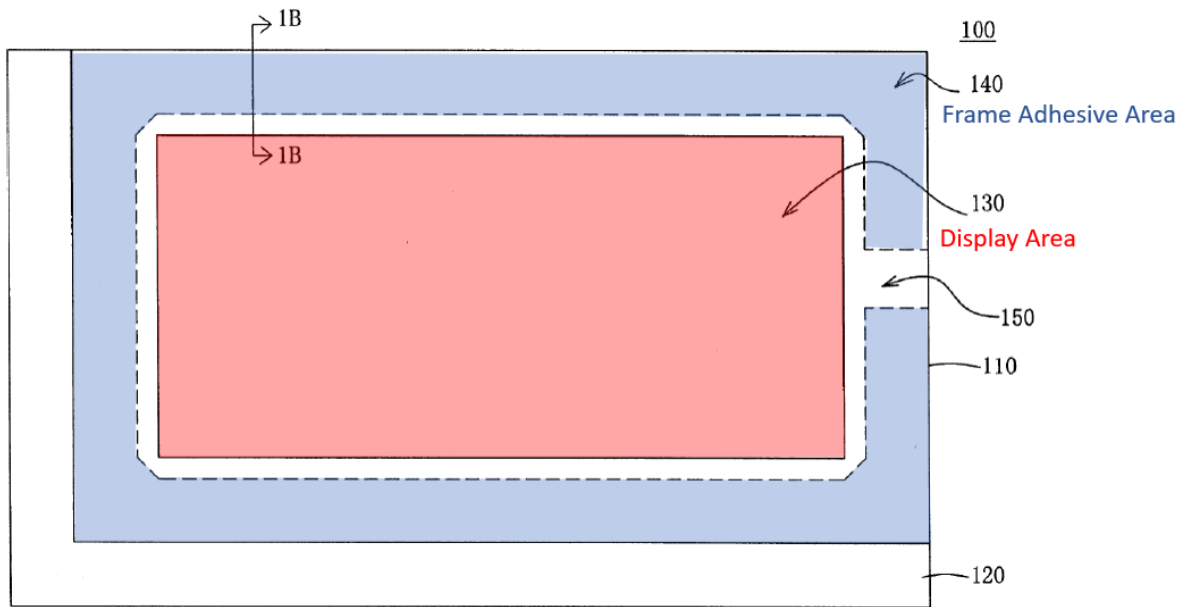


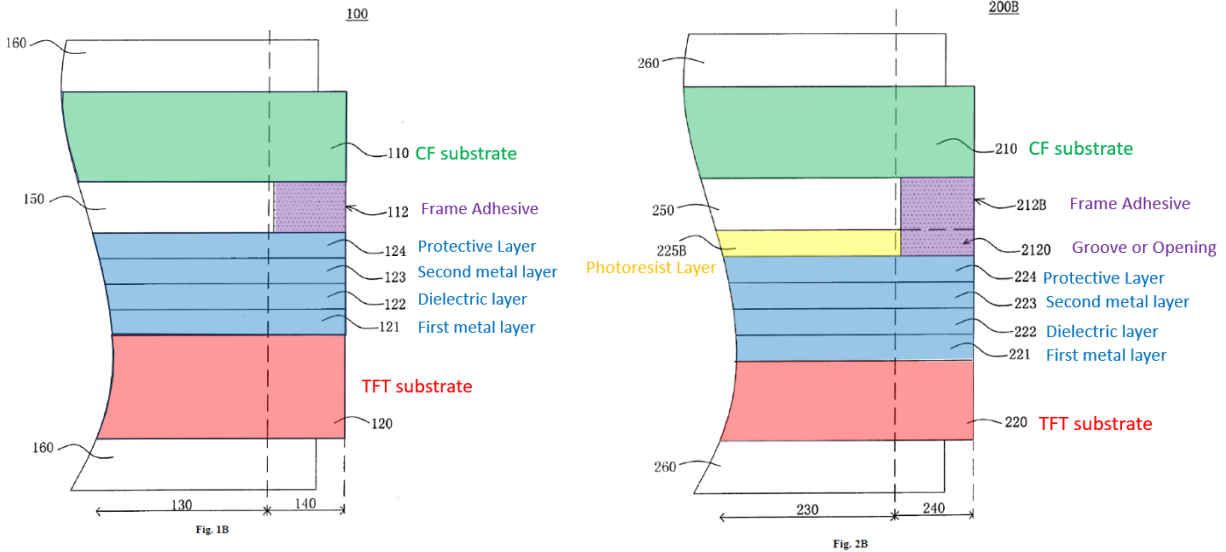
Fig. 1A

1

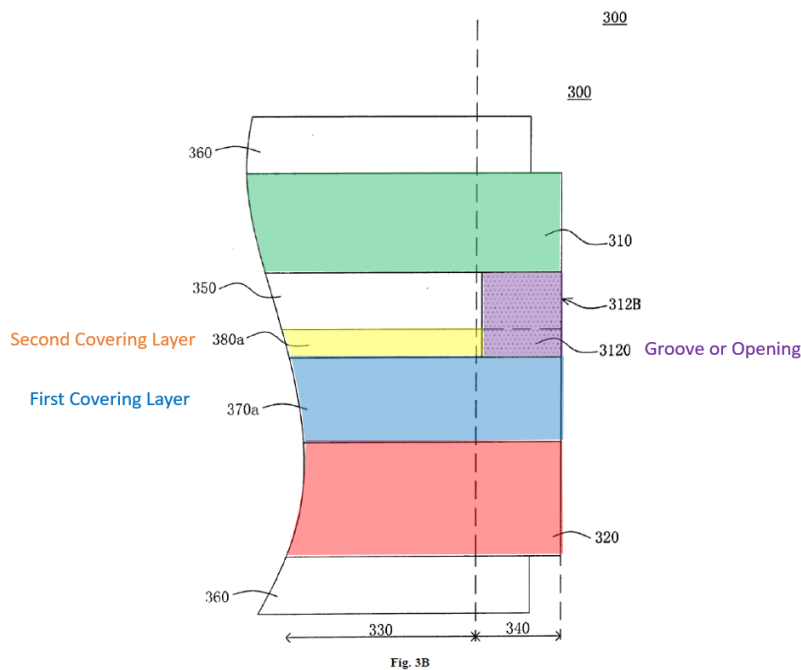
Zhang teaches that conventional LCDs included a TFT substrate (120 and 220) opposite a color filter substrate (110 and 210). EX1006, 4-6, Figs. 1B, 2B. Zhang also teaches that conventional LCDs may comprise multiple layers between these substrates, including a first metal layer (121 and 221), a dielectric layer (122 and 222), a second metal layer (123 and 223), a protective layer (124 and 224), and, in the case of conventional reflective LCDs, an organic photoresist layer (225B). EX1006, 4-6, Figs. 1B, 2A-2B. Conventional LCDs also included frame

¹ Unless otherwise noted the figures in this petition are annotations of the original figures from the corresponding reference.

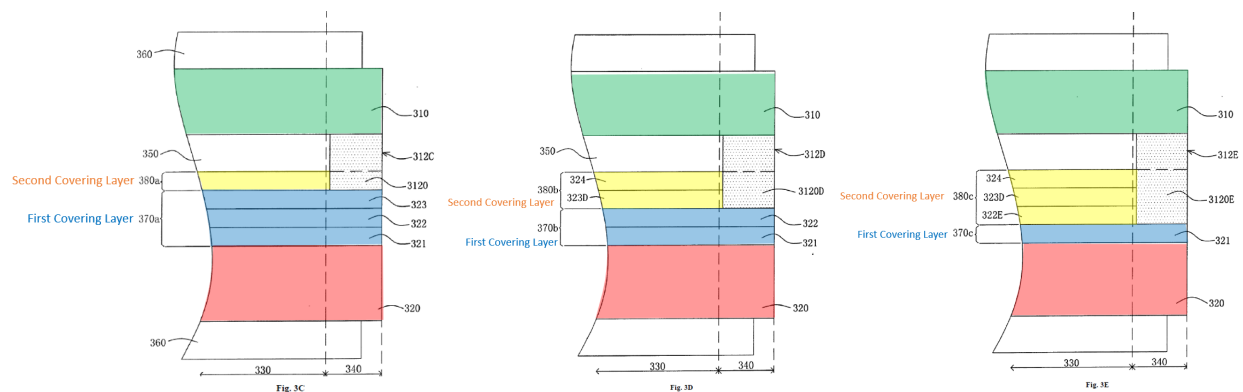
adhesive (112 and 212B), and conventional reflective LCDs also included an opening (2120) through the photoresist layer (225B) exposing the underlying protective layer (224). EX1006, 6, Figs. 2B.



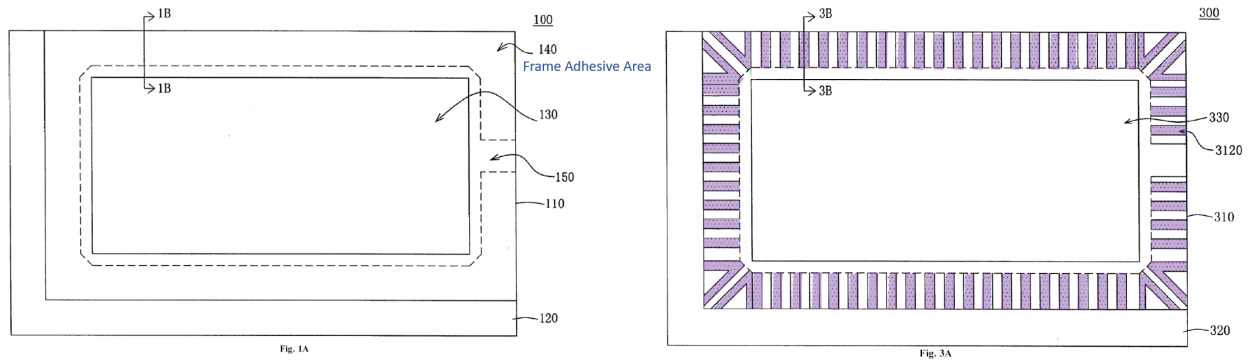
Zhang describes a groove or opening in a second covering layer to expose an underlying first covering layer as depicted in Figure 3B. *See, e.g., id.* at cl. 1.



Zhang does not require that the first or second cover layers comprise specific material or layers. Instead, it describes examples of the first and second covering layers comprising different combinations of layers, including a protective layer, a dielectric layer, and metal layers. EX1006, 9-10, Figs. 3C-3E. Zhang also teaches that “enlarging the openings successively to lower layers achieves the goal of increasing the contact area of the frame adhesive, enabling more adhesive to penetrate into the openings and thus enhancing the bonding strength between the [substrates].” EX1006, 9.



Zhang’s grooves or openings in the second covering layer can take many forms. See EX1006 11, Figs. 3A, 5A, 5B, cls. 5, 7, 8. For example, Figure 3A depicts the additional “elongated” grooves or openings 3120, which extend below the conventional adhesive area depicted in Figure 1A in an alternating pattern. EX1006, 8-10; EX1003, ¶¶65-68.



Zhang discloses that “the shape of the groove or opening . . . is not limited to a specific type” and “can [] be X-shaped [as shown in Figure 5A] or matrix-shaped [as shown in Figure 5B].” EX1006, 11, Figs. 5A-B.

Zhang teaches “provid[ing] a display panel frame adhesive structure with greater bonding strength.” *Id.*, 7. “By increasing the contact area of the frame adhesive, more frame adhesive can penetrate into grooves or openings, thereby increasing the bonding strength between [substrates].” *Id.*; *see also id.* 1, 8, 9. Zhang recognized that bond strength may be increased by increasing the surface area by creating vertical, angled openings through subsequent layers. The increased space occupied by the frame adhesive “can prevent the occurrence of cracks at the interface between the [substrates] . . . , thereby effectively improving the quality of the panel.” *Id.*, 1. Zhang’s invention “allows the structure to withstand greater external impact or vibration forces, avoiding the generation of damaging cracks between the CF substrate and the TFT substrate, thus affecting the display quality of the panel.” *Id.*, 7.

C. EX1007 – Vaganov

U.S. Patent No. 6,406,636 (“Vaganov”) was filed on 6/2/1999 and issued 6/18/2002. Vaganov is prior art at least under 35 U.S.C. §§ 102(a), (b), and (e).

The methods and techniques described in Vaganov are directed to, among other things, “increasing mechanical strength” by “microprofiling the bonding area,” “providing a larger bonding surface area,” and “increasing the bonding force due to the partial substitution for pull force of shear force.” EX1007 2:57-3:14; EX1003, ¶¶69-73. Vaganov “increase[es] mechanical strength” by using microstructures with angled sidewalls in the bonded surfaces. *See* EX1007 2:57-3:14, 3:29-33 (“increase total bonding surface area and therefore increase mechanical strength and hermeticity of the bond”), 4:50-5:13, 5:31-39 (discussing replacing tensile stress with shear stress), 5:58-67. Vaganov discloses how microstructures, including those with angled sidewalls, may solve reliability issues stemming from “delamination due to insufficient adhesion, cracking or breakage.” *Id.* 6:1-16.

Vaganov describes techniques that were well-known in the art for creating a variety of predetermined angles, including 90°, 54°44′, 45°, and 35°16′. *See id.*, 10:23-12:42, 12:46-52, Figs. 36-55. The reference also teaches that the dimensions and angles of any given opening are determined by the processes used and by design considerations. *Id.*, 5:14-22, 10:23-51, 12:46-53. Vaganov explains that no

specific dimensions are required and provides examples of dimensions that would result in an angle less than 30°. *Id.*, 2:57-3:14, 5:14-22; EX1003, ¶¶72-73.

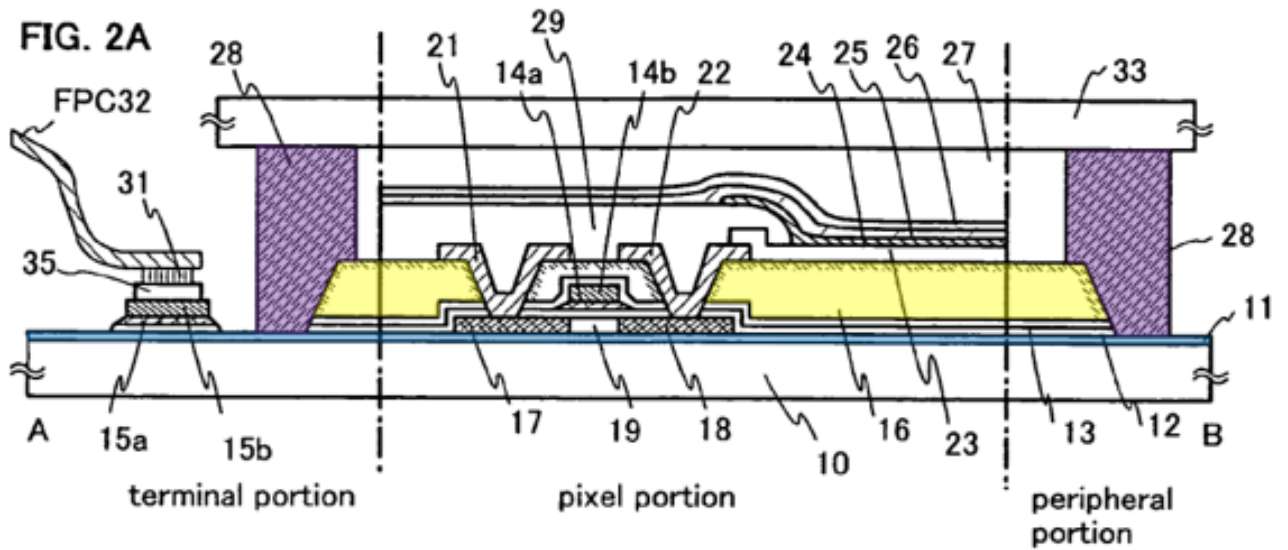
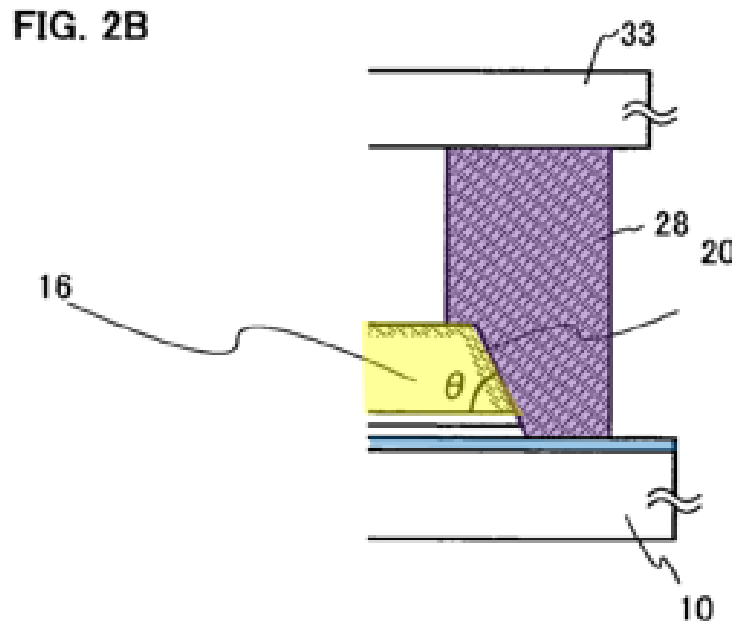
D. EX1008 – Kim

U.S. Patent Publication No. 2003/0076452 (“Kim”) was filed on 10/17/2002, published on 4/24/2003, and issued 9/18/2007. Kim is prior art at least under 35 U.S.C. §§ 102(a), (b), and (e).

Kim describes forming openings in an organic layer comprising sidewall angles between 30-60° to expose multiple various underlying layers. *See, e.g.*, EX1008, 0010, 0055-0065, 0072, 0106, 0119, Figs. 3, 9, 11, 12, 21A; EX1003, ¶¶74-75. Kim explains that creating openings with such angles allows for the smooth creation of later layers formed on top of the organic layer. EX1008, 0062, 0074, 0085. In this way, the organic insulating layer may remain sufficiently thick while simultaneously allowing for better contacts through the openings. *Id.*

E. EX1009 – Yamazaki

U.S. Patent No. 7,446,336 (“Yamazaki”) was filed on 8/26/2004 and issued 11/4/2008. Yamazaki is prior art at least under 35 U.S.C. §§ 102(a) and (e).



Yamazaki discloses an LCD device with sealant (28) between two opposing substrates (10 and 33) where the sealant is formed on an angled opening in a planarizing film 16 to expose an underlying insulating layer 11. EX1009, Figs 2A-B, 3A-B, 8A-B, 9, 10A-B, 11; EX1003, ¶¶76-79. Yamazaki discloses an LCD

device with a sealant region comprising an organic planarizing film with an opening exposing the underlying insulating layers, where the opening has an “angle θ more than 30° and less than 75° .” *See* EX1009, 1:8-64, 4:1-20, 4:32--5:2, 5:43-49, 7:24-29, 8:28-33, 11:15-12:12, 12:45-48, 19:47-63, Figs 2A-B, 3A-B, 5A-C, 6, 8A-B, 9, 10A-B, 11. “[T]he high thermostability planarizing film is an SiO_x film containing an alkyl group,” and the side of the planarizing film 16 “is formed to have a . . . taper angle θ more than 30° and less than 75° . *Id.*, 4:64, 5:2, 5:43-49, 7:24-29, 12:45-48, 15:10-11, Fig. 2B. Thus, the angled sidewall of organic planarizing film 16 and the underlying insulating layers 11, 12 and 13 form an angle between 30° - 75° . *Id.*; EX1003, ¶¶77-79.

The planarizing film of Yamazaki comprised organic material. EX1003, ¶77; *see* EX1009, 11:15-19, 4:48-5:2 (explaining that planarizing film “has at least one kind of hydrogen, fluorine, an alkyl group or aromatic hydrocarbon as a substituent”), 11:20-12:12, Figs. 5A-C, 6. The planarizing film of Yamazaki would be implemented in liquid crystal displays. EX1003, ¶78; *see, e.g.*, EX1009, 1:8-64, 4:32-47, 8:28-33 (using planarizing film to prevent defects in a liquid crystal display), 19:47-63, Fig. 11.

The reference teaches a solution to known issues with moisture or oxygen intrusion in traditional liquid crystal displays. *See e.g., id.*, 1:8-3:25, 2:66-3:25, 4:1-20, 19:9-14; EX1003, ¶79. Yamazaki 366’s solution includes the use of “a high

thermostability planarizing film, typically, an interlayer insulating film” where an “edge portion or an opening portion is formed to have a tapered shape.” *Id.* 3:46-67. Implementing a planarizing layer with a tapered slope in the sealant area would have decreased moisture intrusion and chances of delamination in the display device. “[P]referably, the edge portion of the high thermostability planarizing film is covered with the sealant so as to overlap with the pattern of the sealant.” EX1009, 4:5-20. “When the sealant is arranged so as to cover the side surface of the . . . planarizing film, [a] display device with high reliability can be obtained by shielding intruding moisture or oxygen which causes deterioration . . .” *Id.*, 5:50-59. “[A]dding an inert element” to the sidewall will create a high density surface “for preventing the intrusion of moisture or oxygen.” *Id.*, 3:46-67, 4:1-20 (“Further, intrusion of moisture or oxygen is prevented by forming the edge portion of the high thermostability planarizing film to have a tapered shape and adding an inert element there to highly densify.”), 12:34-63. Yamazaki teaches the use of a taper angle between 30° and 75° to facilitate doping the sidewall with the inert element. *Id.*, 12:45-48, 12:60-63.

F. State of the Art

1. Implementations of angled openings in an organic layer

Shigeno discloses an LCD device with sealant (105) between two opposing substrates (10 and 102) where the sealant enters into an opening (52) through a

thick organic resin film (5) where the inner wall slope of the opening is about 45° to expose the underlying layer 31a. EX1010, 0071-0083, 0113, 0168, Fig. 4, 14, 32 EX1003, ¶80. Shigeno further discloses that these components would be utilized in liquid crystal display devices. See EX1010, 0005, 0011, 0024, 0089, 0106, 0124-125, 0212-213, cl. 5.

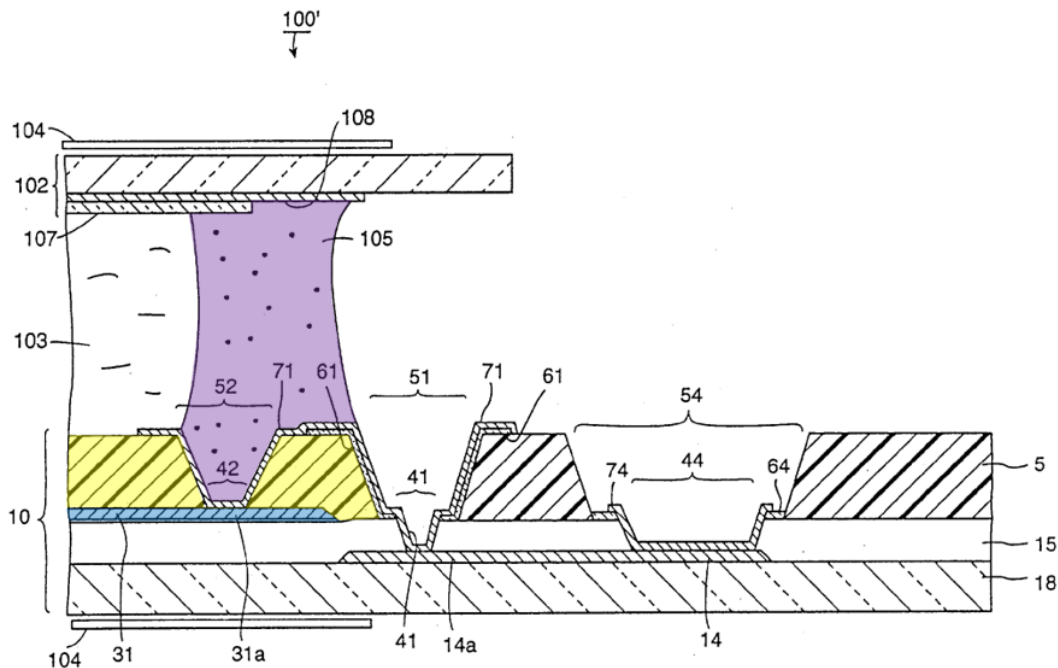
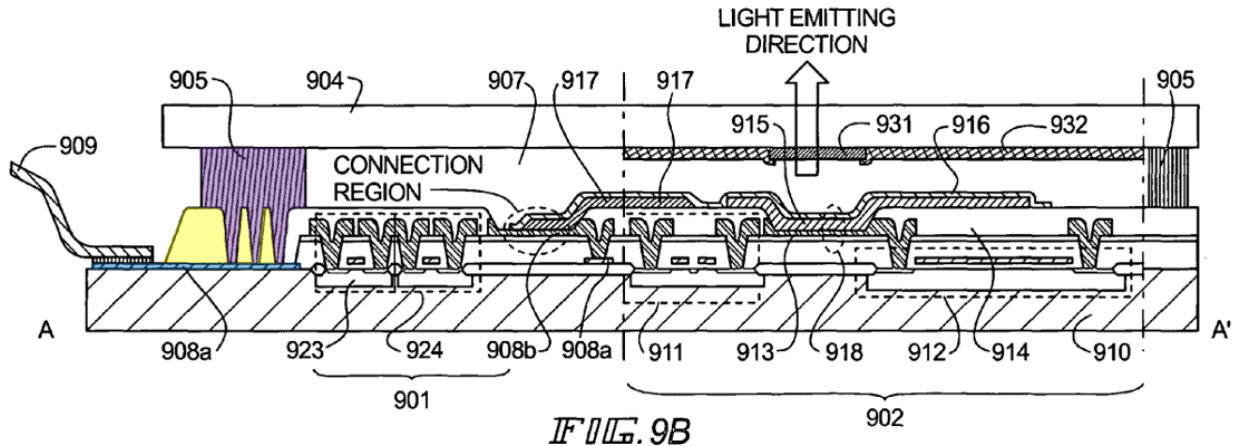


FIG.4

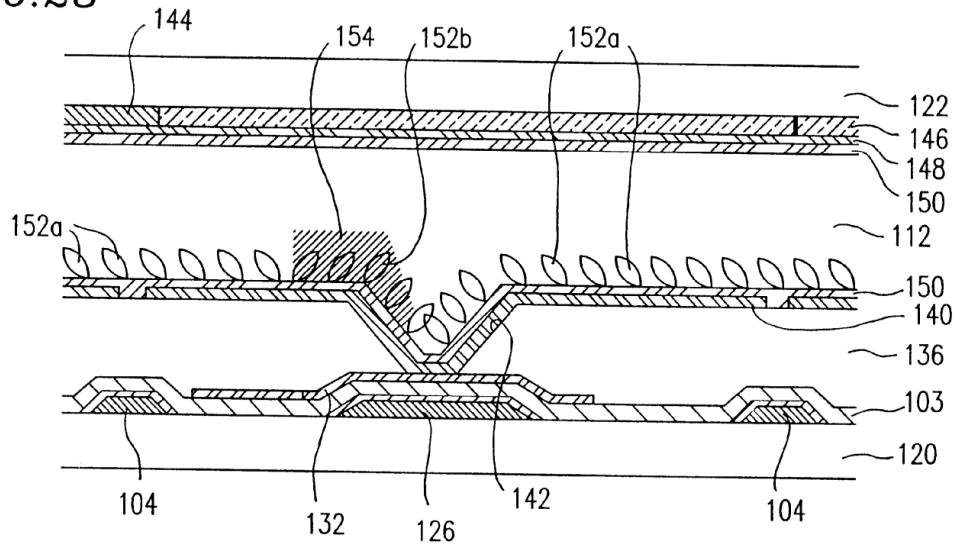
Yamazaki 496 discloses a display device with sealant (728) between the periphery of two opposing substrates (710 and 733) where the sealant enters into one or more angled openings in an insulation layer. EX1011, 19:16-21:33, Fig. 9B; EX1003, ¶81. The insulation layer taught by Yamazaki 496 may include “a photosensitive or non-photosensitive organic material (polyimide, acrylic, polyamide, polyimideamide, resist, or benzocyclobutene)” and have a “taper

angle” from “35° to 55°.” *See id.*, 4:17-29, 8:43-53, 10:20-24, 15:3-13, 15:43-53, 16:23-39, 16:48-54.



Shimada 722 discloses an LCD panel comprising openings in an acrylic resin interlaying insulating film 136 that expose the underlying layers where the “angle θ of an inclined inner wall of each contact hole 142 is preferably between about 45° or more and less than about 65°.” EX1012, 18:47-19:20, Figs. 2A, 11A, 14A, 17, 20, 23, 28; EX1003, ¶¶82-83. A POSITA would have understood that the interlayer insulating film comprising “acrylic resin or the like” would comprise an organic layer. *Id.*, 10:50-54, 18:47-54; EX1003, ¶¶82-83. Shimada 722 describes an insulating film formed with a thickness approximately 2-4 μm and contact holes with a diameter of 3.5-6 μm . *Id.* An embodiment with a hole diameter of 6 μm and a thickness or depth of 2 μm would result in an angle of approximately 30°. EX1003, ¶¶82-83.

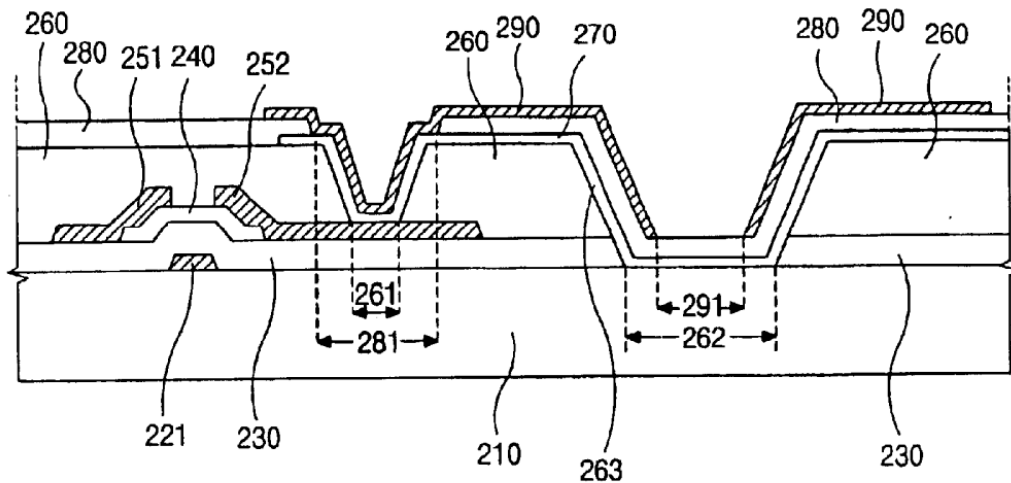
FIG. 28



Shimada 376 discloses an LCD comprising a photo-sensitive acrylic resin inter-layer insulating film 9 with contact holes 10 that expose the underlying layers. EX1013, 1:52-60, 4:51-5:25, 7:52-59, 8:30-36, 8:61-66, Figs. 3, 5, 10; EX1003, ¶84. A POSITA would have understood the disclosed acrylic resin would comprise an organic layer. *See e.g., id.*, 8:30-36 (“photosensitive acrylic resin . . . was used as a material for the inter-layer insulating film”), 8:61-9:2 (same as well as “benzocyclobutene”), cl. 2; EX1003, ¶84. The sidewalls of contact hole 10 are typically between 45° and 60°. *Id.* Shimada 376 discloses that smaller angles are possible based on temperature gradient (Table 1) and pre-baking temperature (Table 2). *Id.*, 6:4-60, 8:25-60.

Kim 935 discloses an LCD device comprising opposing substrates (10 and 30), and an interlayer/passivation layer formed from a photosensitive resin and including openings exposing the underlying layers, such as transparent electrode

13. EX1014, 5:23-57, 7:41-8:30, Figs. 2, 5, 7-10; EX1003, ¶85. The inclined portion 17 may have an angle “within a range of about 20 to 110 degrees.” *Id.* 6:22-28, 6:49-53, 9:5-16; *see generally id.*, 8:35-9:57. A POSITA would have understood the disclosed passivation layer would comprise an organic layer. EX1003, ¶85; *id.*, 5:31-33, 6:28-29 (“The first passivation layer includes one of a benzocyclobutene (BCB) and a photosensitive acrylic resin”), 6:53-54, 8:1-3, 9:40-45, 10:6-14, 10:58-67, cl. 5.



2. Known techniques for creating openings with specific angles

Vaganov describes known etching techniques, such as anisotropic etching, reactive ion etching, isotropic plasma etching, sidewall masking, and combinations of the same. *See* EX1007 10:23-12:42, Figs. 36-54; EX1003, ¶86. These known techniques were capable of creating a variety of predetermined angles, including

90°, 54°44'', 45°, and 35°16''. *See id.* Vaganov teaches “standard etching processes of types well known in the art. EX1007 12:46-52, Figs. 36-55.

Other references describe using commonly known photolithography methods to create a mask pattern with a tapered side edge angle between 50° to 80°. *See* EX1015, 6:23-41; EX1008, 0132 (referring to using a mask and slit pattern to form angled openings in an underlying organic layer); EX1003, ¶87.

FIG. 5

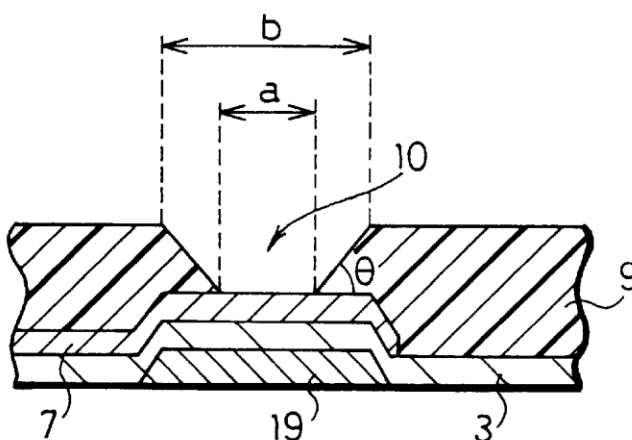


TABLE 1

Temperature gradient [° C./minute]	Tilt angle θ [degree]	b/a
5	55	2.3
10	45	2.8
15	35	3.6

TABLE 2

Pre-baking temp. [° C.]	Tilt angle θ [degree]
90	50
95	45
100	35

3. Known benefits of utilizing predetermined angles

Tanaka describes that it was well known to remove an organic insulating film from the sealant area using “obtuse angles” of the opening to “ensure good adhesion” between substrates. EX1003, ¶88; EX1016 1:49-53, Fig. 7, 8; *see also id.* 2:43-60, cl. 9. For example, Tanaka explains that the “the end surface of each organic insulating film is formed So as to make an obtuse angle with respect to the Surface of the array Substrate, facilitating contact between the end surface of each organic insulating film and the sealant.” EX1016, 6:60-67.

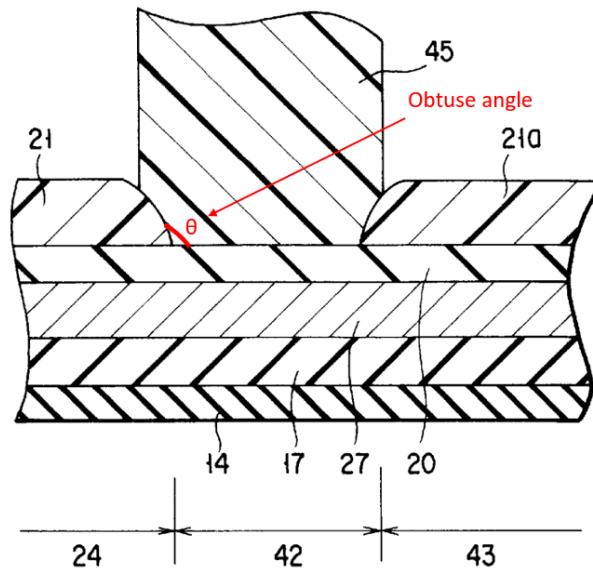


FIG. 7

A POSITA would also have understood that the use of angle openings in the organic layer stabilizes the sealant by providing a trench or opposing barriers for the sealant. EX1003, ¶88; EX1016 1:65-67, 2:43-60, 6:50-67; 7:13-17.

Miyoshi describes how angles larger than 60° may cause the upper layers “to be thin at the boundary (i.e., the end) of the insulation layer.” EXMIYOSHI 29:42-60; EX1003, ¶89. Miyoshi provides test results indicating the benefits of taper angles less than 60° and as low as 30°. *Id.* Table 1.

4. PMMA was a common component in LCD manufacture

PMMA was a well-known compound at the time of the ’801 patent that was widely used in the manufacture of electronics and displays. EX1003, ¶¶90-91. PMMA was also known to a POSITA by generic names, such as “acrylic” or “acrylic resin.” *Id.* For example, U.S. Patent No. 7,342,619 to Arakawa et al. discusses LCD panels using “acrylic resins such as polymethyl methacrylate (PMMA).” EX1017, 14:59-63, 14:10-13. U.S. Patent No. 8,076,782 to Asai et al. describes “acrylic resin such as PMMA (polymethyl methacrylate).” EX1018, 18:38-44, 25:31-36. U.S. Patent No. 7,696,100 to Maekawa describes “a thermoplastic resin . . . such as poly(methyl methacrylate) (PMMA)” and using “PMMA for the insulating film.” EX1019, 4:59-5:3.

V. GROUND 1: CLAIM 9 IS ANTICIPATED BY KWAK²

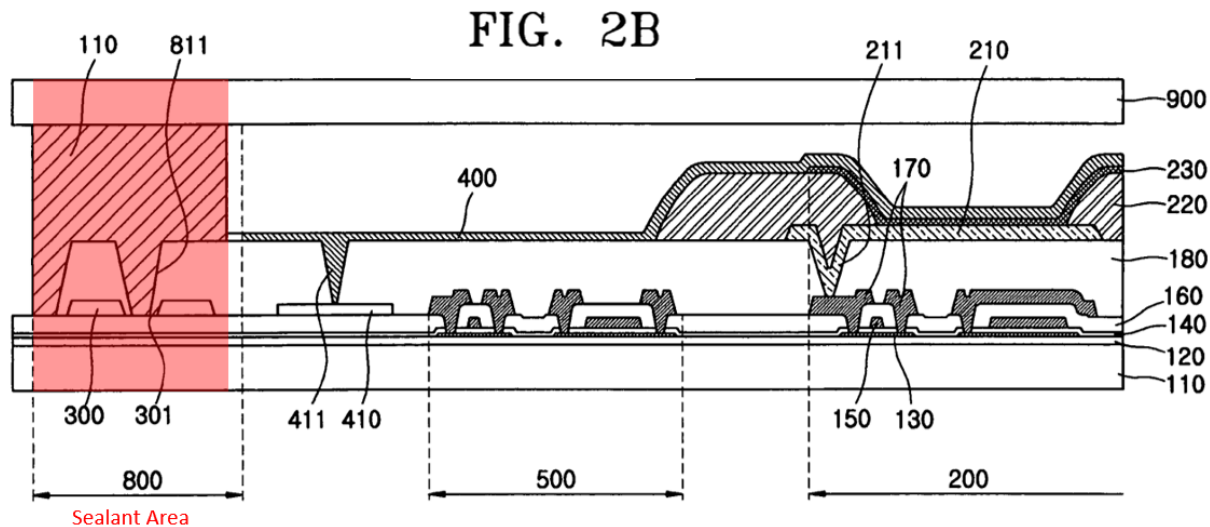
A. Claim 9

Kwak anticipates Claim 9. EX1003, ¶¶92-100.

² For the grounds discussed, the petition will address system claims 9-14 first, followed by method claims 1-8.

1. [9pre]

To the extent the preamble is limiting, Kwak discloses “[a] sealant region pattern for a liquid crystal display [liquid crystal display panel 300].” EX1005, 11:30-38, Figs. 1B, 2A-D, 3A-C, 4A-C, 5A-E; *see also id.*, 2:53-3:22, 3:54-5:2, 5:38-52, 8:21-10:4, 10:21-36, 11:56-69, cls. 1, 10-15, 22, 25-26. Kwak discloses a “flat panel display” that comprises “a sealing portion 800 applied to an outer edge of the display area 200 to seal the [substrates].” *Id.*, 6:46-60. The patent also states that its embodiments “can be applied to other types of flat panel displays, such as liquid crystal displays (LCDs).” *Id.*, 11:30-38.

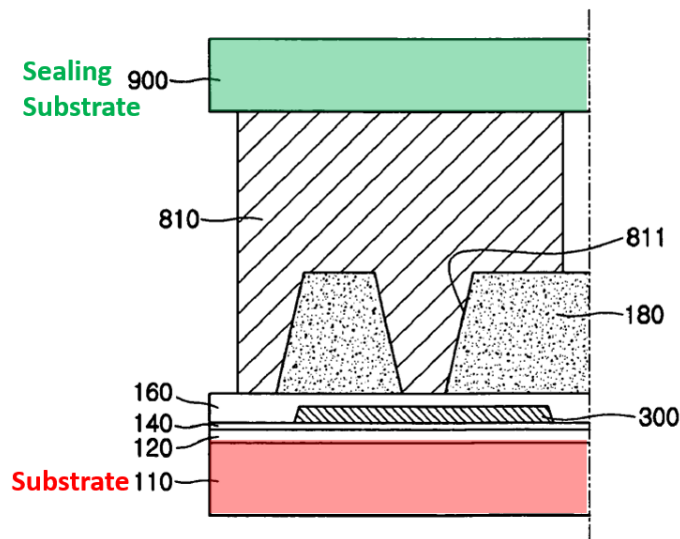


³ Figure 2B of Kwak contains a typographical error in which sealant 810 is given the same moniker (110) as substrate 110. All other figures and the specification correctly label sealant 810.

2. [9a]

Kwak discloses “a first substrate [substrate 110] and a second substrate [sealing/encapsulation substrate 900] opposite thereto.” EX1005, 6:52-60, Figs. 2B-D, 3A-C, 4A-C; *see also id.*, 9:58-10:4, 10:36-62, cls. 1, 10-15, 22, 25-26. Substrate 110 and sealing substrate 900 are opposite of one another within the display. *See id.*

FIG. 2D



3. [9b]

Kwak discloses “a predetermined material layer [interlayer 160, gate insulating layer 140, buffer layer 120, or a combination of the same] formed on the first substrate [substrate 110].” EX1005, 6:52-60, Figs. 2B-D, 3A-C, 4A-C. Kwak discloses that the disclosed buffer layer, gate insulating layer, and interlayer may be comprised of inorganic material. *See* EX1005, 3:9-3:49, 3:66-30, 4:54-5-8, 5:15-32, 5:54-6:6, 9:58-10:4, 10:21-62, 11:46-53, cls. 5-7, 10-15, 17-19, 22, 25-28.

Kwak further discloses “a gate insulating layer 140 [comprising] SiO₂” and an “interlayer 160, which can be a single layer or a double layered structure [] formed of a material, such as SiO₂ or SiN_x.” *Id.*, 7:3-24, 10:21-36.

FIG. 2D

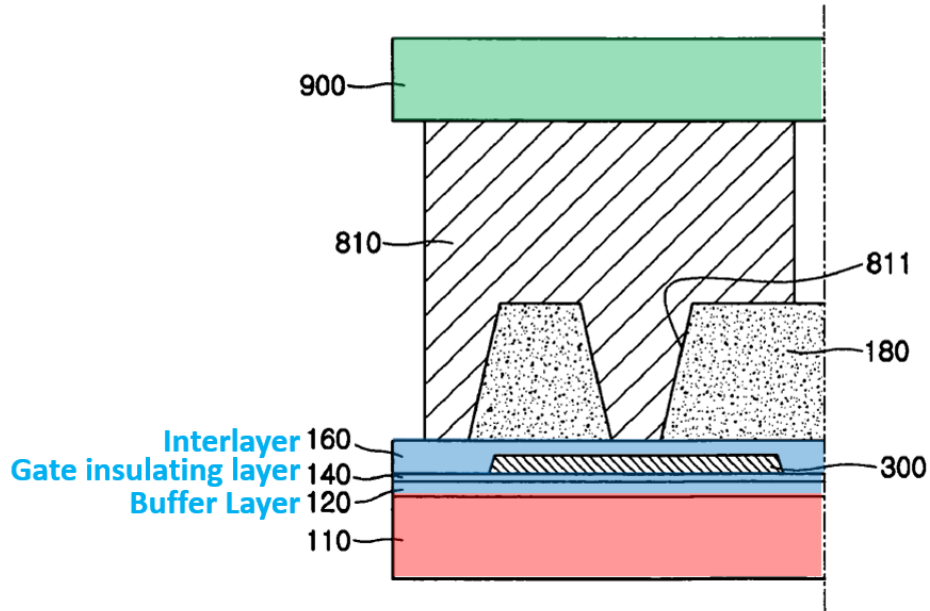


FIG. 3A

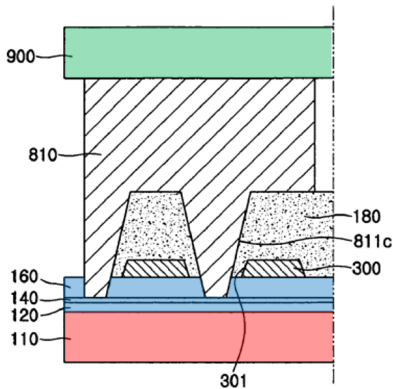


FIG. 3B

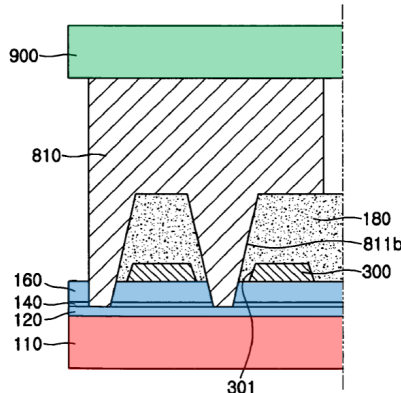
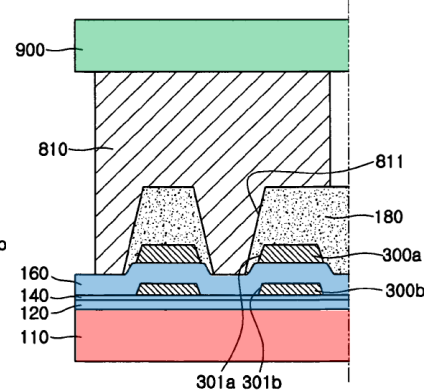


FIG. 4A



4. [9c]

Kwak discloses “an organic material pattern layer [protection layer 180] having a saw tooth opening [e.g., opening or grooves in a saw-tooth pattern, such

as in Fig. 5D] formed on the predetermined material layer [interlayer 160, gate insulating layer 140, or buffer layer 120] to expose the surface of the predetermined material layer underneath [*e.g.*, via opening 811 extends through the protection layer 180 and exposes the underlying predetermined material layer, as shown in Figs. 2A-D, 3A-C, 4A-C], wherein the surface of the predetermined material layer [interlayer 160, gate insulating layer 140, or buffer layer 120] and the sidewall of the organic material pattern layer [protective layer 180] form a predetermined angle [*e.g.*, angled openings as shown in Figs. 2B-D, 3A-C, 4A-C].”

Kwak discloses “an organic material pattern layer . . . on the predetermined material layer.” Kwak discloses a “protection layer (a passivation layer and/or planarization layer) 180.” EX1005, 7:24-33, Figs. 2B-D, 3A-C, 4A-C; EX1003, ¶97. “The protection layer 180 can be formed of . . . an organic material . . . such as a benzocyclobutene or acryl upper layer, or a multilayered structure.” *Id.*, 7:24-33; *see also id.*, 5:3-4, 9:58-10:4 (same), 11:47-53 (“organic protection layer”), cls. 2, 16. The protection layer 180 is formed on the underlying layers, including interlayer 160, gate insulating layer 140, and/or buffer layer 120. *See, e.g., id.*, 3:9-22 (“an inorganic layer under the protection layer”), 3:66-4:31, 4:54-5:2, 5:53-6:2, 9:58-7:4, 11:46-53, cls. 1, 10-15, 22, 25-28.

FIG. 2D

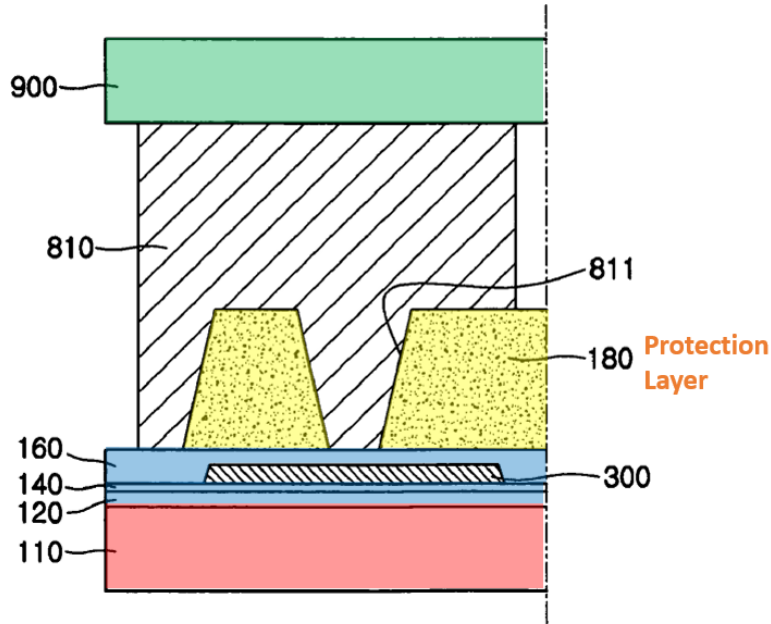


FIG. 3A

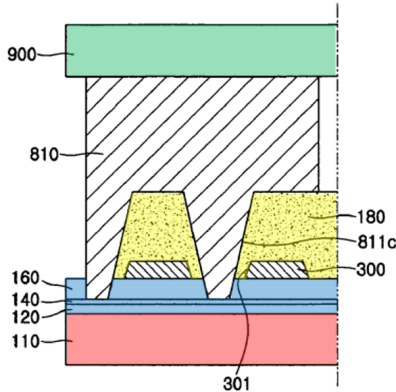


FIG. 3B

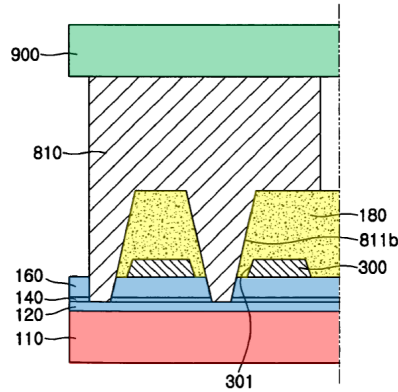
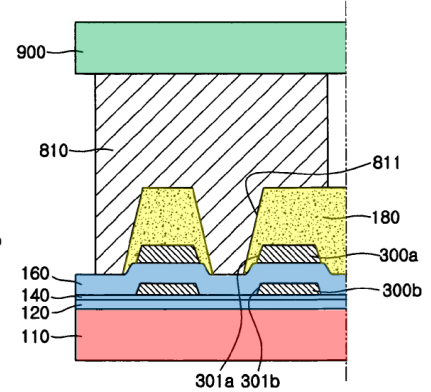


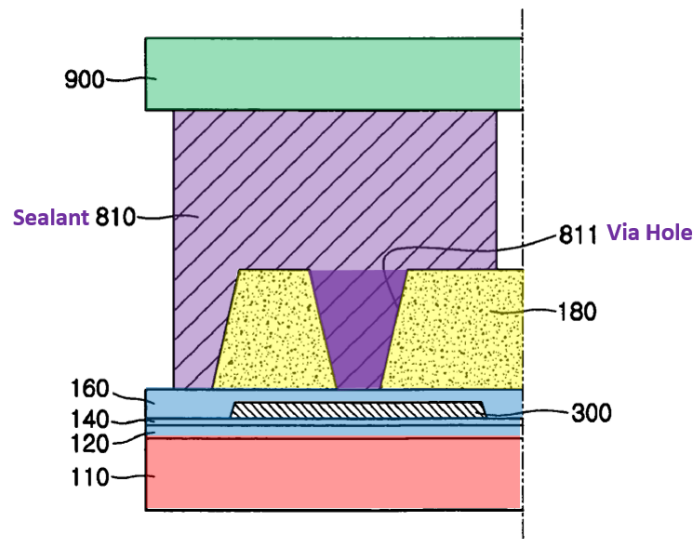
FIG. 4A



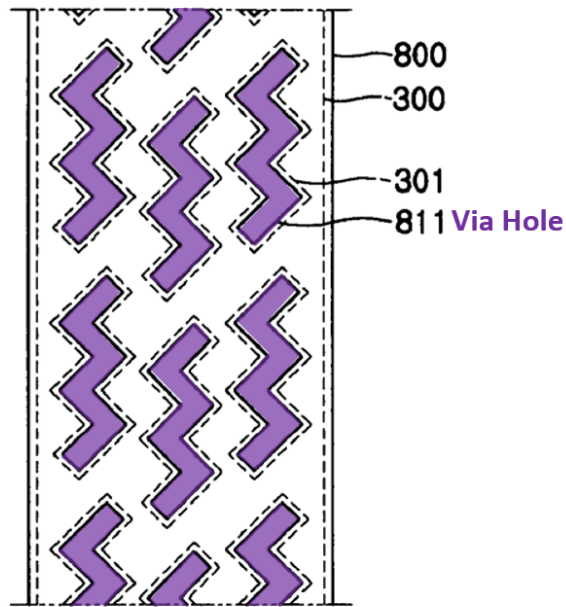
Organic protective layer 180 comprises an “opening [e.g., via hole 811] . . . to expose the surface of the predetermined material layer [interlayer 160, gate insulating layer 140, or buffer layer 120] underneath [e.g., via hole 811 extends through the protection layer and exposes the underlying layer].” Kwak teaches a “via hole 811” in the organic protective layer 180 and “at the bottom of the via

hole 811 is an inorganic layer (interlayer 160, gate insulating layer 140, and/or buffer layer 120) under the protection layer 180.” EX1005, 9:58-10:4; *see e.g., id.*, 3:9-22, 3:66-4:31, 4:54-5:2, 5:53-6:2, Figs. 2B-D, 3A-C, 4A-C.

FIG. 2D

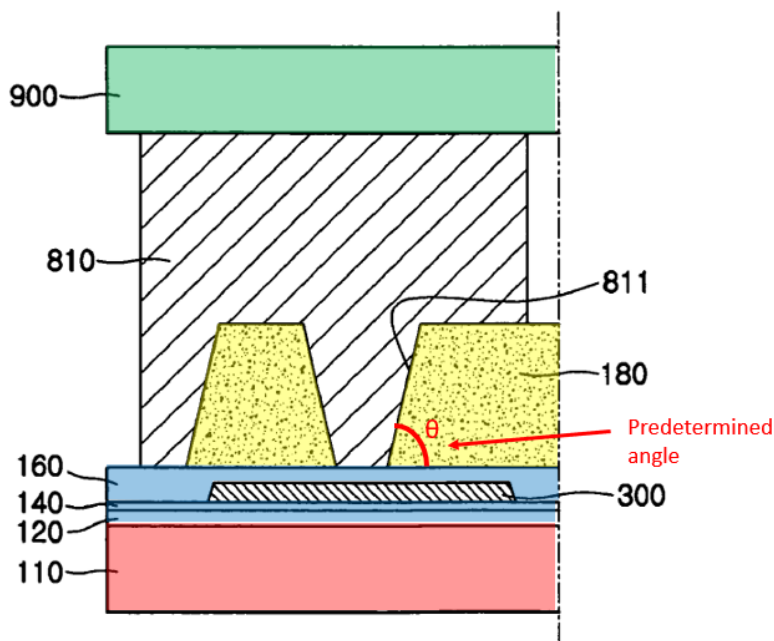


The opening in the protective layer 180 is a “sawtooth opening”. “Via hole 811 formed in the protection layer 180, can be formed in various shapes.” EX1005, 11:4-29. Figures 5A-E show examples of shapes that the via openings 811 may take. Via opening 811 as displayed in Figure 5D of Kwak comprises a “sawtooth” opening that includes evenly distributed indentions and protrusions. EX1005, Fig. 5D.



Kwak discloses an opening such that “the surface of the predetermined material layer and the sidewall of the organic material pattern layer form a predetermined angle.” *See, e.g.*, EX1005, Figs. 2B-D, 3A-C, 4A-C. The surface of the predetermined material layer (interlayer 160, gate insulating layer 140, and/or buffer layer 120) and the sidewall of the organic material pattern layer (protective layer 180) of via opening 811 form a predetermined angle. *Id.* Kwak consistently discloses implementing openings with the same, less-than-90° angle across its embodiments. *See, e.g.*, EX1005, Figs. 2B-D, 3A-C, 4A-C.

FIG. 2D



VI. GROUND 2: CLAIMS 1-6, 8-14 ARE OBVIOUS OVER KWAK

A. Claim 9

Kwak in view of the knowledge of a POSITA renders obvious Claim 9.

EX1003, ¶¶101-113.

1. [9pre]

Kwak alone and in view of the knowledge of a POSITA discloses 9pre. *See* Ground 1 (Kwak), 9pre.

2. [9a]

Kwak alone and in view of the knowledge of a POSITA discloses 9a. *See* Ground 1 (Kwak), 9a.

3. [9b]

Kwak alone and in view of the knowledge of a POSITA discloses 9b. *See* Ground 1 (Kwak), 9b.

4. [9c]

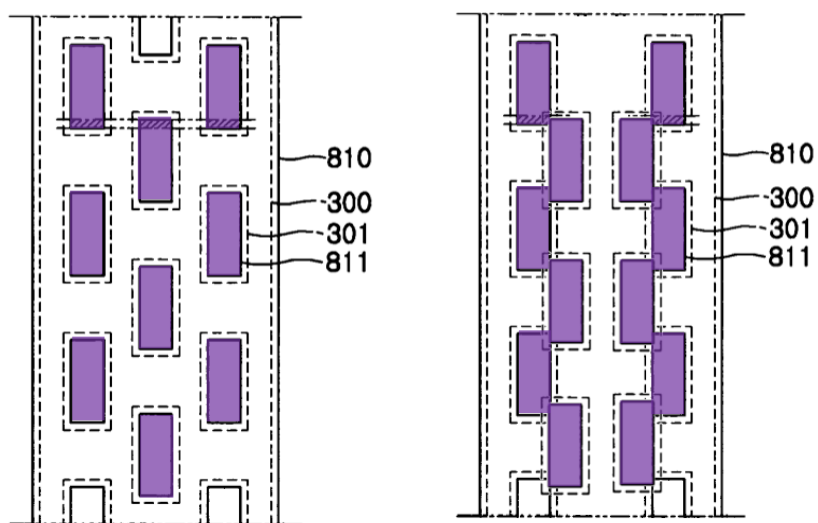
Kwak alone and in view of the knowledge of a POSITA discloses 9c. *See* Ground 1 (Kwak), 9c.

To the extent that Kwak does not explicitly disclose a “saw tooth opening,” it would have been obvious to a POSITA to modify Kwak to comprise other “saw tooth”-shaped embodiments. EX1003, ¶106. Kwak explained that the shape of the opening “can be formed in various shapes,” such as “square,” “circular,” or “rhombic” shapes. EX1005, 11:4-29. A POSITA would have been motivated to try different shaped openings at least because Kwak teaches improving sealant bond by enlarging the contact area with the underlying inorganic layer. EX1005, 10:58-11:4, 11:47-53; EX1003, ¶106.

For example, A POSITA would have understood that the patterns of Figures 5B and 5E could easily be modified to into sawtooth-like shapes, as depicted below. *Id.*, ¶107.

FIG. 5B

FIG. 5B

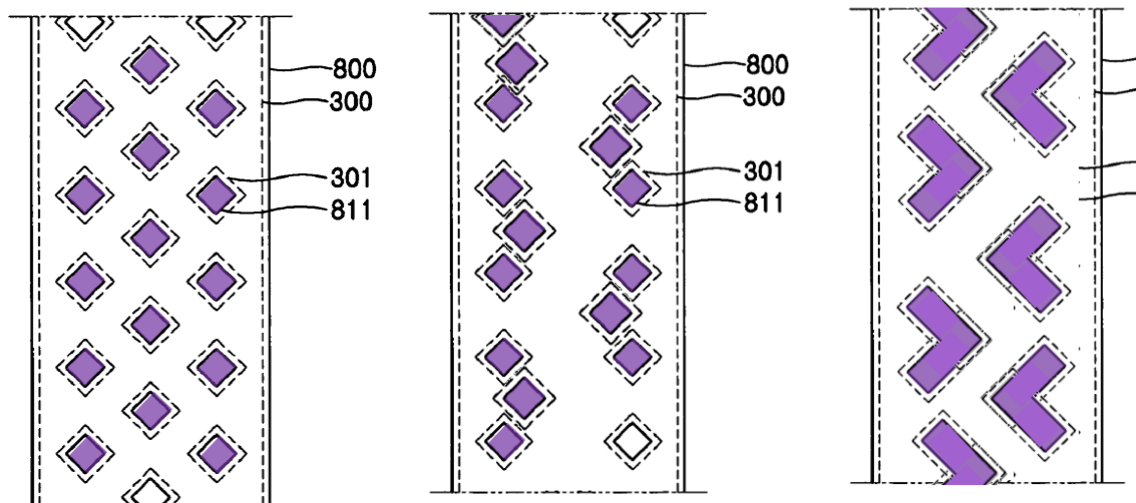


Kwak, Fig. 5B (left, original), 5B (right, modified)

FIG. 5E

FIG. 5E

FIG. 5E



Kwak, Fig. 5E (left, original), 5E (center and right, modified)

A POSITA would have been motivated to try these and other pattern variations to increase the contact area between the sealant and the underlying

inorganic layer and thus increase the bond strength and would have a reasonable expectation of success. EX1003, ¶108.

To the extent that Kwak does not explicitly disclose that “the surface of the predetermined material layer and the sidewall of the organic material pattern layer form a predetermined angle,” a POSITA would have understood Kwak’s angled opening to be intentional (i.e., be predetermined) based on design choices, including the use of various known etching methods in the art. *Id.*, ¶109.

Kwak discloses the use of a consistent, less-than-90° angle without providing a specific numerical value for the angle. EX1005, Figs. 2B-D, 3A-C, 4A-C. Regardless, creating such angled openings, including openings with angles less than 30° or 60°, was well known in the art and using these known techniques would result in a predetermined angle. *See id.*; EX1003, ¶110.

A POSITA would have understood that utilizing angled openings within sealant areas in LCD screens was known and understood, as was shown in various prior art references. *See* IV.E (Yamazaki 366), IV.F; EX1003, ¶111.

Further, various well-known and conventional techniques existed in the art that would form a V-shaped opening comprising predetermined angles less than 90°. *See* IV.C (Vaganov), IV.F; EX1003, ¶112.

Thus, one of skill would have understood that the angles disclosed by Kwak would have been created using known techniques resulting in corresponding

predetermined angles. EX1003, ¶109-113. A POSITA would have understood that the angled openings of Kwak could take many forms, from substantially 90° to less than 30° angles and that there were known methods for creating these openings in an organic layer. *Id.*, ¶113. Implementing these known methods to achieve openings with a predetermined angle would have been within a POSITA's knowledge and skill and a POSITA would have a reasonable expectation of success. *Id.*

B. Claim 10

Kwak alone and in view of the knowledge of a POSITA discloses “[t]he sealant region of claim 9, wherein the predetermined angle is less than about 60 degree.” *See* Ground 2 (Kwak), 9; EX1003, ¶¶114-119.

Kwak discloses a via opening 811 that extends through the protective layer 180 to expose the inorganic layer below (i.e., interlayer 160, gate insulating layer 140, and/or buffer layer 120). *See* EX1005, 9:58-10:4; *see e.g., id.*, 3:9-22, 3:66-4:31, 4:54-5:2, 5:53-6:2, Figs. 2B-D, 3A-C, 4A-C.

While Kwak does not identify a numerical value for its angles, a POSITA would have been aware of common manufacturing methods and the design choices involved and would have understood that openings with an angle less than 60° and even less than 30° were possible and how they would be implemented. EX1003, ¶116. A POSITA would have understood, as demonstrated by the state of the art

disclosed in prior art references, that the openings in Kwak's protective layer would utilize an angle less than 60° and even as low as 20°-30°. *Id.*; *see* IV.C (Vaganov), IV.D (Kim), IV.E (Yamazaki 366), IV.F.

A POSITA would have been motivated to apply these known methods to Kwak to create an opening with an angle less than 60° and even less than 30° at least because these methods and angles provide the same benefits sought by Kwak. EX1003, ¶117. Kwak describes how the opening through the organic protective layer to expose the underlying inorganic layer can “compensate[] for any weakness in the adhesion between the sealant 810 . . . and the protection layer 180” EX1005, 9:58-10:4; *see also id.* 2:53-56, 9:1-12. “This improves the seal and enhances protection against moisture infiltration.” *Id.* at 11:46-53. Kwak's angled openings improve contact area between the sealant and the various layers and improve reliability by preventing moisture infiltration. *See id.*, 2:53-56, 9:1-12, 9:58-10:4, 11:46-53; EX1003, ¶117.

The benefits of implementing angled openings, and specifically angled openings less than 60° and as small as 20°-30° were well known in the art. EX1003, ¶118. For example, Vaganov describes increasing the strength of a seal and preventing cracks and breakage by using angled openings in a sealant region to increase the surface area for sealant contact. *See* IV.C (Vaganov). Tanaka describes creating a sealant region with an opening where the top of the opening is wider

than the base of the opening. *See* IV.F. Tanaka teaches that creating “obtuse angles” such that the sidewalls slope away from the center of the opening improves adhesion between the substrates. *Id.* Conversely, Miyoshi teaches away from angles above 60° as they may cause the upper layers to be thin at the boundary or corner and provides test results indicating the benefits of angles as low as 30. *See* IV.F.

For at least these reasons, one of skill in the art would have understood and would have been motivated to create the angled openings of Kwak using known techniques including acute angles less than 60° and as low as 20° to 30° and would have a reasonable expectation of success. EX1003, ¶119.

C. Claim 11

Kwak alone and in view of the knowledge of a POSITA discloses claim 11 for the same reasons explained above. *See* Ground 2 (Kwak), 9, 10; EX1003, ¶120.

D. Claim 12

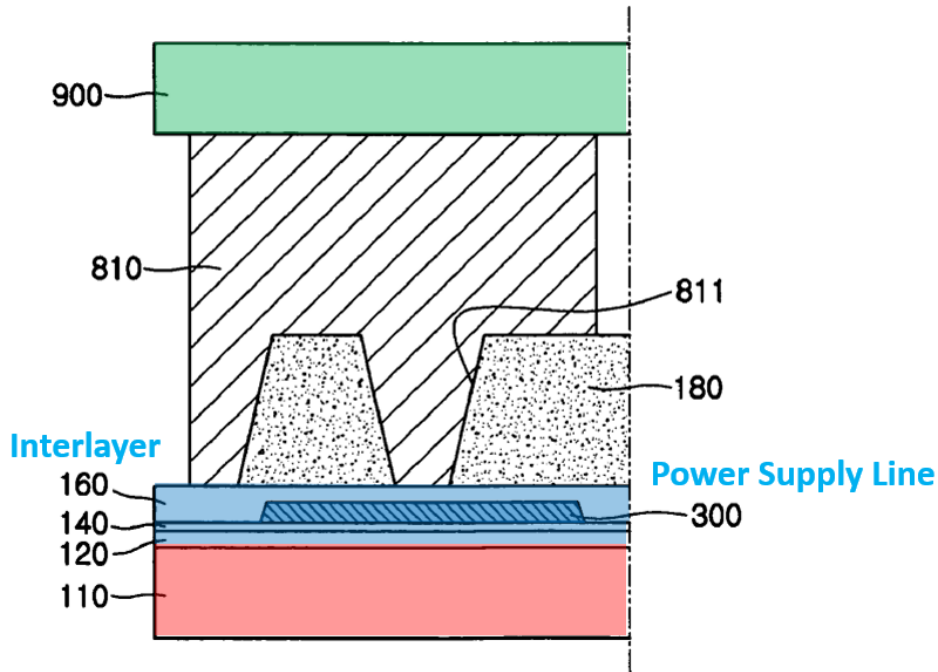
Kwak alone and in view of the knowledge of a POSITA discloses “[t]he sealant region of claim 9, wherein the predetermined material layer comprises a passivation layer.” EX1003, ¶121. Kwak teaches that “interlayer 160, [] can be . . . formed of a material, such as SiO₂ or SiN_x.” EX1005, 7:3-24, 10:21-36. A POSITA would have understood Kwak’s silicon nitride interlayer to comprise a passivation layer. EX1003, ¶121. Similarly, the ’801 patent describes a

“predetermined material layer such as a silicon nitride layer 242 . . . serving as a passivation layer.” EX1001, 2:27-30, 2:46-55.

E. Claim 13

Kwak alone and in view of the knowledge of a POSITA discloses “[t]he sealant region of claim 9, wherein the predetermined material layer comprises a metal electrode layer.” As shown for claim 9, Kwak discloses embodiments wherein each of layers 160, 140 and 120 (or combination thereof) satisfies the claimed “predetermined material layer.” Kwak additionally teaches protective layer 160 can be formed around and over conductive layer 300, which is made of “the same material as that of a gate electrode” to serve as a power supply line. EX1005, 5:20-23, 9:1-12, Fig. 2D; EX1003, ¶122-123. In this embodiment, a POSITA would have understood the predetermined layer (the combination of protective layer 160 and conductive layer 300, or the combination of 160, 140, 120 and 300) to comprise a metal electrode layer (conductive layer and power supply line 300). *Id.*

FIG. 2D



F. Claim 14

Kwak alone and in view of the knowledge of a POSITA discloses “[t]he sealant region of claim 9, wherein the organic material layer comprises polymethyl methacrylate (PMMA) or photosensitive-methylsilsesquiazane (PS-MSZ).” EX1003, ¶¶124-126.

Kwak discloses that protection layer 180 can be formed of . . . an organic material . . . such as a benzocyclobutene or acryl upper layer, or a multilayered structure.” *Id.*, 7:24-33; *see also id.*, 5:3-4, 9:58-10:4 (same), 11:47-53 (“organic protection layer”), cls. 2, 16.

A POSITA would have understood that the “acryl” organic material likely would refer to a form of PMMA. *See* IV.F; EX1003, ¶126. Regardless, while

Kwak does not explicitly disclose the chemical composition, a POSITA would have been motivated to utilize a suitable material and would have known that PMMA was such a material as taught in the prior art. A POSITA would have used PMMA for the organic layer at least because it merely involved application of a known material in a known manner to achieve expected results with a reasonable expectation of success. *Id.*

G. Claim 1

Kwak alone and in view of the knowledge of a POSITA discloses claim 1. *See* Ground 2 (Kwak), 9; EX1003, ¶¶127-131. Claim 1 claims a method of “providing” and “forming” the elements of apparatus claim 9 without further specificity and, therefore, is rendered obvious by Kwak alone and in view of the knowledge of a POSITA. *See* Ground 2 (Kwak), 9.

1. [1pre]

To the extent the preamble is limiting, Kwak alone and in view of the knowledge of a POSITA discloses 1pre. *See* Ground 2 (Kwak), 9pre.

2. [1a]

Kwak alone and in view of the knowledge of a POSITA discloses 1a. *See* Ground 2 (Kwak), 9a.

3. [1b]

Kwak alone and in view of the knowledge of a POSITA discloses 1b. *See* Ground 2 (Kwak), 9b.

4. [1c]

Kwak alone and in view of the knowledge of a POSITA discloses 9c. *See* Ground 2 (Kwak), 9c.

H. Claim 2

Kwak alone and in view of the knowledge of a POSITA discloses claim 2. *See* Ground 2 (Kwak), 10; EX1003, ¶132.

I. Claim 3

Kwak alone and in view of the knowledge of a POSITA discloses claim 3. *See* Ground 2 (Kwak), 11; EX1003, ¶133.

J. Claim 4

Kwak alone and in view of the knowledge of a POSITA discloses claim 4. *See* Ground 2 (Kwak), 2 EX1003, ¶134.

K. Claim 5

Kwak alone and in view of the knowledge of a POSITA discloses claim 5. *See* Ground 2 (Kwak), 13; EX1003, ¶135.

L. Claim 6

Kwak alone and in view of the knowledge of a POSITA discloses claim 6. IV.C-F; EX1003, ¶¶136-142.

1. Claim [6a]

Kwak alone and in view of the knowledge of a POSITA discloses “The method of claim 1 (see claim 1, 9), wherein formation of the organic material

pattern layer comprises: forming an organic material layer on the predetermined material layer (see [1b-c], [9b-c]); and patterning the organic material layer to form the saw tooth opening therein (see [1c]. [9c]).” *See* Ground 2 (Kwak), 9 and 1. Kwak discloses these steps to a POSITA by disclosing Kwak’s organic layer 180 is formed on the predetermined material layer (160, 140, and/or 120) and that Kwak’s sawtooth opening (pattern) is created by making holes in the organic layer. *See id.*; EX1005, 7:16-8:2; EX.1003, ¶137. Kwak does not explicitly disclose the precise technique for creating the sawtooth pattern, but the claim is not limited to any particular technique.

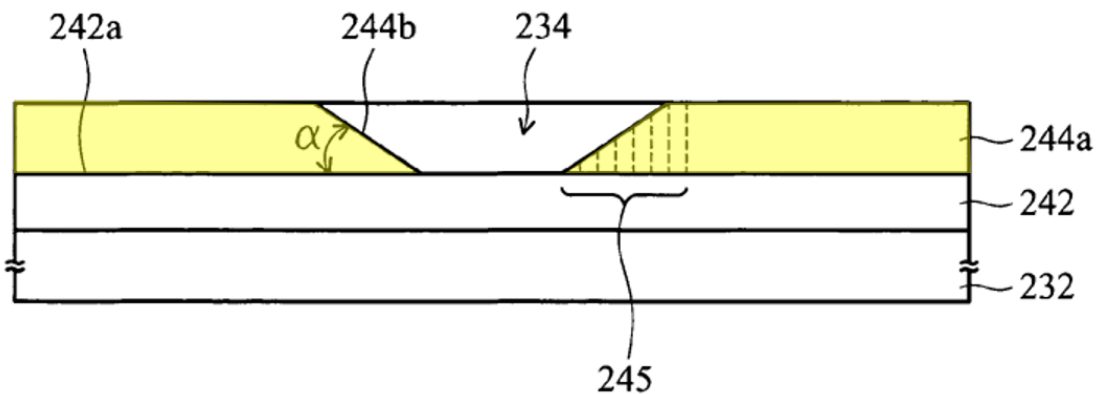
In the alternative, this claim would have been obvious to a POSITA. A POSITA implementing Kwak would have been motivated to use known techniques within their knowledge and skill, any one of which would satisfy this claim. *See* Section IV.C-F (discussing known techniques for forming angled openings in organic layers); EX1003, ¶137. Vaganov, Kim and Yamazaki disclose examples of known techniques and are incorporated herein by reference. *See* Grounds 3-5. A POSITA would have had a reasonable expectation of success in using these known techniques to achieve predictable results patterning the organic layer of Kwak.

2. Claim [6b]

Kwak alone and in view of the knowledge of a POSITA discloses “wherein the organic material pattern layer comprises a plurality of segments adjacent to the

saw tooth opening, and the respective height of the plurality segments gradually increases with respect to the distance from the saw tooth opening.”

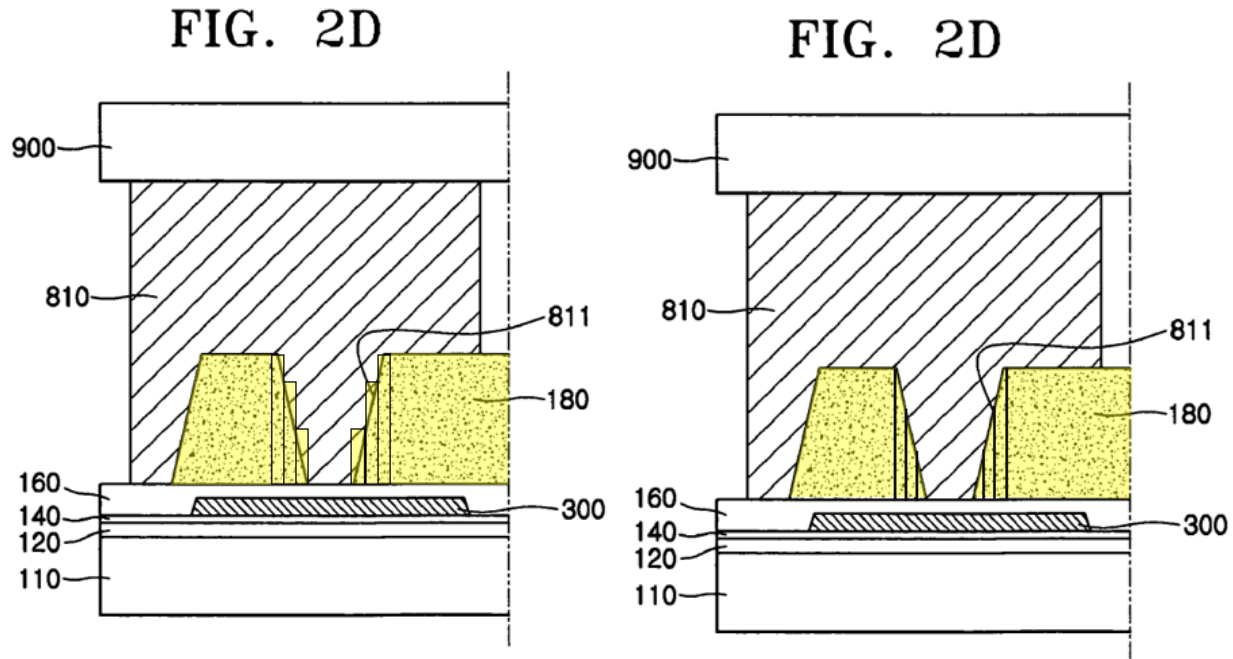
For example, Kwak discloses an opening with angled sidewalls such that the height of the segments gradually increases as they move away from the center of the opening. *See* Ground 2 (Kwak), 9c, 10, 1c, 2. Claim 1 of the '801 patent requires a “predetermined angle,” which includes openings with angles that are substantially 90°. Claim 6, similar to claims 2 and 3, requires that the sidewalls form an angle less than 90°. The '801 patent depicts the plurality of segments 245 as a continuous angled slope away from the center of the opening. EX1001, Fig. 2B-C.



'801 patent Fig. 2B

Kwak teaches a similar opening with an angled slope. EX1003, ¶142. Further, a POSITA would have understood that the opening would be formed via “stepped” segments that would then optionally be etched to create a continuous

slope. EX1003, ¶¶ 140-141. A POSITA would have been motivated to try these methods and would have had a reasonable expectation of success. *Id.*



Kwak, Fig. 2D (left, modified), 2D (right, annotated original)

Kwak discloses this limitation at least to the same extent and scope as disclosed in the '801 patent.

M. Claim 8

Kwak alone and in view of the knowledge of a POSITA discloses Claim 8.

See Ground 2 (Kwak), 6, 14; EX1003, ¶143.

VII. GROUND 3: CLAIMS 2-3, 6, 10-11 ARE OBVIOUS OVER KWAK IN VIEW OF VAGANOV

A. Combination Rationale

It would have been obvious for a POSITA to combine Kwak's teachings related to increasing the bonding strength and improving the quality of the LCD

panel by preventing moisture degradation with Vaganov's teachings of increasing bonding strength in semiconductors which also increases reliability by reducing cracking or breakage. EX1003, ¶144.

Kwak teaches angled openings in the sealant region to increase the contact area between the sealant and the various layers, thus increasing the bond strength, and improving reliability by preventing moisture infiltration. *See* IV.A (Kwak); EX1003, ¶145.

Vaganov is directed to bonding strength by using microstructures with angled sidewalls in the bonded surfaces to increase the bonding surface area and volume of sealant. *See* IV.C (Vaganov). Vaganov's angled sidewalls also improve reliability and prevent "delamination due to insufficient adhesion, cracking or breakage." EX1007, 6:1-16. Vaganov describes well-known techniques for creating a variety of predetermined angles of below 60°. *See* IV.C (Vaganov). The specific dimensions and angles are determined by design considerations and the processes used and would result in angles at or below 30°. EX1007, 2:57-3:14, 5:14-22, 10:23-51, 12:46-53; *See* IV.C (Vaganov); EX1003, ¶146.

Kwak, Vaganov, and the 801 patent are in the same field of endeavor (i.e., disclosing methods for manufacturing electronic devices) and describe implementing their improvements in similar structures. EX1003, ¶147; *see* IV.A (Kwak), IV.C (Vaganov); Ground 2 (Kwak), 9; *see also* EX1005, 11:30-38, Figs.

1B, 2A-D, 3A-C, 4A-C, 5A-E; EX1007, 1:5-61, 3:33-44, 4:50-67, 14:27-35, 14:58-63.

Both references teach increasing the surface area by implementing angled opening in the layers. Kwak discloses an organic layer (protective layer 180) that rests above a predetermined material layer (interlayer 160, gate insulating layer 140, or buffer layer 120) and has an angled opening (811) in the organic layer to expose the underlying layers. While Kwak describes and depicts openings with various angles, it does not explicitly identify any specific angles for implementation. Vaganov discloses methods for creating openings in similar materials that result in specific angles, including 90°, 54°44'', 45°, and 35°16''. A POSITA would have recognized the similar structures, materials, methods, and goals between the two and would have found it routine and straightforward to combine Vaganov's specific angled opening with Kwak's angled opening with a reasonable expectation of success. EX1003, ¶148.

A POSITA would have been motivated to use the specific angles and methods of Vaganov when implementing Kwak. EX1003, ¶149. Both references teach similar improvements that provide similar results. *Id.* Kwak is directed to increasing the contact area for the adhesive, which improves the bond strength. The increased bond strength has the additional benefit of reducing damage to the seal that might allow for moisture intrusion. Vaganov describes techniques for

creating openings with angled sidewalls to increase the contact area between the sealant and various layers. *Id.* A stronger bond would improve the reliability by preventing intrusion from moisture and oxygen and thus reducing delamination. *See* EX1007, 1:28-37 (“Bonding also should provide a certain level of hermeticity (airtightness)”), 1:62-2:27, 2:56-3:4, 3:29-33, 7:6-9.

B. Overview and Incorporation of Grounds 1 and 2

Ground 3 relies on Grounds 1 and 2, which are incorporated herein by reference, and the combination of Kwak and Vaganov, including the discussions regarding motivation to combine.

C. Claim 10

Kwak in view of Vaganov discloses claim 10. *See* Ground 2 (Kwak), 10; EX1003, ¶151.

D. Claim 11

Kwak in view of Vaganov discloses claim 11. *See* Ground 2 (Kwak), 11; EX1003, ¶152.

E. Claim 2

Kwak in view of Vaganov discloses claim 2. *See* Ground 2 (Kwak), 2; EX1003, ¶153.

F. Claim 3

Kwak in view of Vaganov discloses claim 3. *See* Ground 2 (Kwak), 3; EX1003, ¶154.

G. Claim 6

Kwak in view of Vaganov discloses claim 6. *See* Ground 2 (Kwak), 6; IV.C-F; EX1003, ¶155.

VIII. GROUND 4: CLAIMS 2-3, 6, 8, 10-11, 14 ARE OBVIOUS OVER KWAK IN VIEW OF KIM

A. Combination Rationale

It would have been obvious for a POSITA to combine Kwak's teachings related to increasing the bonding strength and improving the quality of the LCD panel with Kim's teachings regarding creating openings with a gradual incline in an organic polymer layer to expose underlying layers. EX1003, ¶156.

Both references describe similar improvements in similar structures to obtain similar benefits. Kwak teaches angled openings in the sealant region to increase the contact area between the sealant and the various layers, thus increasing the bond strength, and improving reliability by preventing moisture infiltration. *See* IV.A (Kwak); EX1003, ¶157. Kim describes forming openings comprising sidewall angles between 30-60° that allows layers to be smoothly created on top of the organic layer in order to maintain the thickness of the organic layer and provide better contacts through the opening. *See* IV.D (Kim).

A POSITA implementing Kwak would have been motivated to use the methods of Kim, at least as they pertain to its methods for creating an opening in the organic layer at specific angles with a reasonable expectation of success.

EX1003, ¶158. Kwak is directed to increasing the contact area for the adhesive and a POSITA would have understood that the gradually inclined sidewalls of Kim would increase the contact area for layers (including sealant layers) created on top of the organic layer. *Id.* Further, Kwak teaches that the openings may increase reliability by reducing moisture infiltration and degradation. A POSITA would have understood that a smooth, uniform application of sealant, which would result from using the teachings of Kim, would increase contact between sealant and the surfaces, thereby helping to reduce moisture infiltration. *Id.*

B. Overview and Incorporation of Grounds 1 and 2

Ground 4 relies on Grounds 1 and 2, which are incorporated herein by reference, and the combination of Kwak and Kim, including the discussions regarding motivation to combine.

C. Claim 10

Kwak in view of Kim discloses claim 10. *See* Ground 2 (Kwak), 10; EX1003, ¶160.

D. Claim 11

Kwak in view of Kim discloses claim 11. *See* Ground 2 (Kwak), 11. Specifically, Kim discloses a tapered angle as small as “about 30°” and the claim requires an angle between 20° and “about 30 degree[s].” EX1008, 0010, 0072, 0106, 0119, cl. 20. Thus, Kim discloses the claimed predetermined angle. EX1003, ¶¶161-162.

E. Claim 14

Kwak in view of Kim discloses claim 14. *See* Ground 2 (Kwak), 14; EX1003, ¶¶163-164.

Kim further discloses “an organic insulating layer 75 is formed on the protective layer 70 with a low dielectric acryl-based organic material.” EX1008, 0062. A POSITA would have understood that the acryl-based organic material would comprise PMMA. *See* IV.F.

F. Claim 2

Kwak in view of Kim discloses claim 2. *See* Ground 2 (Kwak), 2; EX1003, ¶165.

G. Claim 3

Kwak in view of Kim discloses claim 3. *See* Ground 2 (Kwak), 3; EX1003, ¶166.

H. Claim 6

Kwak in view of Kim discloses claim 6. *See* Ground 2 (Kwak), 6; IV.C-F; EX1003, ¶167.

I. Claim 8

Kwak in view of Kim discloses claim 8. *See* Ground 4, 6, 14; Ground 2 (Kwak), 6 and 14; EX1003, ¶168.

IX. GROUND 5: CLAIMS 2-3, 6, 10-11 ARE OBVIOUS OVER KWAK IN VIEW OF YMAZAKI 336

A. Combination Rationale

It would have been obvious for a POSITA to combine Kwak's teachings related to increasing the bonding strength and improving the quality of the LCD panel with Yamazaki's teachings regarding creating sealant regions including an organic layer with an angled slope to improve the seal and reliability by preventing moisture and oxygen intrusion. EX1003, ¶169.

Kwak teaches angled openings in the sealant region to increase the contact area between the sealant and the various layers, thus increasing the bond strength, and improving reliability by preventing moisture infiltration. *See* IV.A (Kwak); EX1003, ¶170.

Yamazaki discloses an LCD device with a sealant region comprising an organic layer with openings that expose the underlying insulating layers, where the sidewalls of the opening have an "angle θ more than 30° and less than 75° ." *See* IV.E (Yamazaki); EX1003, ¶171. Yamazaki 366's tapered slope would have decreased moisture intrusion and chances of delamination in the display device. *Id.*

Kwak, Yamazaki 366, and the 801 patent are in the same field of endeavor, including disclosing methods for manufacturing liquid crystal displays, and describe implementing their improvements in similar structures to achieve similar

benefits. EX1003, ¶172; *see* IV.A, IV.E; *see also* EX1005, 11:30-38, Figs. 1B, 2A-D, 3A-C, 4A-C, 5A-E; EX1009, 1:8-64, 4:32-47, 8:28-33, Fig. 11.

Both references describe an organic layer overlaying an underlying layer and an opening through the former to expose the latter. EX1003, ¶173. Kwak discloses an organic layer (protective layer 180) that rests above a predetermined material layer (interlayer 160, gate insulating layer 140, or buffer layer 120) and has an angled opening (811) in the organic layer to expose the underlying layers. While Kwak describes openings with a consistent angle, it does not identify a numerical value for its angle. Yamazaki 366 discloses an organic layer (planarizing film 16) that rests above a predetermined material layer (insulating layers 11, 12, and 13) and comprises openings in the organic layer to expose the underlying layers where the opening sidewalls have a predetermined angle between 30°-75°.

A POSITA implementing the teachings of Kwak would have been motivated to use the techniques and methods of Yamazaki with a reasonable expectation of success, at least as they pertain to its methods for creating an opening with specific angles in the protective layer of the sealant region. EX1003, ¶174-175. A POSITA would have understood that both Kwak and Yamazaki teach similar improvements that provide similar results, and thus would have been obvious to combine. Kwak is directed to increasing the contact area for the adhesive to improve bond and reliability. The increased bond strength has the additional benefit of reducing

damage or cracks in the sealant that might allow for intrusion of moisture.

Yamazaki 366 describes angled sidewalls that would also increase the contact area between the sealant and various layers. The sealant area of Yamazaki 366 also creates a more reliable product by preventing intrusion from moisture and oxygen and thus reducing the likelihood of delamination or degradation.

One of skill in the art would have recognized the similar structures and materials and would have found it routine and straightforward to combine Yamazaki's teaching of a specific angled opening with Kwak's angled opening. EX1003, ¶176.

B. Overview and Incorporation of Grounds 1 and 2

Ground 5 relies on Grounds 1 and 2, which are incorporated herein by reference, and the combination of Kwak and Yamazaki, including the discussions regarding motivation to combine.

C. Claim 10

Kwak in view of Yamazaki discloses claim 10. *See* Ground 2 (Kwak), 10; EX1003, ¶178.

D. Claim 11

Kwak in view of Yamazaki discloses claim 11. *See* Ground 2 (Kwak), 11; EX1003, ¶179.

E. Claim 2

Kwak in view of Yamazaki discloses claim 2. *See* Ground 2 (Kwak), 2; EX1003, ¶180.

F. Claim 3

Kwak in view of Yamazaki discloses claim 3. *See* Ground 2 (Kwak), 3; EX1003, ¶181.

G. Claim 6

Kwak in view of Yamazaki discloses claim 6. *See* Ground 2 (Kwak), 6; IV.C-F; EX1003, ¶182.

X. GROUND 6: CLAIMS 1-6, 9-13 ARE OBVIOUS OVER ZHANG

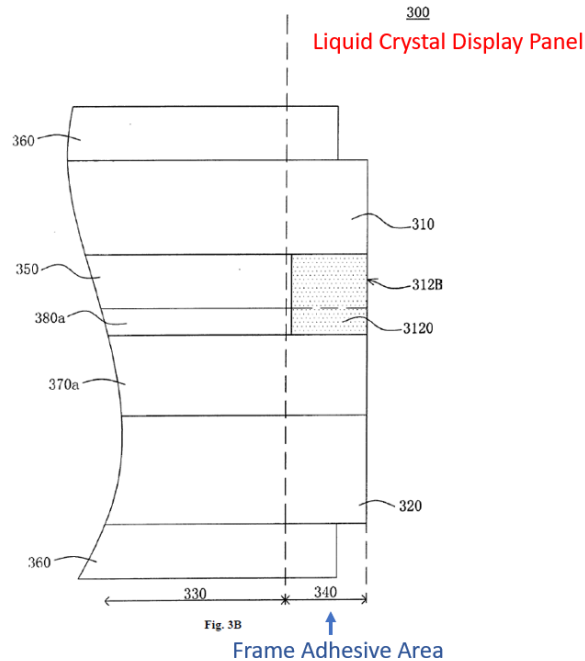
A. Claim 9

Zhang in view of the knowledge of a POSITA renders obvious Claim 9. EX1003, ¶¶ 183-207.

1. [9pre]

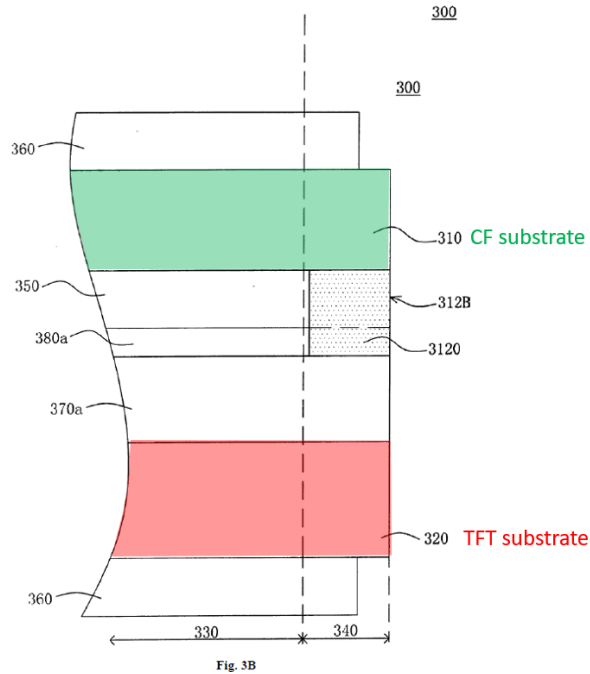
To the extent the preamble is limiting, Zhang discloses “[a] sealant region pattern for a liquid crystal display [liquid crystal display panel 300].” EX1006, 4; *see also id.*, 7-11 (describing the patent figures), Figs. 1A-B, 2A-B, 3A-E, 4, 5A-B, and 6A-B; EX1003, ¶184. Zhang discloses a “liquid crystal display panel 300” comprising a “a frame adhesive area 340.” *Id.*, 8. More specifically, Zhang discloses a method for forming a sealant region pattern in the frame adhesive area including creating openings in various layers and the assembly process of injecting

liquid crystal (350), adding sealant (312B), “pressing” the substrates together, and “bak[ing] in an oven.” *Id.*, 8-10, Figs. 3A-E.



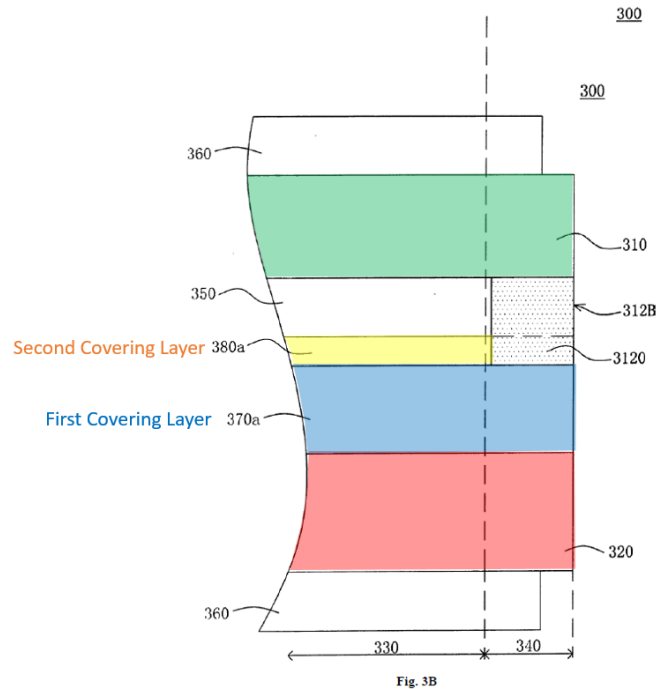
2. [9a]

Zhang discloses “a first substrate [lower substrate 320] and a second substrate [upper substrate 310] opposite thereto.” EX1006, 8. TFT substrate 320 and CF substrate 310 are opposite of one another within the LCD. *See id.*, 8-10, Figs. 3A-E; *see also id.* Figs. 1B, 2A-B; EX1003, ¶185. Zhang also discloses polarizing plates 160 opposite each other on the outer sides of the two substrates. *See, e.g., id.* at 8, Fig. 3B.



3. [9b]

Zhang discloses “a predetermined material layer [first cover layer 370a] formed on the first substrate [TFT substrate 320].” Zhang discloses that, “[i]n the frame adhesive area 340, the TFT substrate 320 also includes the two covering layers 370a and 380a extending from the display area 330.” EX1006, 8; *see also id.*, 7, 9-10, Figs. 1B, 2A-B, 3B-E, 6A-B, cls 1-4; EX1003, ¶186. Zhang’s first covering layer may comprise a single layer or combination of layers, including a first metal layer, a dielectric layer, a second metal layer, and/or a protective layer. EX1003, ¶ 186.

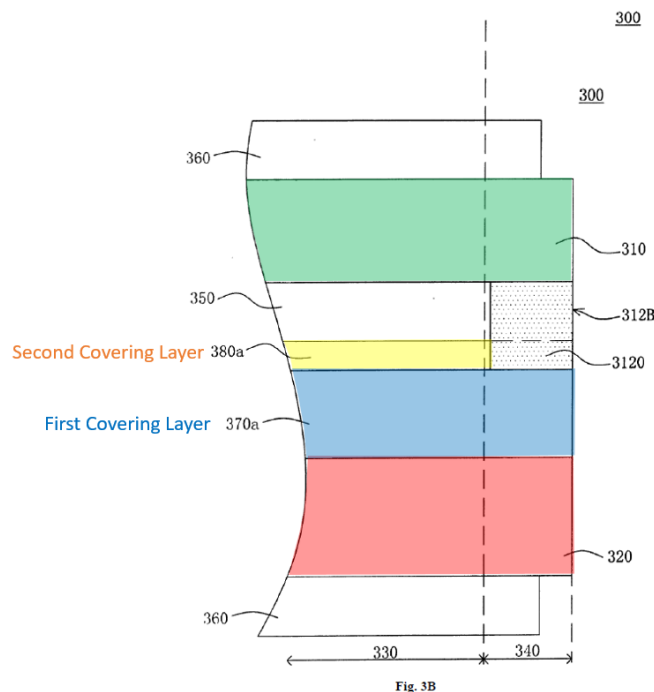


4. [9c]

Zhang alone and in view of the knowledge of a POSITA discloses “an organic material pattern layer [second covering layer 380a, which Zhang discloses or renders obvious would have comprised photoresist layer 225B] having a saw tooth opening [e.g., opening or grooves in elongated, X-shaped, matrix-shaped patterns, or other openings and shapes, such as in figures 3A, 5A-B and discussed below] formed on the predetermined material layer [first covering layer 370a, which would comprise one or more of protective layer 224, second metal layer 223, dielectric layer 222, and first metal layer 221] to expose the surface of the predetermined material layer underneath [e.g., opening 2120 that exposes at least a portion of protective layer 224, and which can optionally be extended further (i.e., opening 3120) to expose additional underlying layers], wherein the surface of the

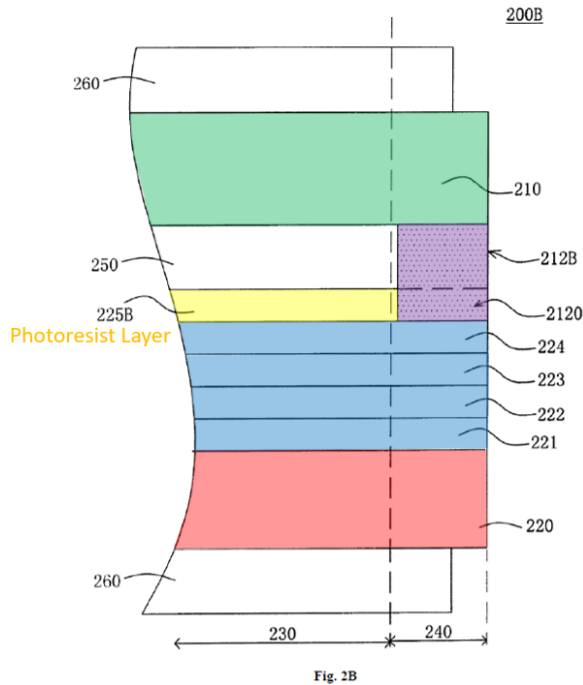
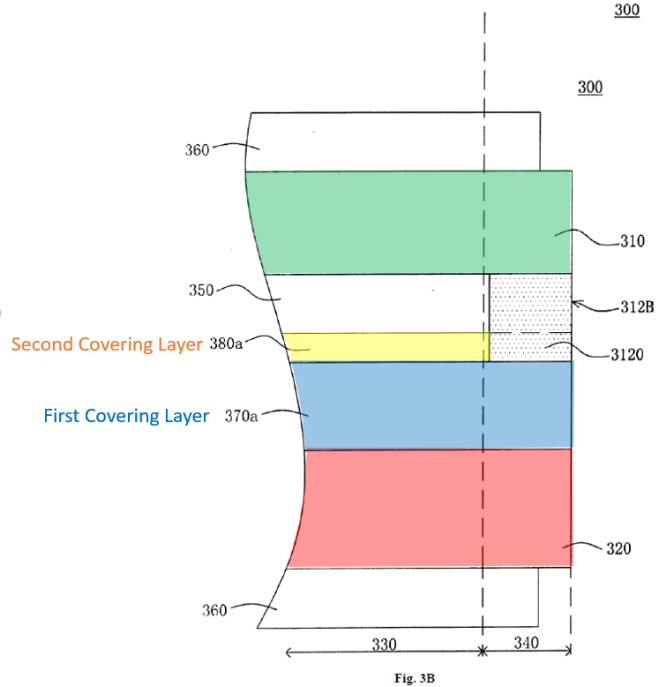
predetermined material layer [first covering layer 370a] and the sidewall of the organic material pattern layer [second covering layer 380a, which may comprise photoresist layer 225B] form a predetermined angle [*e.g.*, a substantially 90° angle, such as those in Figs. 3B-E, 6B, or a V-shaped groove or opening, such as in Fig. 6A].” EX1003, ¶187-207.

Zhang discloses “an organic material pattern layer . . . on the predetermined material layer.” Zhang discloses a “second covering layer 380a positioned above the first covering layer 370a.” *See, e.g.*, EX1006, 8. Zhang does not limit the second covering layer to any specific layer or combination of layers. *See* EX1006, 8-9, cl. 1. “In Figure 3B, both the first covering layer 370a and the second covering layer 380a on the TFT substrate 320 are single-layer structures.” EX1006, 9.



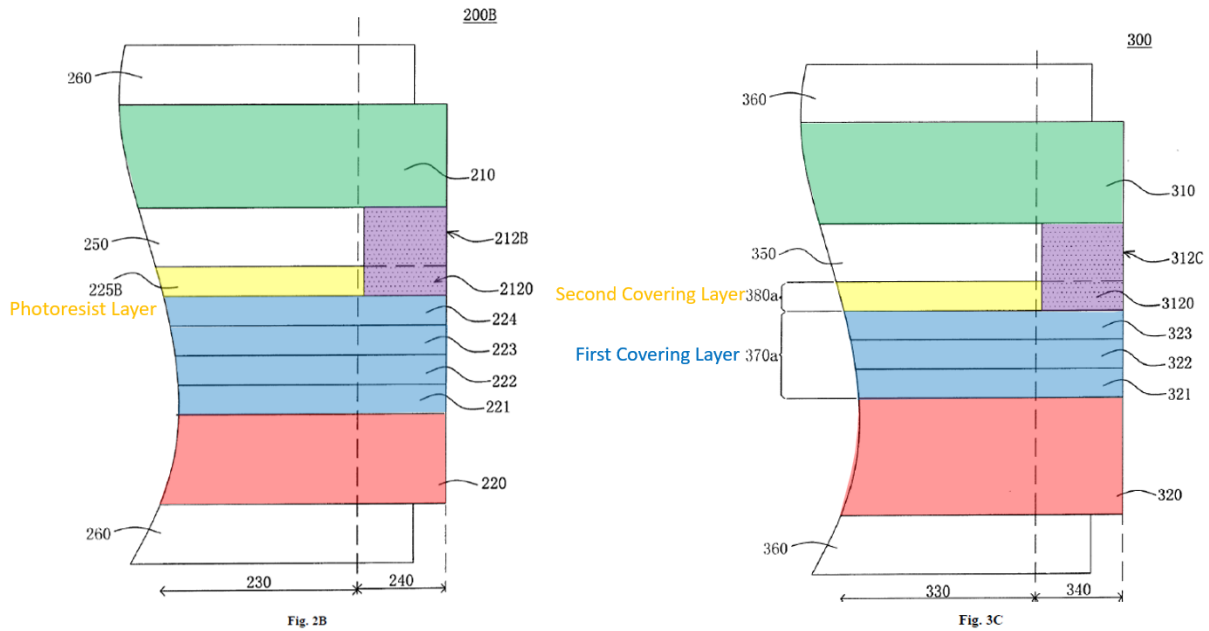
Zhang explains that conventional reflective LCD panels may include an organic layer, such as photoresist layers 225A and 225B. EX1006 at 4-6, Figs. 2A-B. The disclosed organic layer “covers” the other layers, including “the protective layer 224,” and would contact the sealant via the opening 2120 (organic layer 225B) or 3120 (second covering layer). *Id.*, 5-6, Figs. 2A-B. Thus, Zhang discloses a second covering 380a that, when implemented in a conventional reflective LCD, would comprise at least organic layer 225B, and would optionally include additional underlying layers such as protective layer 224. *See, e.g., id.*, 11 (explaining that modifications to the described embodiments that fall within the spirit of the invention are within the scope of the claims), Figs. 2B, 3B.

A POSITA would have understood Zhang to teach that the second covering layer 380a would, when implemented in conventional reflective LCDs, consist of or comprise organic photoresist layer 225B. EX1003, ¶190; *see id.*, 5-6, 11 (“[T]hose skilled in the art should understand that . . . various changes and modifications may be made [] without departing from the scope of the present invention”), Figs. 2A-B, 3B-E.



Zhang discloses an “opening” in the organic layer “to expose the surface of the predetermined material layer underneath.” Figure 2B depicts a conventional reflective LCD with an opening (2120) in the organic photoresist layer (225B) to expose the underlying layers (e.g., protective layer 224). EX1006, 5-6, Figs. 2A-B. Figure 3B of Zhang depicts opening 3120 in the second covering layer 380a to expose the underlying first covering layer 370a. EX1006 8-10, Figs. 3A-3E. Opening 3120 may extend through the second covering layer (comprising at least an organic layer, such as 225B, and optionally additional underlying layers, such as protective layer) to expose the underlying layers. *Id.* When implemented in a conventional reflective LCD, Zhang’s second covering 380a would comprise organic layer 225B as well as protective layer 224 and opening 3120 would extend through one or both. *See, e.g., id.*, 11, Figs. 2B, 3B. Thus, Zhang discloses an

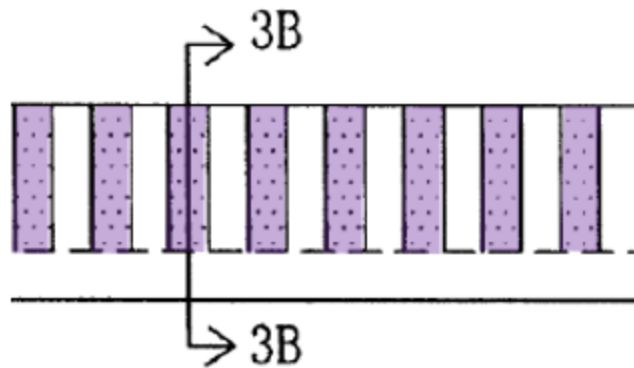
opening (opening 3120) in the organic material layer (second covering layer 380a comprising at least organic photoresist layer 225B and potentially other layers) to expose an underlying predetermined material layer (first covering layer 370a).



To the extent the disclosure is not explicit, a POSITA would have understood that the teachings of Zhang, as depicted in Figures 3A-3E, would be applied to conventional reflective LCDs with an organic photoresist layer to obtain similar improvements in adhesion and would have had a reasonable expectation of success doing so. EX1003, ¶192. For example, a POSITA would have understood Zhang to teach both an opening through an organic photoresist layer (e.g., Figs. 2A-B) as well as an opening through an organic photoresist and additional layers (e.g., Figs. 3B-E), such as a protective layer, to expose the underlying layers. *Id.* A POSITA would have been motivated to implement Zhang's teachings within a

conventional reflective LCDs to increase the contact area and allow more sealant to penetrate the groove or opening to create a stronger bond. *Id.*

Zhang discloses a “sawtooth opening”. Zhang explains that the groove or opening may be an “elongated shape,” “matrix-shaped,” or “X-shaped” but “the shape of the groove or opening . . . is not limited to a specific type.” EX1006 at 1, cls. 5, 7, 8, Figs. 3A, 5A-B. Figure 3A of Zhang depicts a “groove or opening 3120” similar to the teeth of a saw or comb. *See* EX1006 8, Fig 3.

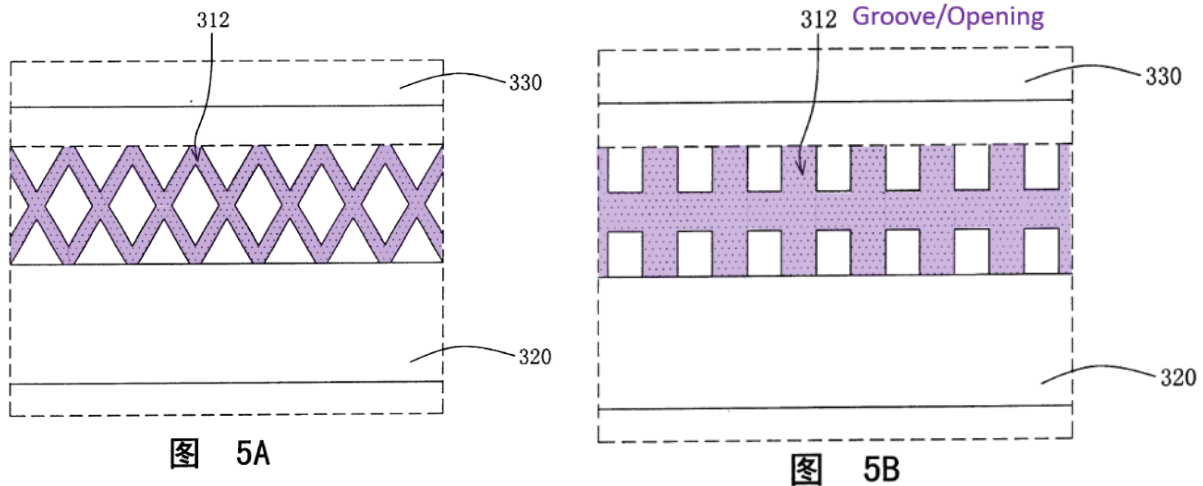


Zhang, Fig. 3A (annotated excerpt)

Zhang explains that “the second covering layer 380a has a groove or opening 3120 exposing a portion of the first covering layer 370a.” EX1006 at 8. One of skill in the art would have understood that the Zhang’s teachings of various shapes for the groove or opening, as depicted in Figures 3A and 5A-B, would be applied to conventional reflective LCDs with an organic photoresist layer such that the elongated, X-shaped, or matrix-shaped openings in the second covering layer 380

would be formed on at least the organic photoresist layer and optionally additional underlying layers. EX1003, ¶193-194.

Zhang discloses various “saw tooth”-shaped openings that include indentions and protrusions evenly distributed on either side of a central axis, including the “X-shaped” opening of Fig. 5A and the saw tooth opening of Fig. 5B. See EX1006 11, Fig 5A.



Further, Zhang’s opening “is not limited to a specific type. EX1006 1. It would have been obvious to one of skill in the art that the teachings of Zhang could be modified to comprise other “saw tooth”-shaped embodiments. EX1003, ¶196. The X-shaped grooves of Figure 5A could be modified to remove the interior islands, forming a different saw-tooth pattern. *Id.* ¶ 197.

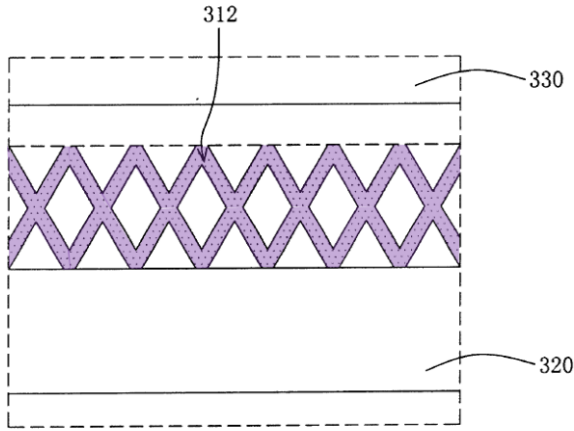


图 5A

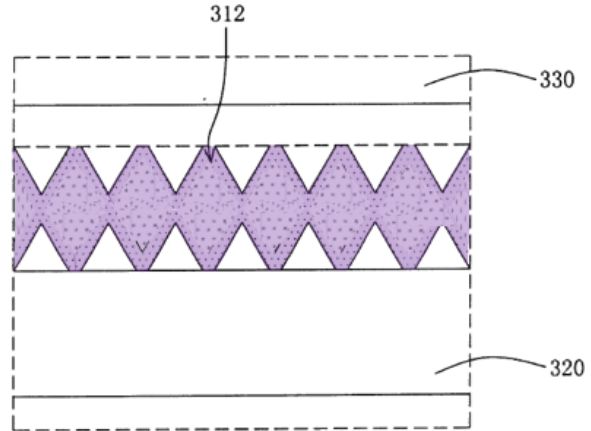


图 5A

Zhang, Fig. 5A (left, original), 5A (right, modified)

Likewise, the matrix-shaped grooves of Figure 5B can be derived from the elongated grooves of Figure 3A by extending the groove down the center axis.

EX1003, ¶198.

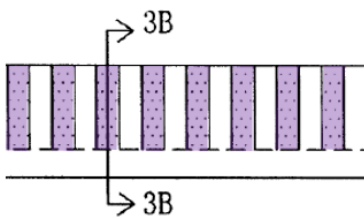
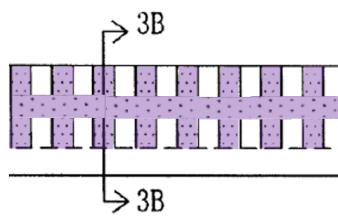
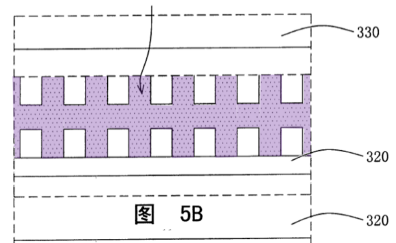
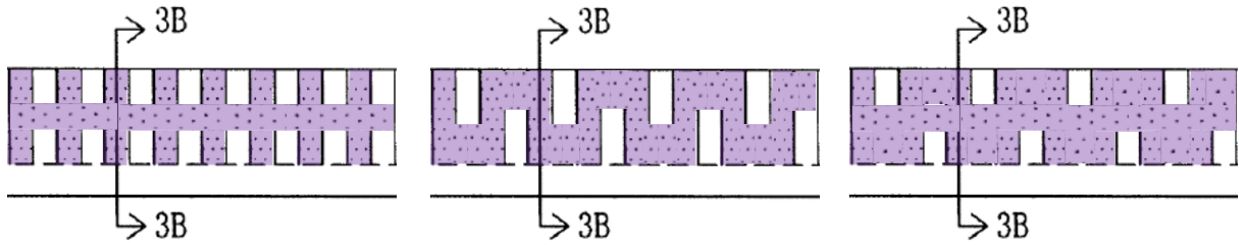


图 5B

Zhang, Fig. 3A (left, excerpt of original) 3A (center, modified), 5B (right, original)

A POSITA would have also understood that the groove patterns disclosed by Zhang could be modified to form alternative groove patterns in other sawtooth-like shape, including those shown below. EX1003, ¶199.

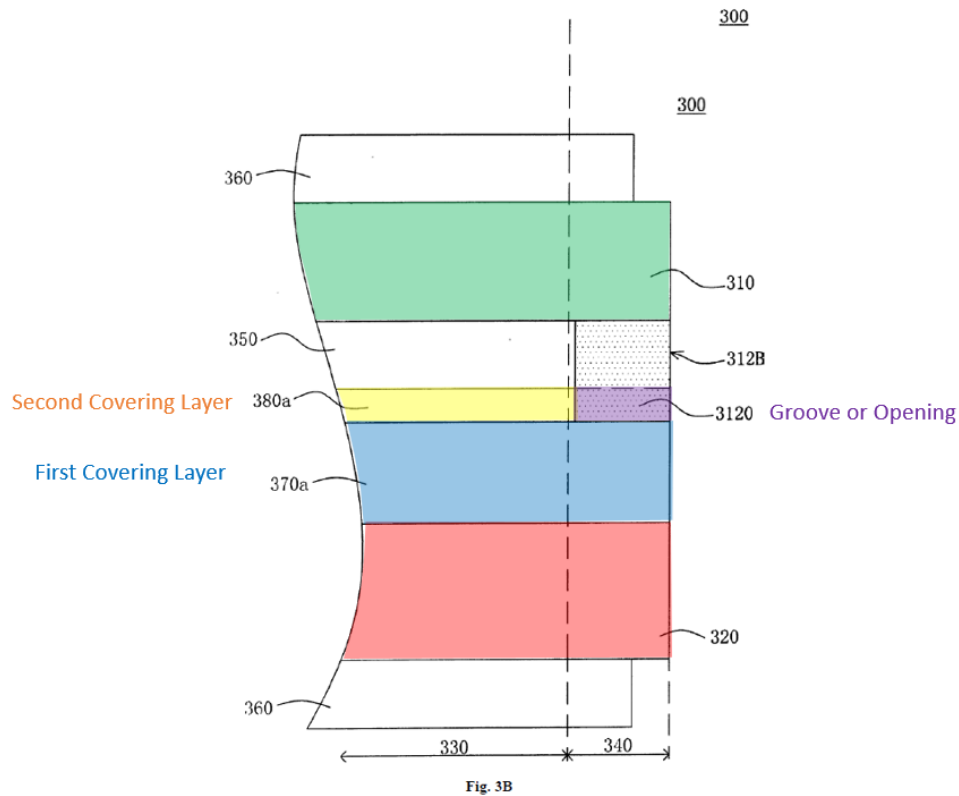


Zhang, Fig. 3A (modified excerpts)

A POSITA would have understood and been motivated to try different options at least because Zhang teaches improving sealant bond by enlarging the contact area and allowing more sealant to penetrate into the groove or opening and would have had a reasonable expectation of success doing so. EX1006, 9; EX1003, ¶200. When describing Figures 3A and 3B, Zhang teaches that “the main purpose of this embodiment is to increase the contact area of the frame adhesive, allowing more adhesive to penetrate into the grooves/openings, thereby enhancing the bonding strength between the TFT substrate and CF substrate.” EX1006 at 8, *see also id.* at 1, 9. A POSITA would have been motivated to try these other obvious groove pattern variations to increase the amount of adhesive that enters the opening and thus increase the bond strength. EX1003, ¶200

Zhang discloses an opening such that “the surface of the predetermined material layer and the sidewall of the organic material pattern layer form a predetermined angle.” Zhang teaches an opening 3120 where the surface of the predetermined material layer (first covering layer 370a) and the sidewall of the organic material pattern layer (second covering layer 380a comprising at least

organic layer 225B and optionally additional layers such as protective layer) form a substantially 90° angle. *See* EX1006, Figs. 3B-E, 6B; *see also id.* 5-6, Figs. 2A-2B. One of skill in the art would have understood Zhang’s substantially 90° angle to be intentional (i.e., be predetermined) based on design choices, including the use of various known etching methods in the art. EX1003, ¶201.

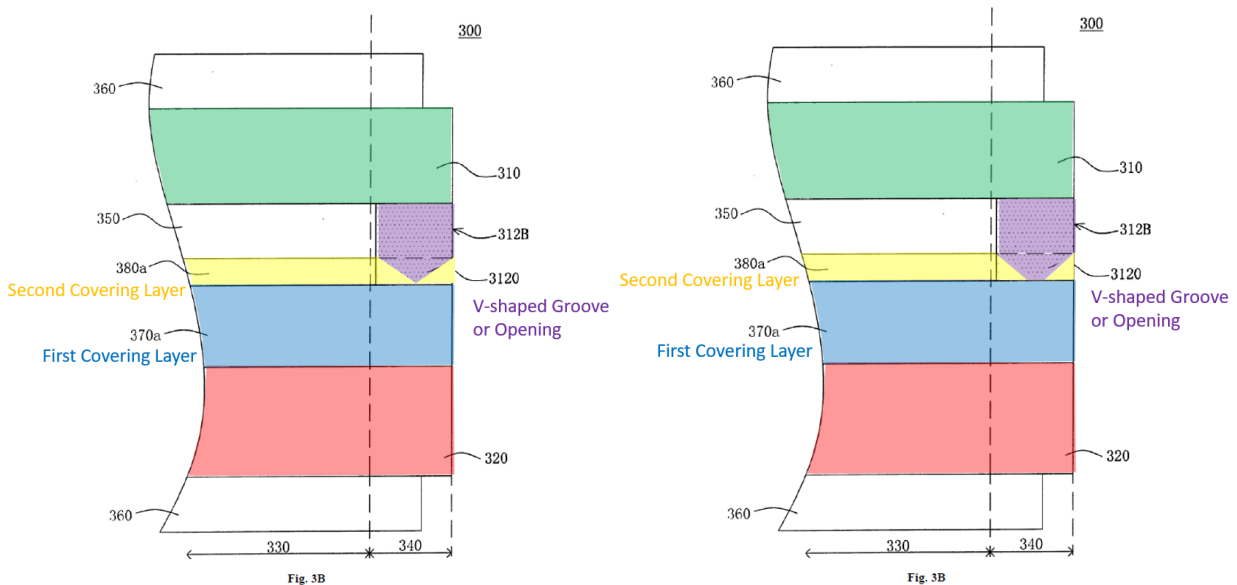


Zhang also describes a “V-shaped” groove or opening as seen from a profile view, where the surface of the predetermined material layer and the sidewall of the organic layer form an angle less than 90°. EX1006 at 1, 11, Fig. 6A, cls. 9, 17. Zhang’s V-shaped opening would be implemented in a conventional reflective LCD such that it would extend through at least the organic photoresist layer and

optionally extend through additional layers, such as protective layer, to expose the predetermined material layer beneath. *See, e.g., id.*, 5-6, 8-9, Figs. 2B, 3B-E, 6B.

One of skill in the art would have understood Zhang's V-shaped angle to be intentional (i.e., be predetermined) based on design choices, including the use of various known etching methods in the art. EX1003, ¶202.

Zhang's V-shaped opening may extend through multiple layers. EX1006, 3A-3E, cl. 9; EX1003, ¶203. Figure 3B describes a single-layer first covering layer 370a, a single-layer second covering layer 380a, and a groove or opening through the second covering layer to expose the first covering layer. *See* EX1006 at 8-9, Fig. 3B. This opening may be "V-shaped." EX1006, 7-10, cl. 1, 9.



Zhang, Fig. 3B (modified)

Likewise, the V-shaped opening may extend through the other layers of the second covering. *See* EX1006 at 8-10, Figs. 3C-E, cl. 9; *see also id.* at Fig. 6A.

A POSITA would have understood that using well-known methods and techniques to create the V-shaped opening of Zhang would result in “a predetermined angle.” EX1003, ¶204. Zhang discloses angled openings but does not a numeric value for its angle. EX1006, 9-10, cl. 9. Regardless, methods for creating the substantially 90° angle or V-shaped angle of Zhang were well known and would result in a predetermined angle. *See* EX1006, Fig. 2B, 3B.

A POSITA would have understood that utilizing angled openings within sealant areas in LCD screens was known and understood, as was shown in various prior art references. *See* IV.E (Yamazaki 366), IV.F; EX1003, ¶205.

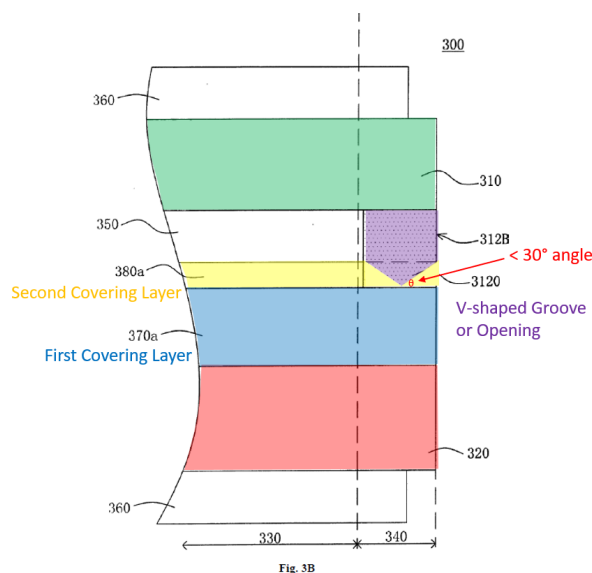
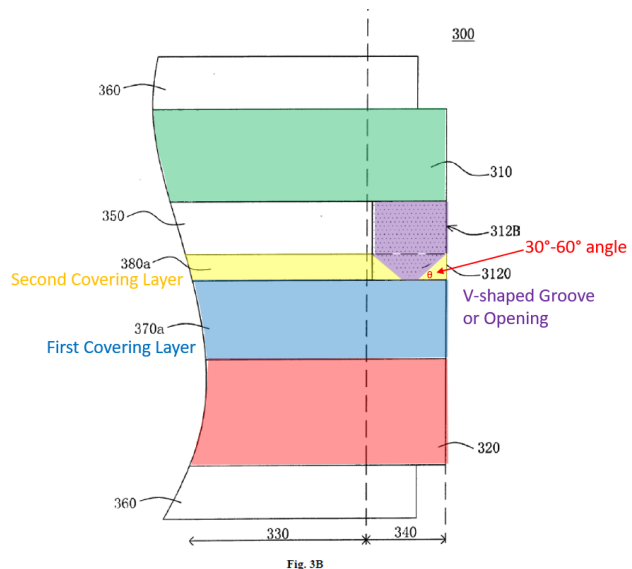
Further, various well-known and conventional techniques existed in the art that would form a V-shaped opening comprising predetermined angles less than 90°. EX1003, ¶206; *see* IV.C (Vaganov), IV.F.

A POSITA would have understood that the angles disclosed by Zhang would have been created using known techniques resulting in predetermined angles and would have been motivated to do so with a reasonable expectation of success. EX1003, ¶207. Zhang discloses implementing different angled openings, from substantially 90° to angles between 20° to 30°. A POSITA would have understood and known of various methods for creating these openings in an organic layer to achieve angled openings with a specific, intentional angle. *Id.*

B. Claim 10

Zhang alone and in view of the knowledge of a POSITA discloses “[t]he sealant region of claim 9, wherein the predetermined angle is less than about 60 degree.” EX1003, ¶¶ 208-214.

Zhang discloses a V-shaped “groove or opening” that extends through the second covering layer, comprising at least the organic photoresist layer and optionally additional layers such as the protective layer, to expose a predetermined material layer below. *See* EX1006 at 8-9, Figs. 2A-B, 3B-E. While the figures of Zhang may not be to scale, they depict to a POSITA a frame adhesive area 340 with a width approximately 3.5-times greater than the height of the protective layer 380a. Thus, a POSITA would have understood Zhang to disclose dimensions that would result in an angle well below 60° and approximately equal to or less than 30°. EX1003, ¶209.



Zhang, Fig. 3B (modified)

A POSITA would have been aware of the common manufacturing methods for semiconductor displays and the design choices involved and would have understood that openings with an angle less than 60° and even less than 30° were possible and how they would be implemented with a reasonable expectation of success. EX1003, ¶210.

A POSITA would have known and understood, as demonstrated by the state of the art disclosed in prior art references, that the openings in Zhang's organic layer would utilize an angle less than 60° and even as low as 20°-30°. *See* IV.C (Vaganov), IV.D (Kim), IV.E (Yamazaki 366), IV.F; EX1003, ¶211. The benefits of implementing angled openings, and specifically angled openings less than 60° and as small as 20°-30° were well known in the art. EX1003, ¶211; *see* IV.C (Vaganov), IV.D (Kim), IV.E (Yamazaki 366), IV.F.

A POSITA would have been motivated to apply these known methods to Zhang to create an opening with an angle less than 60° and as low as 20-30° at least because these methods and angles provide the same benefits sought by Zhang. *See* Ground 6 (Zhang), 9c; IV.C; IV.F; EX1003, ¶212. Zhang purports describes improving the bonding strength in a display panel and reducing cracks and damage by increasing the contact area for the adhesive. *See* IV.C.

The state of the art—as evidenced by references such as Vaganov, Tanaka, Miyoshi—recognized that angles below 60° and as low as 20°-30° would improve bond strength and reliability and reduce cracks, breaks, and moisture intrusion. *See* IV.C (Vaganov), IV.F; EX1003, ¶213.

For at least these reasons, one of skill in the art would have understood and would have been motivated to use known techniques to implement the angled openings of Zhang with angles less than 60° and as low as 20° to 30° with a reasonable expectation of success. EX1003, ¶214.

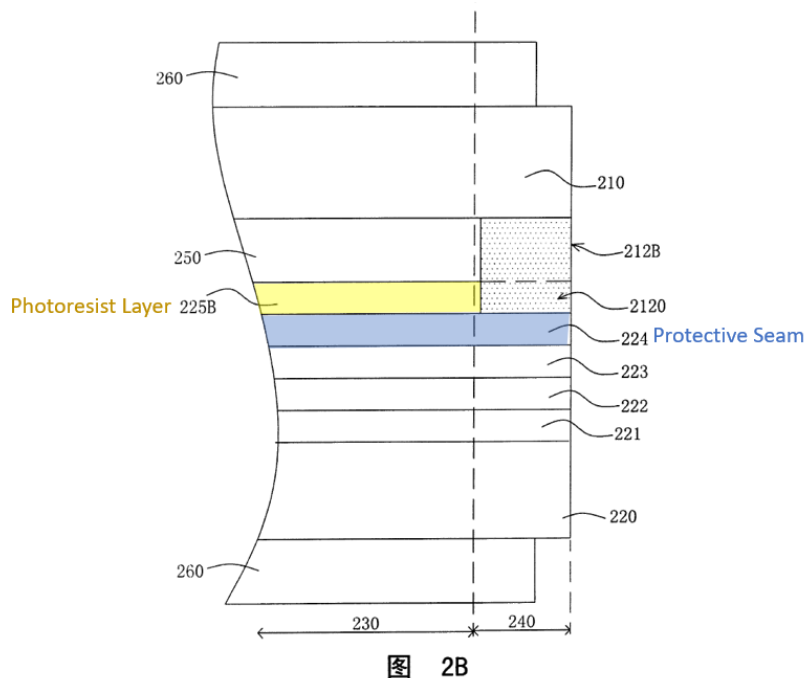
C. Claim 11

Zhang alone and in view of the knowledge of a POSITA discloses “[t]he sealant region of claim 9, wherein the predetermined angle ranges from about 20 degree to about 30 degree.” *See* Ground 6 (Zhang), 9c and 10; EX1003, ¶215.

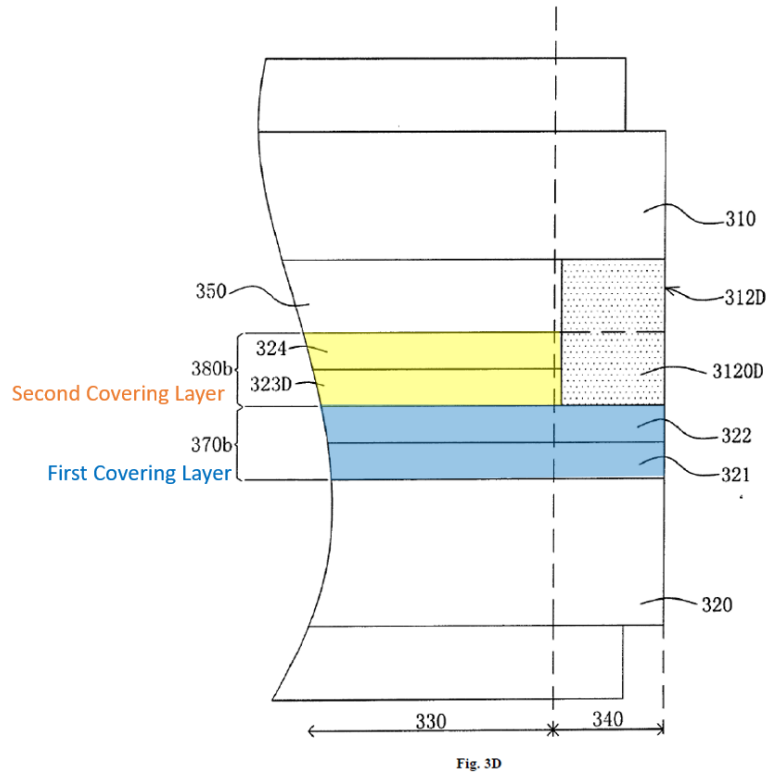
D. Claim 12

Zhang alone and in view of the knowledge of a POSITA discloses “[t]he sealant region of claim 9, wherein the predetermined material layer comprises a passivation layer.” *See* Ground 6 (Zhang), 9b; EX1003, ¶¶216-219.

Zhang’s conventional reflective LCD display would include at least an organic photoresist layer 225B with an opening 2120 that exposes a protection layer 224 (predetermined material layer) comprised of silicon dioxide (SiO₂) or silicon nitride (Si₃N₄). *Id.*, 6, Fig. 2B, cl. 6.



Similarly, Zhang discloses a second covering layer comprising an organic layer as well as additional layers, such as protective layer 324 and second metal layer 323, covering a first covering layer comprising other layers, including a dielectric layer 322 that can be “composed of a material such as silicon nitride (SiN_x).” EX1006 4, 5, 6, 9, 10, Figs. 3B-E.



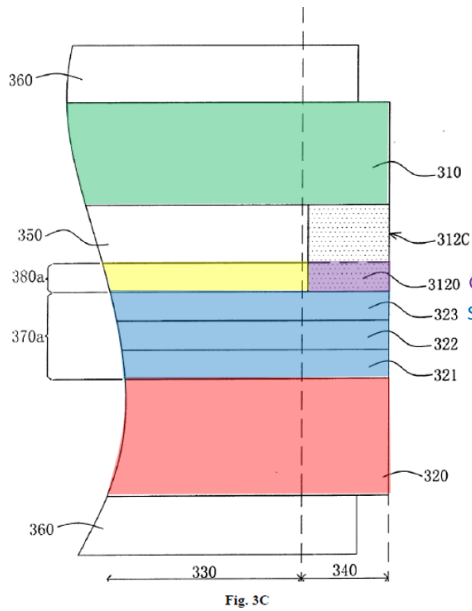
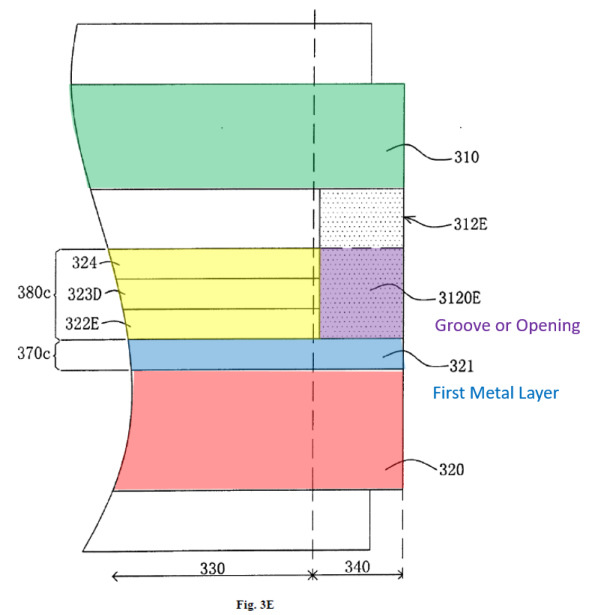
The '801 patent describes a “predetermined material layer such as a silicon nitride layer 242 . . . serving as a passivation layer.” EX1001 at 2:46-55. The first covering of Zhang, like the passivation layer of the '801 patent, may comprise both a silicon nitride layer as well as one or more metal layers, such as a metal electrode. Further, one of skill in the art would have understood the dielectric layer within the first covering of Zhang to refer to a passivation layer. EX1003, ¶219.

E. Claim 13

Zhang alone and in view of the knowledge of a POSITA discloses “[t]he sealant region of claim 9, wherein the predetermined material layer comprises a metal electrode layer.” See Ground 6 (Zhang), 9b. The first covering layer 370 of

Zhang comprises a first metal layer 321 and a second metal layer 323. EX1006 9, 10, Figs. 3A-3E, cls. 2-6; *see also id.* 4-7. The '801 patent describes a “predetermined material layer [that] may further comprise [various metal compounds] or a combination thereof, serving as a metal electrode layer.” EX1001 at 2:46-55. One of skill in the art would have understood the metal layers within the first covering of Zhang to refer to metal electrode layers. EX1003, ¶220.

Zhang discloses creating a groove or opening in the second covering layer 380 to expose the metal layers 321 and/or 323 of first covering layer 370. EX1006, 9-10, Figs. 3C-E, cls. 1-6; EX1003, ¶221. For example, in Figure 3C “the groove or opening 3120 exposes portion of the second metal layer 323,” and in Figure 3E “the groove or opening 3120 exposes portion of the second metal layer 323.” EX1006, 9-10, Figs. 3C-E. This groove structure allows the “frame adhesive [to] . . . penetrat[e] into the opening 3120 and mak[e] contact with the surface of the [first or second metal layer].” *Id.*, 9-10.



F. Claim 1

Zhang alone and in view of the knowledge of a POSITA discloses claim 1. See Ground 6 (Zhang), 9; EX1003, ¶222-226. Claim 1 claims a method of “providing” and “forming” the elements of apparatus claim 9 without further specificity and, therefore, is rendered obvious by Zhang alone and in view of the knowledge of a POSITA. See Ground 6 (Zhang), 9.

1. [1pre]

To the extent the preamble is limiting, Zhang alone and in view of the knowledge of a POSITA discloses 1pre. Ground 6 (Zhang), 9pre.

2. [1a]

Zhang alone and in view of the knowledge of a POSITA discloses 1a. See Ground 6 (Zhang), 9a.

3. [1b]

Zhang alone and in view of the knowledge of a POSITA discloses 1b. *See* Ground 6 (Zhang), 9b.

4. [1c]

Zhang alone and in view of the knowledge of a POSITA discloses 1c. *See* Ground 6 (Zhang), 9c.

G. Claim 2

Zhang alone and in view of the knowledge of a POSITA discloses claim 2. *See* Ground 6 (Zhang), 10; EX1003, ¶227.

H. Claim 3

Zhang alone and in view of the knowledge of a POSITA discloses claim 3. *See* Ground 6 (Zhang), 11; EX1003, ¶228.

I. Claim 4

Zhang alone and in view of the knowledge of a POSITA discloses claim 4. *See* Ground 6 (Zhang), 12; EX1003, ¶229.

J. Claim 5

Zhang alone and in view of the knowledge of a POSITA discloses claim 5. *See* Ground 6 (Zhang), 13; EX1003, ¶230.

K. Claim 6

Zhang alone and in view of the knowledge of a POSITA discloses claim 6. EX1003, ¶¶ 231-239.

1. Claim [6a]

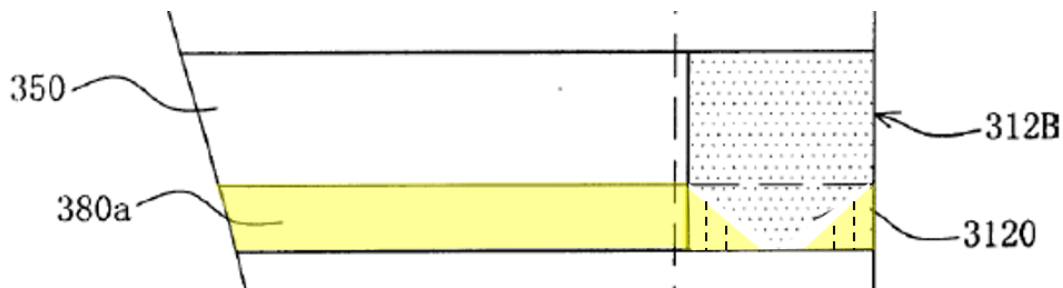
Zhang alone and in view of the knowledge of a POSITA discloses 6a. *See* Ground 6 (Zhang), 9 and 1. Zhang discloses an organic layer formed on the predetermined material layer and a sawtooth opening is created by making holes in the organic layer. *See id.*; EX.1003, ¶ 232. Zhang does not disclose a specific patterning technique, nor is the claim limited to one.

A POSITA would have found this claim obvious would have been motivated to implement Zhang using a technique within their knowledge and skill, any one of which would satisfy this claim. *See* EX.1003, ¶ 232; Section IV.C-F (discussing known techniques). Vaganov, Kim, and Yamazaki provide examples of techniques for particular angles and are incorporated herein by reference. *See* Grounds 7-8. A POSITA would have had a reasonable expectation of success in using these techniques for the predictable result of patterning.

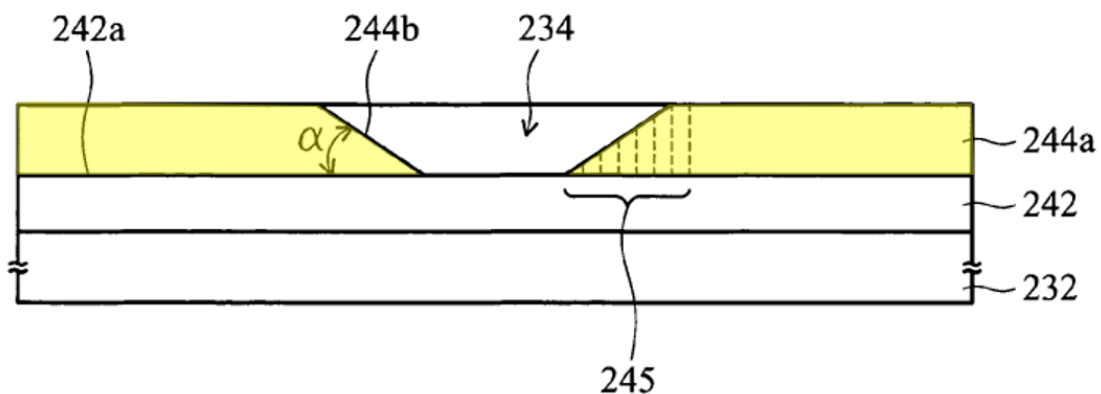
2. Claim [6b]

Zhang alone and in view of the knowledge of a POSITA discloses “wherein the organic material pattern layer comprises a plurality of segments adjacent to the saw tooth opening, and the respective height of the plurality segments gradually increases with respect to the distance from the saw tooth opening.” EX1003, ¶ 233-239.

For example, Zhang discloses that the groove or opening may be V-shaped such that the height of the segments gradually increases as they move away from the center of the opening. *See* Ground 6 (Zhang), 9c, 10, 1c, 2. Claim 1 of the '801 patent requires a "predetermined angle," which includes openings with angles that are substantially 90°. Claim 6, similar to claims 2 and 3, requires that the sidewalls form an angle less than 90°. The '801 patent depicts the plurality of segments 245 as a continuous angled slope away from the center of the opening. EX1001, Fig. 2B-C. Similarly, Zhang teaches a V-shaped opening with an angled slope.

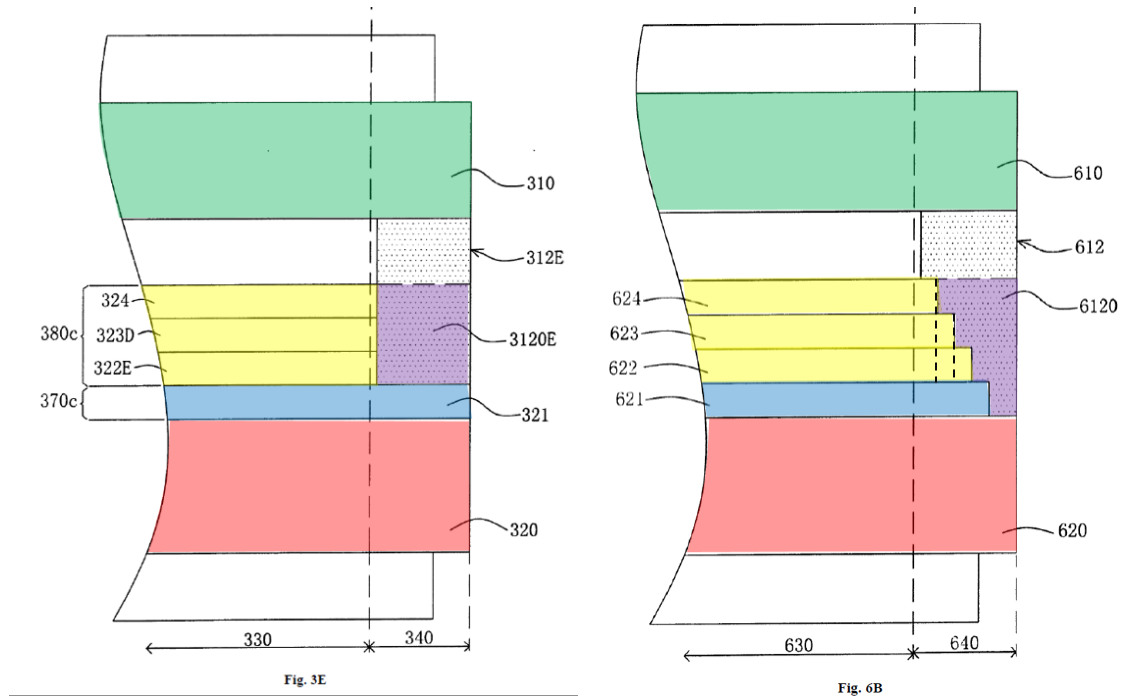


Zhang Fig. 3B (modified excerpt)



'801 patent Fig. 2B

To the extent the claims require explicit and separate segments, Zhang discloses this as well. For example, Zhang discloses a “groove or opening . . . distributed in a stepped manner, as shown in Figure 6B.” EX1006, 11, Fig. 6B. Similarly, the embodiment using a V-shaped groove as shown in Figure 6A includes separate segments at each level that satisfy this claim. *Id.*, 11, Fig. 6A. As established above, Zhang discloses, or at least renders obvious, that the multi-layered second covering layer would have included an organic layer for reflective LCDs. *See* Ground 6 (Zhang) claims 9, 13, 1 and 5. A POSITA would have understood that the multi-layered second covering layer, as depicted in Fig. 3B-E, and including an organic layer, would be formed in the same stepped manner as Fig. 6A&B. EX1003, ¶237; EX1006, Figs. 3B-E, 6A&B. A POSITA would also have understood whether to use the stepped opening of 6B (and sacrifice some volume for additional adhesive material) or the angled V-shaped of 6A for the multi-layered second covering layer including the organic layer would merely be a design choice. EX1003, ¶238. Thus, a POSITA would have understood that the opening of Zhang, including the organic layer, would include the stepped segments, including segments that gradually increase. EX1003, ¶237-238.



XI. GROUND 7: CLAIMS 2-3, 6, 10-11 ARE OBVIOUS OVER ZHANG IN VIEW OF VAGANOV

A. Combination Rationale

It would have been obvious for a POSITA to combine Zhang's teachings related to increasing the bonding strength in the manufacture of LCDs and improving the quality of the panel by preventing moisture degradation with Vaganov's teachings of increasing bonding strength in semiconductor and chip manufacture and increasing the reliability by reducing cracking or breakage. EX1003, ¶239.

Zhang is directed improving the quality and bond strength of display panels by increasing the contact area of openings in the layers to allow more adhesive to

penetrate the openings and come into contact with the various layers. *See* IV.B (Zhang); EX1003, ¶240.

Vaganov is directed to bonding strength by using microstructures with angled sidewalls in the bonded surfaces to increase the bonding surface area and volume of sealant. *See* IV.C. Vaganov's angled sidewalls also improve reliability and prevent "delamination due to insufficient adhesion, cracking or breakage." EX1007, 6:1-16. Vaganov describes well-known techniques for creating a variety of predetermined angles of below 60°. *See* IV.C. The specific dimensions and angles are determined by design considerations and the processes used and could result in angles at or below 30°. EX1007, 2:57-3:14, 5:14-22, 10:23-51, 12:46-53; *See* IV.C (Vaganov); EX1003, ¶241.

Zhang, Vaganov, and the 801 patent are in the same field of endeavor, including disclosing methods for manufacturing electronic devices, such as LCDs and integrated circuits, and describe implementing their improvements in similar structures. EX1003, ¶242; *see* IV.B, IV.C; *see also* EX1006, 7-11, Figs. 1A-B, 2A-B, 3A-E, 4, 5A-B, and 6A-B; EX1007, 1:5-8, 1:11-36, 1:38-61, 3:33-44, 4:50-67, 14:27-35, 14:58-63, Figs. 1.

Both references teach increasing the surface area by implementing angled opening in the layers. Zhang discloses an organic layer (second covering 380 comprising at least photoresist layer 225 and optionally other layers) that covers a

predetermined material layer (first covering 370) and has an angled (V-shaped) opening to expose the underlying layers. While Zhang describes and depicts openings with various angles (including substantially 90° and less), Zhang does not identify a numerical value for its angle. Vaganov discloses methods for creating openings in similar materials that result in specific angles, including 90°, 54°44'', 45°, and 35°16''. A POSITA would have recognized the similar structures and materials and would have found it routine and straightforward to combine Vaganov's teaching of a specific angle with Zhang's angled opening. EX1003, ¶243.

A POSITA implementing Zhang would have been motivated to use the methods of Vaganov and would have had a reasonable expectation of success in doing so, at least as they pertain to creating an opening with a specific angle. EX1003, ¶244. A POSITA would have understood that Zhang and Vaganov teach similar improvements that provide similar results. Zhang is directed to increasing the contact area for the adhesive to improve bond and reliability. The increased bond strength has the additional benefit of reducing damage or cracks in the sealant that might allow for intrusion of moisture. Vaganov describes techniques for creating openings with angled sidewalls that would also increase the contact area between the sealant and various layers. EX1003, ¶244. The sealant area of Vaganov would improve the reliability by preventing intrusion from moisture and

oxygen and thus reducing the likelihood of delamination or degradation. *See*

EX1007, 1:28-37, 1:62-2:27, 2:56-3:4, 3:29-33, 7:6-9.

B. Overview and Incorporation of Ground 6

Ground 7 relies on Ground 6, which is incorporated herein by reference, and the combination of Zhang and Vaganov, including the discussions regarding motivation to combine.

C. Claim 10

Zhang in view of Vaganov discloses claim 10. *See* Ground 6 (Zhang), 10; EX1003, ¶246.

D. Claim 11

Zhang in view of Vaganov discloses claim 11. *See* Ground 6 (Zhang), 11; EX1003, ¶247.

E. Claim 2

Zhang in view of Vaganov discloses claim 2. *See* Ground 6 (Zhang), 2; EX1003, ¶248.

F. Claim 3

Zhang in view of Vaganov discloses claim 3. *See* Ground 6 (Zhang), 3; EX1003, ¶249.

G. Claim 6

Zhang in view of Vaganov discloses claim 6. *See* Ground 6 (Zhang), 6; IV.C-F; EX1003, ¶250.

**XII. GROUND 8: CLAIMS 2-3, 6, 10-11 ARE OBVIOUS OVER ZHANG
IN VIEW OF YAMAZAKI**

A. Combination Rationale

It would have been obvious for a POSITA to combine the Zhang's teachings related to increasing the bonding strength and reliability with Yamazaki's teachings regarding creating sealant regions including an organic layer with an angled slope to improve the seal and reliability by prevent moisture and oxygen intrusion. EX1003, ¶251.

Zhang is directed improving the quality and bond strength of display panels by increasing the contact area of openings in the layers to allow more adhesive to penetrate the openings and come into contact with the various layers. *See* IV.B; EX1003, ¶252.

Yamazaki discloses an LCD device with a sealant region comprising an organic layer with openings that expose the underlying insulating layers, where the sidewalls of the opening have an "angle θ more than 30° and less than 75° ." *See* IV.E (Yamazaki); EX1003, ¶253. Yamazaki 366's tapered slope would have decreased moisture intrusion and chances of delamination in the display device. *Id.*

Zhang, Yamazaki 366, and the 801 patent are in the same field of endeavor, including disclosing methods for manufacturing liquid crystal displays, and describe implementing their improvements in similar structures and products to achieve similar benefits. EX1003, ¶254; EX1006, 7-11, Figs. 1A-B, 2A-B, 3A-E,

4, 5A-B, and 6A-B; EX1009, 1:8-64, 4:32-47, 8:28-33, Fig. 11. Both references describe an organic layer overlaying an underlying layer and an opening through the former to expose the latter. Zhang discloses an organic layer (second covering 380 comprising at least photoresist layer 225 and optionally including additional layers, such as a protective layer) that rests above a predetermined material layer (first covering 370) and has an angled (V-shaped) opening in the organic layer to expose the underlying layers. Zhang describes openings with various angles (including substantially 90° and less) but does not identify a numerical value for its angle. Yamazaki 366 discloses an organic layer (planarizing film 16) that rests above a predetermined material layer (insulating layers 11, 12, and 13) and has an angled (30°-75°) sidewall or opening in the organic layer to expose the underlying layers. One of skill in the art would have recognized the similar structures and materials and would have found it routine and straightforward to combine Yamazaki's teaching of a specific angle with Zhang's angled opening. EX1003, ¶254.

A POSITA implementing Zhang would have been motivated to use the methods of Yamazaki and would have had a reasonable expectation of success in doing so, at least as they pertain to creating an opening with specific angles. EX1003, ¶255. A POSITA would have understood that both Zhang and Yamazaki teach similar improvements that provide similar results, and thus would have been

obvious to combine. Zhang is directed to increasing the contact area for the adhesive to improve bond and reliability. The increased bond strength has the additional benefit of reducing damage or cracks in the sealant that might allow for intrusion of moisture. Yamazaki 366 describes angled sidewalls that would also increase the contact area between the sealant and various layers. EX1003, ¶255. The sealant area of Yamazaki 366 also creates a more reliable product by preventing intrusion from moisture and oxygen and thus reducing the likelihood of delamination or degradation.

B. Overview and Incorporation of Ground 6

Ground 8 relies on Ground 6 which is incorporated herein by reference, and the combination of Zhang and Yamazaki, including the discussions regarding motivation to combine.

C. Claim 10

Zhang in view of Yamazaki discloses claim 10. *See* Ground 6 (Zhang), 10; EX1003, ¶ 257.

D. Claim 11

Zhang in view of Yamazaki discloses claim 11. *See* Ground 6 (Zhang), 11. Yamazaki discloses a taper angle “more than 30° and less than 75°.” EX1009, 5:43-45, 12:47-48. A POSITA would have understood that an angle “more than 30°” could also be “about 30 degree.” EX1003, ¶258. Techniques for creating an opening with angled sidewalls of “about 30 degree” were well known. *Id.* A

POSITA would have been motivated to implement Yamazaki's approximately 30 degrees angle in Zhang because the smaller angle would allow for more surface area, more sealant, and, thus, a stronger bond. *Id.*

E. Claim 2

Zhang in view of Yamazaki discloses claim 2. *See* Ground 6 (Zhang), 2; EX1003, ¶259.

F. Claim 3

Zhang in view of Yamazaki discloses claim 3. *See* Ground 6 (Zhang), 3; EX1003, ¶260.

G. Claim 6

Zhang in view of Yamazaki discloses claim 6. *See* Ground 6 (Zhang), 6; IV.C-F; EX1003, ¶261.

XIII. DISCRETIONARY DENIAL IS NOT WARRANTED

A. 35 U.S.C. § 314(a) Analysis

The *Fintiv* factors (enumerated below) weigh against discretionary denial. IPR2020-00019, Paper 11, 5-6 (PTAB Mar. 20, 2020) (precedential).

1. Stay

This factor is neutral because no party has requested a stay yet.

2. Trial Date

This factor favors institution because no trial date has been set.

3. Parallel Proceeding

This factor favors institution because Petitioner has not yet answered the Complaint.

4. Issue Overlap

This factor favors institution because Petitioner challenges 13 claims and the Complaint in the Litigation explicitly asserts only one claim.

5. Same Party

This factor slightly favors institution because Petitioner and the PO are the parties in the Litigation and because this Board is likely to reach the merits around the same time as the district court. *See NVIDIA Corp. v. Invensas Corp.*, IPR2020-00603, Paper 11, at 23.

6. Other Considerations

Other considerations weigh strongly against a discretionary denial. The Challenged Claims are clearly invalid and Petitioner has not previously challenged the patent or a related patent in a post-issuance proceeding.

Even if the Board were to determine that *Fintiv* factors on balance weigh in favor of denial, institution should nonetheless be granted because this Petition satisfies the compelling merits standards. Interim Guidance at 4; *Vizio, Inc. v. Maxell, Ltd.*, IPR2022-01458, Paper 8, at 62.

B. 35 U.S.C. § 325(b) Analysis

Applying the two-part framework discussed in *Advanced Bionics, LLC v. Med-El Elektromedizinische Gerate GMBH*, IPR2019-01469, Pap. 6, *8-9, the Board should not exercise its §325(d) discretion to deny institution.

None of the challenges are substantially the same as those considered during prosecution. In the event that the challenges herein are found to be based on prior art that is the same as or cumulative to prior art considered by the examiner during prosecution, the examiner has made a clear error in allowing the claims over such prior art. This is at least because the challenges in this Petition satisfy the compelling merits standard, and allowing the claims over such prior art is therefore clear error.

XIV. COMPLIANCE WITH FORMAL REQUIREMENTS

A. Mandatory Notices Under 37 C.F.R. §§ 42.8(b)(1)-(4)

1. Real Party-In-Interest

BOE Technology Group Co., LTD is the real party-in-interest.

2. Related Matters

The '801 patent is subject to the following actions: *Optronic Sciences LLC v. BOE Technology Group Co., LTD*, 2:23-cv-00549 (EDTX).

3. Lead and Backup Counsel

(a) Lead Counsel	(b) Backup Counsel
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4. Service Information

Please address correspondence to counsel at the addresses above. Petitioner consents to electronic service to: dla-boe-optronicsciences-IPR@us.dlapiper.com and the email addresses listed above.

B. Proof of Service on the Patent Owner

In accordance with 37 C.F.R. §§42.6(e) and 42.105, as identified in the attached Certificate of Service, a copy of this Petition in its entirety is being served electronically to the Patent Owner's attorney of record, as well as on counsel for Patent Owner in the District Court Litigation

C. Power of Attorney

Powers of attorney are being filed with designation of counsel in accordance with 37 C.F.R. § 41.10(b).

D. Standing

In accordance with 37 C.F.R. §42.104(a), Petitioner certifies that the '801 patent is available for *inter partes* review and that Petitioner is not barred or estopped from requesting an *inter partes* review challenging the patent claims on the grounds identified in this Petition.

E. Fees

The undersigned authorizes the Director to charge the fee specified by 37 C.F.R. § 42.15(a) and any additional fees that might be due in connection with this Petition to Deposit Account No. 503266.

XV. CONCLUSION

All Challenged Claims of the '801 patent should be found unpatentable for the reasons discussed in this Petition.

Respectfully submitted,

/s/ Brian Erickson

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CERTIFICATE OF WORD COUNT

Pursuant to 37 C.F.R. § 42.24(d), Petitioner certifies that this petition includes 13,999 words, as measured by Microsoft Word, exclusive of the table of contents, mandatory notices under § 42.8, certificates of service, word count, claim listing, and exhibits.

Date: July 12, 2024

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CERTIFICATE OF SERVICE

The undersigned certifies pursuant to 37 C.F.R. §§ 42.6(e) and 42.105 that on July 12, 2024, a true and correct copy of the Petition for *Inter Partes* Review of U.S. Patent No. 7,226,801 was served by emailing a copy of same (by agreement) to the following attorneys for the Patent Owner:

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Respectfully submitted,

/s/ Brian Erickson