

BOE Tech. Group. Co., Ltd.

V.

Optronic Sciences LLC

IPR2024-01131

Pat. 7,226,801

Patent Owner's Demonstrative Exhibits

Technology Background

Background: Patent 7,226,801

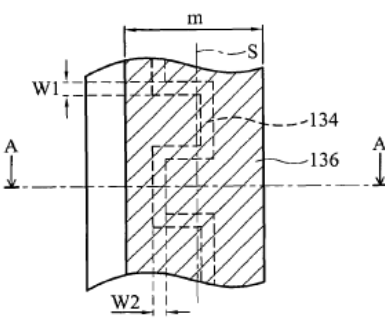
The present invention reduces reliability and integrity problems encountered in conventional methods. Peeling of sealant, uneven cell gaps, and formation of voids in sealant regions during assembly are all reduced.



Ex. 1001 at 1:47–50.

Ex. 2008 (Bretschneider), ¶¶54–55

 US007226801B2	
(12) United States Patent Chiang et al.	(10) Patent No.: US 7,226,801 B2 (45) Date of Patent: Jun. 5, 2007
(54) SEALANT REGION PATTERN FOR LIQUID CRYSTAL DISPLAY AND METHOD FOR FABRICATING THE SAME	6,998,221 B2 * 2/2006 Kirmse 216/51 2005/0178498 A1 * 8/2005 Chen et al. 156/268
(75) Inventors: Yi-Chen Chiang, Yijhu Township, Chiayi County (TW); Kuo-Yu Huang, Hsinchu (TW)	FOREIGN PATENT DOCUMENTS TW 464778 11/2001
(73) Assignee: AU Optronics Corp., Hsinchu (TW)	OTHER PUBLICATIONS Taiwan Office Action mailed May 23, 2006. * cited by examiner Primary Examiner—Kevin M. Picardat (74) <i>Attorney, Agent, or Firm</i> —Thomas, Kayden, Horstemeier & Risley
(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.	
(21) Appl. No.: 11/319,839 (22) Filed: Dec. 28, 2005 (65) Prior Publication Data US 2006/0160259 A1 Jul. 20, 2006 (30) Foreign Application Priority Data Jun. 27, 2005 (TW) 94121405 A	(57) ABSTRACT A sealant region pattern for a liquid crystal display apparatus and a method for fabricating the same. The method comprises providing a first substrate and a second substrate opposite thereto, forming a predetermined material layer on the first substrate, forming an organic material pattern layer having openings of a saw tooth pattern on the predetermined material layer to expose the surface of the predetermined material layer underneath. The surface of the predetermined material layer and the sidewall of the organic material pattern layer form a predetermined angle.
(51) Int. Cl. H01L 21/00 (2006.01) H01L 29/04 (2006.01) (52) U.S. Cl. 438/30; 438/27; 257/59; 257/72 (58) Field of Classification Search 438/35, 438/30, 25, 26, 27, 116; 257/59, 72 See application file for complete search history.	(56) References Cited U.S. PATENT DOCUMENTS 6,559,917 B2 5/2003 Ikano
14 Claims, 3 Drawing Sheets	



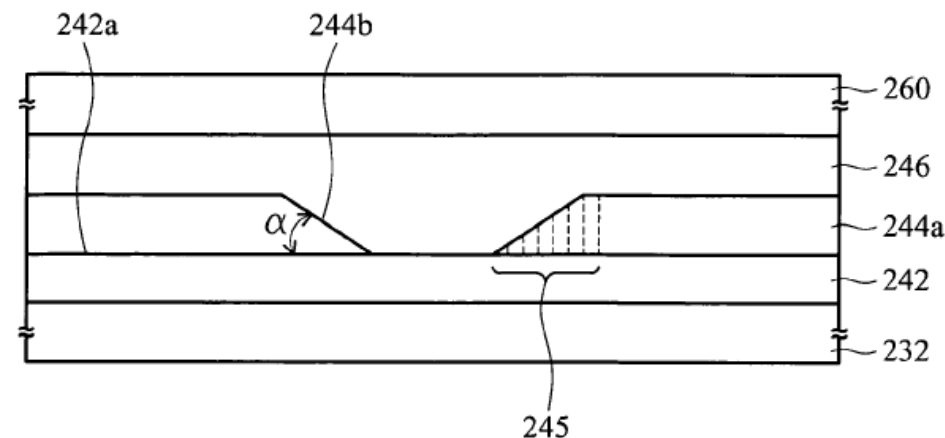


FIG. 2C

Ex. 1001 (801 Patent)

Background: Patent 7,226,801

As shown in Fig. 1C . . . **Voids or bubbles 150 formed during application of the sealant 146 occur due to angle θ** between sidewall of saw tooth openings 134 and the surface of silicon nitride layer 142 exceeding 60 degrees.

Ex. 1001 at 2:27, 37–40.

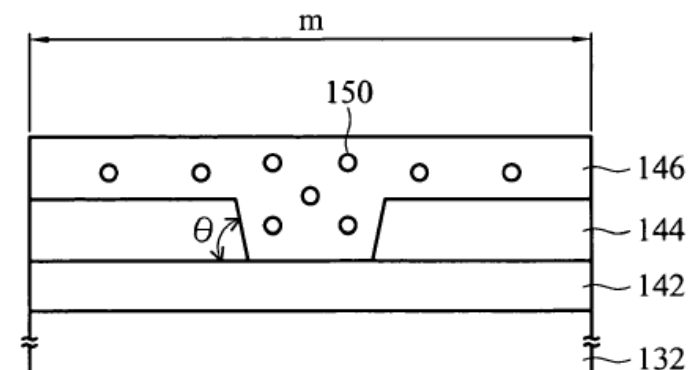


FIG. 1C

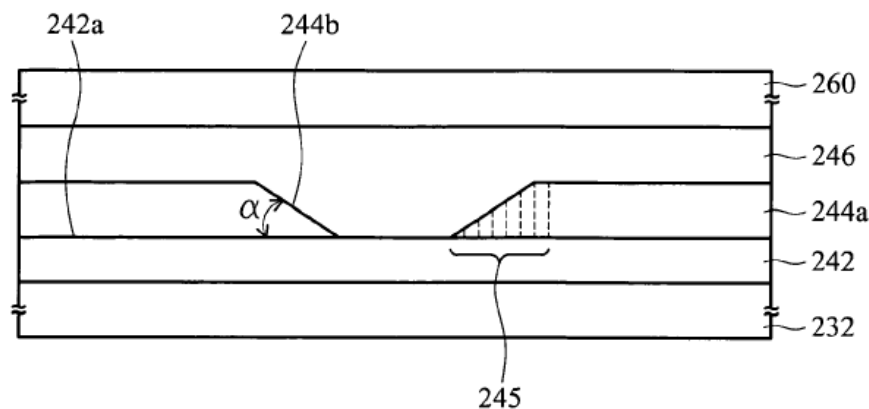


FIG. 2C

In Fig. 2C . . . **With predetermined angle α , air exhausts easily via the tapered profile of the saw tooth opening 234 during application of sealant, avoiding formation of voids or bubbles in the sealant.**

Ex. 1001 at 3:27–30.

Background: Patent 7,226,801

Creating Predetermined Angles: Photolithography Techniques (e.g., Half-tone Mask)

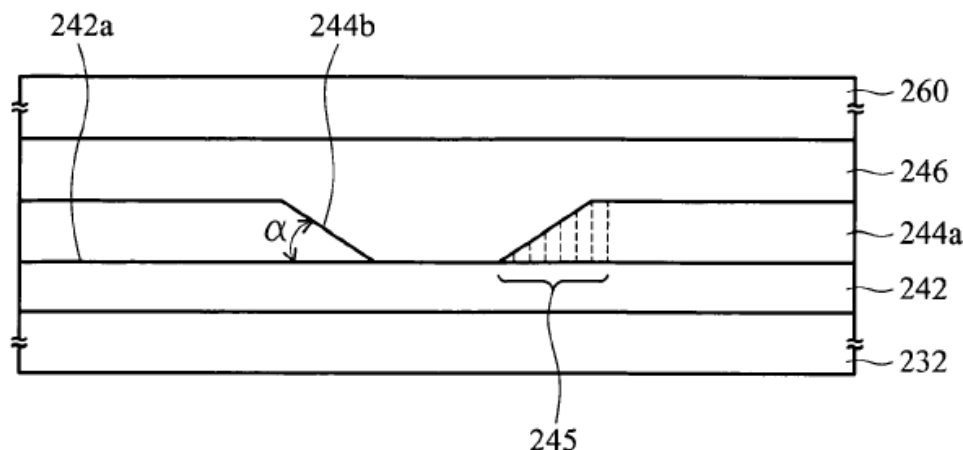


FIG. 2C

An organic material layer 244 is formed on the silicon nitride layer 242. The organic material layer 244 is patterned by lithography, exposed to UV light 250 through a half-tone mask 248 with a predetermined pattern thereon. The predetermined pattern can comprise various openings of different size, providing various local transmittances. Accordingly, the organic material layer 244 is tapered after subsequent development and etching. The organic material layer 244 comprises polymethyl methacrylate (PMMA), photosensitive-methylsilsesquiazane (PS-MSZ), or the like.

In FIG. 2B, saw tooth opening 234 are formed in the organic material layer 244 by etching, similar to saw tooth opening 134 shown in FIG. 1B. The half-tone mask 248 can comprise a gray-tone or slit-pattern mask. Preferably, no etching is performed when using photosensitive low-k organic materials in the organic material layer 244.



11. The sealant region of claim 9, wherein the predetermined angle ranges from about 20 degree to about 30 degree.

District Court's Claim Construction

District Court's Claim Construction

"A sealant region pattern for a liquid crystal display" ('801 Patent, Claims 9, 10) "An encapsulating structure for a liquid crystal display device" ('914 Patent, Claims 1, 5)	The preambles are limiting only with respect to "a sealant region pattern" in the '801 Patent and "an encapsulating structure" in the '914 Patent
"saw tooth opening" ('801 Patent, Claim 9); "saw tooth pattern" ('914 Patent, Claim 1)	Plain and ordinary meaning
"formed on" ('801 Patent, Claim 9) "directly formed on" ('121 Patent, Claim 1) "the gate oxide layer in the first area is formed directly on the substrate" ('117 Patent, Claim 1)	"formed in a manner directly touching the layer below"
"a predetermined material layer formed on the first substrate" ('801 Patent, Claim 9)	Plain and ordinary meaning

Ex. 1026 (Markman Order) at 34–35

9. A sealant region pattern for a liquid crystal display, comprising:

- a first substrate and a second substrate opposite thereto;
- a predetermined material layer formed on the first substrate; and
- 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.

Ex. 1001, Claim 9

Claim Construction

“Predetermined Angle”

- Plain and ordinary meaning requires that the angle be predetermined
 - *e.g.*, special photolithography techniques like a half-tone mask create a predetermined angle
- An arbitrary angle within a structure does not meet the claimed “predetermined angle”

POR at 38

“State of the Art”: Evidence of Hindsight

“State of the Art”: Shinego

1) Shinego does not disclose creating an angled sidewall for an organic film

86. In both examples, the films being etched are the silicon oxide or silicon nitride, not organic films. See Ex. 1010, ¶ [0140] . . . In addition, a POSITA would be aware that HF based etchant solutions do not attack or etch organic films. For this reason alone, it is my opinion that Dr. Neikirk failed to perform an adequate review of the actual teachings of the Shigeno reference. Nowhere does Shigeno teach or disclose a specific sidewall angle for any organic film.

Ex. 2008 (Bretschneider Decl.) at ¶ 86.

“State of the Art”: Shinego

2) Shinego’s angles are not in the sealant region

88. By inspection, it is evident that, contrary to Dr. Neikirk’s opinion, “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.” Ex. 1003 ¶(bottom of page 13). Shigeno’s sealant is not even applied over the etch features in Shigeno’s gate insulation film 15. Dr. Neikirk’s opinion misstates the actual content and teachings of the Shigeno reference and indicates a reliance on hindsight.

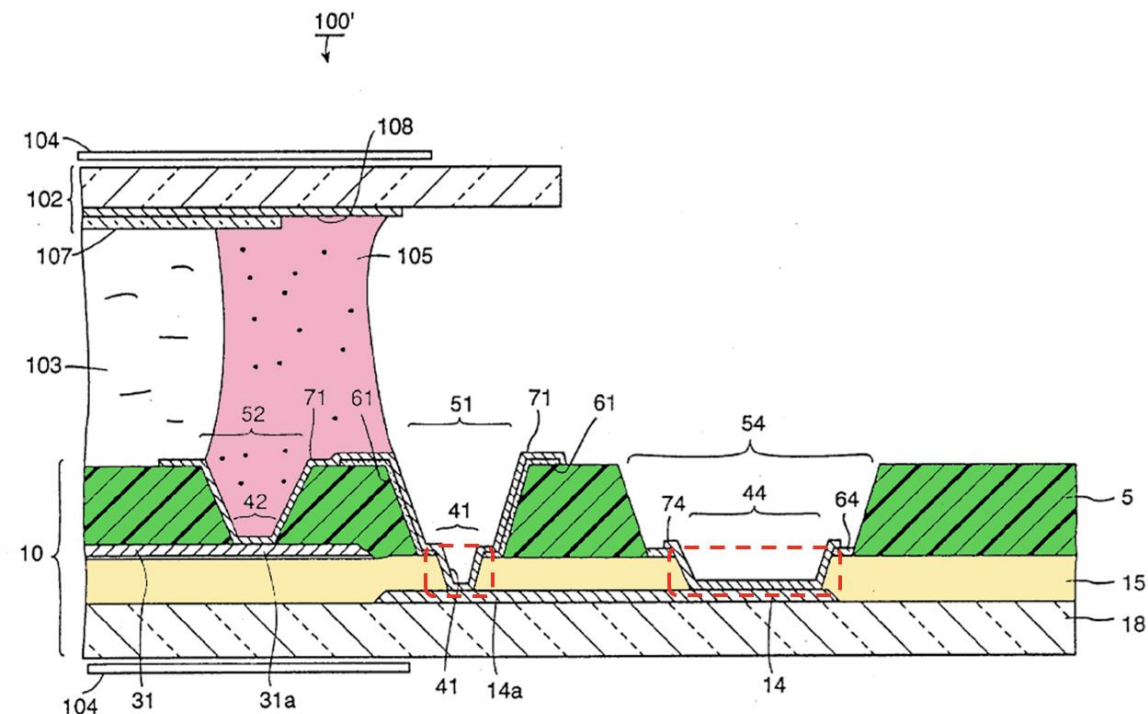
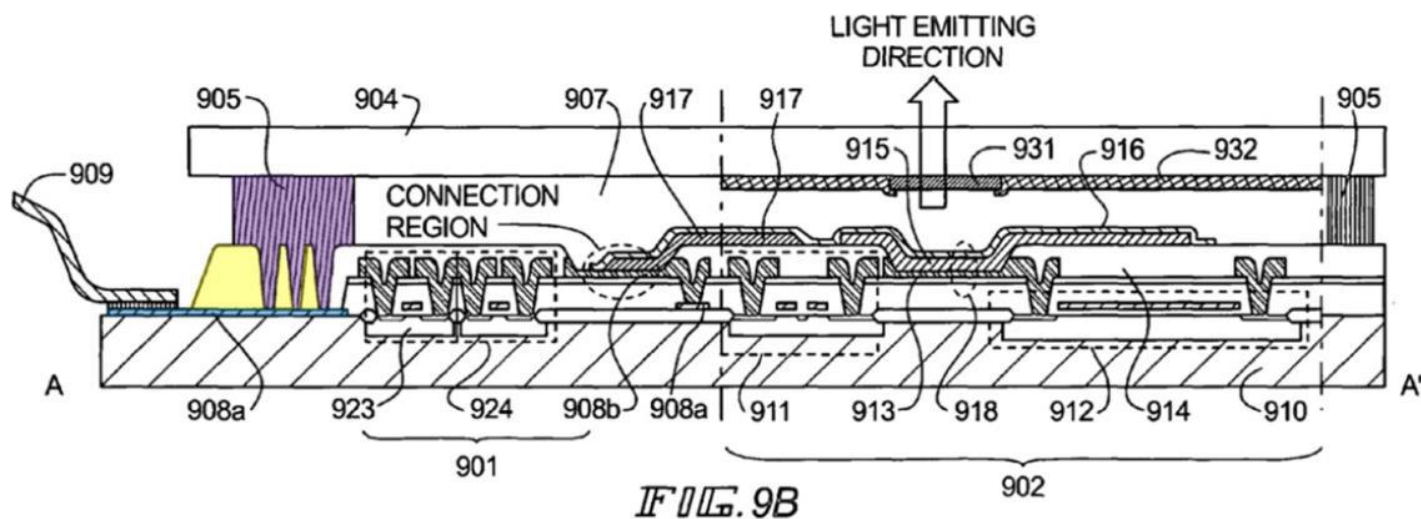


FIG.4

Ex. 2008 (Bretschneider Decl.), ¶¶87–88

“State of the Art”: Yamazaki 496

1) The Petition provides highly misleading annotations



The actual “insulation layer” with angles from 35° to 55° (45° +/- 10°) is completely unrelated to the sealant region (correctly shown in yellow in Fig. 1A).

Petitioner’s yellow annotation is not discussed in Yamazaki 496.

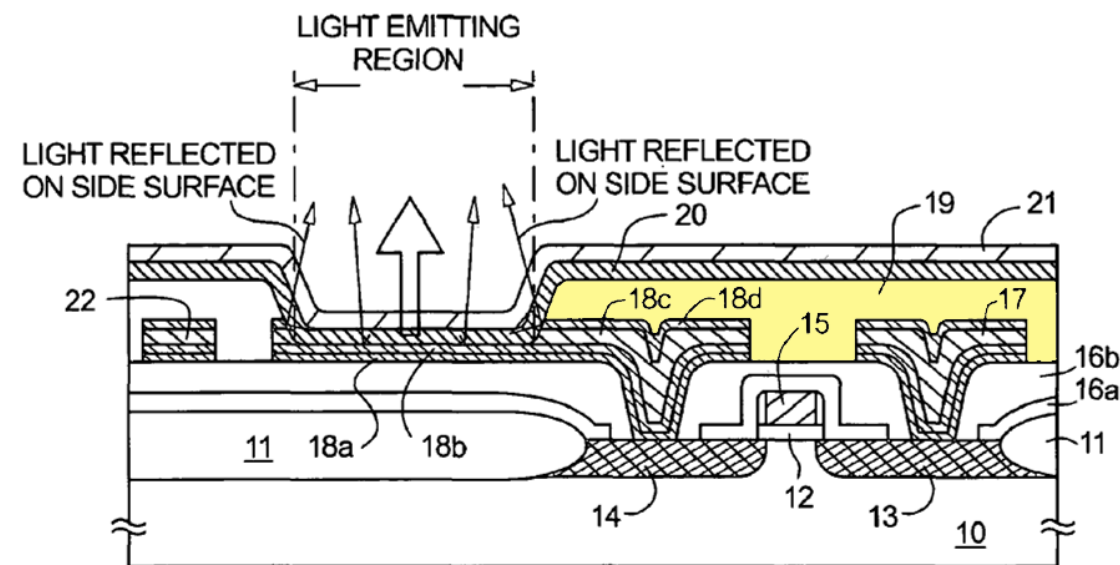


FIG. 1A

“State of the Art”: Shimada 722

1) Shimada uses angled reflectors for light control, not sealant

“The contact holes 142 are formed at predetermined positions through the interlayer insulating film 136 by a predetermined method. An angle θ of an inclined inner wall of each contact hole 142 is preferably between about 45° or more and less than about 65° . A diameter ϕ of the contact hole 142 is preferably in the range of about $3.5\text{ }\mu\text{m}$ to about $6\text{ }\mu\text{m}$, typically about $4\text{ }\mu\text{m}$. With the above settings, the storage capacitor electrode 126 **can effectively prevent light leakage** from the reverse tilt domain 154 as described above.”

Ex. 1012 (Shimada) at 18:55–63.

2) Shimada does not disclose creating angles in an organic material

“Shimada 722 does not disclose that the insulating film is an organic layer. See Ex. 1012. I note that Dr. Neikirk simply interprets Shimada 722’s the word “or the like” as something that “indicates that the layer may” comprise an organic layer with no reasoning behind this speculation . . . This further supports my conclusion that Dr. Neikirk relied on hindsight in shaping his opinion.”

Ex. 2008 (Bretschneider Decl.), ¶ 100

“State of the Art”: Shimada 376

1) Shimada 376 similarly is directed towards controlling light, not sealant

“101. Shimada 376 is similar to Shimada 722 and also is directed towards using angled reflectors to control light and to prevent light leakage. See Ex. 1013 at 2:9–18, 36–45. Shimada 376’s angled reflectors have nothing to do with sealing.”

Ex. 2008 (Bretschneider Decl.) at ¶ 101.

“State of the Art”: Kim 935

1) Kim 935 similarly is directed towards controlling light and does not even mention sealing

“Similarly, Dr. Neikirk opines that Kim 935 teaches openings with specific angles. Ex. 1003, ¶85 (“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 that expose the underlying layers, such as a transparent electrode. The sidewalls of the openings form an angle ‘within a range of about 20 to 110 degrees.’”) (citations omitted). Kim 935 describes angled reflectors and does not even mention sealing. See Ex. 1014.”

Ex. 2008 (Bretschneider Decl.) at ¶ 102

“State of the Art”: Tanaka

1) Tanaka teaches not to undercut—not predetermined angles

“Dr. Neikirk’s reliance on hindsight is further evident from his opinions with respect to Tanaka. Dr. Neikirk relies on Tanaka to support his hindsight opinion that the benefits of utilizing predetermined angles were well known at the time. See Ex. 1003, ¶88.

104. This is a truly remarkable conclusion, as Tanaka does not teach any specific predetermined angle. Rather, Tanaka teaches “It is preferable that each of those end surfaces of the organic insulating film formed over the display area and the organic insulating film formed over the peripheral area which abut against the seal area be formed to make an obtuse angle with respect to the surface of the array substrate. This ensures good contact between the sealant and the organic insulating film.” Ex. 1016 2:54-60. Tanaka is clear that etch end surface of the organic insulating film should form an obtuse angle with respect to the surface of the substrate. Tanaka’s requirement means that **any etch process that does not produce an undercut would suffice** and that the acceptable angle θ between the side surface and the substrate surface is $90^\circ < \theta < 180^\circ$.”

Ex. 2008 (Bretschneider Decl.) at ¶ 103–104 (emphasis in original)

“State of the Art”: EXMIYOSHI

1) EXMIYOSHI is not in evidence

“State of the Art”: Showcase of Hindsight

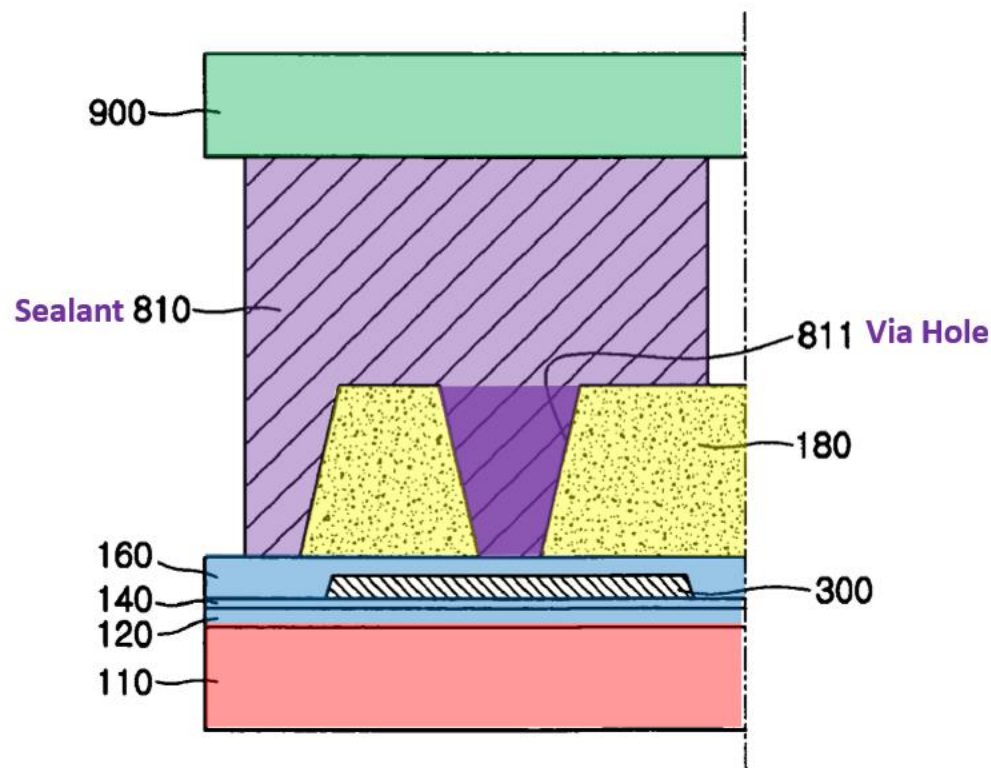
- Petition ignores key inventive concepts of the '801 Patent:
 - *Peeling of sealant, uneven cell gaps, and formation of voids in sealant regions during assembly are all reduced.* Ex. 1001 at 1:47–50.
 - *With predetermined angle α , air exhausts easily via the tapered profile of the saw tooth opening 234 during application of sealant, avoiding formation of voids or bubbles in the sealant.* Ex. 1001 at 3:27–30.
- Word-search for “predetermined angle” yielded non-organic layers and contexts outside of sealant region.
- None of the “state of the art” is relevant to the claims, e.g.:
 - 9. A ***sealant region pattern for a liquid crystal display***, comprising:
 - ...
 - wherein the surface of the predetermined material layer and the sidewall of the ***organic material pattern layer form a predetermined angle***.

Ground 1: Kwak § 102 (Claim 9)

Kwak: Vias to Increase Contact Area

Kwak Does Not Discuss “Angles” at All

FIG. 2D



Pet. at 27 (annotating Ex. 1005, Fig. 2D)

Referring to FIG. 2D, one or more via holes 811 are arranged on a portion of the protection layer 180 that overlaps the sealing portion 800 to increase the contact area of the sealant 810 with layers stacked on the substrate, thereby tightly sealing the substrate 110 and the encapsulation substrate 900. Also, at the bottom of the via hole 811 is an inorganic layer (interlayer 160 in FIG. 2D) under the protection layer 180, which compensates for any weakness in the adhesion between the sealant 810 composed of a synthetic material, such as an epoxy resin, and the protection layer 180

Ex. 1005 (Kwak) at 9:58–67

110. When the depth of the via hole 811 is increased, the contact area with the sealing portion 810 increases and the adhesive strength between the substrate 110 and the encapsulation substrate 900 can be increased. However, if the substrate 110 is exposed, it can receive stress, and thus an appropriate depth of the via hole should be determined in consideration of design specifications. In the above embodiments, the via hole 811 penetrates the inorganic layer. However, alternative embodiments are possible. For example, the

Ex. 1005 (Kwak) at 10:50–58

Kwak's Design: Depth of Vias, Not Predetermined Angles

165. However, via holes do not require or disclose predetermined angles of the sidewall. As discussed above in §IV.A, during deposition Dr. Neikirk described vias as essentially vertical holes that extend through one or more layers, similar to if a thumbtack were pushed through several coatings on a wall. Ex. 2011 at 24:7–13.

The crux of the via is the depth, not a particular angle of the sidewall. Unless there is a call to create a specific angle, the angle of the sidewall is simply a by-product and is not predetermined.

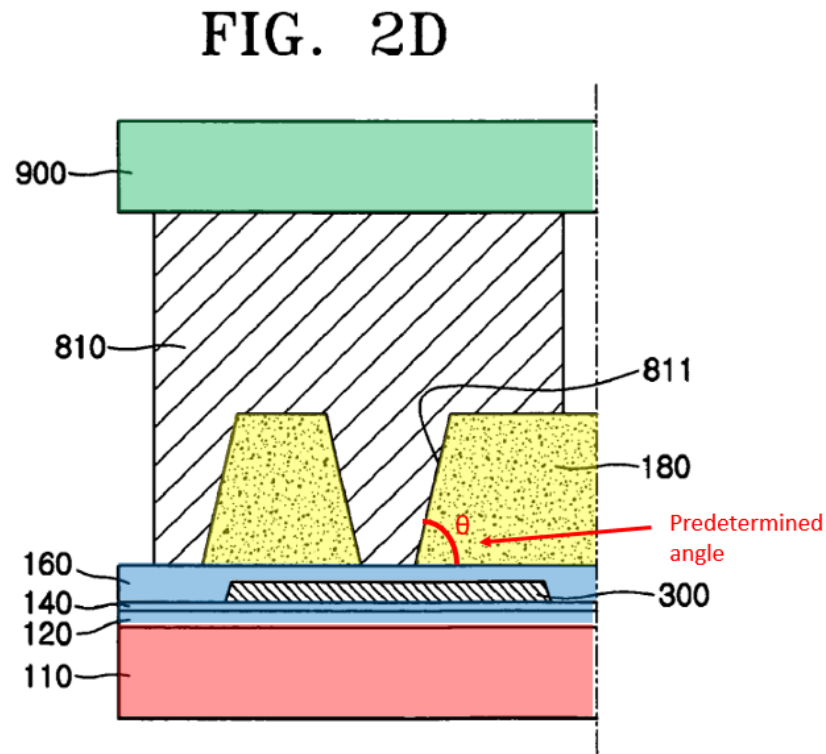
Ex. 2008 (Bretschneider Decl.), ¶ 165.

“Vias are generally steep features, but **the emphasis is on the depth and diameter at the bottom**. While the angle of the sidewall is preferably close to vertical, it is certainly not a specific, predetermined angle unless such an angle is specifically called for. In my experience, the angle is not specifically defined, nor is it typically measured, and it may take a range of values that depend on other process parameters, the most critical parameter being the exposed area at the bottom of the via. After reviewing Kwak, ***it is clear that the angles of the sidewall are not contemplated at all.*** See Ex. 1005. Nothing discloses that the angle identified by Dr. Niekirk was predetermined, and a POSITA would not have understood them to be.”

Ex. 2008 (Bretschneider Decl.), ¶ 41.

Kwak: No Disclosure of Angles

Petition annotates Figures to show undisclosed angles and then simply calls them “predetermined”.



No anticipation under § 102

“When the reference does not disclose that the drawings are to scale and is silent as to dimensions, arguments based on measurement of the drawing features are of little value.”

MPEP § 2125(II)

Pet. at 29 (annotating Ex. 1005, Fig. 2D)

Kwak: Maximizing Contact Area

No disclosure about using angled sidewalls or reducing voids

Referring to FIG. 2D, one or more via holes **811** are arranged on a portion of the protection layer **180** that overlaps the sealing portion **800** to increase the contact area of the sealant **810** with layers stacked on the substrate, thereby tightly sealing the substrate **110** and the encapsulation substrate **900**. Also, at the bottom of the via hole **811** is an inorganic layer (interlayer **160** in FIG. 2D) under the protection layer **180**, which compensates for any weakness in the adhesion between the sealant **810** composed of a synthetic material, such as an epoxy resin, and the protection layer **180**

Ex. 1005 (Kwak) at 9:58–67

“An attempt to achieve a predetermined angle of Kwak’s via would reduce the angle”

Ex. 2008 (Bretschneider Decl.), ¶ 44.

“[D]ecreasing the angle of a via’s sidewall reduces overall contact area”

Ex. 2008 (Bretschneider Decl.), ¶ 51.

The use of photolithography techniques to create predetermined angles would *reduce* Kwak’s angles—directly contrary to Kwak’s goals

Ground 2: Kwak § 103, Claims 1–6, 8–14

Ground 2: Petitioner's Hindsight Revealed

“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.” Pet. at 32–33.

Kwak does not discuss “angles” anywhere

The “**known techniques**” discussed in the state of the art section relate generally to fabricating predetermined angles but ***are not related to organic materials and are not in the sealant region***

Ground 2: Petitioner's Hindsight Revealed

1) Kwak's via does not result in a predetermined angle

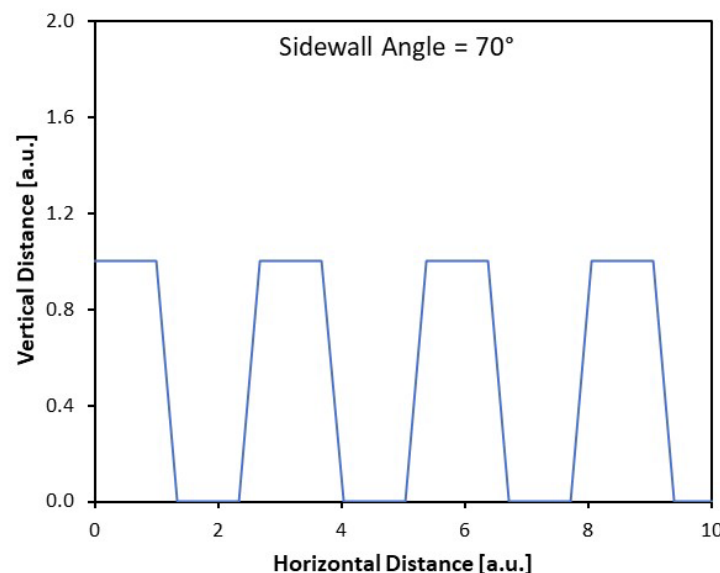
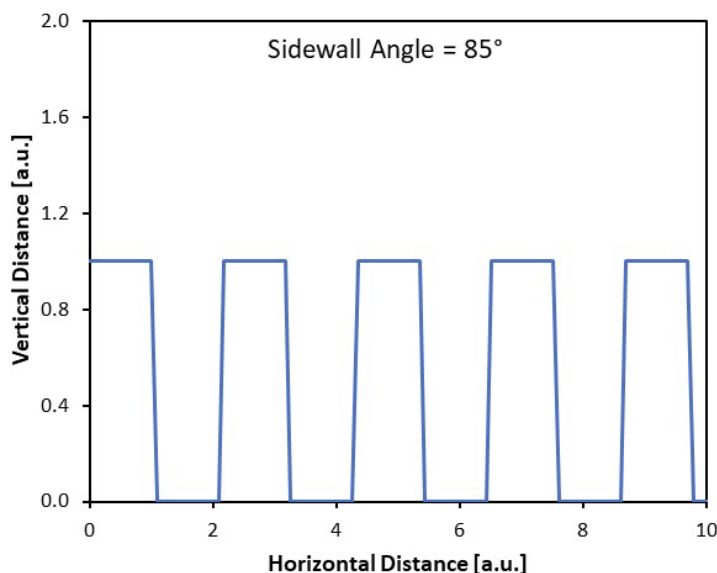
165. However, via holes do not require or disclose predetermined angles of the sidewall. As discussed above in §IV.A, during deposition Dr. Neikirk described vias as essentially vertical holes that extend through one or more layers, similar to if a thumbtack were pushed through several coatings on a wall. Ex. 2011 at 24:7–13.

The crux of the via is the depth, not a particular angle of the sidewall. Unless there is a call to create a specific angle, the angle of the sidewall is simply a by-product and is not predetermined.

Ex. 2008 (Bretschneider Decl.), ¶ 165.

Ground 2: Petitioner's Hindsight Revealed

2) Kwak's call to increase contact area is at odds with creating a predetermined angle



“An attempt to achieve a predetermined angle of Kwak’s via would reduce the angle”

Ex. 2008 (Bretschneider Decl.), ¶ 44.

“[D]ecreasing the angle of a via’s sidewall reduces overall contact area”

Ex. 2008 (Bretschneider Decl.), ¶ 51.

Ex. 2008 (Bretschneider Decl.), ¶¶ 45–52.

Ground 2: No Motivation to Flatten Vias (e.g., Claim 10)

Kwak's call to increase contact area is at inconsistent with flattening the sidewalls of Kwak's via

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.

Pet. at 34.

“An attempt to achieve a predetermined angle of Kwak's via would reduce the angle”

Ex. 2008 (Bretschneider Decl.), ¶ 44.

“[D]ecreasing the angle of a via's sidewall reduces overall contact area”

Ex. 2008 (Bretschneider Decl.), ¶ 51.

Ground 3: Kwak / Vaganov § 103, Claims 2–3, 6, 10–11

Ground 3: Vaganov Overview

Vaganov is for Wafer-to-Wafer Bonding

- Vaganov does not discuss “LCD” or “liquid crystal display” at all

(12) **United States Patent** **Vaganov**

(54) **METHODS FOR WAFER TO WAFER BONDING USING MICROSTRUCTURES**

(75) Inventor: **Vladimir I. Vaganov**, Los Gatos, CA
(US)

Ex. 1007 (Vaganov)

silicon or other wafers.”). Wafer-to-wafer bonding is a different problem than LCD panel assembly.

54. A POSITA understood that the wafers of Vaganov are crystalline materials—more specifically, single crystal materials. In other words, Vaganov’s wafers are a single crystal material with no grain boundaries or amorphous regions. As such, this places significant limitations on the applicability of Vaganov’s teachings. This understanding is readily evident upon a review of Vaganov from the

Ex. 2008 (Bretschneider Decl.) at ¶ 53–54

Ground 3: Vaganov Overview

Vaganov is a Separate field

Single-crystal materials have unique properties not the etchants are not generally applicable

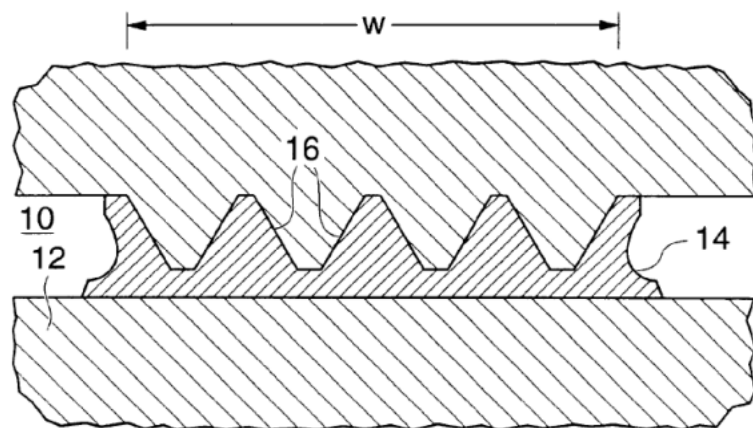


FIG. 4

Ex. 1007 (Vaganov), Fig. 4

54. A POSITA understood that the wafers of Vaganov are crystalline materials—more specifically, single crystal materials. In other words, Vaganov's wafers are a single crystal material with no grain boundaries or amorphous regions. As such, this places significant limitations on the applicability of Vaganov's teachings. This understanding is readily evident upon a review of Vaganov from the disclosure of the use of crystalline wafers and, in some cases, use of crystalline wafers of a particular orientation. See Ex. 1007, 2:63-64 ("For example, for silicon (100) crystalline orientation wafers"), 5:25-26 ("[F]or example by anisotropic etching of a (100) crystalline orientation silicon surface"), 10:23-26 ("The following describes various microstructures and etching processes for forming the above-described wafer bridges, pits, pyramids, etc., profiles, these processes are for monocrystalline silicon wafers"); see also Ex. 1007, 10:29-35, 10:36-43, 10:44-51, 10:54-59, 10:60-67, 11:1-8, 11:29-44, 11:57-12-5. The etches taught by Vaganov are specific to single crystal silicon materials. The rate at which these solutions etch silicon varies depending on the specific crystal plane exposed. More specifically,

Ground 3: No Motivation to Combine / Hindsight

2) Vaganov's Wafer-to-Wafer Techniques Cannot be Combined with Kwak

the etches of Vaganov are designed to be highly anisotropic and proceed very slowly on certain exposed crystal planes. If applied to amorphous or polycrystalline silicon, the crystal planes would be randomly oriented meaning that the etch would produce random surfaces with different orientations to each other. As such, they would produce a random, textured surface in which the angle with respect to the substrate would vary tremendously over the etched surface and would have no fixed angle. A POSITA would be unable to predict or control the rate of etch on amorphous or polycrystalline silicon. The silicon etch chemistries of Vaganov work by first oxidizing an exposed silicon surface and then etching of the oxide by HF. These types of etches *do not significantly attack organic films and are not compatible with such materials*. A POSITA would be aware that such chemistries have little

"In my declaration, I talk about Vaganov's isotropic etch for silicon, and I say that it wouldn't work because the materials don't attack – the etchants wouldn't attack organic materials. What I didn't include as well is that the other etchants, the anisotropic etchants, also wouldn't work for organic materials because they're just too aggressive. It's too difficult to control. Most of them are the equivalent of Drano. So if a chemical will etch inches of material in minutes, then microns of material, it's essentially impossible to control."

Ex. 1025 (Bretschneider Depo) at 12:7–19

Ex. 2008 (Bretschneider Decl.) at ¶ 54

Ground 4: Kwak / Kim § 103, Claims 2–3, 6, 10–11, 14

Ground 4: Kim Overview

Kim's teaching is also unrelated to sealing LCDs

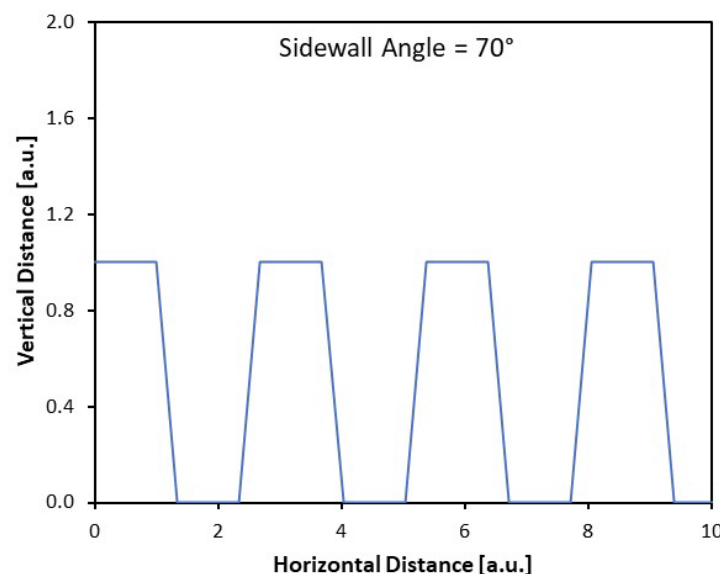
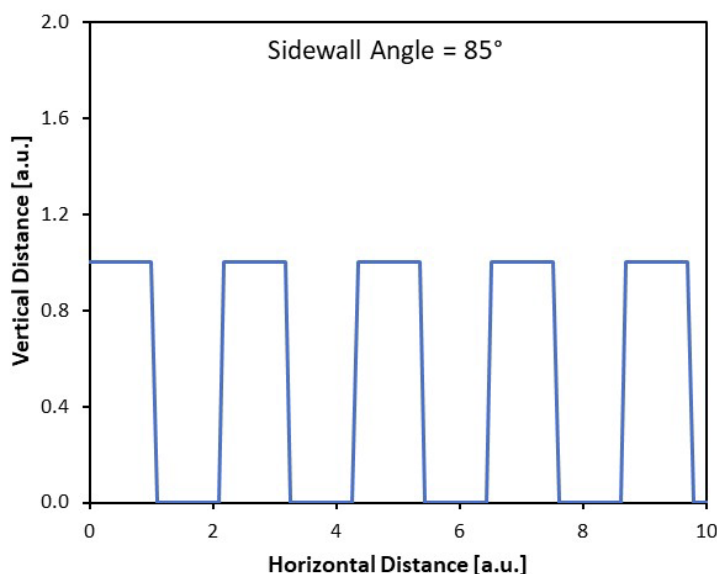
Kim's only teaching relates to the formation of electrodes:

“The organic insulating layer 75 suffers curing so that the ***sidewall thereof defining the contact holes 72, 74, 76 and 78 is tapered to be gradually inclined*** by the range of about 30-60. ***This smoothly guides the profile of subsidiary pads 84 and 88 and pixel electrodes 82 to be formed later.***”

Kim at [0062].

Ground 4: No Motivation to Combine / Hindsight

Reducing Kwak's via's sidewalls to 30-60° decreases the contact area, contrary to the Petition's purported motivation



Ex. 2008 (Bretschneider Decl.), ¶¶ 45–52.

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

Pet. at 47

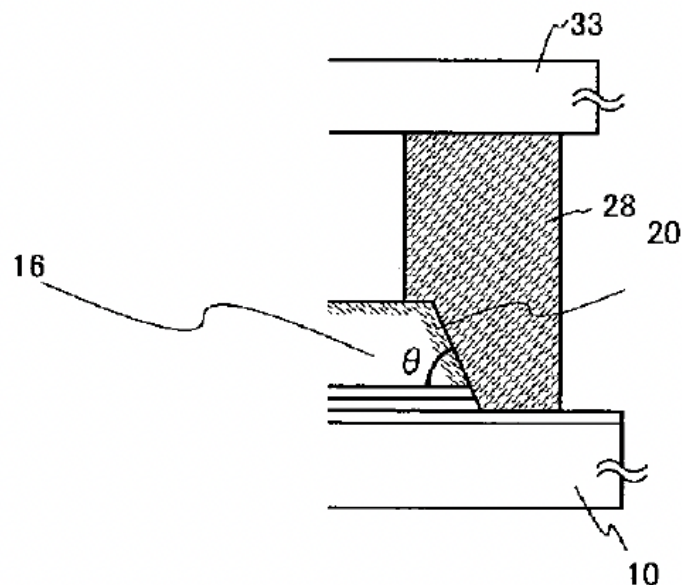
“[D]ecreasing the angle of a via's sidewall reduces overall contact area”

Ex. 2008 (Bretschneider Decl.), ¶ 51.

Ground 5: Kwak / Yamazaki 336 § 103, Claims 2–3, 6, 10–11

Ground 5: Yamazaki 336 Overview

Yamazaki's Tapering is Only for Ion Implantation of the Planarizing Film



Ex. 1009 (Yamazaki), Fig. 2

2×10^{19} atoms/cm³ to 2×10^{21} atoms/cm³. In addition, the side surface of the high thermostability planarizing film 16 is formed to have a tapered shape so as to be doped. It is desirable to set the taper angle θ more than 30° and less than 75° .

Ex. 1009 (Yamazaki) at 5:45–49

In addition, as for each above-mentioned configuration, a taper angle at an edge portion of the high thermostability planarizing film is more than 30° and less than 75° . However, when the inert element is added by using plasma treatment or oblique doping, a side surface of the high thermostability planarizing film can be modified without forming the edge portion to have a tapered shape.

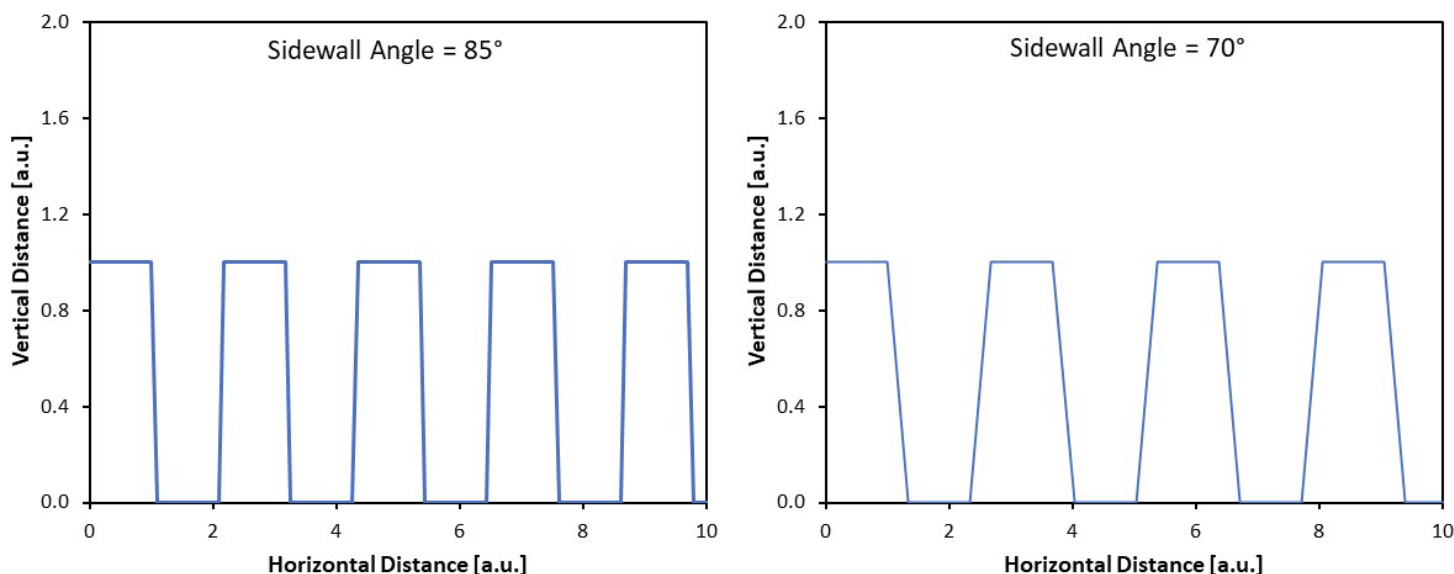
Ex. 1009 (Yamazaki) at 12:45–48

Ground 5: No Motivation to Combine / Hindsight

Reducing Kwak's via's sidewalls to 30-60° decreases the contact area, contrary to the Petition's purported motivation

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

Pet. at 51



Ex. 2008 (Bretschneider Decl.), ¶¶ 45–52.

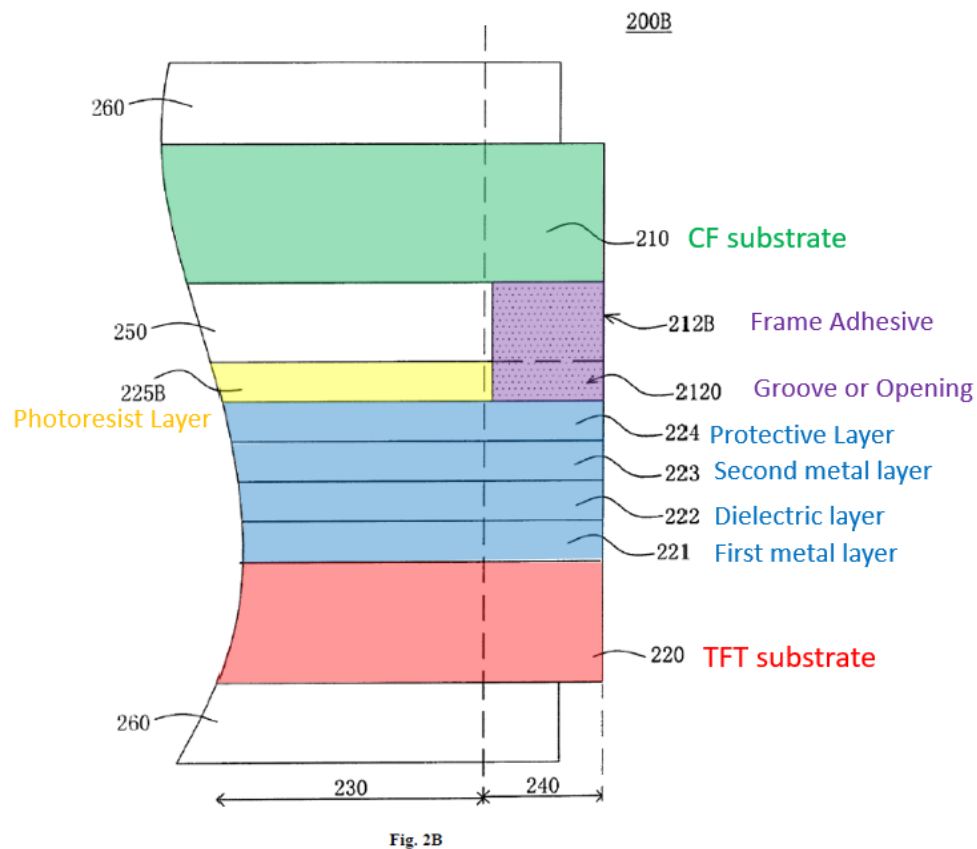
“[D]ecreasing the angle of a via's sidewall reduces overall contact area”

Ex. 2008 (Bretschneider Decl.), ¶ 51.

Ground 6: Zhang § 103, Claims 1–6, 9–13

Ground 6: Zhang Overview

Zhang's Discusses the Problems in "Conventional Reflective LCDs"



“Figure 2B is a side view of another conventional reflective liquid crystal display panel. Referring to Figure 2B, similar to the reflective liquid crystal display panel 200A in Figure 2A

...

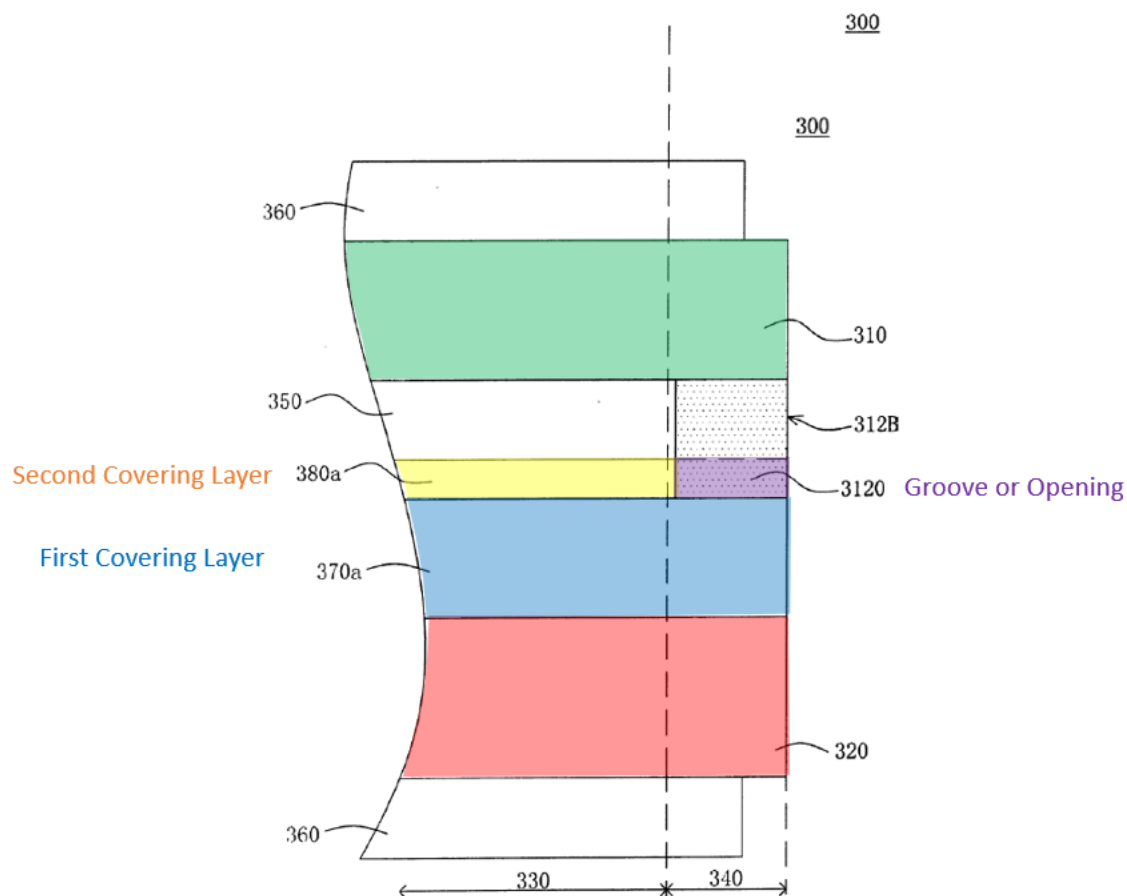
However, ***the bonding strength*** of the assembled liquid crystal display panels 100, 200A, ***and 200B is insufficient.*** During reliability tests or drop tests, ***the panels are prone to developing cracks at the contact interface between the TFT substrate and the CF substrate due to impact or vibrational forces.*** This results in damage to the display panel, significantly affecting the quality of the display panel.”

Ex. 1006 (Zhang) at 7.

Petition at 7 (annotating Ex. 1006, Fig. 2B).

Ground 6: Zhang Overview

Zhang's Solution: A Groove or Opening In an *Inorganic* Layer



Zhang's invention teaches that a groove may be made in "Second Covering Layer 380a," which is explicitly **not** an organic material:

"the protective layer 324 is composed of silicon dioxide (SiO₂) or silicon nitride (Si₃N₄). . . . In this case, the second covering layer 380a refers to the protective layer 324"

Ex. 1006 (Zhang) at 9.

Petition at 64 (annotating Ex. 1006, Fig. 3B).

Ground 6: Petitioner Mixes Prior Art With Embodiment

Petitioner mixes elements of “conventional” LCDs (organic layer 225B) with the embodiment of Zhang’s invention:

“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.”

Pet. at 63.

See, e.g., Abiomed, Inc. v. Maquet Cardiovascular, LLC, IPR2017-01204, -01205, Paper 8 at 8-12 (holding “Petitioner has failed to establish sufficiently that the features of those different embodiments are interchangeable or provide sufficient rationale to combine the teachings of those different embodiments”)

Ground 6: Petitioner Misunderstood the Teachings of Zhang

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.

Pet. at 59

“the protective layer 324 is composed of **silicon dioxide (SiO₂) or silicon nitride (Si₃N₄)**. . . . In this case, the second covering layer 380a refers to the protective layer 324”

Ex. 1006 (Zhang) at 9.

Ground 6: Petitioner Misunderstood the Teachings of Zhang

[Q] So with that clarification, is it your understanding that Zhang explicitly discloses that a part of 380a in Figure 3B is an organic photoresist material?

...

[A] So given Zhang's teachings about the use of photoresist, **yes, I believe there is sufficient teaching there**. So this would be paragraphs 187 through 191. And this is in view of the POSITA's knowledge, so it's still -- this ground, to be clear, is an obviousness ground, not an anticipation ground. So as I've stated in paragraph 187, this does depend on the knowledge of one of ordinary skill looking at the entirety of these disclosures from Zhang, **but Zhang does explicitly disclose the use of photoresist, and I believe one of ordinary skill would understand that to include the use of photoresist as part of layer 380a**.

Ex. 2011 (Neikirk Depo) at 107:11–108:4

Ground 6: No Motivation to Return to Organic Material Layer

3. PO's "Motivation to Swap" Is Irrelevant

PO's search for "a motivation to swap the inorganic layer over a conventional organic layer (or vice versa)" has no basis in Petitioner's arguments. POR at 67-68. The Petition, which the POR cites, explains that a POSITA would have understood the teachings of Zhang to apply to conventional reflective LCD panels. POR at 67 (citing Petition at 59-60). No swapping is needed. PO's misunderstanding appears to derive from its incorrect understanding that Zhang

Reply at 20

Ground 6: No Motivation to Return to Organic Material Layer

Petitioner never sets forth a complete theory regarding the conventional art, **only** starts with Zhang’s embodiment in Fig. 3:

E.g.:

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

Pet. at 52 (claim element 9pre)

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,

Pet. at 53 (claim element 9a)

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*

Pet. at 54 (claim element 9b)

Ground 6: No Motivation Return to Organic Material Layer

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.*

Pet. at 59–60

Ground 6: No Motivation to Return to Organic Material Layer

The Petition Provides No Motivation to Return to the Undisputedly Weaker Organic Material Found in “Conventional” LCDs

190. Zhang discloses an organic material pattern layer as part of the *conventional LCD*, an “photoresist layer 225 can be composed of an organic material.” Ex. 1006 at 6. Then Zhang describes the invention (improving the sealing of the conventional LCD) by teaching that the frame adhesive may be applied to a groove or opening, including an opening in a “V-shaped manner.” *Id.* at 12. However, Zhang explicitly teaches that for the embodiments where the frame adhesive is applied to a groove or opening, there is no organic layer. Specifically, the corresponding layer is changed to be an *inorganic* material. *Id.* at 10 (teaching “the protective layer 324 is composed of silicone dioxide . . . or silicon nitride.”).

191. A POSITA would have understood the difference in the material properties between an organic layer and an inorganic layer that makes an inorganic material more desirable for adhesion. Put plainly, organic materials are soft and

and the CF substrate due to impact or vibrational forces.”). Put simply, a POSITA understood that organic layers are soft and squishy and inorganic layers are hard and durable—an adhesive applied to a hard layer is more durable than if it is applied to a soft and squishy layer. Thus, a POSITA understood Zhang’s substitution of an organic layer for an inorganic layer was part of the design that improved durability.

Ex. 2008 (Bretschneider Decl.) at ¶¶81

Ex. 2008 (Bretschneider Decl) at ¶¶190–91.

Ground 6: No Motivation to Return to Organic Material Layer

The Petition Provides No Motivation to Return to the Undisputedly Weaker Organic Material Found in “Conventional” LCDs

Even Petitioner’s other primary reference explicitly recognizes the problem with using an organic layer for adhesion with sealant:

Also, at the bottom of the via hole 811 *is an inorganic layer* (interlayer 160 in FIG. 2D) under the protection layer 180, *which compensates for any weakness in the adhesion between the sealant . . . and the protection layer 180 formed of the organic material*, such as an acryl or BCB.

Ex. 1005 (Kwak) at 9:63–10:1

Ground 7: Zhang / Vaganov § 103, Claims 2, 3, 6, 10, 11

Ground 7: Vaganov Does Not Add an Organic Layer

**Vaganov does not cure Zhang's lack of an organic layer, and
Petitioner makes no assertion that it does**

Ground 7: Vaganov Is Not Combinable With Zhang

Vaganov is a Separate field

Single-crystal materials have unique properties not the etchants are not generally applicable

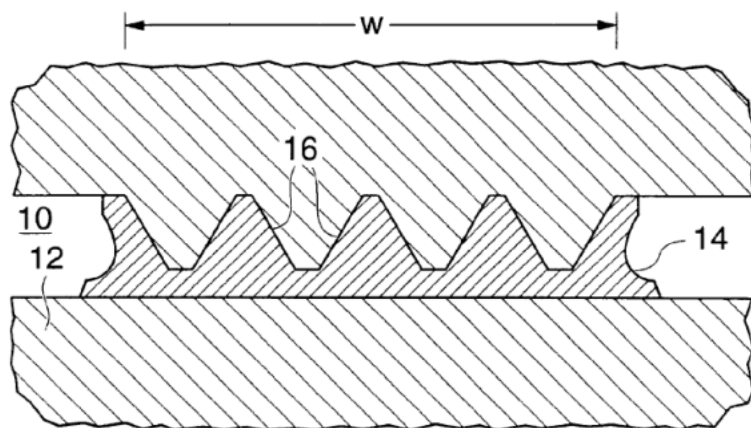


FIG. 4

Ex. 1007 (Vaganov), Fig. 4

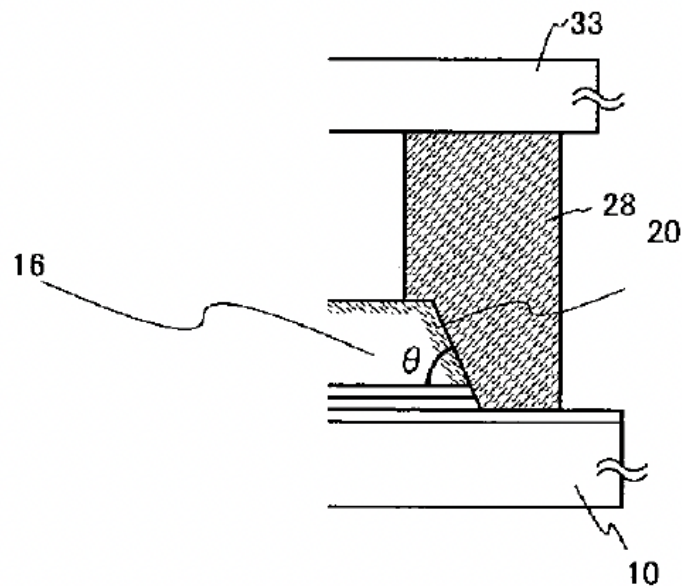
197. For similar reasons to those discussed above in relation to Challenge 3, it is my opinion that a POSITA would not seek to combine Zhang and Vaganov as they represent different fields of endeavor. More specifically, the teachings of Vaganov are directed specifically to inorganic single crystal wafers and are incompatible with the substrates of Zhang. I further reiterate that Vaganov's field of art is integrated circuits, microsensors, and micromachining. *See* Ex. 1007 1:6-8. This is a distinct field and different from that of thin film displays.

198. As the methods of Vaganov are specific to single crystal wafers, a POSITA would have no reasonable expectation of success even if they were to attempt to apply the teachings of Vaganov to the polycrystalline and amorphous films of Zhang. Specifically, Vaganov's wafers are a single crystal material with no grain boundaries or amorphous regions. As such, this places significant limitations on the applicability of Vaganov's teachings. This understanding is readily evident

Ground 8: Zhang / Yamazaki § 103, Claims 2, 3, 6, 10, 11

Ground 8: Yamazaki 336

Yamazaki's Tapering is Only for Ion Implantation, which Zhang is Not Concerned With



Ex. 1009 (Yamazaki), Fig. 2

2×10^{19} atoms/cm³ to 2×10^{21} atoms/cm³. In addition, the side surface of the high thermostability planarizing film 16 is formed to have a tapered shape so as to be doped. It is desirable to set the taper angle θ more than 30° and less than 75° .

Ex. 1009 at 5:45–49

In addition, as for each above-mentioned configuration, a taper angle at an edge portion of the high thermostability planarizing film is more than 30° and less than 75° . However, when the inert element is added by using plasma treatment or oblique doping, a side surface of the high thermostability planarizing film can be modified without forming the edge portion to have a tapered shape.

Ex. 1009 at 12:45–48

Thank you.