

**UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD**

SAMSUNG DISPLAY CO., LTD.

Petitioner,

v.

PICTIVA DISPLAYS INTERNATIONAL LTD.

Patent Owner.

IPR2024-01223
U.S. Patent No. 6,949,389

December 9, 2025



pictivadisplays

Pictiva EX2052
Samsung v Pictiva
IPR2024-01222

389-2.1

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Claim Construction for “Planarization Layer”

The Agreed-to and Adopted District Court Construction

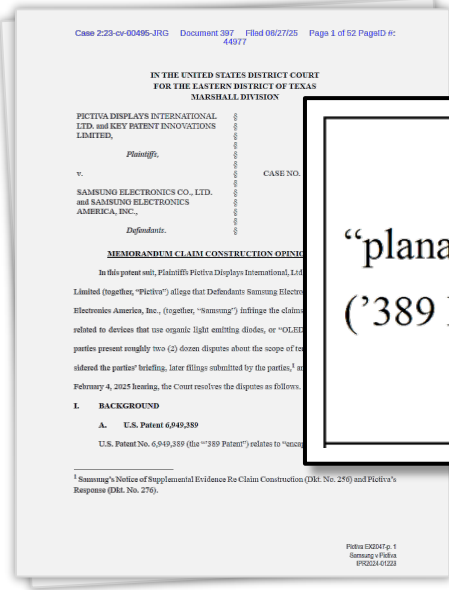
“Planarization Layer”



34. A method of encapsulating a plurality of devices fabricated upon a substrate, the steps of said method comprising:

fabricating a plurality of devices on a substrate;
selectively depositing at least one planarization layer
upon said devices; and
selectively depositing at least one barrier layer over said
planarization layer.

The Agreed-to and Adopted District Court Claim Construction



“planarization layer”
(’389 Patent, Claims 34, 35, 41, 46)

“a layer of material that planarizes such that the propagation of defects from one layer to another layer can be interrupted and the topography of the underlying layer is not reproduced.”

EX2047 (Claim Construction Order) at 49

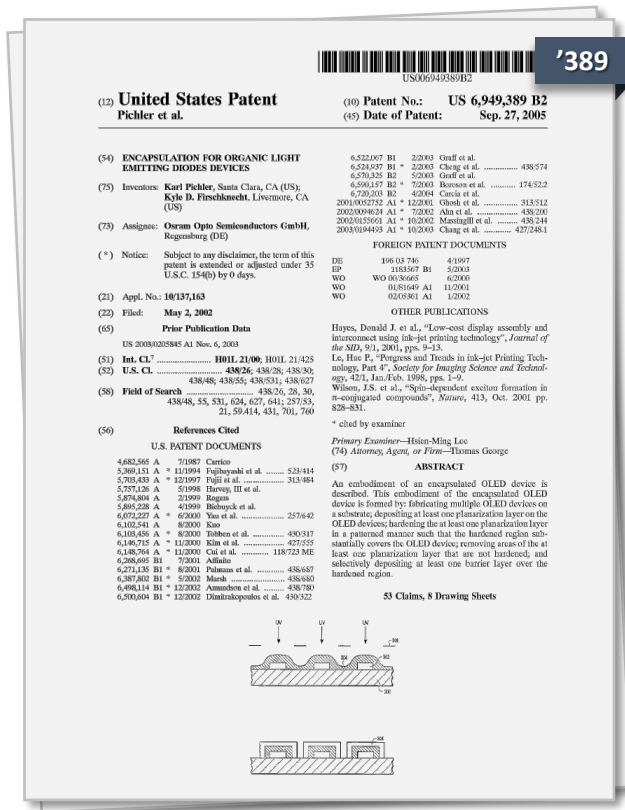
First Planarization Prong: Propagation of defects from one layer to another can be interrupted

Second Planarization Prong: Topology of underlying layer is not reproduced

The Intrinsic Evidence Supports the Claim Construction for Planarization Layer

First Planarization Prong

Propagation of defects from one layer to another can be interrupted



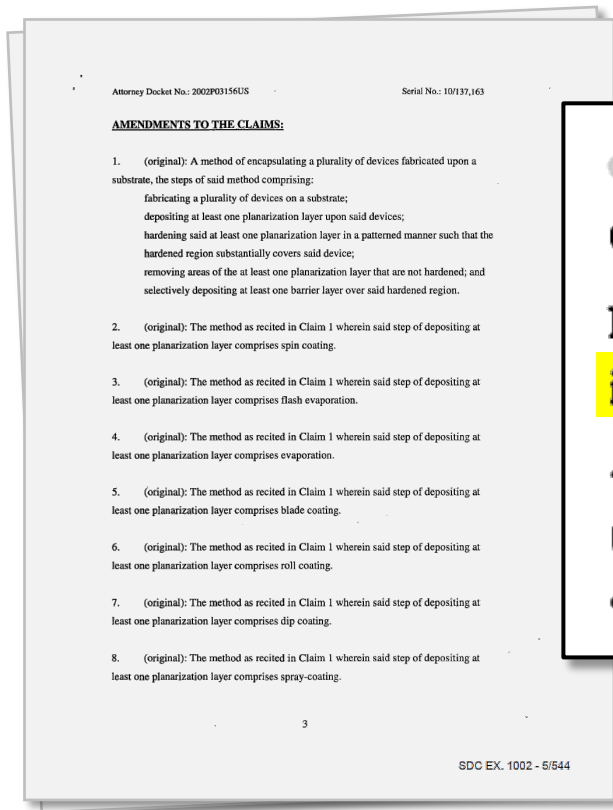
might suffice. Such an organic layer might provide a planar structure on which to deposit a barrier layer and to substantially cover point defects (e.g. dirt particles) in lower layers. It is generally desirable that the organic layer be deposited in sufficient quantity so that any such layer is no longer “conformal” to the point defect—i.e. any point defects are not geometrically projected upwards into layers deposited above. Such a first organic layer might also serve to protect

EX1001 (389 patent) at 4:33-41

The Intrinsic Evidence Supports the Claim Construction for Planarization Layer

First Planarization Prong

Propagation of defects from one layer to another can be interrupted

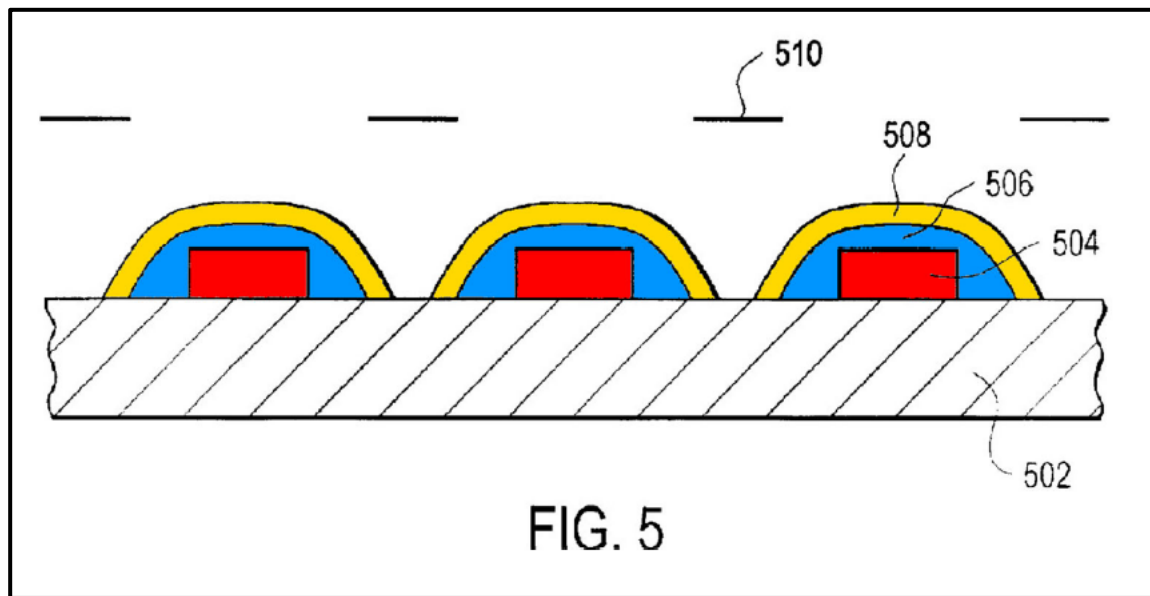


disclose “hardening the planarization layer” as recited in claim 1.” On page 4 of the Office Action, the Examiner refers to the “sealing material 20” of *Boroson* as a planarization layer; however, this “sealing material 20” is not a planarization layer since it is not used to interrupt the propagation of defects from one layer to another layer (see Applicants’ specification at page 7, lines 16-21). Rather than being a planarization layer, the “sealing material 20” of *Boroson* is an adhesive that is used to bond the “encapsulation enclosure 30” to the “substrate 10”. See *Boroson* at col. 8, lines 36-42. In

EX1002 (389 file history) at 371

The Intrinsic Evidence Supports the Claim Construction for Planarization Layer

Second Planarization Prong Topology of underlying layer is not reproduced



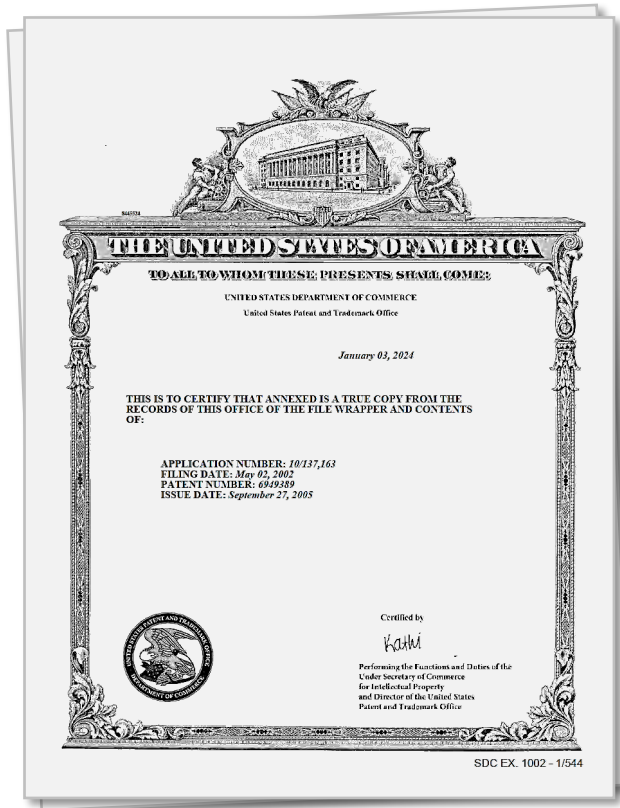
EX1001 (389 patent) at FIG. 5

- OLED device 504
- Planarization layer 506
- Barrier layer 508

The Intrinsic Evidence Supports the Claim Construction for Planarization Layer

Second Planarization Prong

Topology of underlying layer is not reproduced



Moreover, the metal studs 5 cannot be used as a planarization layer because the metal studs 5 do not provide a flat surface. The metal studs 5 are formed by depositing a copper containing metal. See *Palmans*, column 4, lines 56-57. Metals, and copper in particular, that are evaporated onto a layer do not cover-up the imperfections of the underlying layer, but rather, the metals reproduce the topography of the underlying layer. Therefore, metals cannot be used as a planarization layer.

EX1002 (389 file history) at 18

Samsung's Claim Construction Expert Confirmed the District Court Claim Construction for Planarization Layer is Correct



Dr. Schubert
Expert Witness

SAMSUNG

56. One characteristic of the “planarization layer” is that the layer of material planarizes. The '389 patent makes clear throughout that the material in the “planarization layer” acts to add a layer on top of another layer that makes the surface more “planar,” or flatter. In the

EX2002 (Schubert Decl.) at ¶ 56.

Samsung's Claim Construction Expert Confirmed the District Court Claim Construction for Planarization Layer is Correct



Dr. Schubert
Expert Witness

SAMSUNG

First Planarization Prong

Propagation of defects from one layer to another can be interrupted

57. Another well-accepted characteristic of a planarization layer that goes hand in hand with planarizing is that the layer of material interrupts the propagation of defects from one layer to another layer. *See, e.g., '389 patent at 4:33-41* (“It should be appreciated that layer 304 could

EX2002 (Schubert Decl.) at ¶ 57.

58. A layer of material that does not have this smoothing over property is not a planarization layer. *The applicants stated that a material cannot be a “planarization layer” where*

EX2002 (Schubert Decl.) at ¶ 58.

Samsung's Claim Construction Expert Confirmed the District Court Claim Construction for Planarization Layer is Correct

Second Planarization Prong Topology of underlying layer is not reproduced



Dr. Schubert
Expert Witness

SAMSUNG

59. The applicants also stated “metals cannot be used as a planarization layers” because “[m]etals . . . that are evaporated onto a layer do not cover-up the imperfections of the underlying layer, but rather the metals reproduce the topography of the underlying layer.” Nov. 24, 2003 Response to Non-Final Rejection at 16. Thus, the applicants made clear that the “planarization layer” they claimed could only encompass a layer that “cover[s]-up the imperfections of the underlying layer” and that does not “reproduce the topography of the underlying layer.”

EX2002 (Schubert Decl.) at ¶ 59.

Dr. Subramanian Agrees the District Court Construction of “Planarization Layer” is Reasonable



Dr. Subramanian
Expert Witness

SAMSUNG

Samsung’s district court constructions are “generally reasonable claim constructions.”

EX2020 (First Subramanian Dep.) at 212:9-213:9

The district court’s construction of “planarization layer” is “certainly a reasonable construction”

EX2049 (Second Subramanian Dep.) at 27:12-28:1

Mr. Humphrey Agrees With (and Applied) the District Court Claim Construction for Planarization Layer



Mr. Humphrey
Expert Witness



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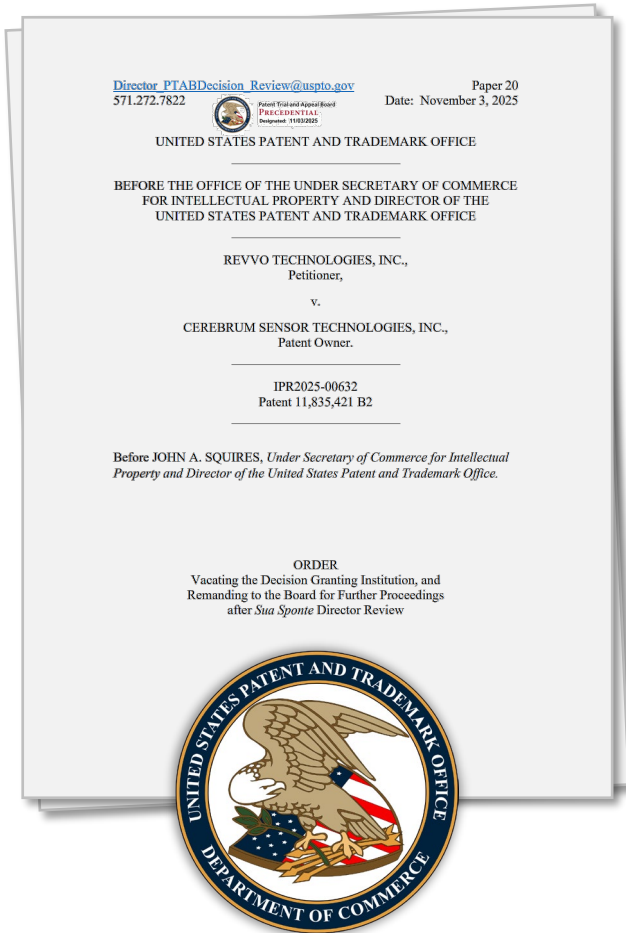
25. In my opinion, the agreed construction of “planarization layer” is consistent with the ’389 patent and prosecution history, and therefore I have applied that construction below in Section VI, which addresses whether the cited prior art discloses the recited “planarization layer.” I may also refer to certain

EX2018 (Humphrey Decl.) at ¶ 25.

Claim Construction for “Planarization Layer”

Samsung’s Inconsistent Claim Construction Positions

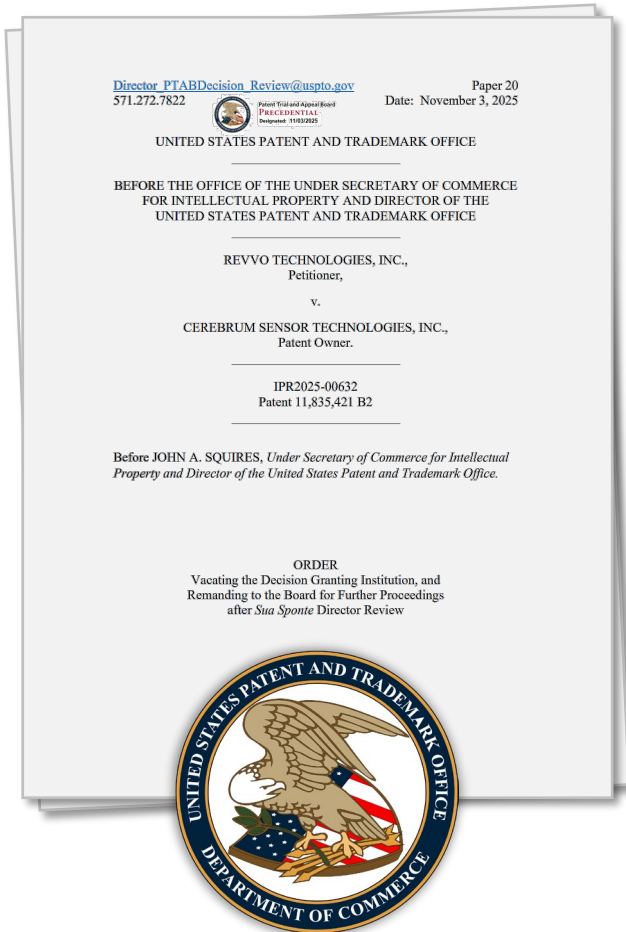
Deviation from District Court Construction Must Be Explained



- “[W]hen a petitioner takes alternative positions before the Board and a district court, the petitioner should, at a minimum, explain why alternate positions are warranted.”
- “[T]he Board erred when it determined that Petitioner complied with Rule 42.104(b)(3) by proposing Patent Owner’s district court constructions” and not “explain[ing] sufficiently why the different positions were warranted”

Revvo Technologies, Inc. v. Cerebrum Sensor Technologies, Inc., IPR2025-00632, Paper 20 at 3-5 (Squires November 3, 2025) (precedential)

Deviation from District Court Construction Must Be Explained

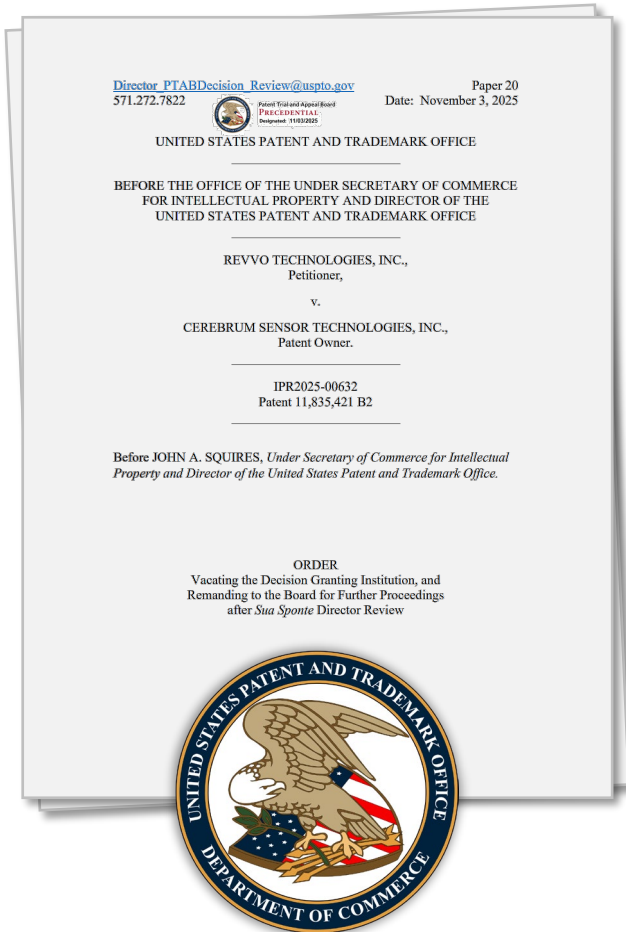


“[A]lthough a petitioner is not necessarily precluded from arguing different claim construction positions before a district court and the Board, ***the petitioner must explain sufficiently why the different positions are warranted***, even in instances that do not implicate Section 112(f).”

“Simply noting that the petitioner is adopting a patent owner’s claim construction proposals from district court, however, is not a sufficient reason for advancing different positions in the two forums.”

Revvo Technologies, Inc. v. Cerebrum Sensor Technologies, Inc.,
IPR2025-00632, Paper 20 at 5 (Squires November 3, 2025) (precedential)

Deviation from District Court Construction Must Be Explained



- “The Board’s claim construction rules are designed to ensure that the Board correctly construes claim terms and to minimize inconsistency in claim construction between forums.”
- The rules “discourage petitioners from seeking broader construction at the Board to support a patentability challenge while seeking narrower constructions in litigation to avoid infringement liability”
- “Allowing petitioner to continue this practice [proposing different claim constructions in the two forums] does not further the Office’s goal of ‘providing greater predictability and certainty in the patent system’”

Revvo Technologies, Inc. v. Cerebrum Sensor Technologies, Inc.,
IPR2025-00632, Paper 20 at 4 (Squires November 3, 2025) (precedential)

Timeline of Samsung's Claim Construction Positions for "Planarization Layer"



Subramanian's Construction of "Planarization Layer"



Dr. Subramanian
Expert Witness

SAMSUNG

So your understanding of the planarization layer is a layer that increases the planarity of the surface; is that correct?

A. Relative to what it was pre-imposition of the planarization layer, yes, that's a reasonable description of it. I mean, that's a certainly reasonable characteristic of it.

Q. That is the understanding applied in your analysis of this '389 patent; is that correct?

A. As a general statement, yes. As you

EX2020 (First Subramanian Dep.) at 18:4-18

Subramanian's Construction of "Planarization Layer"



Dr. Subramanian
Expert Witness

SAMSUNG

Q In your original declaration, did you apply the meaning of "planarization layer" that you believe a person of ordinary skill in the art would generally assign to that term?

MR. GARR: Objection.

THE WITNESS: So, in my original declaration, I applied the plain and ordinary meaning, because I didn't offer any specific construction with respect to the meaning of a planarization layer.

EX2049 (Second Subramanian Dep.) at 14:4-13

Timeline of Samsung's Claim Construction Positions for "Planarization Layer"

**No Construction
Proposed.
Expert Applied P&O.**

8/12/24
Petition

10/22/24
**Samsung
Formally Proposed
Constructions
in District Court
EX2004**

2024

2025

Samsung Proposes Narrower Construction for “Planarization Layer”

Filed
October 22, 2024

IN THE UNITED STATES DISTRICT COURT
EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

PICTIVA DISPLAYS INTERNATIONAL LTD.,

Plaintiff,

v.

SAMSUNG ELECTRONIC CO., LTD and
SAMSUNG ELECTRONICS AMERICA, INC.,

Defendants.

Civil Action No. 2:23-cv-00495-JRG

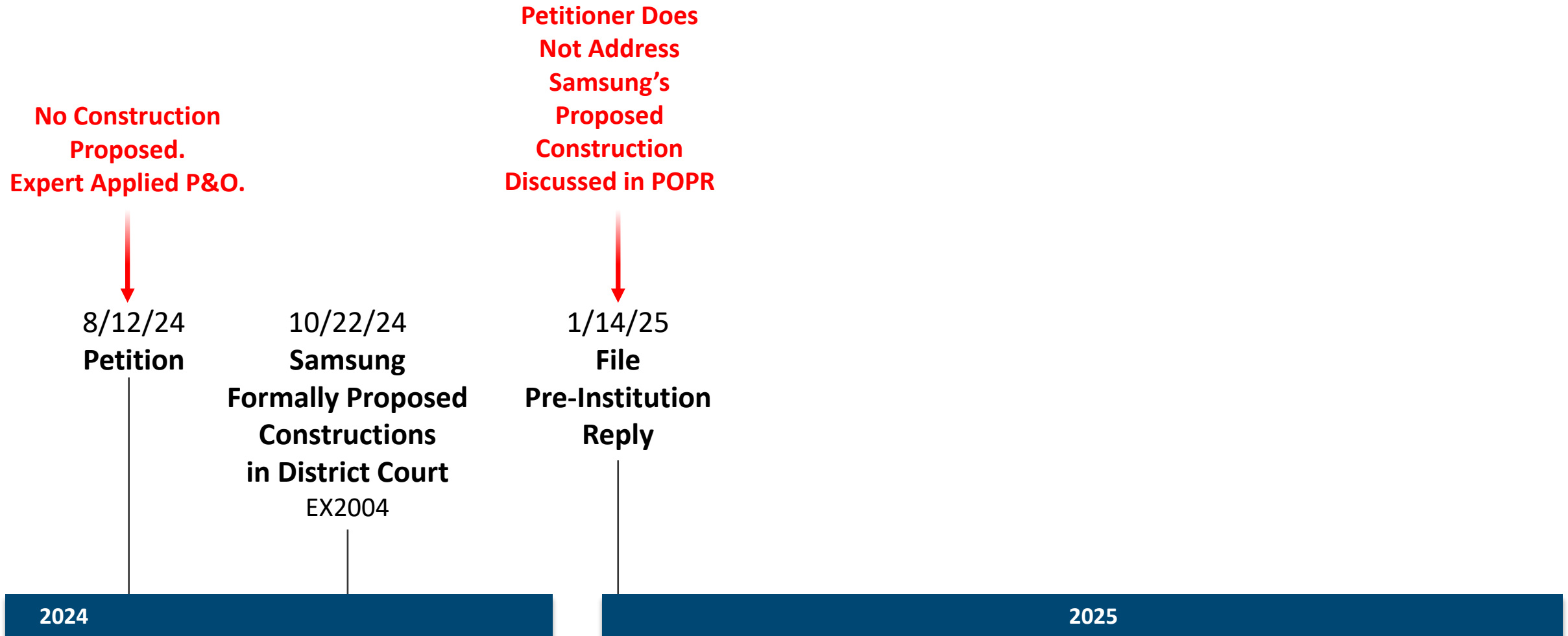
JURY TRIAL DEMANDED

SAMSUNG’S PROPOSED CLAIM CONSTRUCTIONS FOR THE TERMS AND PHRASES IDENTIFIED FOR CONSTRUCTION PER LOCAL PATENT RULE 4-2

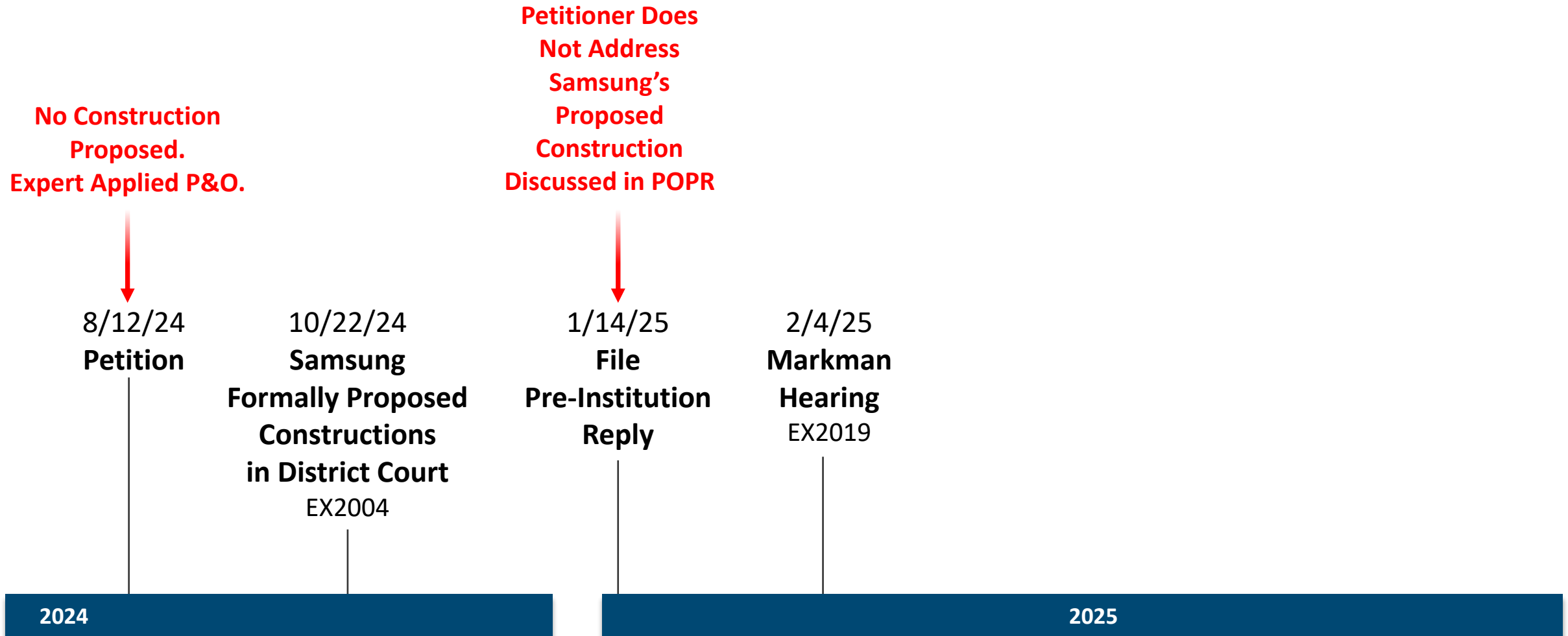
6,949,389	planarization layer	34, 35, 41, 46	“a layer of material that planarizes such that the propagation of defects from one layer to another layer is interrupted and the topography of the underlying layer is not reproduced.”
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EX2004 at 4-5.

Timeline of Samsung's Claim Construction Positions for "Planarization Layer"



Timeline of Samsung's Claim Construction Positions for "Planarization Layer"



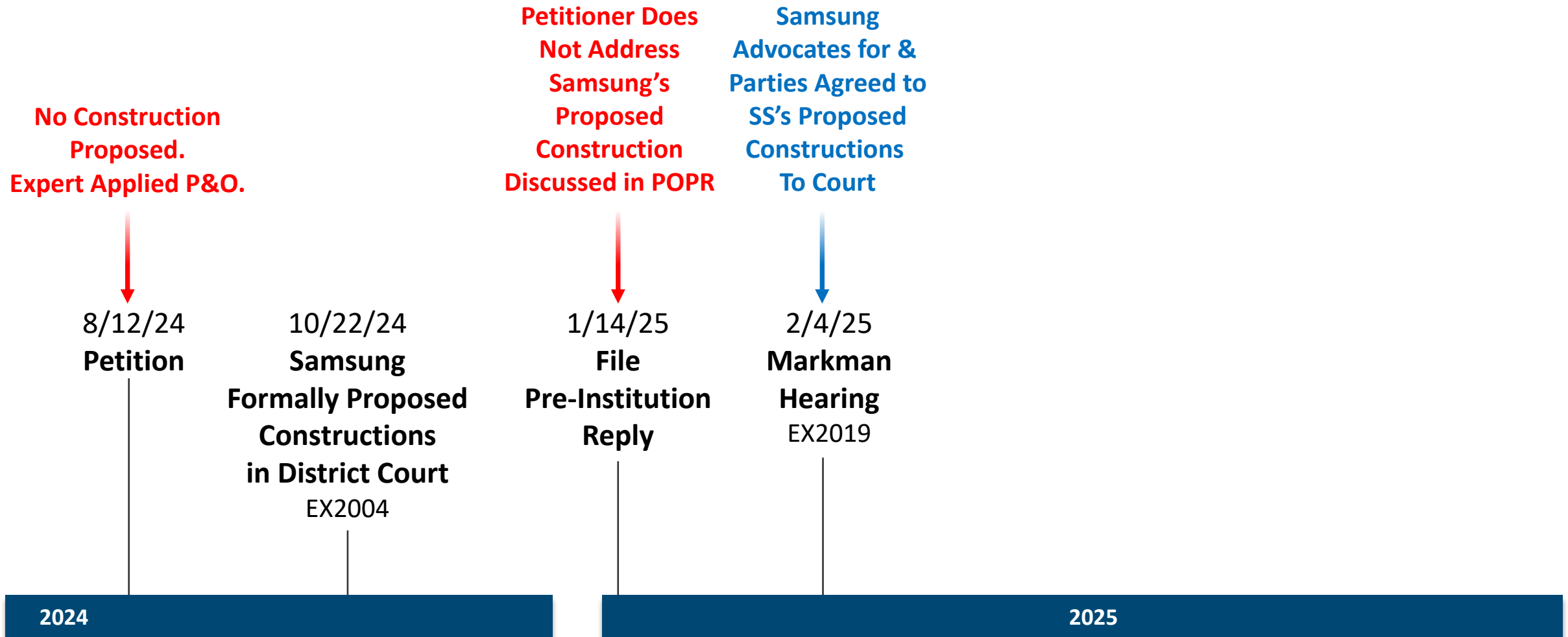
Samsung Advocates for Narrower Construction of “Planarization Layer”

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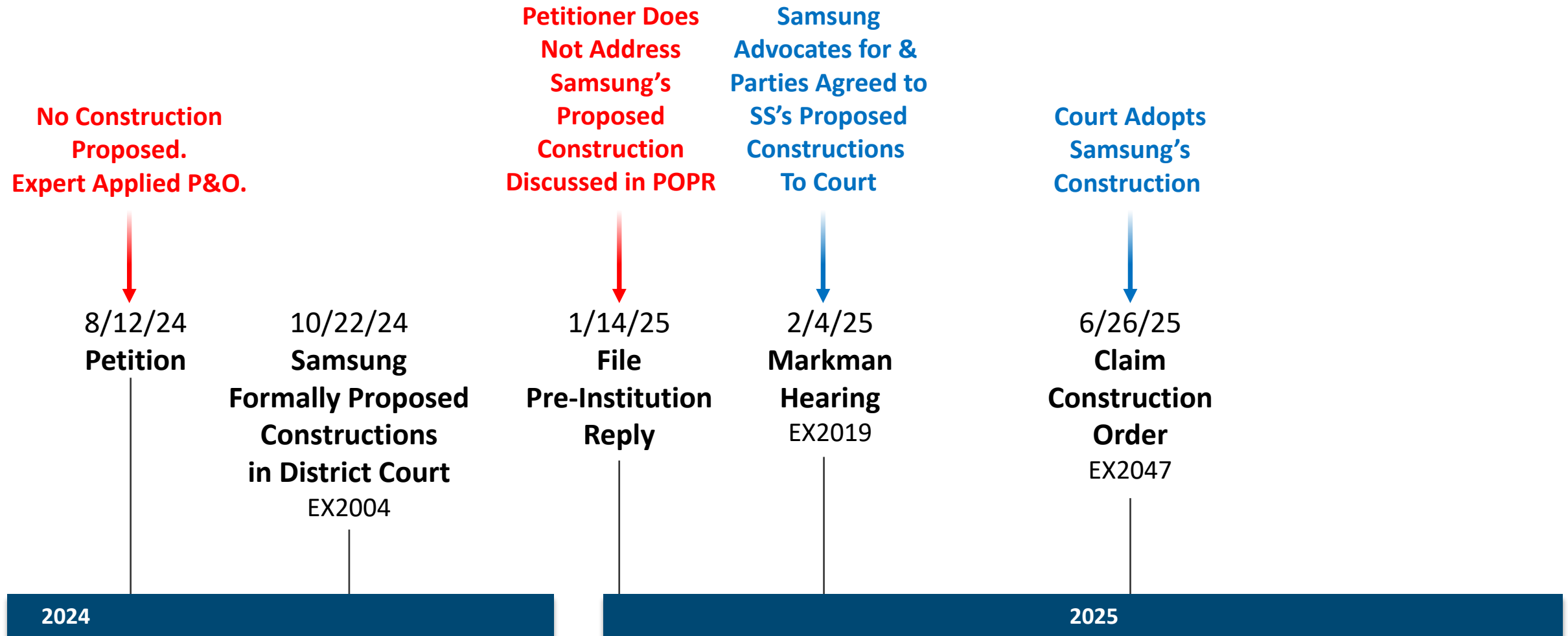
So the planarization layer, Your Honor, *performs two functions*. One is, *to the extent that you have a defect* in the underlying layer, for example, there might be a dust particle in the OLED device, that dust particle *does not get propagated* up towards the upper layers. *And then also you are not reproducing the underlying topography*, which is another way of saying you're *smoothing out the contours* of the underlying device structure.

EX2019 (Markman Hearing) at 29:15-22

Timeline of Samsung's Claim Construction Positions for "Planarization Layer"



Timeline of Samsung's Claim Construction Positions for "Planarization Layer"



District Court Adopts Agreed-to Construction of “Planarization Layer”



Case 2:23-cv-00496-JRG Document 397 Filed 08/27/25 Page 1 of 52 PageID #: 44077

IN THE UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

PICTIVA DISPLAYS INTERNATIONAL
LTD. and KEY PATENT INNOVATIONS
LIMITED,

Plaintiff,

v.

SAMSUNG ELECTRONICS CO., LTD.
and SAMSUNG ELECTRONICS
AMERICA, INC.,

Defendants.

MEMORANDUM CLAIM CONSTRUCTION ORDER

In this patent suit, Plaintiff Pictiva Displays International, Ltd. Limited (together, "Pictiva") alleges that Defendants Samsung Electronics America, Inc., (together, "Samsung") infringe the claims related to devices that use organic light emitting diodes, or "OLEDs." The parties present roughly two (2) dozen disputes about the scope of the claims. After the parties' briefing, later filings submitted by the parties,¹ and February 4, 2025 hearing, the Court resolves the disputes as follows.

I. BACKGROUND

A. U.S. Patent 6,949,389

U.S. Patent No. 6,949,389 (the "'389 Patent") relates to "OLEDs."

¹ Samsung's Notice of Supplemental Evidence Re Claim Construction (Dkt. No. 296) and Pictiva's Response (Dkt. No. 296).

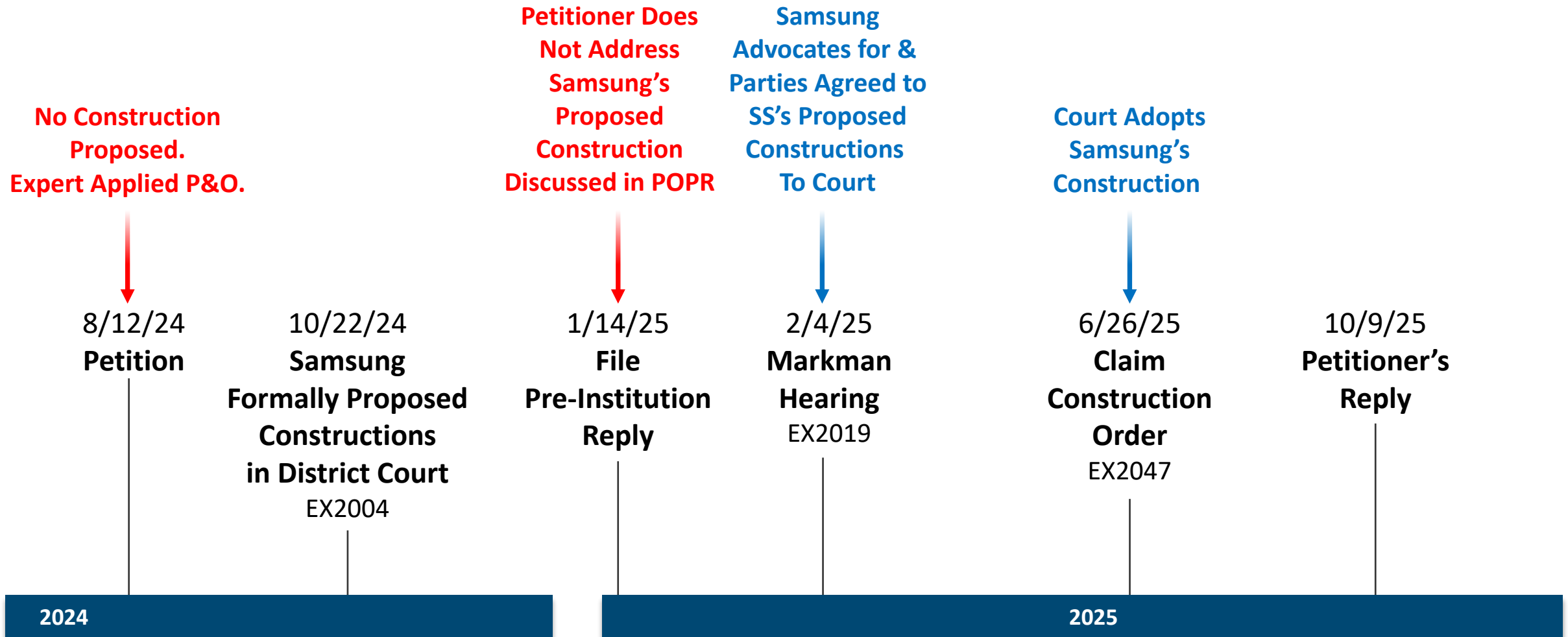
Pictiva EX2047 p. 1
Samsung v. Pictiva
PDF224 01/23

“planarization layer”
(’389 Patent, Claims 34, 35, 41, 46)

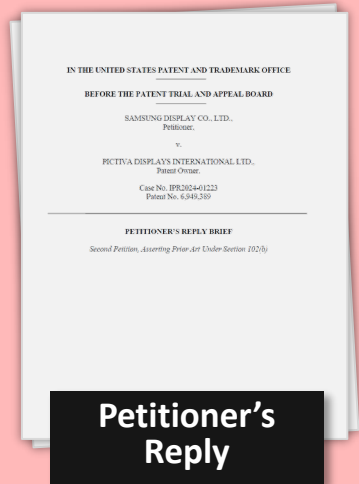
“a layer of material that planarizes such that the propagation of defects from one layer to another layer can be interrupted and the topography of the underlying layer is not reproduced.”

EX2047 (Claim Construction Order) at 49

Timeline of Samsung's Claim Construction Positions for "Planarization Layer"



Petitioner's Reply Does Not Address District Court Construction



SAMSUNG

A. “Planarization Layer”

Pictiva urges the Board to adopt the parties’ agreed construction in the district court of “planarization layer”—namely “a layer of material that planarizes such that the propagation of defects from one layer to another layer can be interrupted and the topography of the underlying layer is not reproduced.” Ex. 2048, 18-19. Petitioner did not propose a construction for this term in the Petition, because it did not believe a construction was necessary to determine that the relied-upon prior art teaches or suggests a “planarization layer.” Regardless, the prior art clearly teaches a “planarization layer” under district court construction for the reasons provided in the Petition and discussed further below. Therefore, Petitioner does not believe an express construction is necessary to resolve the parties’ disputes.

Subramanian Did Not Analyze Prior Art Under the District Court Construction



Dr. Subramanian
Expert Witness

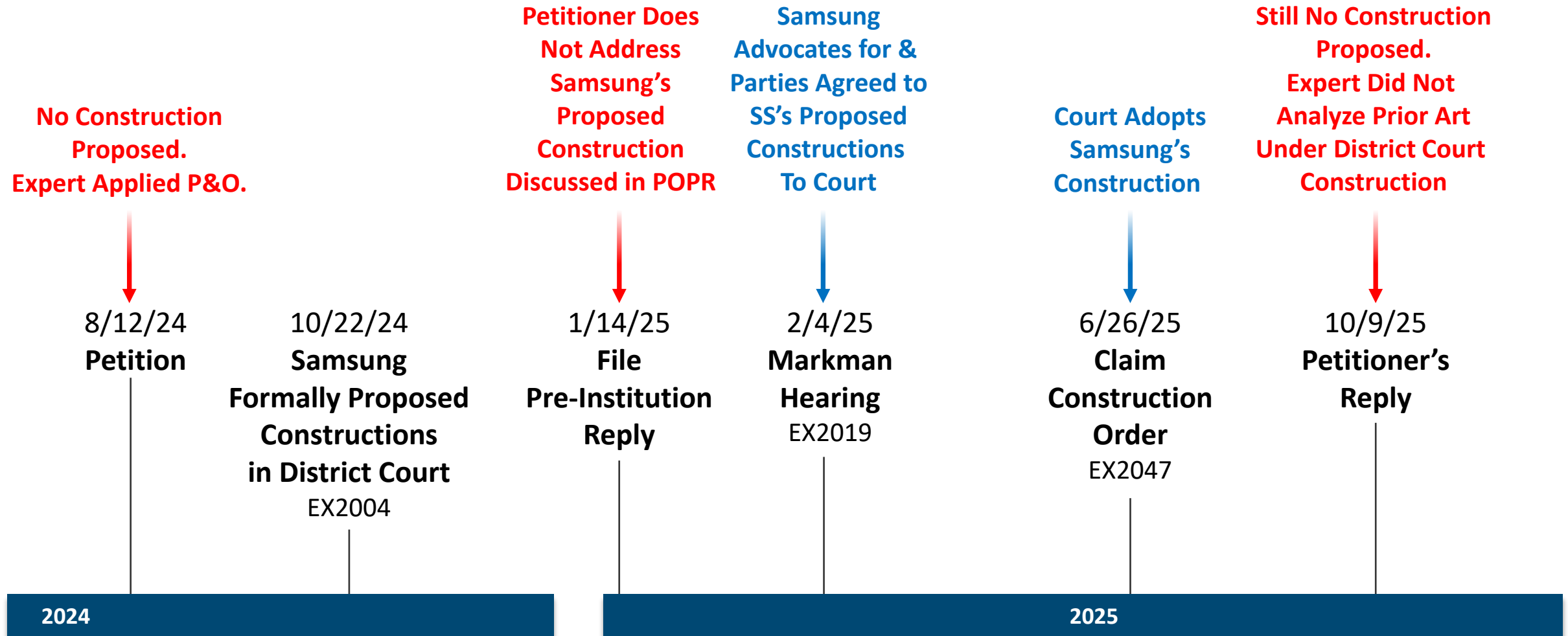
SAMSUNG

Do you agree with the district court's construction for planarization layer?

A I hadn't really thought about it in detail. It's reasonable. I don't have a disagreement with it but, you know, it's -- I don't -- I didn't have to adopt that specifically for the purposes of my analysis.

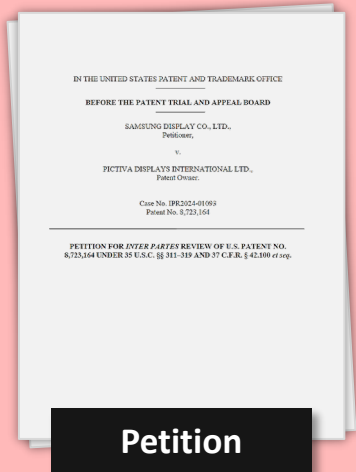
EX2049 (Second Subramanian Dep.) at 28:11-17

Timeline of Samsung's Claim Construction Positions for "Planarization Layer"



The Combination of Kijima and Suzuki Does Not Comprise a Planarization Layer (All Grounds)

All Grounds Rely on the Proposed Kijima-Suzuki



SAMSUNG

Petitioner requests IPR based on the following grounds:

- **Ground I:** Claims 34, 37, and 40 are obvious over Kijima in view of Suzuki;
- **Ground II:** Claim 35 is obvious over Kijima in view of Suzuki and Sturm;
- **Ground III:** Claim 36 is obvious over Kijima in view of Suzuki and Duthaler; and
- **Ground IV:** Claims 41-46 are obvious over Kijima in view of Suzuki and Fujimori.

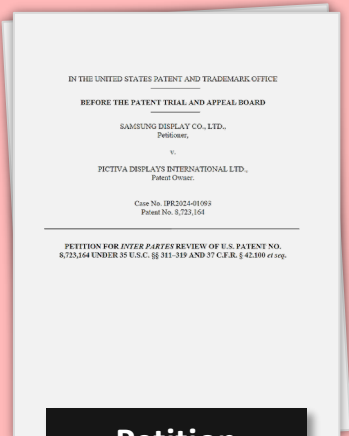
The Proposed Kijima-Suzuki Combination

the benefits as taught by Suzuki. As shown in following modification of Kijima's

Figure 12, this simple modification would entail adding a new organic sealing layer

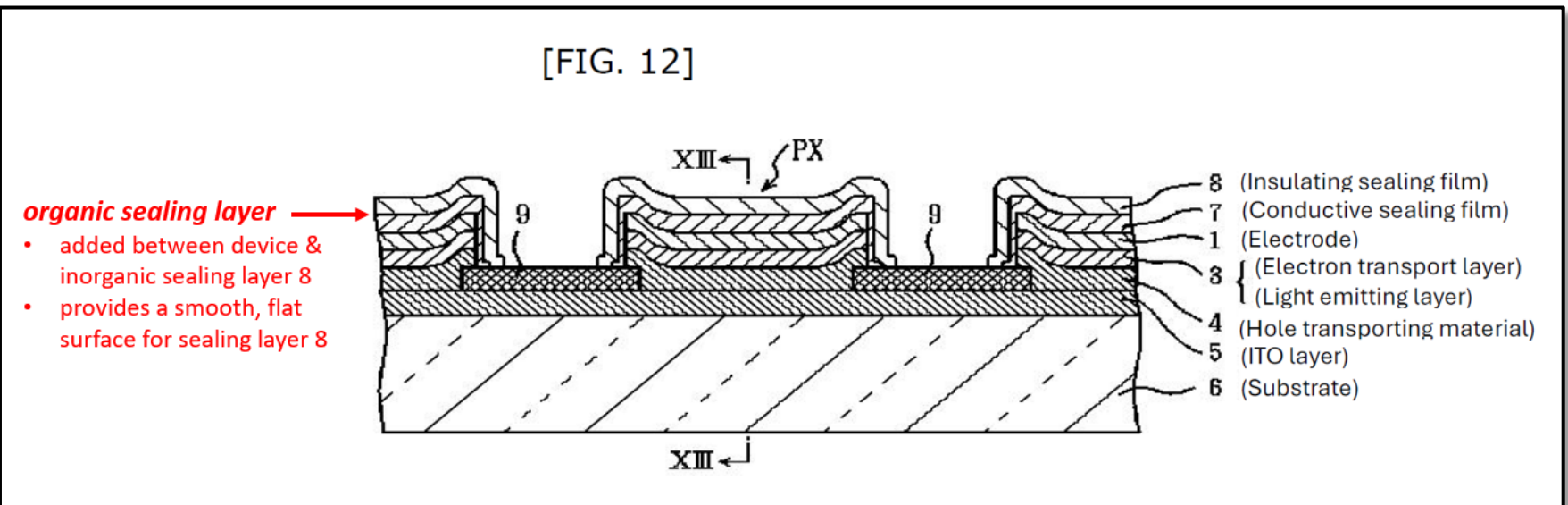
on top of Kijima's OLED in order to form a smooth surface on which to deposit

Kijima's inorganic sealing film 8.



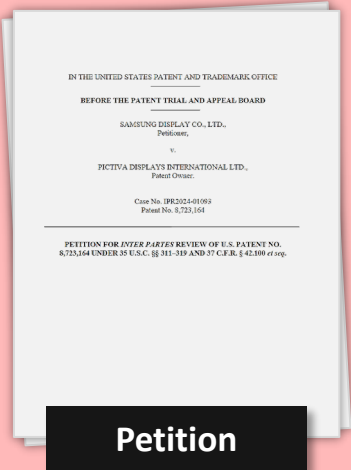
Petition

SAMSUNG



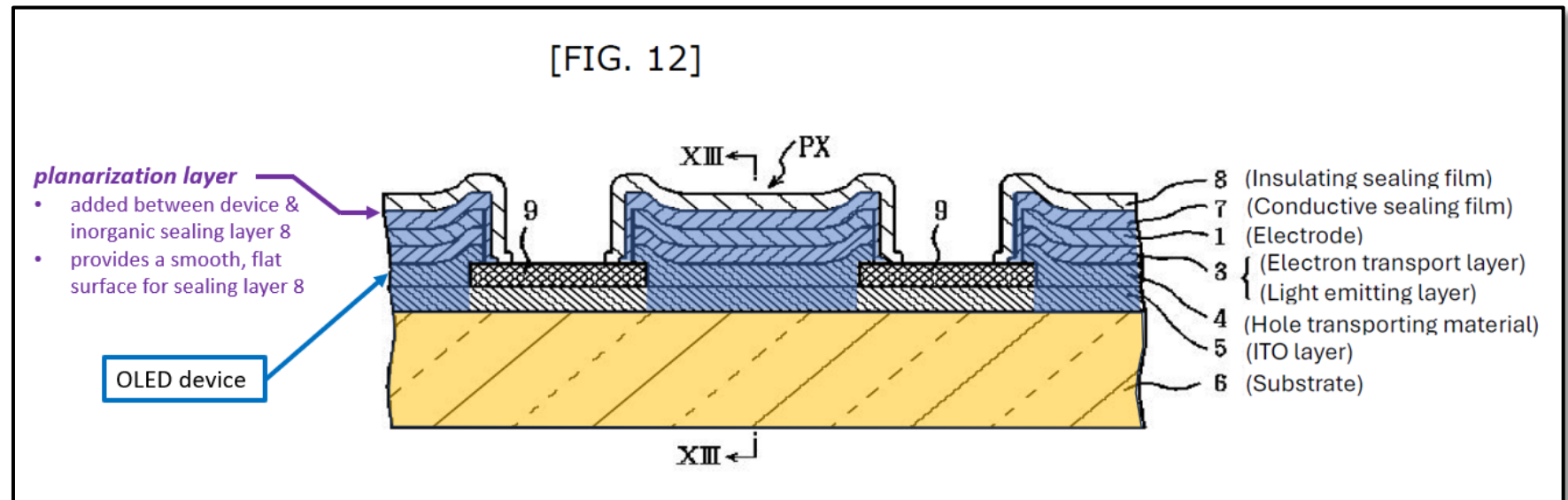
The Proposed Kijima-Suzuki Combination

Finally, this layer would be *selectively deposited* upon the OLED devices because the layer would be deposited on top of the OLED's conductive sealing film 7, as discussed above and shown in Figure 12.



Petition

SAMSUNG



Dr. Subramanian Relies on Kijima's Disclosure for the Method of Encapsulation Used in the Combination



Dr. Subramanian
Expert Witness

SAMSUNG

34[pre]. A method of encapsulating a plurality of devices fabricated upon a substrate, the steps of said method comprising:

So, it's Kijima's teachings that you are identifying as -- as the part of your combination that satisfies the preamble of claim 34.

A Assuming it's limiting. Yeah, I'm only pointing to Kijima. If we look at what I'm pointing to between paragraphs 59 and 65, I only point to disclosures within Kijima itself.

EX2049 (Second Subramanian Dep.) at 37:21-38:2

Dr. Subramanian Relies on Kijima for Device Fabrication



Dr. Subramanian
Expert Witness

SAMSUNG

34[a]. “fabricating a plurality of devices on a substrate”

So for this element, Element 34(a) under ground one, you are again relying on Kijima's disclosure as satisfying the limitation?

A Yes, that's fair.

EX2049 (Second Subramanian Dep.) at 38:16-19

Dr. Subramanian Relies on Kijima for Selective Deposition



Dr. Subramanian
Expert Witness

SAMSUNG

34[b]. “selectively depositing at least one planarization layer upon said devices”

With respect to the specific disclosure of performing the deposition selectively, I'm relying on the disclosure of Kijima for the selective aspect of it.

EX2049 (Second Subramanian Dep.) at 40:1-4

Dr. Subramanian Relies on Kijima for Deposition of Suzuki's Added Layer



Dr. Subramanian
Expert Witness

SAMSUNG

out that -- I would agree that, yes, it's true that the deposition techniques would generally follow what Kijima discloses.

And what we are doing is we are making a structural modification which would then require an additional deposition step, and it's a selective deposition step through a mask. But we're still following the kinds of steps that are taught by Kijima.

EX2049 (Second Subramanian Dep.) at 45:6-14

Mr. Humphrey Confirmed the Topology of the Combination Would Follow Kijima

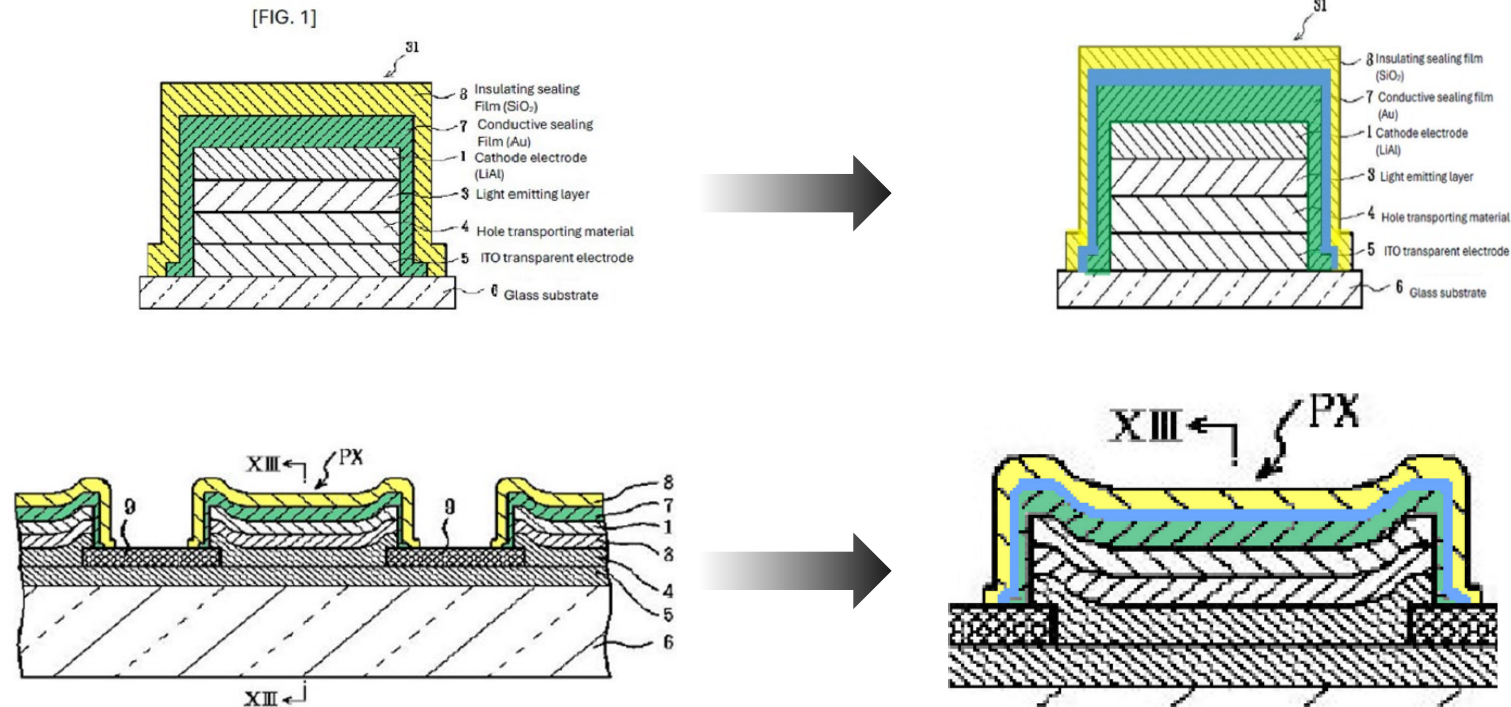


Mr. Humphrey
Expert Witness



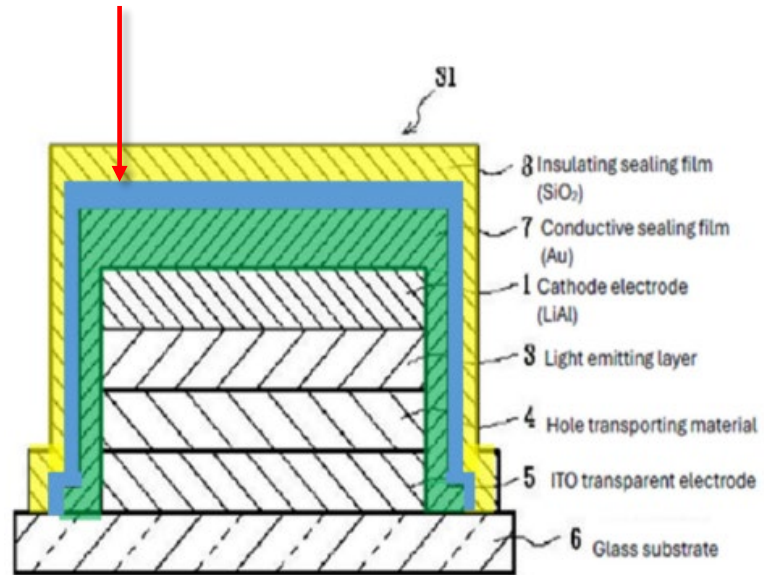
pictiva displays

35. However, when added to Kijima, the organic layer would have a substantially similar topography to the existing conductive sealing film 7 below it.



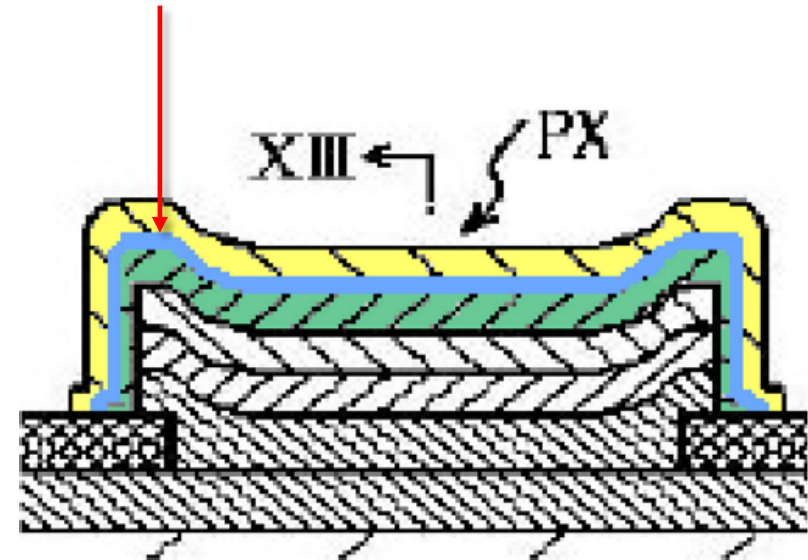
The Combination's Alleged “Planarization Layer” Reproduces the Underlying Topology

Alleged “Planarization Layer”
From Suzuki



Kijima, FIG. 1 (annotated)

Alleged “Planarization Layer”
From Suzuki



Kijima, FIG. 12 (annotated)

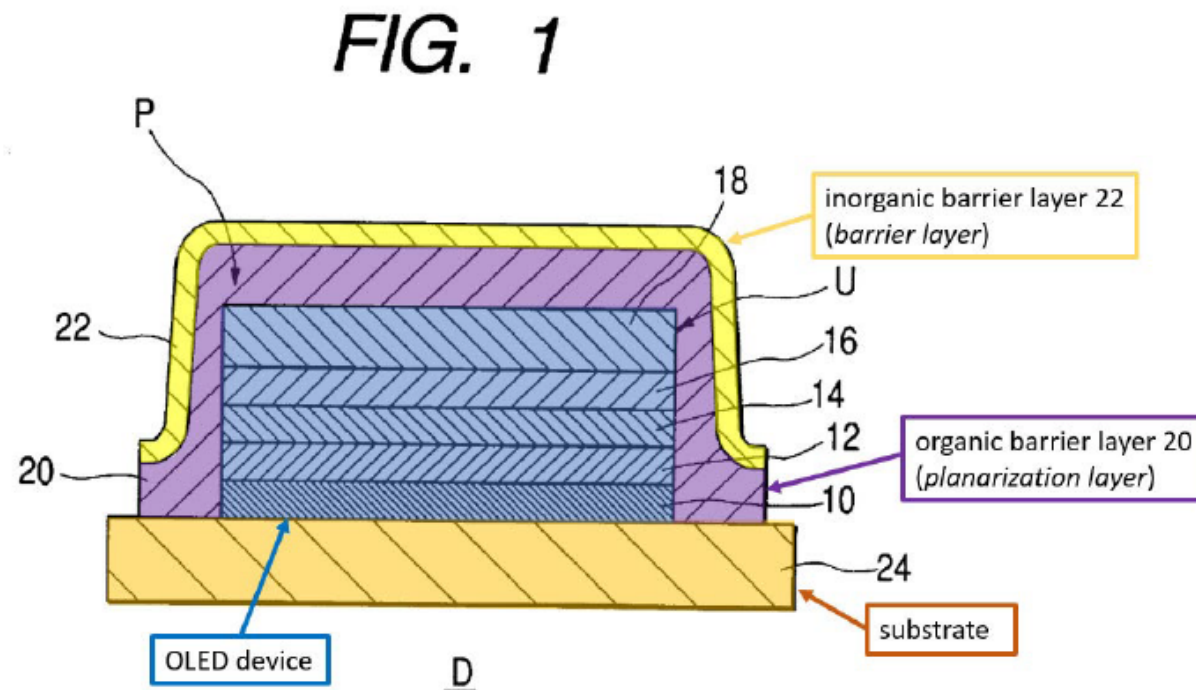
EX2018 at ¶¶ 35-37 (annotating Kijima’s FIG. 1 and 12)

Petitioner's New Reply Theory Is Improper and Contrary to the Evidence



SAMSUNG

Suzuki, 5:59-67. Suzuki's Figure 1 depicts this smoothing, with the top of this layer (purple) having visibly rounded corners, unlike the sharp corners of the underlying topology:



Petitioner's New Reply Theory is Not Supported By The Evidence

- The combination is **not** based on Suzuki's manufacturing techniques and therefore would not have rounded corners.
- Humphrey: even with "some minor rounding of the corners, [] it largely follows the topology" EX1036, 18:2-13.
- Suzuki does not suggest drawings are to scale or that there is any intended significance to the shape of its corners.

FIG. 1

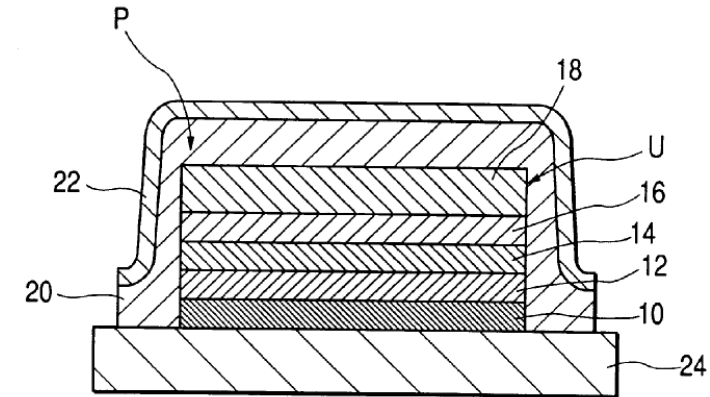
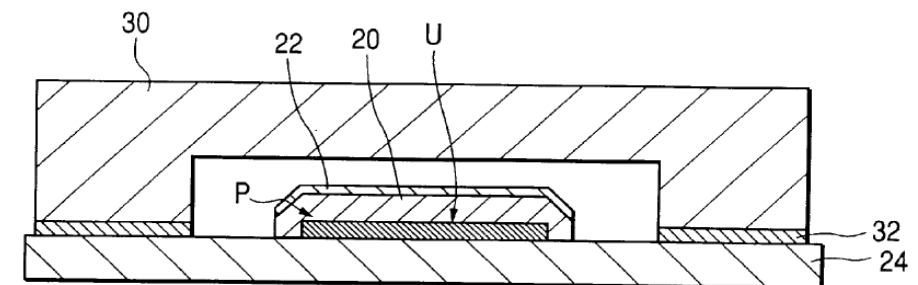
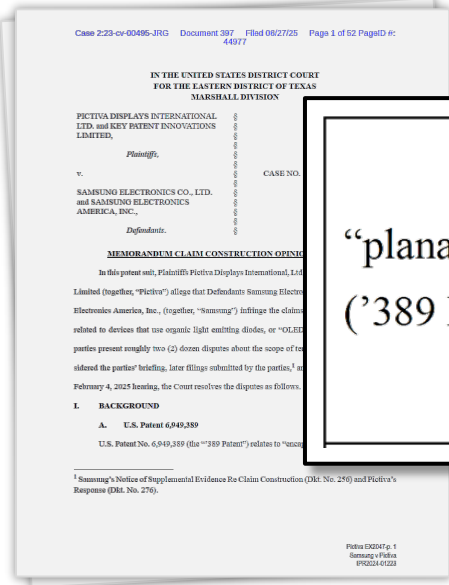


FIG. 2



***Petitioner's New Reply Argument Misapplies the Claim Construction for
Planarization Layer***

The Agreed-to and Adopted District Court Claim Construction



“planarization layer”
(’389 Patent, Claims 34, 35, 41, 46)

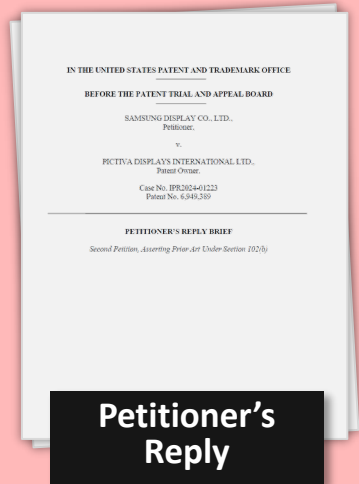
“a layer of material that planarizes such that the propagation of defects from one layer to another layer can be interrupted and the topography of the underlying layer is not reproduced.”

EX2047 (Claim Construction Order) at 49

First Planarization Prong: Propagation of defects from one layer to another can be interrupted

Second Planarization Prong: Topology of underlying layer is not reproduced

Petitioner's New Reply Argument Improperly Conflates the Claim Construction's Distinct Prongs



SAMSUNG

Suzuki. Pet., 32-33. Moreover, Suzuki's organic barrier layer 20 is a planarization layer under the district court construction, because it smooths out the irregular surface beneath it, thereby not following the underlying topography, and it covers defects, thereby preventing defects from propagating. *See, e.g.*, Suzuki, 5:51-67; Ex.1033 ¶¶11-12.

Subramanian's New Theory is That Suzuki's Defect "Smoothing" Also Results in the Underlying Topology Not Being Followed



Dr. Subramanian
Expert Witness

SAMSUNG

12. A POSITA would have understood from these teachings of Suzuki that its organic barrier layer 20 does not follow the underlying topology, because Suzuki teaches that this layer smooths out the irregular surface beneath it. Thus, it does not follow the underlying topography. Additionally, Suzuki teaches that this layer covers defects, including pinholes, that may be formed in the underlying layers. Suzuki thus teaches that its organic barrier layer 20 prevents defects from propagating to other layers.

EX1033 (Second Subramanian Decl.) at ¶ 12

Suzuki's "Smoothing" Covers Defects

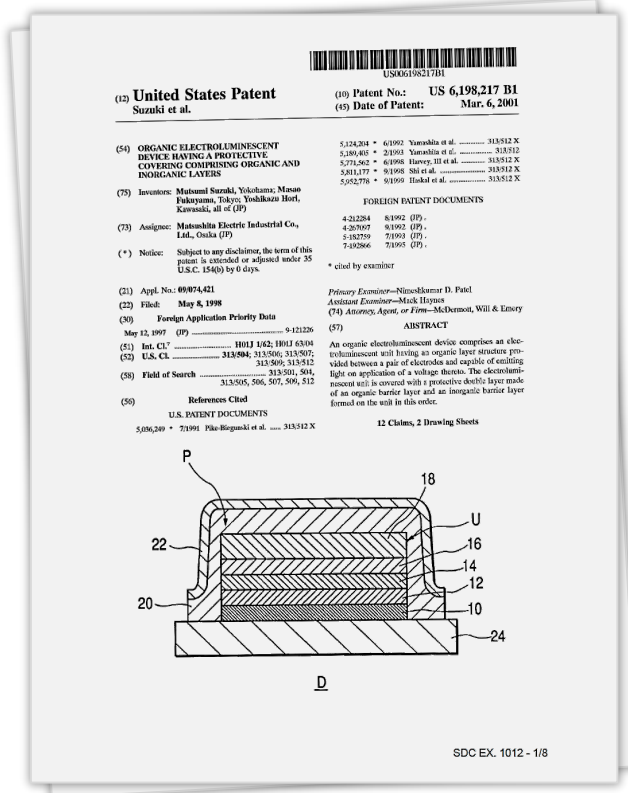


FIG. 1. The protective layer P includes two layers including an organic barrier layer 20 covering defects or pinholes inevitably formed particularly in the uppermost cathode layer 18, and an inorganic barrier layer 22. It will be noted that defects are mainly caused by foreign matter inevitably deposited on the electroluminescent unit U during the course of the fabrication thereof under very severely controlled conditions.

The organic barrier layer 20, which exhibits good affinity for the metal or alloy cathode, covers defects in the electroluminescent unit U therewith and makes a smooth surface on the relatively irregular surface of the cathode 18. Then, the inorganic barrier layer 22 is formed on the smooth surface of the organic barrier layer 20, thus ensuring the formation of the layer 22, which is substantially defect-free and dense. The thus formed double-layer structure can remarkably contribute to moisture proofing.

EX1012 (Suzuki) at 5:51-67

Intentional Topography is Distinct From Unintentional Defects



Mr. Humphrey
Expert Witness



pictivadisplays

33. Even if the organic layer is sufficiently thick to cover particles and other defects, if any, on the conductive sealing film 7, those defects are created unintentionally on the surface of the underlying layer and is generally not considered to be part of the underlying layer's topology, which is a property of design. Thus, even with an added organic layer, there would not be a planarization layer in the modified Kijima device.

EX2001 at ¶ 33

Subramanian Acknowledges That Intentional Topography is Distinct From Unintentional Defects



Dr. Subramanian
Expert Witness

SAMSUNG

Q So, smoothing out the irregular surface, do you mean covering defects and pinholes then?

A I mean it's certainly true that that would be a reasonable consequences or an expected consequence of smoothing out. But that's not the only thing that gets smoothed out.

You could have intentional topology or topological variations and those would get smoothed out as well.

I agree that, generally speaking, defects such as pinholes are not intentional. They may be

EX2049 (Second Subramanian Dep.) at 19:14-22; 22:7-8

Samsung Argued Extensively to the District Court that the Planarization Prongs Are Distinct Requirements

Samsung Counsel

SAMSUNG

MR. PAK: So the planarization layer, Your Honor, performs two functions. One is, to the extent that you have a defect in the underlying layer, for example, there might be a dust particle in the OLED device, that dust particle does not get propagated up towards the upper layers. And then also you are not reproducing the underlying topography, which is another way of saying you're smoothing out the contours of the underlying device structure.

EX2019 (Markman Hearing) at 29:15-22

Samsung Argued that the Second Prong Is to Smooth Out the Contour of the Underlying Topography Over the OLED Devices Even Without a Defect

Samsung Counsel

SAMSUNG

The second point, Your Honor, is about a different issue. So there are these defects, for example, the dust particles and so on that might exist on the OLED device, but the other really important aspect of the planarization layer is that -- if you remember, Your Honor, the OLED device is a structure that protrudes from the surface of the substrate.

...

breakage in that foil. So what you want to do is actually -- this second piece is about smoothing out the contour of that underlying topography over the OLED device. Regardless of whether there's a defect or not, you want a smooth, flatter surface. And so there I think we can maintain this idea that

EX2019 (Markman Hearing) at 31:22:32:11

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

389-2.54

Samsung Argued that the Second Prong Is to Smooth Out the Contour of the Underlying Topography Over the OLED Devices Even Without a Defect

Samsung Counsel

SAMSUNG

The second function is about smoothing out the underlying contour of what's there. And that -- even in situations where you have no defects, you could have OLED devices that protrude from the surface, and when you try to put a barrier layer on top of that OLED structure now you're folding -- you're creating folds and creases in that barrier layer.

So the second function is about smoothing out the surface before you put down the barrier layer. So there I do think it's appropriate to maintain 'is not reproduced' because the whole point of the planarization layer from that standpoint is to flatten out the surface contour.

EX2019 (Markman Hearing) at 36:13-23

Samsung's Claim Construction Expert Confirmed That the Planarization Prongs Are Distinct



Dr. Schubert
Expert Witness

SAMSUNG

59. The applicants also stated “metals cannot be used as a planarization layers” because “[m]etals . . . that are evaporated onto a layer do not cover-up the imperfections of the underlying layer, but rather the metals reproduce the topography of the underlying layer.” Nov. 24, 2003 Response to Non-Final Rejection at 16. Thus, the applicants made clear that the “planarization layer” they claimed could only encompass a layer that “cover[s]-up the imperfections of the underlying layer” and that does not “reproduce the topography of the underlying layer.”

EX2002 (Schubert Decl.) at ¶ 59.

Samsung Argued That the “Topography” Requirement Is to Prevent Creases and Cracks in the Barrier Layer

Samsung Counsel

SAMSUNG

MR. PAK: So when you don't reproduce the topography of the underlying layer, for example, here we see a much flatter smoother contour with the planarization layer, so when you put the metal layer on top of that, it doesn't have the sharp creases and cracks, so it's much less likely that the barrier layer itself will have defects and cause air or moisture to seep through.

So to us, Your Honor, these -- both of these functions were highlighted during prosecution to distinguish over just putting barrier layers on top of each other, for example, and that's because these two functions--shielding defects from traveling upwards and then providing a substantially smoother surface--are both important aspects of the planarization layer, and that's the reason why we proposed the language, Your Honor.

The “Topography” Requirement Must Be Met Even When There Are No Defects in the Underlying Layer

Samsung Counsel

SAMSUNG

MR. PAK: Yes. We do believe from an engineering standpoint it is important. Because if you remember, the barrier layer is actually protecting the underlying OLED device from moisture and air, so even if there are no defects underneath that layer, if there are cracks that form or creases that form that over time causes air or moisture to seep into the OLED device, you have an issue. And that's the reason why this technique that the patentee was trying to improve upon requires a planarization layer that smoothes out the surface before you put down the barrier layer so that the barrier layer can be thin but it's being put down in a flat fashion so it doesn't have creases and cracks because it doesn't have to follow the contour of the OLED device underneath it.

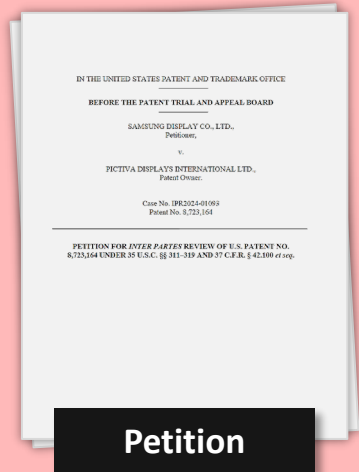
EX2019 (Markman Hearing) at 37:3-16

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Motivation to Combine Kijima and Suzuki (All Grounds)

No Evidence Motivating the Proposed Triple Protective Layer Structure

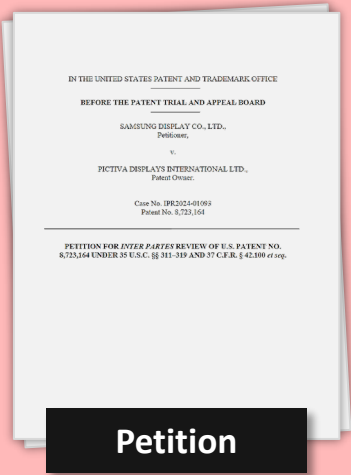
The Petition Mischaracterizes Kijima as Disclosing a Single Protective Layer



SAMSUNG

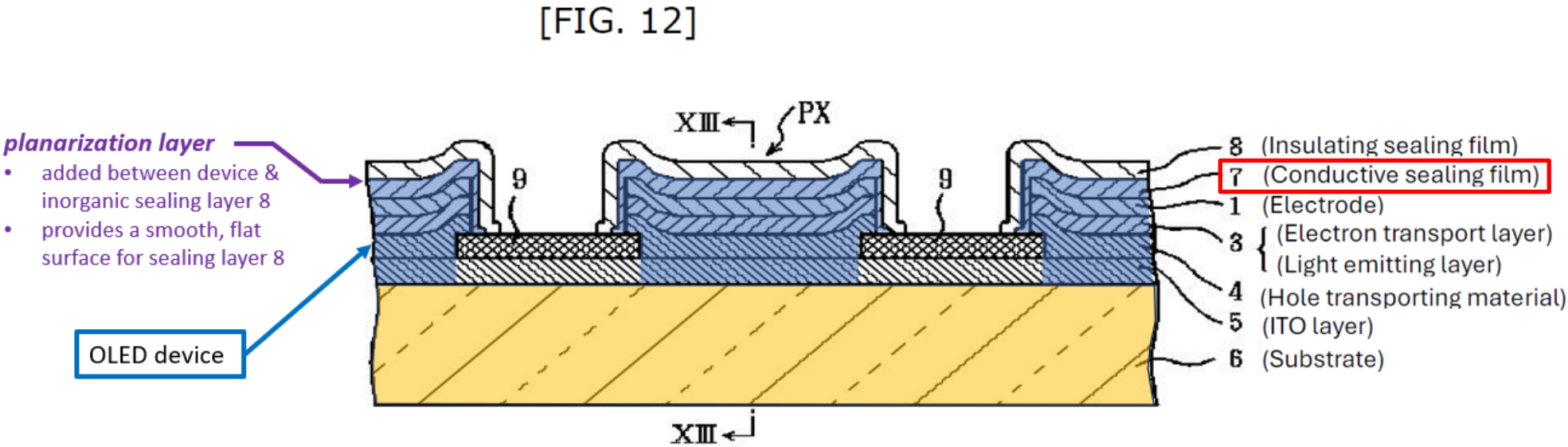
It would have been obvious at the time of the alleged invention to use such a “protective double layer” in Kijima’s selective encapsulation methods. Specifically, instead of using a single inorganic “insulating sealing film 8” as depicted in Kijima, it would have been obvious to use a “protective double layer made of an organic barrier layer and an inorganic barrier layer” (Suzuki, [Abstract]) in order to obtain the benefits as taught by Suzuki. As shown in following modification of Kijima’s

Petitioner Mischaracterizes Kijima's Sealing Film 7 as Being Only Part of the OLED Device



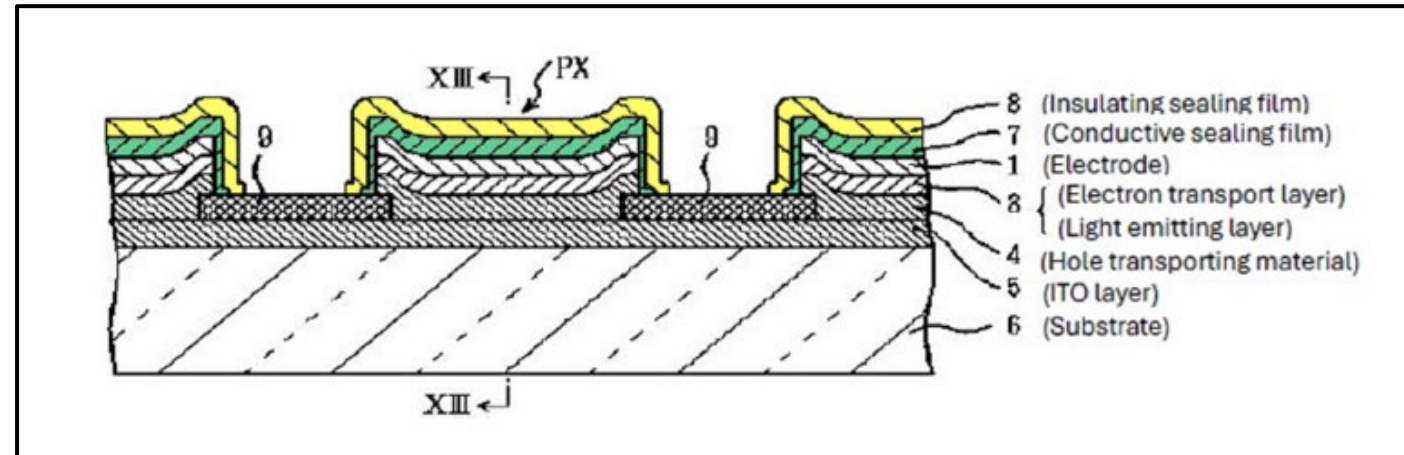
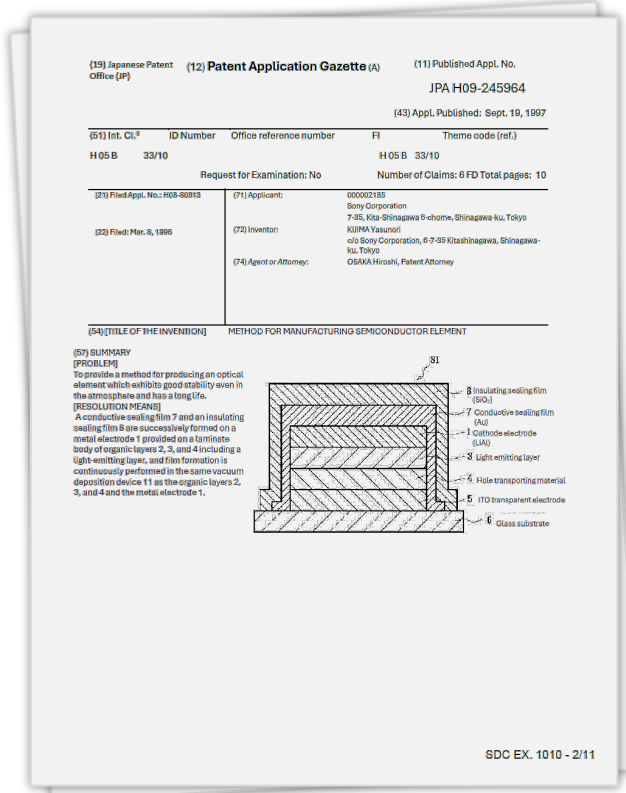
Petition

SAMSUNG



Kijima Discloses a Protective Double Protective Layer Structure

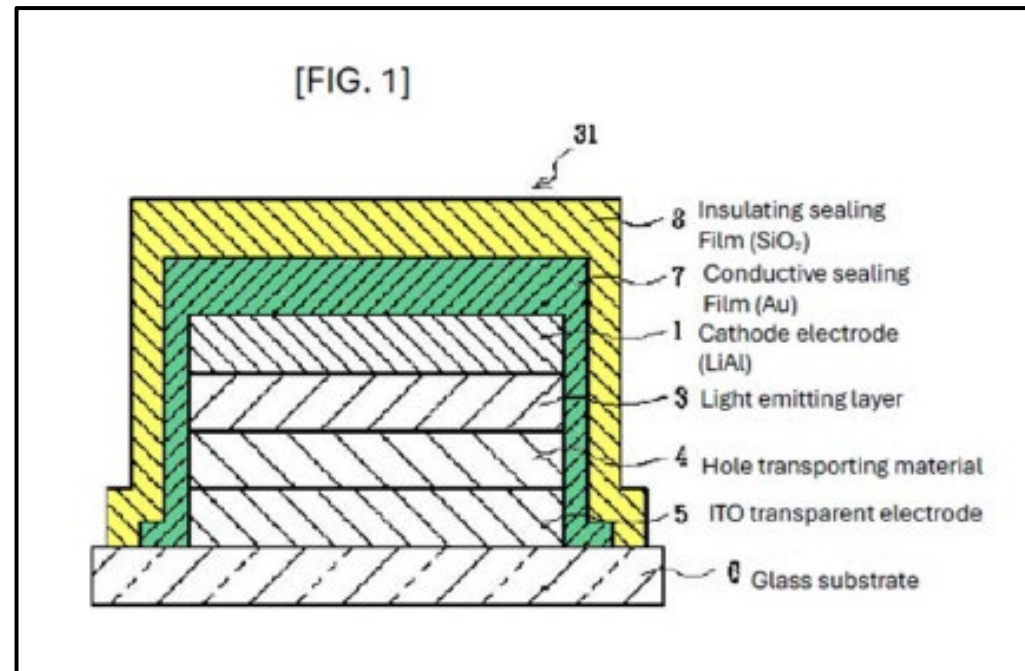
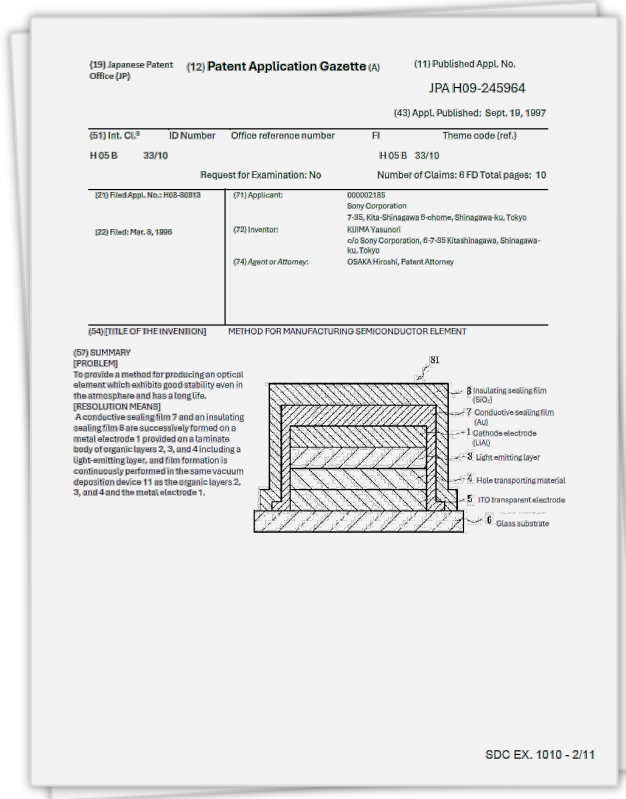
[0055] With this embodiment, the conductive sealing film 7 provided on the electrode 1 is continuously formed in the same vacuum deposition device. In addition to protecting the underlying organic layer and electrode and preventing oxidation of the electrode 1, the conductive sealing film 7 is further sealed with an insulating sealing film 8 made of SiO_2 , which further enhances the effects of preventing oxidation of the electrode 1 and degradation of the organic layer.



EX1010 at [0055], FIG. 12 (annotated)

Kijima Discloses a Protective Double Protective Layer Structure

[0038] A conductive sealing film 7 and an insulating sealing film 8 are successively formed on the electrode 1 so as to cover the side surfaces of the element. These sealing films were formed by using a vacuum deposition device described later and by the method of the present embodiment.



EX1010 at [0038],
FIG. 1 (annotated)

Subramanian Agrees Kijima's Conductive Sealing Film Functions As a Protective Layer



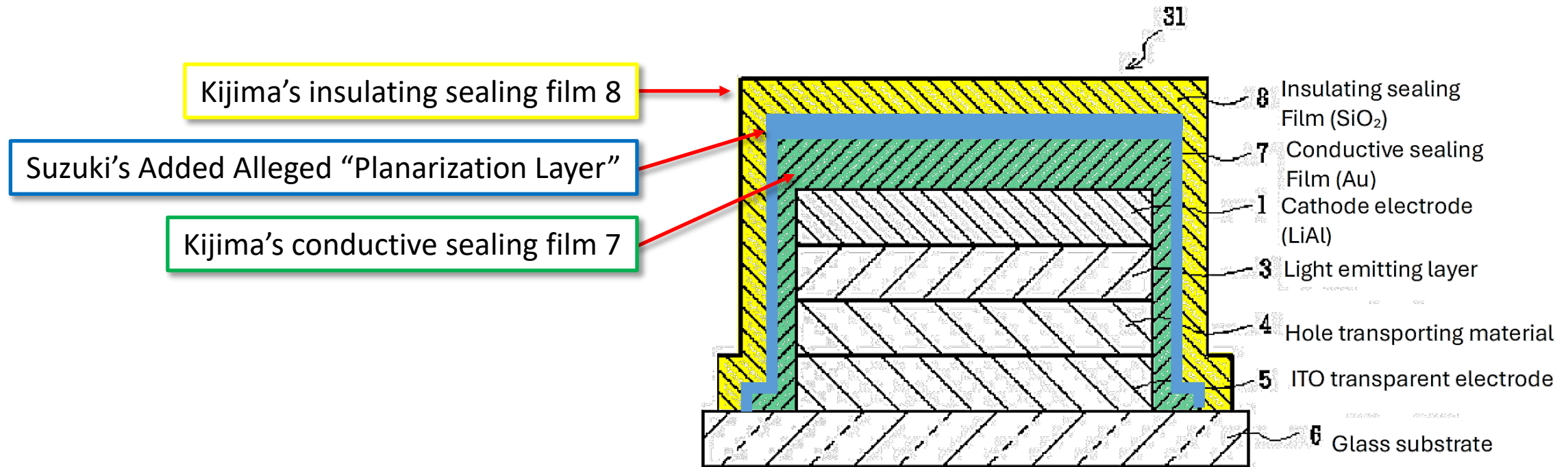
Dr. Subramanian
Expert Witness

SAMSUNG

So I agree that functions or benefits that are called out with respect to the conductive sealing film are inclusive of protecting the underlying organic layer and electrode and preventing oxidation of the electrode.

EX2021 (First Subramanian Dep.), 152:19-24

The Proposed Combination Results in a Triple Protective Barrier Layer Structure



Kijima, FIG. 1 (annotated)

None of Petitioner's Prior Art Addresses Triple Protective Layer Structures



Dr. Subramanian
Expert Witness

SAMSUNG

Subramanian confirmed:

- Kijima “doesn’t talk about using three sealing layers” and “it wouldn’t identify benefits therewith because it's not even talking about three layers” (EX2021 at 151:17-152:1).
- Suzuki teaches “the benefits of a double barrier layer” and does not address “the use of triple barrier layers” (EX2021, 150:11-17, EX2049 at 60:2-13).
- Komatsu discloses only two layers (EX2049 at 60:22-61:9; EX1017, 10:13-15).

Subramanian Has Never Seen The Proposed Triple-Layer Barrier Structure



Dr. Subramanian
Expert Witness

SAMSUNG

Q. Have you seen the use of an organic layer on top of a relatively thick gold layer then an inorganic layer on top of an organic layer?

A. I don't recall.

I know that I've definitely seen -- and personally within my group we have done planarization layers on top of gold specifically to deal with asperities. But in our work I'm positive we did not put a third layer on top of that.

But I don't know about other work. Certainly I cannot recall it off the top of my head.

**Proposed
Combination**

Subramanian Has Never Seen The Proposed Triple-Layer Barrier Structure



Dr. Subramanian
Expert Witness

SAMSUNG

Q. Okay. And I just want to be clear that I -- when I'm talking about the literature, I'm not just talking about at the time of the invention but since the invention as well.

A. I understand.

I mean, my answers would be the same.

EX2021 (First Subramanian Dep.) at 71:20-72:2

Subramanian Is Unaware of Prior Art That Uses More Than Two Protective Layers



Dr. Subramanian
Expert Witness

SAMSUNG

Q So, is it fair to say that you can't say for sure that you've ever seen references describe more than two protective layers before the date of the invention?

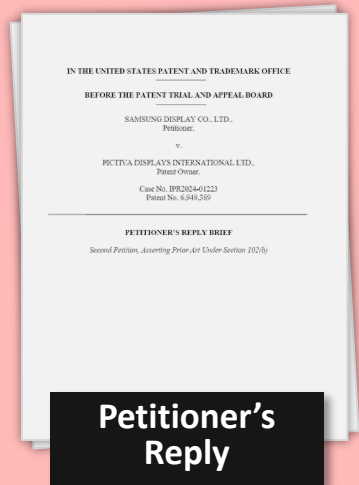
A I certainly couldn't say one way or another, not off the top of my head. And I haven't cited to -- what I cited to with respect to this is Suzuki and Komatsu specifically and those are two-layer disclosures with respect to the prospective layer stack.

EX2049 (Second Subramanian Dep.) at 62:20-63:4

Motivation to Combine Kijima and Suzuki (All Grounds)

***Petitioner's New Reply Theory That Kijima's Conductive Sealing Layer 7
is not an Encapsulation Layer Fails***

Petitioner's New Reply Theory is Unsupported by Substantial Evidence



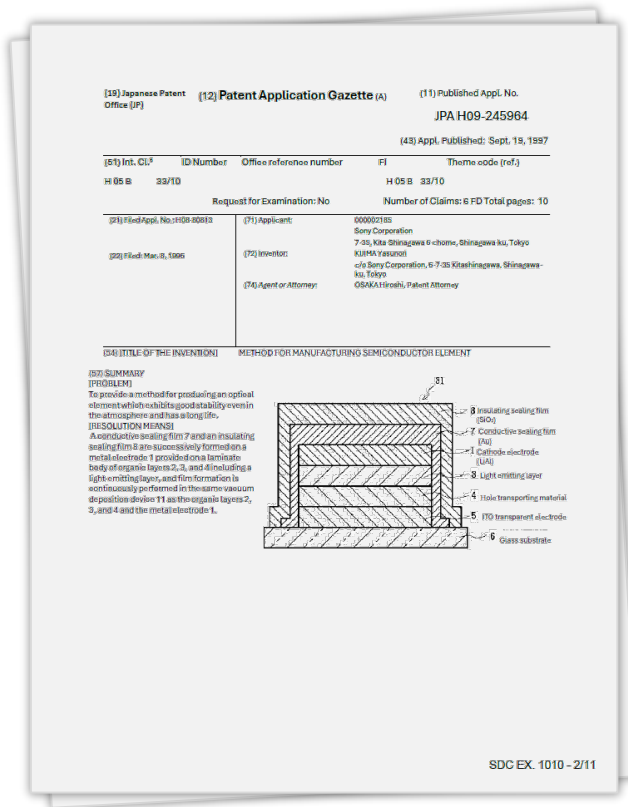
SAMSUNG

argues that this film provides sufficient protection. POR, 30-31. But Kijima makes clear that, in contrast to the protection an encapsulating layer provides, conductive sealing film 7 does not provide adequate protection from exposure after manufacturing. Ex.1033 ¶¶30-31.

...

Kijima, [0086]-[0087]. In other words, conductive sealing film 7 alone, even deposited in vacuum conditions, did not protect the underlying EL device from subsequent exposure. Ex.1033 ¶¶30-31.

Kijima States that the Insulating Sealing Layer Is Optional



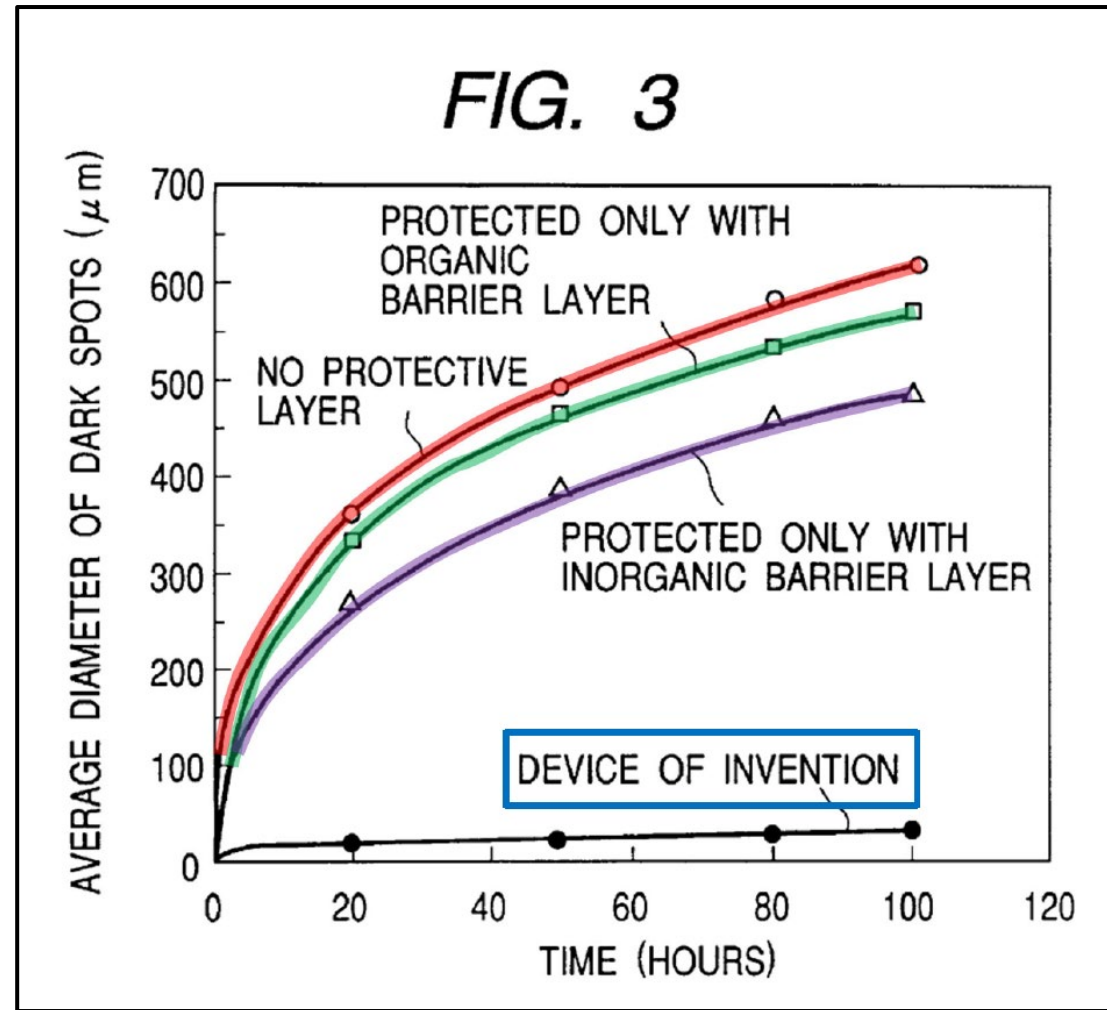
[0030]

MEANS FOR SOLVING THE PROBLEM

In other words, the present invention relates to a method for producing an optical element having an electrode provided on a laminate body of organic layers including a light emitting region, which includes forming the electrode under vacuum film-forming conditions, and then forming at least a conductive sealing film thereon while maintaining the vacuum (and preferably further forming an insulating sealing film thereon).

EX1010-Kijima at [0030]

Suzuki's Barrier Layers Alone Do not Provide Adequate Protection



EX1012-Suzuki at FIG. 3 (annotated)

Kijima's Objectively Discloses That Its Conductive Sealing Layer Is a Protective Barrier Layer

Comparative Example 2

[0080] The organic EL element produced in this manner was left in air for one month after production, and then the properties of the element were measured. The luminance was found to be about 500 cd/m² at an applied voltage of 13 V, but these results were greatly degraded from the result measured immediately after the element was produced. Furthermore, a large number of dark spots were observed.

**Atmospheric exposure before deposition
of the conductive sealing layer 7**

Comparative Example 3

[0086] The organic EL element produced in this manner was left in air for one month after production, and then the properties of the element were measured. The luminance was found to be about 900 cd/m² at an applied voltage of 9 V, but these results were degraded from the result measured immediately after the element was produced. Furthermore, there was also an increase in dark spots.

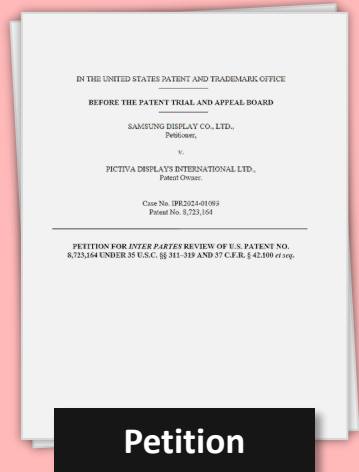
**Atmospheric exposure after deposition
of the conductive sealing layer 7**

EX1010-Kijima at [0080], [0086]

Motivation to Combine Kijima and Suzuki (All Grounds)

No Showing That Adding Suzuki's Layer Would Reduce Defects

Petitioner Contends that Kijima's Conductive Sealing Film Is Vulnerable to the Same Issues as Suzuki's Cathode



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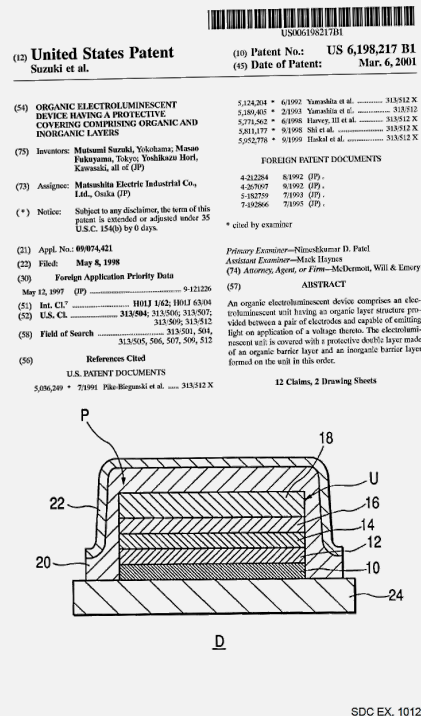
As Dr. Subramanian explains, a POSITA would have recognized that the underlying conductive film 7, which is formed of metal such as gold (and which functions together with electrode 1 to serve as a “negative electrode” to drive the OLED, as discussed in footnote 4 above), would be vulnerable to the known problems associated with the cathode surface discussed in Suzuki. *See* Suzuki, 5:52-57 (explaining that “defects or pinholes [are] inevitably formed” when manufacturing such OLED devices even “under very severely controlled conditions”); Kijima, [0056]; Ex.1004, ¶80. Indeed, this conductive film 7 has a

Suzuki Discloses its Cathode is Susceptible to Pinhole Defects

FIG. 1. The protective layer P includes two layers including an organic barrier layer 20 covering defects or pinholes inevitably formed particularly in the uppermost cathode layer 18, and an inorganic barrier layer 22. It will be noted that defects are mainly caused by foreign matter inevitably deposited on the electroluminescent unit U during the course of the fabrication thereof under very severely controlled conditions.

The organic barrier layer 20, which exhibits good affinity for the metal or alloy cathode, covers defects in the electroluminescent unit U therewith and makes a smooth surface on the relatively irregular surface of the cathode 18. Then, the inorganic barrier layer 22 is formed on the smooth surface of the organic barrier layer 20, thus ensuring the formation of the layer 22, which is substantially defect-free and dense. The thus formed double-layer structure can remarkably contribute to moisture proofing.

EX1012-Suzuki at 5:51-67



Subramanian: Suzuki's Organic Sealing Layer Would Aid in Preventing Pinhole Defects in Kijima



Dr. Subramanian
Expert Witness

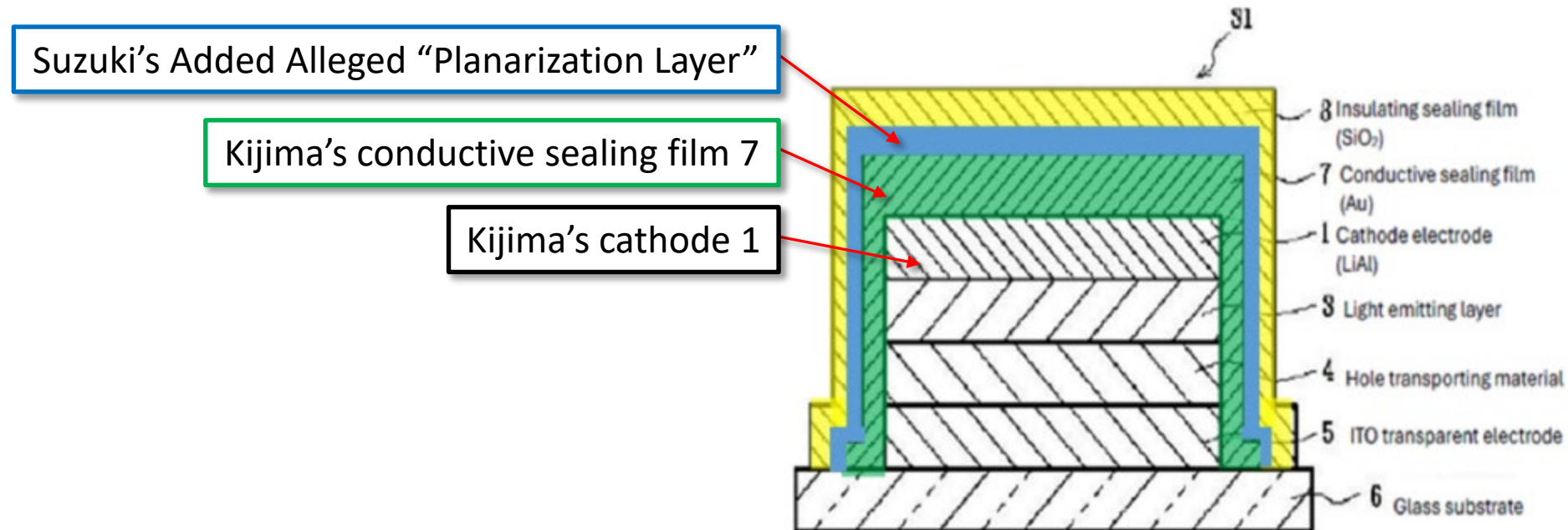
SAMSUNG

sealing layer 8. Suzuki, 5:59–67. In my opinion, a POSITA would also have appreciated, based on Suzuki's teachings, that the added organic sealing layer would aid in preventing the adsorption of moisture through pinholes, and as a result, aid in reducing the formation or enlargement of dark spots on the display manufactured according to Kijima. See Suzuki, 5:38-58; Fig. 3.

EX1004 (Subramanian Decl.) at ¶ 81

Suzuki's Organic Sealing Layer is Added on Top Kijima's Conductive Sealing Layer, Not on Top of the Cathode

The proposed combination adds Suzuki's organic layer on **top** (not beneath) of Kijima's existing conductive sealing layer 7 that already covers the cathode.



Kijima, FIG. 1 (annotated)

Pinhole Defects Are an Issue Only for Thinner Layers, like Suzuki's Cathode

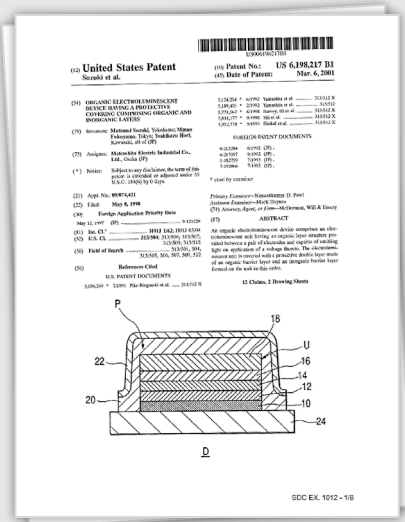


Dr. Subramanian
Expert Witness
SAMSUNG

Q. If you control the process properly, do the gold films have a lot of pinhole defects?

A. It depends on the thickness.
If the films are in the thickness range of a micrometer, then no.

EX2021 (First Subramanian Dep.) at 61:7-12



A transparent glass substrate, on which an indium tin oxide (ITO) film had been preliminarily formed as an anode, was washed well with pure water, and set in a vacuum chamber, followed by continuously forming a 50 nm thick hole transport layer, a 50 nm thick electron-transporting, emission layer, and a **150 nm thick cathode** while keeping reduced pressure conditions at 5×10^{-6} Torr, thereby obtaining an electroluminescent unit.

EX1012-Suzuki at 8:6-13

“Other Types of Defects” Constitute a New Theory



Dr. Subramanian
Expert Witness

SAMSUNG

Q. Okay. So for a 1 micron thick gold film, usually there are no pinhole defects?

A. I agree, the likelihood of getting pinhole defects in a 1 micrometer film will be basically zero or close to zero.

There are other types of defects, but pinhole defects will be almost nonexistent.

Q. Okay. What kind of other defects have you observed?

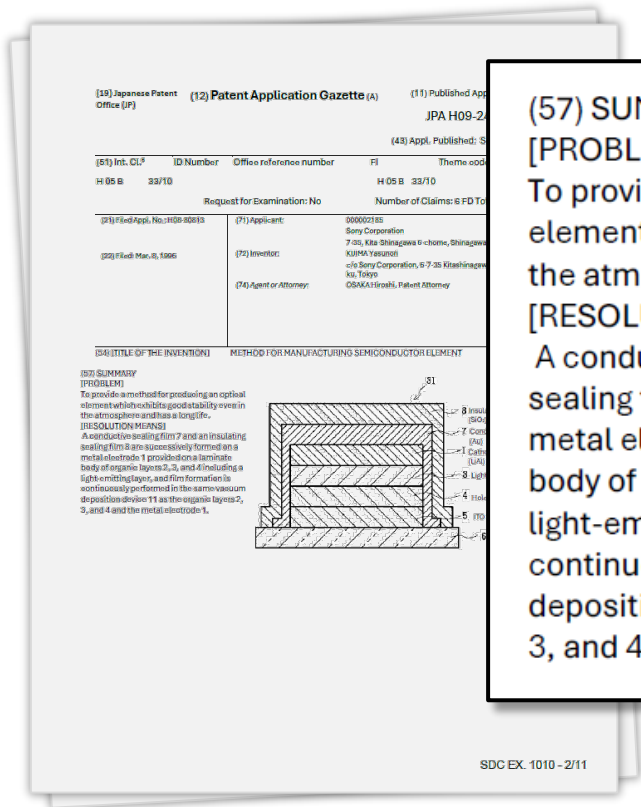
A. There are buckle defects where the gold buckles up and creates an asperity.

That's actually a big problem with gold, and it actually gets worse as the gold gets thicker.

EX2021 (First Subramanian Dep.) at 61:16-62:4

Also No Evidence that Buckle Defects Were a Known Issue for OLED Encapsulation

A POSITA Would Not Have Added an Organic Layer to Address Buckle Defects in Kijima



(57) SUMMARY
[PROBLEM]
To provide a method for producing an optical element which exhibits good stability even in the atmosphere and has a long life.
[RESOLUTION MEANS]
A conductive sealing film 7 and an insulating sealing film 8 are successively formed on a metal electrode 1 provided on a laminate body of organic layers 2, 3, and 4 including a light-emitting layer, and film formation is continuously performed in the same vacuum deposition device 11 as the organic layers 2, 3, and 4 and the metal electrode 1.

[0055] With this embodiment, the conductive sealing film 7 provided on the electrode 1 is continuously formed in the same vacuum deposition device. In addition to protecting the underlying organic layer and electrode and preventing oxidation of the electrode 1, the conductive sealing film 7 is further sealed with an insulating sealing film 8 made of SiO₂, which further enhances the effects of preventing oxidation of the electrode 1 and degradation of the organic layer.

Kijima, Abstract, [0055]

No Organic Layer Needed to Provide the Sealing

A POSITA Would Not Use Sturm's Inkjet Printing in the Kijima-Suzuki Combination (Ground II – Claim 35)

Ground II (Claim 35): Kijima + Suzuki in Further View of Sturm



'389

(12) **United States Patent**
Pichler et al. (10) Patent No.: **US 6,949,389 B2**
(45) Date of Patent: **Sep. 27, 2005**

(54) **ENCAPSULATION FOR ORGANIC LIGHT
EMITTING DIODES DEVICES**

(75) Inventors: **Karl Pichler**, Santa Clara, CA (US);
Kyle D. Firschnereit, Livermore, CA
(US)

(73) Assignee: **Ocean Opto Semiconductors GmbH**,
Regensburg (DE)

(*) 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.: **10/137,163**

(22) Filed: **May 2, 2002**

(65) **Prior Publication Data**
US 2003/020845 A1 Nov. 6, 2003

(51) Int. Cl. **H01L 21/00; H01L 21/425**

(52) U.S. Cl. **438/26; 438/28; 438/30;**

438/48; 438/55; 438/57; 438/67

(58) Field of Search **438/26, 28, 30;**
438/48, 55, 57, 62, 67, 69; 257/53;
21, 50, 61, 63, 70, 76

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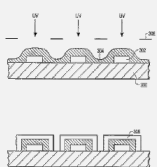
Primary Examiner—Hsiao-Ming Lee

(74) Attorney, Agent, or Firm—Thomas George

ABSTRACT

An embodiment of an encapsulated OLED device is described. This embodiment of the encapsulated OLED device is formed by fabricating multiple OLED devices on a substrate; depositing at least one planarization layer on the OLED devices; hardening the at least one planarization layer in a patterned manner such that the hardened region substantially covers the OLED device; removing areas of the at least one planarization layer that are not hardened; and selectively depositing at least one barrier layer over the hardened region.

53 Claims, 8 Drawing Sheets



35. The method as recited in claim 34 wherein the step for selectively depositing at least one planarization layer further comprises depositing by ink jet of an organic layer.

EX1001, Claim 35

Subramanian Agrees That Neither Kijima Nor Suzuki Hint At Using Inkjetting



Dr. Subramanian
Expert Witness

SAMSUNG

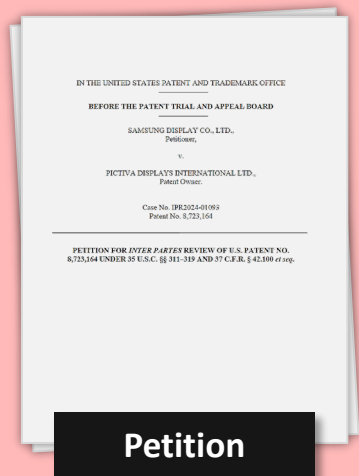
Q. And we agree that neither Kijima nor Suzuki hint using inkjetting to apply organic materials. Correct?

A. Yes, I think that's right.

That's why I do the combination with Sturm for the claims that require inkjetting.

EX2021 (First Subramanian Dep.) at 114:16-21

Sturm Discloses Inkjet Printing of “Islands” of Material in a Pattern



Petition

SAMSUNG

C. Sturm (Ex.1013)

Consistent with the '389 patent's explanation that "selectively depositing the organic layer and the barrier layer may be accomplished in a variety of ways," including "by inkjet deposition," '389 patent, 6:66-7:03, Sturm teaches methods "of fabricating semiconductor devices, such as OLED's by ink-jet printing." Sturm, 3:42-44. These methods entail "directly deposit[ing] the desired organic or other layers in the desired pattern using inkjet printing." *Id.*, 5:17-19. Sturm discloses using this method to create selectively deposited "islands" of organic electroluminescent (EL) material, *id.*, 5:30-63; patterned OLED electrodes, *id.*, 5:64-6:18; patterned top contacts, *id.*, 6:19-28; and patterned insulators, *id.*, 7:3-12; Ex.1004, ¶53.

Sturm Does Not Use Inkjet Printing to Deposit a Sealing/Encapsulation Layer

Subramanian Confirmed That Sturm Does Not Disclose Inkjet Deposition of an Encapsulation Layer



Dr. Subramanian
Expert Witness

SAMSUNG

A. So in this Exhibit 1013, which is Patent No. 6,087,196, does it involve the encapsulation layer?

A. (Reviewing document.)

No, it doesn't appear that there's any specific discussion of encapsulation within Exhibit 1013.

Sturm is silent. The devices and embodiments shown in Sturm do not have sealing and encapsulation layers of the type that we have been talking about in relation to the patent at issue.

EX2021 (First Subramanian Dep.) at 82:3-9; 177:10-24

Dr. Subramanian Contrasts Inkjet Printing of EL and Inkjet Printing of Encapsulation Layers



Dr. Subramanian
Expert Witness

SAMSUNG

18. Mr. Humphrey's citation to Sturm's range of thickness for an inkjet pass is similarly inapposite. As an initial matter, Sturm's disclosures relate to forming OLED layers, rather than encapsulation layers. It was known that inkjet could be used to deposit thicker layers in a single pass, including, for example, by tuning the ink to increase viscosity.

EX1032, ¶ 18

7 No, it doesn't appear that there's
8 any specific discussion of encapsulation within
9 Exhibit 1013.

EX2021 (Second Subramanian Dep.) at 82:3-9

Samsung's District Court Expert Confirmed Inkjet Printing Technology is "Very Different" Than Printing OLED Device Patterned Areas



Dr. Antoniadis
Expert Witness

SAMSUNG

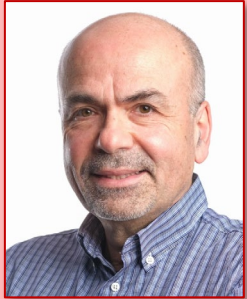
Q. Are you saying that the inkjet printing technology for TFE encapsulation is very different than the inkjet printing technology for the OLED pixel areas?

A. Yes. Yes. That's a good question. Very different indeed. And the proof to this is

EX2031 (Antoniadis) at 142:20-25

TFE = Thin-Film Encapsulation

Inkjet Printing Encapsulation Technology is “Completely Different” and “Totally Incompatible”



Dr. Antoniadis
Expert Witness

SAMSUNG

Thin-Film Encapsulation

Printing the TFE, it requires a
completely different inkjet printing technology.

As a matter of fact, it's made by a different
vendor. So the throughput of materials in one
is totally incompatible with the other and vice
versa.

EX2031 (Antoniadis) at 142:7-12

Subramanian and Sturm Both Agree That Inkjet Printing Is Not Performed Under Vacuum Conditions



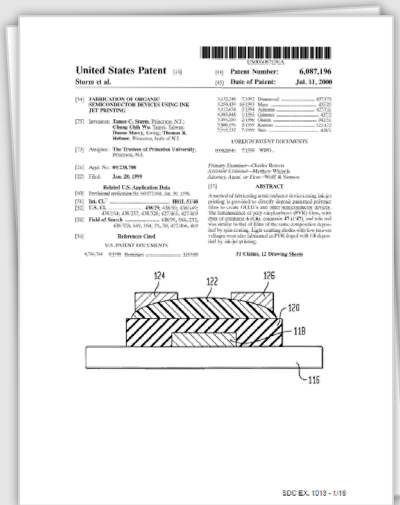
Dr. Subramanian
Expert Witness

SAMSUNG

Q. And do you apply the inkjet in a vacuum?

A. No.

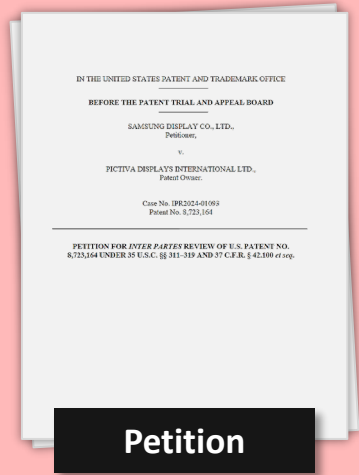
EX2021 (First Subramanian Dep.) at 106:8-10



dots. After ink-jet printing, the samples were loaded into a vacuum chamber with a base pressure of $<10^{-3}$ torr for the metallization step of device fabrication. Typically, at least

EX1013-Sturm at 4:59-61

Subramanian's Alternative "Glove Box" Theory is Improper and Unsupported



SAMSUNG

Accordingly, a POSITA would have been motivated to use *depositing by ink jet as taught in Sturm* to selectively deposit the organic sealing layer that serves as the *planarization layer* in the modified Kijima method. Although other selective

Inkjet Printing Sealing/Encapsulation Layers Presents Unique Challenges



Mr. Humphrey
Expert Witness



pictivadisplays

- Sturm reports thickness of about 40-70 nanometers (Sturm, 4:20-24), considerably thinner than the minimum 500 nanometers needed to provide the sealing protection of Suzuki (Suzuki, Fig. 4).
- Coffee-ring effect and resulting poor planarity of inkjet printing exacerbated with multiple passes.
 - Dr. Subramanian’s 2003 work on gold nanoparticles demonstrates the difficulty in obtaining a planarized film using inkjet printing techniques. EX2023, Fig. 2.
 - Use of elevated temperatures of the substrate (130-160° C) to control coffee-ring effect is unsuitable for temperature-sensitive OLEDs. EX2018, ¶121.
 - Reply Declaration’s reliance on EX1034 confirms inappropriateness of inkjet printing for Kijima which uses TPD. EX1034 at 1 (“TPD is known to have a rather low (~60°C) glass transition temperature.”)

Duthaler

Duthaler Does Not Use Inkjet Printing for OLED Encapsulation



Mr. Humphrey
Expert Witness



pictiva displays

116. Duthaler also does not suggest using inkjet for depositing the organic sealing layer. Duthaler discloses “an addressing device for an electronic display,” and “printing an encapsulant for protecting a portion of the addressing device.” EX1016-Duthaler, 2:5-6, 2:13-30, 21:24-25:22. Duthaler, however, does not discuss OLED displays, but electrophoretic displays. *Id.*

EX2018 (Humphrey Decl.) at ¶¶ 116-117 (citing EX2024, 2)

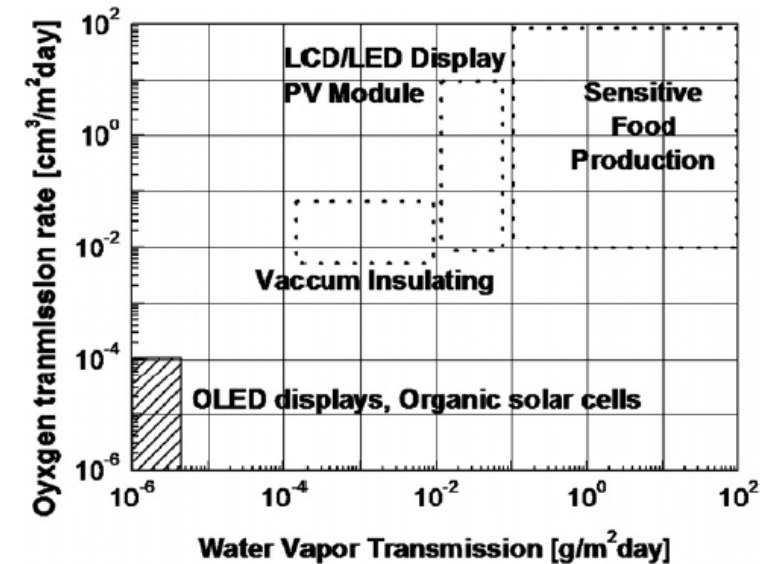


Figure 1. Barrier requirements for different applications.

Subramanian Confirmed That Duthaler's Inkjet Printing Is Not For OLED Materials



Dr. Subramanian
Expert Witness

SAMSUNG

But Duthaler doesn't really use inkjet printing for the OLED portion.

It's for some other circuits; right? That we agree.

A Given that Duthaler is really focused on the circuit elements that control the display, not on the light-emittance elements itself.

And in certainly looking at the figures, that appears to be true.

EX2050 (Second Subramanian Dep.) at 98:23-100:6

A POSITA Would Not Use Duthaler's Screen Printing in the Kijima-Suzuki Combination (Ground III – Claim 36)

Subramanian is Unaware of Any Examples of Screen Printing Being Performed in a Vacuum



Dr. Subramanian
Expert Witness

SAMSUNG

Q. Duthaler, I believe it's Exhibit 1016.

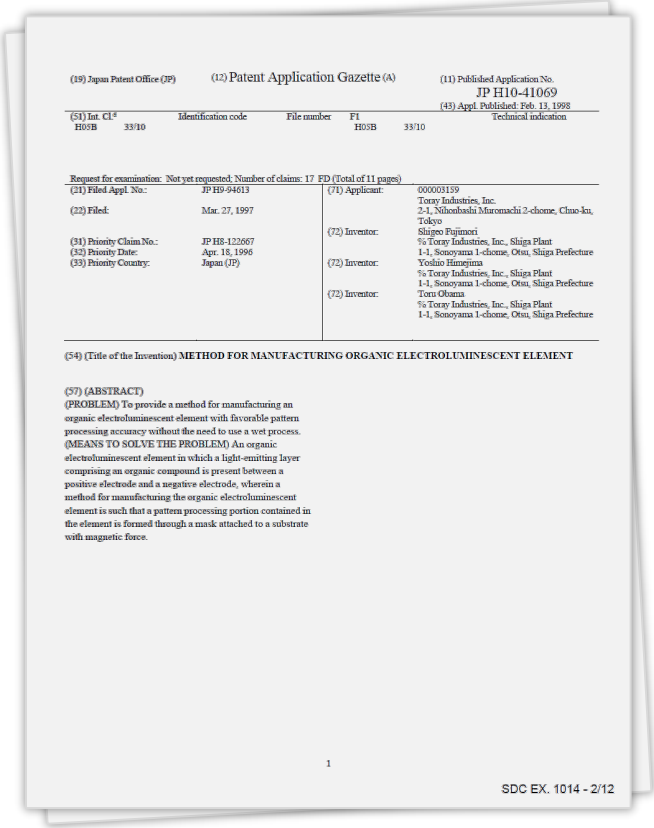
A. Yes, I have it. (Reviewing document.)

I agree that the discussion of screen printing in the relevant sections in Duthaler do not call out the ambient that is used. They certainly don't call out that it's performed in vacuum. I'm not aware of any specific examples of screen printing being performed in vacuum.

EX2021 (First Subramanian Dep.) at 178:5-15.

A POSITA Would Not Use Fujimori's Magnetic Mask in the Kijima-Suzuki Combination (Ground IV – Claims 41-46)

Fujimori Suggests the Use of a Magnetic Mask to Address Shorts and Crosstalk



(0008)
(PROBLEM TO BE SOLVED BY THE INVENTION)
However, the mask must be made thin to accommodate a fine pattern. Since sufficient strength cannot be obtained, the adhesion between the substrate and mask deteriorates due to warping and other factors. Therefore, with conventional methods, the finer the pattern is, the more the position of the deposited material wrapping around the shadow of the mask cannot be ignored, making it difficult to pattern the element with adequate accuracy. This is a major problem that can cause a short in the elements and crosstalk due to increased leakage current. For example, according to Patent Appl. Publication No. JP H2-66873, a pattern pitch of less than 300 μm is a much smaller pixel size than the range where pattern processing using a mask is possible.

EX1014, [0008]

Fujimori Does Not Teach or Suggest Using a Magnetic Mask for Depositing an Encapsulation Layer



Mr. Humphrey
Expert Witness



Fujimori uses the magnetized masks to deposit:

- electrodes above the (OLED) organic layers (EX1014, [0026], [0041]-[0042], [0044], [0047], [0048]);
- materials to create closely spaced blue, green and red multicolor regions (id. [0050]); and
- non-emission regions such as the black matrix that blackens the gaps between the light-emitting region (id., [0027]).

EX2018 (Humphrey Decl.) at ¶150

Subramanian Confirmed That Fujimori Does Not Use a Magnetic Mask for an Encapsulation Layer, Nor Could He Identify any Reference Which Does



Dr. Subramanian
Expert Witness

SAMSUNG

Q Does Fujimori disclose the use of a magnetized mask for depositing encapsulation layers?

A I don't believe Fujimori specifically talks about encapsulation.

...

Q Do you recall ever seeing a reference describing a magnetized mask used for depositing encapsulation layers before the date of the '389 patent?

A I don't recall one way or another. Certainly I didn't cite to it in my declaration.

EX2049 (Second Subramanian Dep.) at 128:4-18

The '389 Patent

Selectively Deposited OLED Encapsulation

(12) United States Patent
Pichler et al.

(10) Patent No.: US 6,949,389 B2
(45) Date of Patent: Sep. 27, 2005

(54) ENCAPSULATION FOR ORGANIC LIGHT
EMITTING DIODES DEVICES

(75) Inventors: Karl Pichler, Santa Clara, CA (US);
Kyle D. Firschnaecht, Livermore, CA
(US)

(73) Assignee: Osrain Opto Semiconductors GmbH,
Regensburg (DE)

(*) 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.: 10/137,163

(22) Filed: May 2, 2002

(65) Prior Publication Data

US 2003/0205845 A1 Nov. 6, 2003

(51) Int. Cl. H01L 21/00; H01L 21/425

(52) U.S. Cl. 438/26; 438/28; 438/30;

438/48; 438/55; 438/53; 438/627

(58) Field of Search 438/26, 28, 30,

438/48, 55, 531, 624, 627, 641; 257/53,

21, 59, 414, 431, 701, 760

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ogy*, 42/1, Jan./Feb. 1998, pps. 1-9.

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π-conjugated compounds", *Nature*, 413, Oct. 2001 pp.
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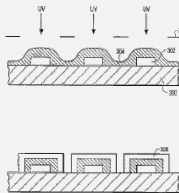
Primary Examiner—Hsien-Ming Lee

(74) Attorney, Agent, or Firm—Thomas George

(57) ABSTRACT

An embodiment of an encapsulated OLED device is
described. This embodiment of the encapsulated OLED
device is formed by: fabricating multiple OLED devices on
a substrate; depositing at least one planarization layer on the
OLED devices; hardening the at least one planarization layer
in a patterned manner such that the hardened region sub-
stantially covers the OLED device; removing areas of the at
least one planarization layer that are not hardened; and
selectively depositing at least one barrier layer over the
hardened region.

53 Claims, 8 Drawing Sheets



(54) ENCAPSULATION FOR ORGANIC LIGHT EMITTING DIODES DEVICES

34. A method of encapsulating a plurality of devices
fabricated upon a substrate, the steps of said method com-
prising:

fabricating a plurality of devices on a substrate;
selectively depositing at least one planarization layer
upon said devices; and

selectively depositing at least one barrier layer over said
planarization layer.

35. The method as recited in claim 34 wherein the step for
selectively depositing at least one planarization layer further
comprises depositing by ink jet of an organic layer.

EX1001 at 14-15 (10:65-11:8)

'389 Teaches Using Selective Deposition to Avoid Electrical Contact Pads and Scribe (Cutting) Lines



The problem with this PML technique is that the only part of the device that requires encapsulation is the OLED structure itself—and not, e.g., the electrical contact pads. In fact, the contact pad must typically be exposed for electrical mating with external driver circuitry. So, at a minimum, additional processing must be performed for the removal of the PML structure over these areas.

Another potential problem with the current PML techniques is that by having the PML layer over the scribe and break lines and/or the glue lines the integrity of the sealed package may be deteriorated, for example by delamination of the PML layer over these areas.

Areas that Need Not Be Covered

US06949389B2

'389

(12) United States Patent
Pichler et al.

(10) Patent No.: US 6,949,389 B2
(45) Date of Patent: Sep. 27, 2005

(54) ENCAPSULATION FOR ORGANIC LIGHT
EMITTING DIODES DEVICES

(75) Inventors: Karl Pichler, Santa Clara, CA (US);
Kyle D. Firschkecht, Livermore, CA
(US)

(73) Assignee: Oram Opto Semiconductors GmbH,
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438/48; 438/55; 438/51; 438/67

(58) Field of Search 438/48, 35, 531, 624, 627, 641; 257/53,
21, 59, 414, 431, 701, 760

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5,874,804 A 2/1999 Rogers
5,895,228 A 4/1999 Huber et al.
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6,103,456 A 8/2000 Tobben et al. 430/317
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6,498,114 B1 12/2002 Amundsen et al. 438/780
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ogy*, 42(1), Jan./Feb. 1998, pp. 1-9.
Wilson, J.S. et al., "Spillo-dependent excimer formation in
n-oxylated compounds", *Nature*, 413, Oct. 2001. pp.
628-631.

* cited by examiner
Primary Examiner—Hsin-Ming Lee
(*) Attorney, Agent, or Firm—Thomas George

(57) ABSTRACT
An embodiment of an encapsulated OLED device is
described. This embodiment of the encapsulated OLED
device is formed by fabricating multiple OLED devices on a
substrate; depositing at least one planarization layer on the
OLED devices; hardening the at least one planarization layer
in a patterned manner such that the hardened region sub-
stantially covers the OLED device; removing areas of the at
least one planarization layer that are not hardened, and
selectively depositing at least one barrier layer over the
hardened region.

53 Claims, 8 Drawing Sheets

FIG. 2 (PRIOR ART) shows a cross-sectional view of an encapsulated OLED device. The device consists of a substrate (10) with an OLED layer (20) on top. A planarization layer (30) is deposited over the OLED layer. The planarization layer is patterned to form a hardened region (32) that covers the OLED layer. A barrier layer (40) is selectively deposited over the hardened region (32). The barrier layer is not deposited over the non-hardened regions (34) of the planarization layer. The barrier layer (40) is shown as a thin layer covering the hardened region (32) and the non-hardened regions (34).

FIG. 2 (PRIOR ART) shows a top-down view of a 3x3 grid of OLED devices. The grid is defined by cutting lines (200) that divide the grid into nine rectangular cells. Each cell contains an OLED device (202). The OLED devices are arranged in a 3x3 grid. The electrical pads (204) are located at the bottom of each OLED device. The electrical pads are shown as a row of five rectangular pads at the bottom of each device. The electrical pads are connected to the OLED devices. The electrical pads are shown as a row of five rectangular pads at the bottom of each device. The electrical pads are connected to the OLED devices. The electrical pads are shown as a row of five rectangular pads at the bottom of each device. The electrical pads are connected to the OLED devices.

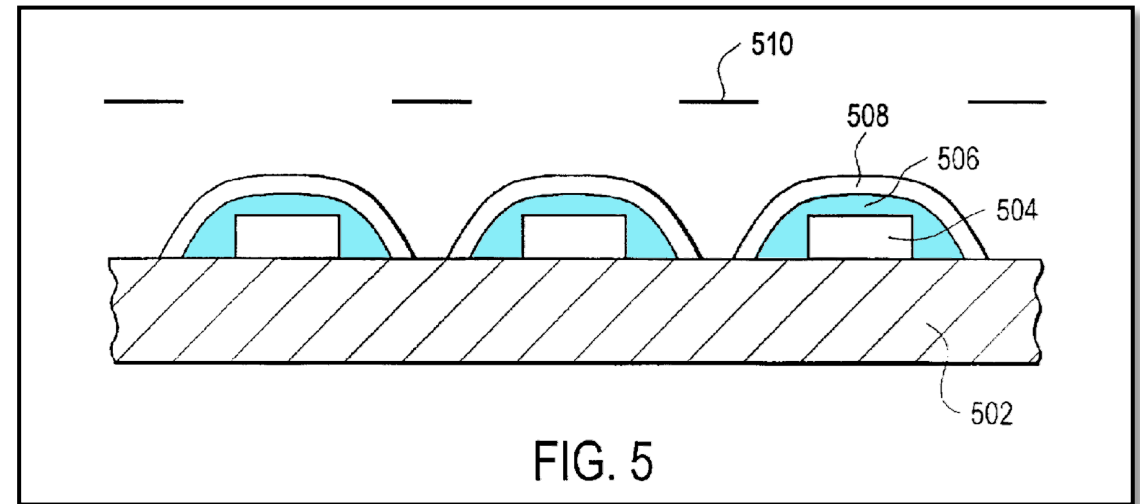
FIG. 2 (PRIOR ART)

EX1001 at Fig. 2

389-1.108

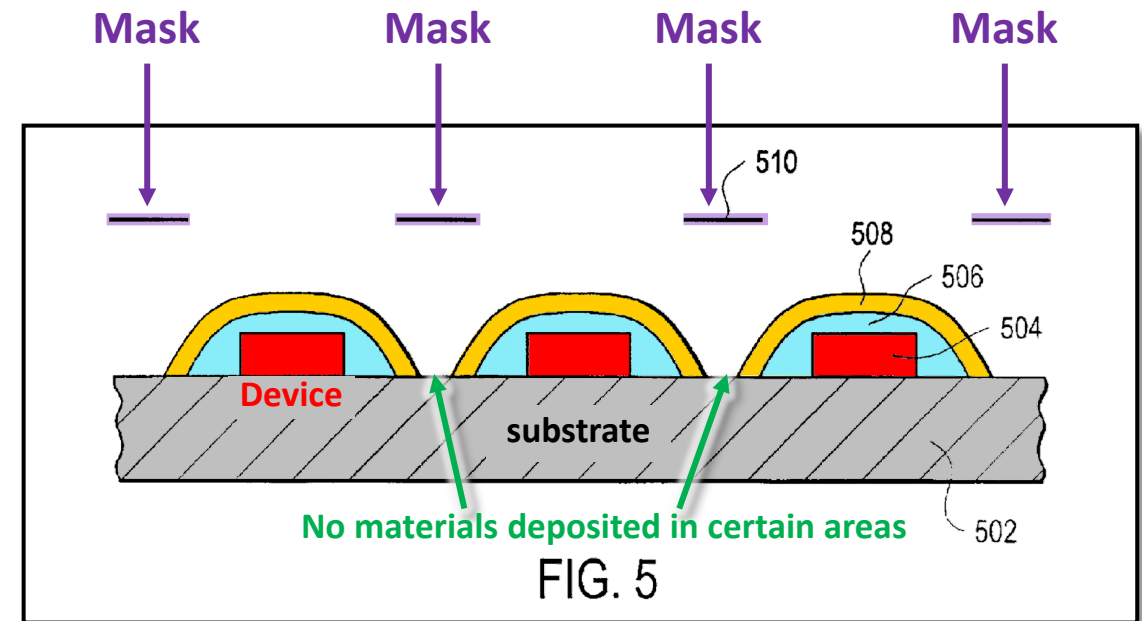
Inkjet Printing is an Example of Selective Deposition

FIG. 5 depicts another embodiment of encapsulation techniques in accordance with the present invention. In this embodiment, OLED device **504** is again formed upon substrate **502**. Organic layer **506** is deposited in a patterned fashion as well as barrier layer **508**. As organic layer **506** is deposited selectively; there may be no need to cure the layer. It should be appreciated that the cure and patterning aspects could be independent; —relating to the type of material and deposition technique of for the planarization layer. For example, if UV (or other)-curable liquids such as for PML or screen- or ink-jet print are used, then it is possible to cure. Alternatively, if evaporation of an organic through a mask is the relevant step, there may be no need to cure.



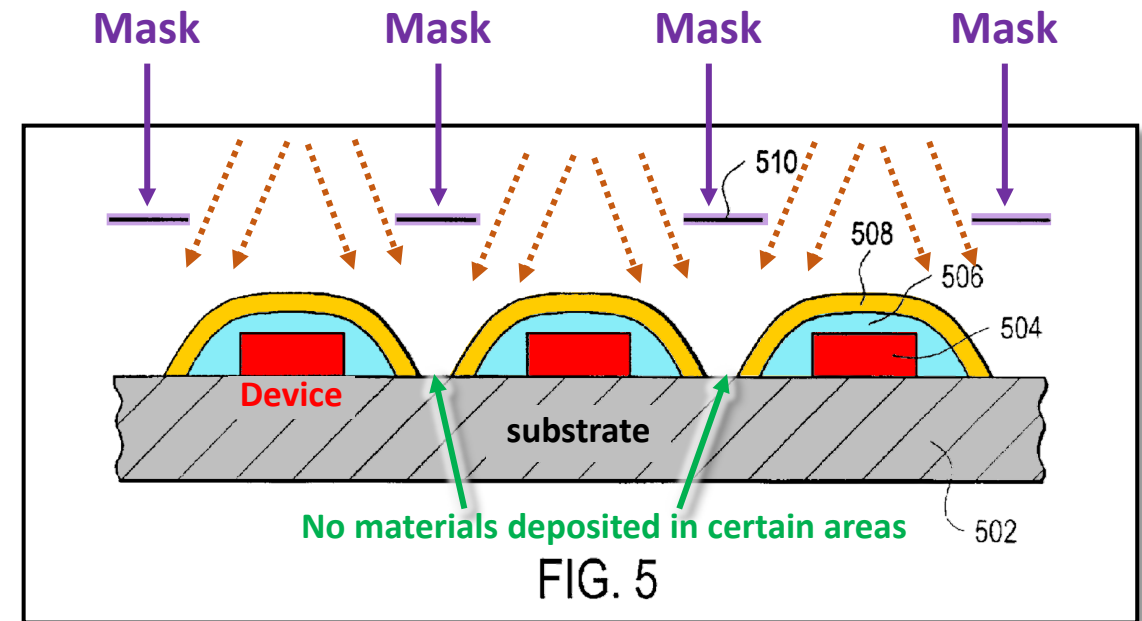
The manner of selectively depositing the organic layer and the barrier layer may be accomplished in a variety of ways. For example, organic layer may be selectively deposited through a shadow mask (as depicted as mask 510) or by ink jet deposition or other screen printing techniques. In fact, generally any printing techniques suitable to deliver the desired planarization layer material can be used. In similar fashion, barrier layer 508 may be selectively deposited. For alternative embodiments, it is possible to employ all options for selective deposition: same mask, different masks and also same mask with different substrate to mask distances (e.g. smaller distance for planarizing layer and then larger distance for barrier such that the barrier coverage is wider—because of slight non-directionality of and differences in the materials deposition).

In the case of printing, screen-printing, ink-jet-printing, the masks can either be not required (ink-jet) or possibly different from that used for a patterned sputter-deposited barrier layer deposition. For other embodiments, it may also be possible to partially cure the planarization layer, deposit the barrier layer and then complete the cure of the planarization layer, if necessary.



The manner of selectively depositing the organic layer and the barrier layer may be accomplished in a variety of ways. For example, organic layer may be selectively deposited through a shadow mask (as depicted as mask 510) or by ink jet deposition or other screen printing techniques. In fact, generally any printing techniques suitable to deliver the desired planarization layer material can be used. In similar fashion, barrier layer 508 may be selectively deposited. For alternative embodiments, it is possible to employ all options for selective deposition: same mask, different masks and also same mask with different substrate to mask distances (e.g. smaller distance for planarizing layer and then larger distance for barrier such that the barrier coverage is wider—because of slight non-directionality of and differences in the materials deposition).

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Additional Slides

Subramanian Relies on the Fact That Kijima's Conductive Sealing Layer is Gold



Dr. Subramanian
Expert Witness

SAMSUNG

63.I note that, according to Kijima, the “conductive sealing film 7” serves to prevent “degradation of the organic layer due to radiant heat during vapor deposition of the insulating sealing film 8.” Kijima, [0056]. In my opinion, however, a POSITA would have appreciated that conductive film 7 also functions together with electrode 1 to serve as a “negative electrode” to drive the OLED. Specifically, conductive film 7 is formed as a stripe (using mask 23a in Figure 3), whereas electrode 1 is formed as an island (using mask 22a in Figure 3). *See* Kijima, [0050] (“gold was deposited through the openings 23a of the mask 23 to form a conductive sealing film 7”); *see also id.*, [0047]-[0049] (“using the same

EX1004 at ¶ 63

Subramanian Confirmed That Weaver Discloses Layers Below the Device



Dr. Subramanian
Expert Witness

SAMSUNG

Q 121, 122?

A Yeah, the layers -- they are calling out the various layers, 121 and 122, I agree. And in the figures that we've discussed, those are all providing -- they are below the device on the substrate.

Q Okay.

So those are not the layers that encapsulate the device?

A And specifically, they don't encapsulate over the device.

Q The OLED device?

A They are not over the OLED device to encapsulate it in those figures, I agree. They are under the device.

EX2050 (Second Subramanian Dep.) at 122:2-16

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Accelerated Lifetime Testing is Standard Practice

- Subramanian confirmed “accelerated lifetime testing” is “a common thing” because “[y]ou don’t want to wait ten years to figure out if a particular encapsulation is good enough.” EX2049, 98:12-100:14.
- Suzuki tests its device over a period of only 100 hours, not 100 days, as Kijima does. EX1012, FIG. 3, 2:45-49, 8:31-41
- A POSITA would expect Kijima also used accelerated lifetime testing because it is “a very standard practice in the industry,” as Dr. Subramanian confirmed. EX2049, 100:7-14