

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.

Case No. IPR2024-01223
Patent No. 6,949,389

PATENT OWNER RESPONSE

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EXHIBIT LIST

Exhibit No.	Document Description
EX2001	Pre-Institution Declaration of Mr. Kurt Humphrey
EX2002	Declaration of Dr. E. Fred Schubert on behalf of Samsung Electronics Co., Ltd. et al. in <i>Pictiva Displays Int'l Ltd. v. Samsung Electronics Co. Ltd.</i> , et al., Case No. 2:23-cv-000495 (Nov. 12, 2024)
EX2003	Samsung's Notice of Corrected Exhibit B to Joint P.R. 4-3 Statement in <i>Pictiva Displays Int'l Ltd. v. Samsung Electronics Co. Ltd.</i> , et al., Case No. 2:23-cv-000495, Dkt. 110 & 110-1 (E.D. Tex. Nov. 13, 2024)
EX2004	Samsung's Proposed Claim Constructions for the Terms and Phrases Identified for Construction per Local Rule 4-2 in <i>Pictiva Displays Int'l Ltd. v. Samsung Electronics Co. Ltd.</i> , et al., Case No. 2:23-cv-000495 (E.D. Tex. Oct. 22, 2024)
EX2005	Thermal Conductivity tables, downloaded from hyperphysics.phy-astr.gsu.edu/hbase/Tables/thren.html (last visited Dec. 11, 2024), referencing Chapter 15 of Young, Hugh D., University Physics, 7th Ed., Addison Wesley, 1992.
EX2006	Thermal conductivities of common solids, liquids and gases, from https://www.engineeringtoolbox.com/thermal-conductivity-d_429.html (last visited Dec. 11, 2024)
EX2007	Ekaterina Selzneva et al., <i>Strong Suppression of Thermal Conductivity in the Presence of Long Terminal Alkyl Chains in Low-Disorder Molecular Semiconductors</i> , Advanced Materials 33, 2008708 (2021)
EX2008-EX2013	omitted
EX2014	Docket Control Order in <i>Pictiva Displays Int'l Ltd. v. Samsung Electronics Co. Ltd.</i> , et al., Case No. 2:23-cv-000495, Dkt. 40 (E.D. Tex. Apr. 17, 2024)
EX2015	Federal Court Management Statistics for U.S. District Courts, available from https://www.uscourts.gov/statistics/table/na/federal-court-management-statistics/2024/06/30-1

Exhibit No.	Document Description
EX2016	Samsung Invalidity Contentions in <i>Pictiva Displays Int'l Ltd. v. Samsung Electronics Co. Ltd., et al.</i> , Case No. 2:23-cv-000495 (E.D. Tex. Jun. 11, 2024)
EX2017	<i>Sotera</i> Stipulation
EX2018	Declaration of Mr. Kurt Humphrey in Support of POR
EX2019	Markman Hearing Transcript in companion district court case, <i>Pictiva Displays Int'l Ltd. v. Samsung Electronics Co. Ltd., et al.</i> , Case No. 2:23-cv-000495 (E.D. Tex. Feb. 4, 2024)
EX2020	2025-05-30 Deposition Transcript of Dr. Vivek Subramanian
EX2021	2025-05-31 Deposition Transcript of Dr. Vivek Subramanian
EX2022	U.S. Patent No. 6,590,157 to Boroson et al.
EX2023	Steven Molesa et al., “High-quality inkjet-printed multilevel interconnects and inductive components on plastic for ultra-low-cost RFID applications,” <i>Mat. Res. Soc. Symp. Proc.</i> Vol. 769, H.8.3.1-H8.3.6 (2003)
EX2024	Jin-Seong Park et al., “Thin film encapsulation for flexible AM-OLED: a review,” <i>Semicond. Sci. Technol.</i> 26, 034001 (2011)
EX2025	Daniel Huang et al., “Plastic-Compatible Low Resistance Printable Gold Nanoparticle Conductors for Flexible Electronics,” <i>Journal of The Electrochemical Society</i> , 150 (7), G412-G417 (2003)
EX2026	Wenbo Zhou et al., “Experimental Study on Viscosity of Colloidal Silica in Aqueous Electrolytic Solutions,” <i>Journal of Dispersion Science and Technology</i> , 29:842-847 (2008)
EX2027	Junhui He et al., “Preparation of Porous and Nonporous Silica Nanofilms from Aqueous Sodium Silicate,” <i>Chem. Mater.</i> , 2003, 15, 3308-3313 (2003)
EX2028	Kyoung-Min Kim et al., “Surface treatment of silica nanoparticles for stable and charge-controlled colloidal silica,” <i>International Journal of Nanomedicine</i> 2014:9 (Suppl 2) 29–40 (2014)
EX2029	389 Invention Disclosures for IPR2024-01223

Exhibit No.	Document Description
EX2030	Lorenza Moro et al, “Large-Scale Manufacturing of Polymer Planarization Layer,” informationdisplay.org, 10-15 (March/April 2021), available from https://sid.onlinelibrary.wiley.com/doi/epdf/10.1002/msid.1194 (last visited Jun. 20, 2025)
EX2031	[Under Seal], Deposition Transcript of Dr. Homer Antoniadis in <i>Pictiva Displays Int’l Ltd. v. Samsung Electronics Co. Ltd., et al.</i> , Case No. 2:23-cv-000495 (E.D. Tex. Jun. 4, 2025)
EX2032	Deposition Exhibit 5 to Dr. Antoniadis’s deposition, Final Technical Progress Report Polymer OLED White Light Development Program – (#DE-FC26-04NT41947)
EX2033	reserved
EX2034	Jeff Hebb of Kateeva, “Advanced Inkjet Printing: Enabling the OLED Revolution” (Sept. 28, 2017), available from https://nccavs-usergroups.avs.org/wp-content/uploads/TFUG2017/TFUG917-3-Hebb.pdf (last visited June 15, 2025)
EX2035	Roll to Roll (R2R) Processing Technology Assessment, Pre-decision draft, available from Available from https://www.energy.gov/sites/prod/files/2015/02/f19/QTR%20Ch8%20-%20Roll%20To%20Roll%20Processing%20TA%20Feb-13-2015.pdf (last visited June 15, 2025)
EX2036	Chandra Kant et al., “Large area inkjet-printed OLED fabrication with solution-processed TADF ink,” nature communications (2023)
EX2037	P.E. Burrows et al., “Gas Permeation and Lifetime Tests on Polymer-Based Barrier Coatings,” Proceedings of SPIE Vol. 4105, 75-83 (2001)
EX2038	Screenshot of https://global.samsungdisplay.com/31159 , “[Learn Display] 100. Inkjet Printing” by Samsung Display
EX2039	[Under Seal] Pictiva 80x48 display product specification
EX2040	U.S. Patent No. 6,605,483 to Add-Vision, Inc.
EX2041	U.S. Patent No. 7,115,216 to Add-Vision, Inc.

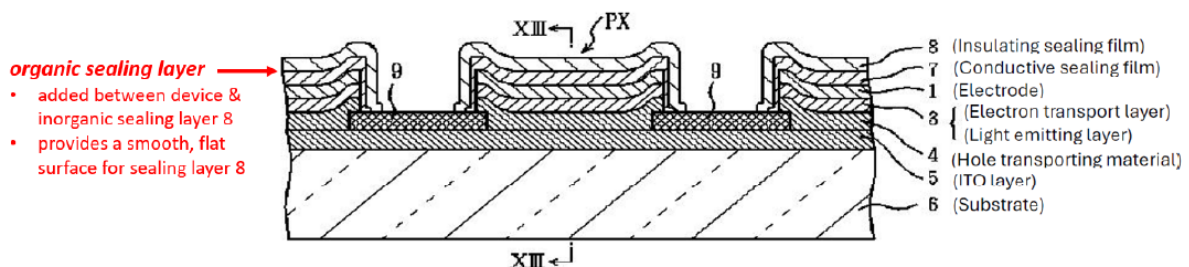
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EX2042	U.S. Patent Application Publication No. 2008/000889 to 3M
EX2043	Patrick Stark et al., “OLED – Evaluation and clarification of the new Organic Light Emitting Display technology,” Department of Science and Technology, Linkopng University, Sweden (Mar. 11, 2002), available from https://www.diva-portal.org/smash/record.jsf?pid=diva2%3A18218&dswid=4057 .
EX2044	U.S. Patent No. 6,337,222 to Shimoda
EX2045	Screenshot of https://kateeva.com/solutions/technology/why-inkjet/ (last visited June 20, 205)
EX2046	Declaration of Mr. Kurt Humphrey in Support of IPR2024-01222 POR
EX2100	Conor Madigan, “Inkjet Technology for OLED SSL Mass Production,” (Jan. 28, 2015), available from https://energy.gov/sites/prod/files/2015/02/f19/brown-madigan_inkjet_sanfrancisco2015.pdf .

I. Introduction

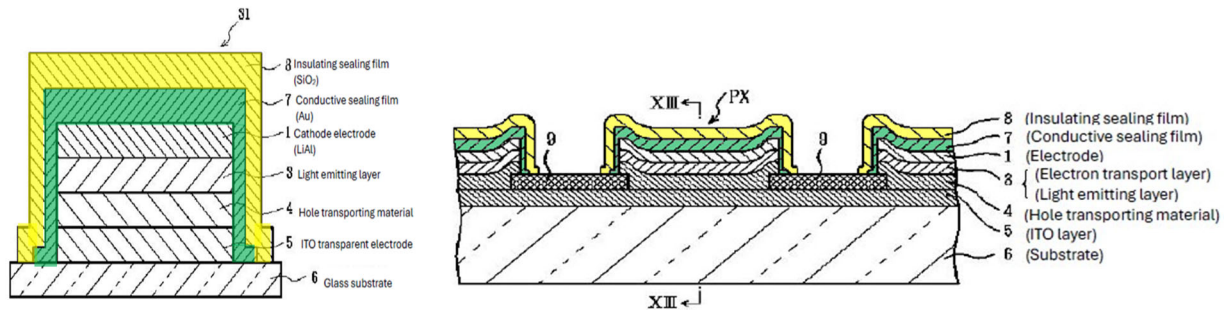
All claims require a “planarization layer,” which the parties have agreed to construe as “a layer of material that planarizes such that the propagation of defects from one layer to another layer can be interrupted and the topography of the underlying layer and/or structure is not reproduced.” EX2019 (Markman), 12:13-19 (“we can agree to their construction of ‘planarization layer’”); 28:25-29, 31:15-21, 35:5-8, 40:20-25. This construction, which is based largely on the construction proposed by Samsung, is consistent with the specification and the prosecution history. *See* Section III.A. The Board should adopt this construction.

This “recited planarization” is mapped against an organic layer Petitioner proposes to insert between Kijima’s existing sealing films 7 and 8. *See* Petitioner’s illustration below.

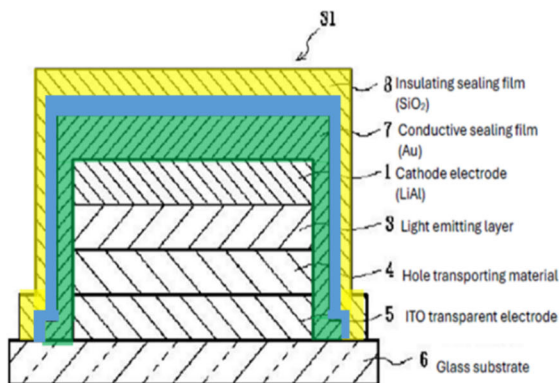
[FIG. 12]



Petitioner and its experts do not illustrate the topography of the inserted organic layer. *Id.* But as seen above and below, Kijima’s existing sealing films 7 and 8 have similar topography.



Thus, the organic layer inserted therebetween would assume the same topography and consequently reproduce the topography of the underlying conductive sealing film (colored in green below). The added organic layer is therefore not a claimed “planarization layer” under the agreed-to construction. Because all grounds rely only on this added organic layer for satisfying the “planarization layer” limitation, Petitioner has failed to show that any challenged claim is unpatentable. *See* Section IV



EX1010-Kijima, Fig. 1

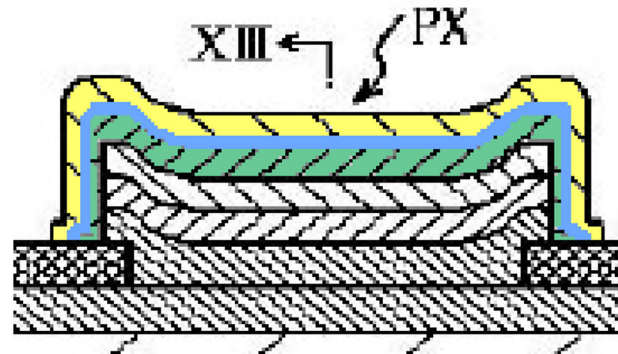


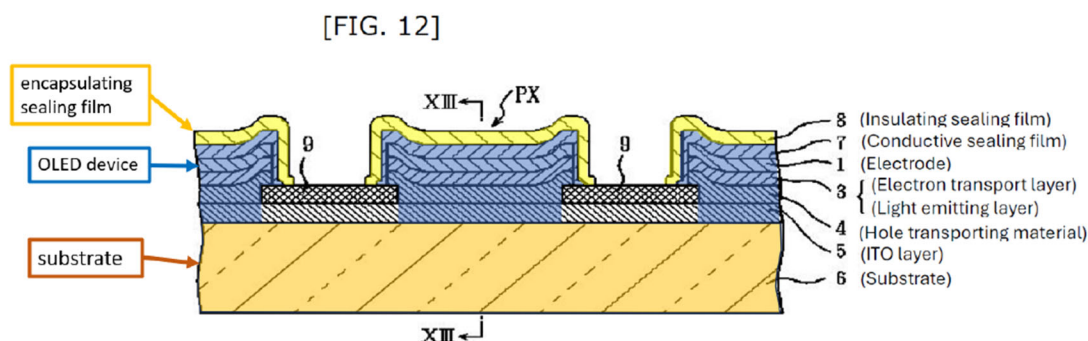
Fig. 12 (partial)

The Petition fails for additional reasons. For instance, there is nothing more than a conclusive assertion that the organic layer would be deposited on top of the

conductive sealing layer and would therefore be “selectively deposit[ed].” Pet., 36. But Kijima does not have the inventors’ insight and does not bar blanket deposition followed by removal of deposited organic materials, as was common to do. There is thus no showing of “selectively depositing” a planarization layer as required by 34[b]. *See* Section V.A

Moreover, Petitioner fails to show that the insulating sealing film deposited through a shadow mask would not have any bled-through material that needed removal, thereby meeting Petitioner’s interpretation of the term “selectively depositing,” which precludes removal of materials deposited in unwanted areas. *See* Section V.B.

Petitioner’s reasons to modify Kijima by inserting an organic layer between Kijima’s two existing sealing films also fail. To justify the modification, Petitioner re-labels Kijima’s conductive sealing film as an electrode and argues that the remaining (single) inorganic sealing layer would thus benefit from the addition of an organic sealing layer in view of EX1012-Suzuki. Pet., 24-25, 32. To support that argument, Petitioner repeatedly color-codes the conductive sealing film 7 with the same blue coloring used for the OLED device.



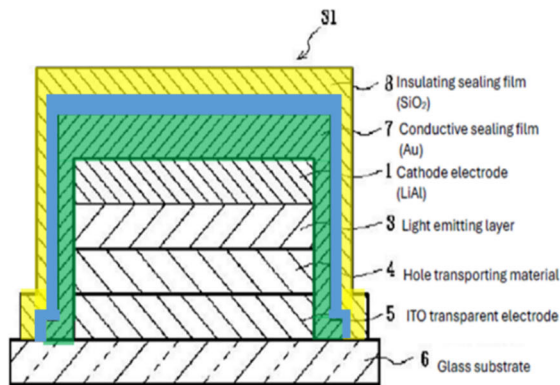
Pet., 18, 24, 27, 29, 37, 38, 51, 52, 56, 59, 61-62, 63, 67, 69.

But Kijima expressly describes the function of its conductive sealing film 7 as “protecting the underlying organic layer and electrode and preventing oxidation of the electrode 1,” consistent with it being part of Kijima’s double-layer sealing structure. EX1010-Kijima, [0055]; *see* Section VI.A. Even if the conductive film 7 also provides an electrical path as Dr. Subramanian asserts, (EX1003, ¶63),¹ Kijima consistently and repeatedly characterizes the conductive sealing film 7 as every bit the protective barrier layer as Kijima’s insulating film 8. EX1010-Kijima, [0038], [0050], [0055], Claim 1.

Thus, Petitioner’s proposed modification effectively creates a metal-organic-inorganic *triple*-layer sealing structure. This resulting triple-layer structure is shown

¹ Kijima never expressly describes the sealing film 7 as a “negative electrode” as Dr. Subramanian characterizes. *Compare* Kijima generally with EX1003, ¶63.

below with the added organic barrier layer shown in blue between Kijima's conductive sealing film 7 (green) and its insulating sealing film 8 (yellow).



EX1010-Kijima, Fig. 1

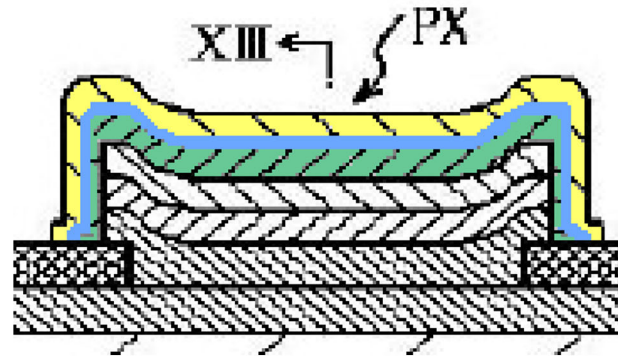


Fig. 12 (partial)

But none of the cited prior art, alone or in combination, suggests any need or benefit of forming the proposed metal-organic-inorganic triple-layer sealing structure. *See* Section VI.B. Both Kijima and Suzuki disclose the use of double protective layers, a fact which Petitioner directly relies on. Pet., 28 (“It would have been obvious to further use a selectively deposited organic planarization layer in view of EX1012-Suzuki, which teaches the *benefits of a protective double layer* made of an organic barrier layer and an inorganic barrier layer.”).

Petitioner's reliance on evidence of alleged benefits for forming a *double* protective barrier to support the creation of a *triple* protective barrier also means the challenge suffers from a fatal evidentiary failure. Even Dr. Subramanian, who testified to having extensive experience in the field, admitted that he has never seen

an OLED device that uses his proposed triple-layer protective structure, nor could he recall ever reading about a smoothing layer being on top of a gold film, with another inorganic barrier layer on top of the organic smoothing layer. EX2021_2025-05-31-Final, 66:5-67:14, 71:11-19. This objective evidence of the path taken by researchers in the field supports non-obviousness.

Petitioner nevertheless assumes that Kijima's gold film would suffer from the same "defects and surface irregularities" as Suzuki's cathode 18, but provides no evidence for that. *See* Section VI.C. The only "defects" Kijima mentions is "pixel defects" in connection with TFT driving circuitry. EX1010-Kijima, [0009]. And Kijima does not express any concerns of surface irregularities or defects in its relatively thick conductive sealing film. *See* EX1010-Kijima *generally*.

To the contrary, the fact that an insulating layer over the gold film could address the "dark spots" in Kijima while large dark spots persisted when Suzuki's inorganic layer was deposited over its cathode indicates that Kijima's gold film and Suzuki's cathode are fundamentally different; and lessons learned from Suzuki would not apply to Kijima. *See* EX1010-Kijima, [0053]-[0055] (example of SiO₂ over gold), EX1012-Suzuki, Fig. 3, 7:15-20 (inorganic layer includes SiO₂); Section VI.C. Indeed, regarding the pinhole defects that motivated Suzuki's double-layer protective structures, Dr. Subramanian agreed that "[t]he likelihood of getting

pinhole defects in a one micrometer [gold] film will be basically zero or close to zero.” EX2021_2025-05-31-Final, 61:16-22.

Relatedly, Kijima’s devices with its double sealing films 7 and 8 were already effective against dark spots formation, and in fact performed better than Suzuki’s double-layer structure. EX1010-Kijima, [0054], [0064], [0068], [0072] (Kijima’s devices had “almost no darks spots” even after a month in air); EX1012-Suzuki, Fig. 4 (still reporting dark spots with organic-inorganic layer structure); Section VI.D. Petitioner offers no evidence that its proposed modification would bring about any improvement to justify the costs associated with increased process steps and material cost as well as increased failure mechanisms with the additional layer and new interfaces. *See* Section VI.E.

Indeed, a POSITA would have specific reasons against the proposed modification. Kijima considers it important to have conductive sealing film with “good thermal conductivity” that is “*adjacent to and below* the insulating sealing film” so that the conductive sealing film can effectively dissipate radiant heat reaching the assembly. EX1010-Kijima, [0073]-[0075], [0056]. The proposed modification eliminates that critical design element, as the conductive sealing layer would no longer be “adjacent to” the insulating sealing film. EX2018, ¶¶107-112.

For Ground II, Petitioner cites Sturm to argue that it would be obvious to use ink-jet to deposit the organic layer, (*see* Pet. 41-46). But Sturm “doesn’t [even]

appear that there's any specific discussion of encapsulation." EX2021_2025-05-31-Final, 82:3-9. The Petition also provides no reason for looking to Sturm for methods of depositing an encapsulation layer. Rather, Dr. Subramanian "recommended him as a source for publications on inkjet related work." *Id.*, 81:9-15. That strongly suggests a hindsight biased approach by using the claims as a roadmap to assemble disparate pieces of art.

Indeed, as Dr. Antoniadis, who was in charge of OSRAM's OLED program in the relevant period and who has been retained by Samsung as an expert in the district court, confirmed that the inkjet printing technology for TFE encapsulation and that for the OLED pixel areas are "[v]ery different indeed." EX2031-Antoniadis, 142:20-25; 141:25-142:19 ("Printing the TFE, it requires a completely different inkjet printing technology"; "*you cannot infer one from the other*"); Section VII.D.

Thus for reasons stated above and for additional reasons stated below, the challenged claims are patentable.

II. The '389 Inventions

The '389 patent relates to encapsulating multiple organic light emitting diode (OLED) devices fabricated on a substrate. EX1001, Abstract, claims 34, 41. At the time of the inventions, thin film encapsulation methods were being explored as "a cheaper and better manner of encapsulation." EX1001, 1:17-19. One way to achieve thin film encapsulation is using PML or polymer multi-layer comprising "alternating

and repeating layers of an organic ... and a barrier layer.” *Id.*, 1:19-22. The organic layer, such as layer 106, typically serves as a “planarization layer” that “is provided to give a planar surface for the deposition of the PML structure 112a” as depicted below. *Id.*, 1:30-36, Fig. 1.

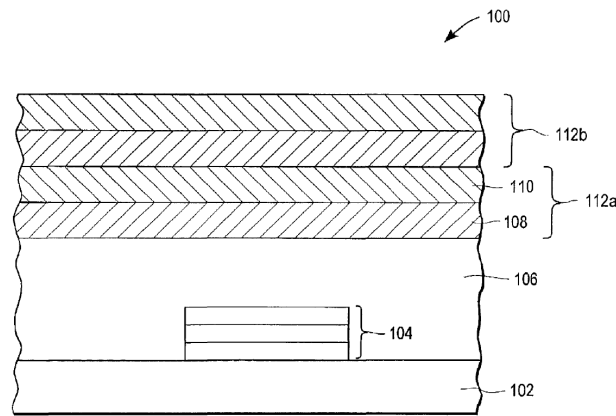


FIG. 1 (PRIOR ART)

The PML structure 112a includes a barrier layer 108 and another organic planarization layer 110. *Id.*, 1:37-47. The PML structure 112 may be repeated with the barrier layer deposited on a planarization layer of a lower PML structure. *Id.* Direct thin-film encapsulation results in “thinner and/or lighter and/or mechanically more flexible” encapsulation with “cost reduction and improved reliability.” *Id.*, 1:48-52. The use of the planarization layer also addresses the drawbacks associated with “point defects (i.e., pin holes) in [the barrier layer’s] surface.” *Id.*, 1:56-62.

One significant drawback of the traditional direct thin film encapsulation method was that the PML structure was deposited on areas—such as “electrical

contact pads,” “scribe and break lines and/or glue lines”—that do not require and should thus not have encapsulation. EX1001, 2:17-29.

The challenged claims address this drawback by providing for selective deposition of the PML layers. *E.g.*, EX1001, Fig. 5 (using a mask to selectively deposit organic layers and barrier layers), Figs. 6A-6E (using masks deposited on the substrate to control the areas of deposition for organic layers, followed by selective deposition of barrier layers); Figs. 7A-7C (using gas to direct organic materials away from undesired areas); EX2018, ¶¶11-14.

III. Claim Construction

A. “Planarization Layer”

Each of the challenged independent claims 34 and 41 recite “planarization layer.” At the Markman hearing in the parallel litigation, the parties agreed that the term means “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 and/or structure is not reproduced.” *See* EX2019, 28:25-29, 31:15-21, 35:5-8, 40:20-25.

The agreed-to construction is consistent with the intrinsic evidence. EX2018, ¶¶20-23. For example, the ’389 patent describes how an organic layer provides a planar structure on which a barrier layer is deposited “to substantially cover point defects (e.g., dirt particles) in lower layers” such that “any point defects are not

geometrically projected upwards into layers deposited above.” EX1001, 4:33-41; *see also id.*, 1:56-62 (“The barrier layer should ideally not contain any point defects (i.e. pin holes) in its surface otherwise its usefulness as a barrier layer is severely compromised. That is primarily the reason that a planar organic layer is typically used as a substrate upon which the barrier layer is deposited.”). This can be seen in FIG. 5 from the ’389 patent, for example, in which the OLED device 504 is shown in **red**, the organic planarization layer 506 is shown in **blue**, and the barrier layer 508 is in **yellow**.

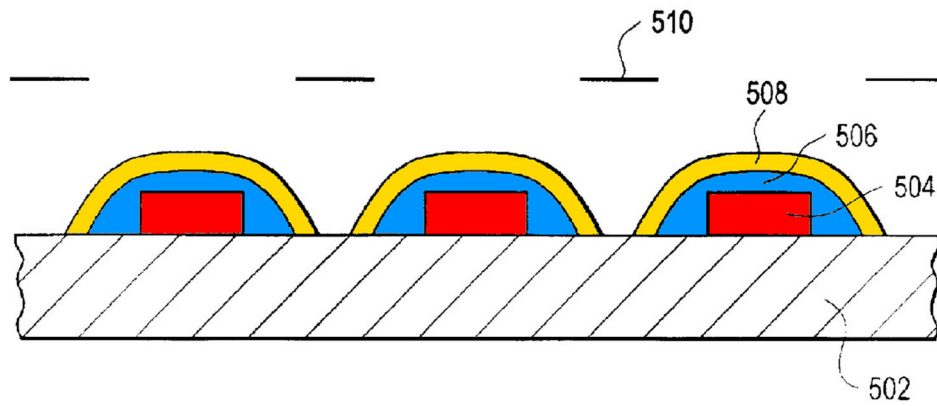


FIG. 5

Similarly, during prosecution the examiner rejected the independent claims, which included “depositing at least one planarization layer,” based on a combination of Ghosh (EX1006) and Boroson (US 6,590,157) (EX2022). *See* EX1002, 292. The examiner cited, in part, to Boroson’s disclosure of a “sealing material 20” as the recited “planarization layer.” EX1002, 293 (citing to Boroson at col. 9, lines 28-52). In response, the applicant argued that Boroson’s ““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)." EX1002, 371. Page 7 of the specification contains the same disclosure cited above at EX1001, 4:33-41. *See* EX1002, 52 (page 7 of the specification).

The examiner also mapped a claimed "planarization layer" to metal studs 5 of another reference, Palmans. *See* EX1002, 212. In response, the applicants argued that the relied-on structure in Palmans "cannot be used as a planarization layer because the metal studs 5 do not provide a flat surface" and because "[m]etals, 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." EX1002, 18.

Based on the specification and prosecution history summarized above, Samsung argued that "planarization layer" must be "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." EX2003, 6; EX2002, ¶¶56-59. While Pictiva initially argued that the plain and ordinary meaning should apply, at the Markman hearing, it agreed to Samsung's construction, with some adjustments in light of the Court's questioning. EX2019 (Markman), 12:13-19 ("we can agree to their construction of 'planarization layer'"), 28:25-29, 31:15-21, 35:5-8, 40:20-25. The agreed-to construction is "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 **and/or structure** is not reproduced.” *Id.* (text in red denotes changes from Samsung’s original proposed construction). Moreover, both Samsung’s and Pictiva’s district court experts applied the agreed construction in their expert reports. Thus, it is that construction which will be argued at trial and applied by the jury. Petitioner’s IPR expert, Dr. Subramanian, agrees that the construction is “generally reasonable.” EX2020_2025-05-30-Final, 212:9-213:9.

The agreed-to construction has three prongs: (1) “a layer of material that planarizes”; (2A) the planarization allows the propagation of defects from one layer to another layer to be interrupted, and (2B) the planarization results in the topography of the underlying layer and/or structure not being reproduced in the planarization layer. Regarding the need for both 2A and 2B, Samsung argued during the Markham hearing that “from an engineering standpoint it is important” to have both conditions. EX2019, 36:24-37:16. Samsung added that “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” *Id.*, 38:13-19. By insisting that the two functions be called out separately, Samsung effectively concedes that

those are distinct functions and one should not infer one function from the existence of another or from the presence of planarity.

The Board should adopt the same claim construction here. Not only have the parties agreed to a construction of “planarization layer” that will be applied in the district court, that construction is supported by the intrinsic evidence. In addition, the agreed-to construction should be applied in the IPR in order to preserve consistency between the district court proceeding and this PTAB proceeding, and because it is based largely on Samsung’s constructions, to hold Petitioner to the requirements under 37 C.F.R. §42.104(b).

B. “Selectively Depositing”

Samsung has proposed in the parallel litigation that “selectively depositing” means “depositing a material in only desired areas, such that no additional processing must be performed for removing unwanted material.” EX2003, 7. In support, Samsung pointed to the statement in the ’389 patent that “at a minimum, additional processing must be performed for the removal of the PML structure over these areas,” and argued that “this is one of the key drawbacks that the claimed invention was seeking to improve upon with PML techniques;” namely, that “one of the drawbacks was that you would have to go back and remove unwanted areas where you had materials being deposited.” EX2019, 46:19-47:3; *see also id.*, 48:1-4 (“Selectively deposit means that you're only putting it down in the areas where you

want it and then there's no need for you to go back and do additional processing to remove materials.”).

Pictiva disagrees with that interpretation. The reference to the removal of “PML structure” does not suggest that any and all post-deposition removal of encapsulant materials—such as residues or scums—is prohibited. EX2046-Humphrey, ¶28. Those residues or scums do not form a “PML structure,” which would be understood as alternating layers of organic-inorganic encapsulant materials (EX1001, 1:19-22, 1:34-36, 1:43-46, Fig. 1), and their removal is therefore not disparaged by the ’389 patent.

But consistent with Samsung’s district court arguments, during his IPR deposition, Dr. Subramanian took the position that “selectively depositing” means that the material is deposited “where you wanted, and it won't be where you don't, so that you don't need to do a subsequent removal step to remove it from unwanted regions.” EX2020_2025-05-30-Final at 20:2-9; *see also id.*, 23:2-17 (if materials deposited using a shadow mask are “in unwanted regions” and “I will follow that up with a removal process, whether it be an ash laser ablation or some other removal process, then it would not be selective”), 21:19-22:2. Thus, Petitioner’s expert is applying an interpretation of “selectively depositing” in this IPR as advocated by Samsung in the district court. *See* EX2003, 7.

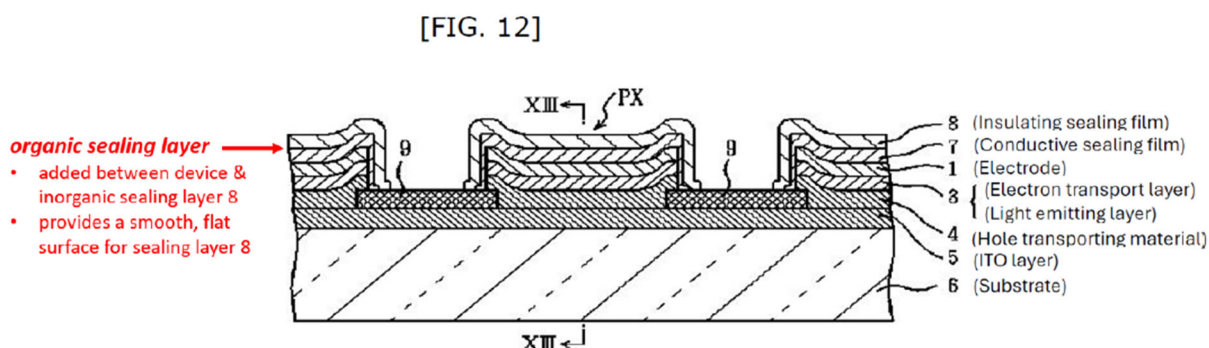
At institution the Board declined to adopt Samsung's district court construction because "Petitioner has not proposed the same constructions here." DI, 9-10. Now, however, Petitioner's expert has testified to his understanding of the term and effectively endorsed Samsung's district court construction. *See* EX2020_2025-05-30-Final at 20-23. Since Petitioner is "the master of its own petition" and is the one that needs to show "[h]ow the challenged claim is to be construed" and "[h]ow the construed claim is unpatentable under the statutory grounds identified...", (37 C.F.R. §42.104(b)(3), (4)), the Board should apply that meaning to evaluate whether the Petitioner has carried its burden based on the record evidence.

IV. The Proposed Combination Would Not Yield the Recited "Planarization Layer" (All Grounds).

The prior art combination of Kijima and Suzuki is relied on under all grounds for allegedly satisfying the 'planarization layer' limitation of challenged claims. *See* Elements 34[b] and 41[c]. As explained below, however, the resulting device of the proposed combination does not include a "planarization layer," under the parties' agreed-to construction. *See supra*, Section III.A. Because the term "planarization layer" appears in all claims, all grounds fail.

Specifically, Petitioner proposes to modify Kijima by interspersing an "organic sealing layer"—the purported planarization layer—between Kijima's

conductive sealing film 7 and insulating sealing film 8, as Petitioner annotates below.

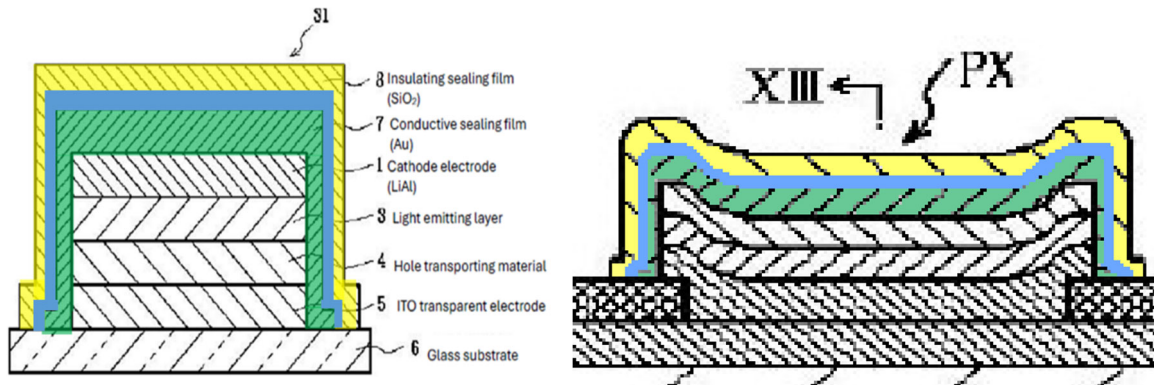


Pet., 32-33.

Petitioner does not show the topography of the resulting organic sealing layer. *Id.*, 28-37; EX20xx_EX2021_2025-05-31-Final, 23:2-9 (Dr. Subramanian agreeing that he didn't draw the contours of the organic layer in the modification and "just pointed an arrow and indicated where it would be").

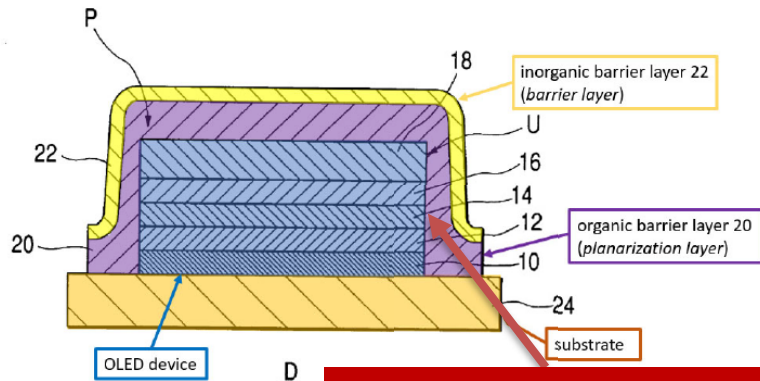
But because the newly-added layer will be between the existing insulating sealing film 8 and the conductive sealing film 7 and because the films 7 and 8—as shown above—have generally the same topography, a POSITA would understand that the added organic layer (annotated in blue below) will also have the same topography to the existing sealing film 7 below it and the sealing film 8 above it. EX2018, ¶¶34-37 (Mr. Humphrey also confirming that the newly added organic layer "would be generally following the topography of the underlying conductive

sealing film 7 (green), just like the inorganic sealing film 8 (yellow) generally following the topography of the underlying conductive sealing film 7”).



Consequently, Petitioner has not shown that the added organic layer is a “planarization layer” as that term is used in the context of the ‘389 patent. EX2018, ¶¶38-39.

Suzuki would also not inspire a “planarization layer” as defined. As seen in the annotated figure below, the purple organic layer 20 generally follows the topography of the layer below, and creates “additional steps at the edges.” EX2018, ¶33. Instead of planarizing, layer 20 increases non-planarity on the underlying layer. *Id.*, ¶¶33, 48.

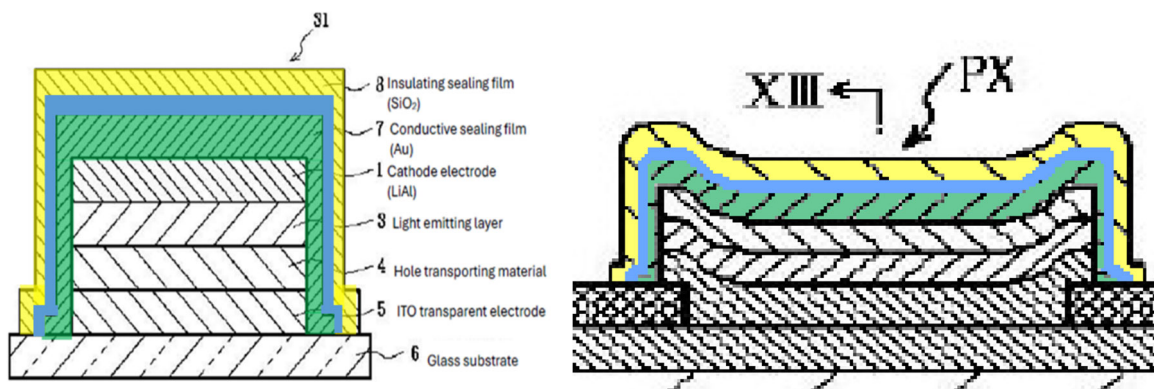
FIG. 1

Largely reproduced topology,
high aspect ratios, additional
steps at the edges

Nor would a POSITA incorporate the shape of Suzuki's organic layer. As Mr. Humphrey observes, these "large step heights" and "additional steps" would not "mitigate[e] potential step coverage and defectivity issues, i.e. pinholes, cracks, etc. in the barrier layer." EX2018, ¶33. Thus, as Mr. Humphrey explains, "inserting the thick non-planarizing organic layer of Suzuki into Kijima's sealing layers in all likelihood does not reduce dark spots, but may introduce additional problems with respect to encapsulation and reliability." *Id.* A POSITA "therefore would not insert an organic layer as depicted in Suzuki between Kijima's sealing films 7 and 8." *Id.*

Again relying on Suzuki's disclosure, which Petitioner has not shown applies to modified Kijima (it does not, *see* discussions in Section VI.C below & Humphrey, ¶¶42-46), Petitioner argues the added organic layer is a planarization layer because allegedly it "covers defects ... and makes a smooth surface." Pet.,

36. But even if the organic layer can cover local defects in Kijima's conductive sealing film 7 and provide a smooth surface, the organic layer reproduces the topography of the underlying layer and structure because "those defects are created incidentally on the surface of the underlying layer and is generally not considered to be part of the underlying layer's topography, which is a macroscopic property by design." Humphrey, ¶47. The added organic layer therefore does not provide a planarization layer in the modified Kijima device. *Id.*



Dr. Subramanian's analysis of the recited "planarization layer" should be set aside also because it is based on an incorrect understanding of the term. EX2020_2025-05-30-Final, 212:9-21. Dr. Subramanian did not take a position on the proper claim construction of "planarization layer" in his declaration, but conceded the agreed-to construction was "generally reasonable." EX1004 generally; EX2020_2025-05-30-Final, 198:11-13, 212:9-21. For his analysis, he interpreted "planarization layer" as "a layer that increases the planarity of the surface." EX2020_2025-05-30-Final, 18:4-18; *see also id.*, 10:3-11:21. This definition is

much broader than what the parties have agreed to in the parallel litigation because it just requires a flatter surface, but does not require either defect decoupling or hiding underlying topography. *See supra*, Section III.A (prongs 2(A) and 2(B)). Dr. Subramanian “think[s] the analysis [he] do[es] would meet those [agreed-to] claim construction, but [he] ha[s]n’t offered that opinion.” *Id.*, 212:9-21. Petitioner should not now be permitted to supplement the Petition under the proper construction. § 37 C.F.R. 42.104(b)(3), (4).

Thus, for reasons stated above, Petitioner has failed to establish that the added organic layer satisfies the “planarization layer” limitation of the challenged claims. And, because the added organic layer is the only structure the Petition relies on for the “planarization layer” limitation, Petitioner has not established that the challenged claims are obvious.

To the extent that Petitioner argues obviousness of applying the organic layer as a planarization layer, for reasons stated in Section VI below, a POSITA would not be so motivated.

V. The Petitioner Has Not Established that the Prior Art Satisfies the “Selectively Depositing” (Grounds I-III)

All claims require “selectively depositing at least one barrier layer over said planarization layer” (34[c] and 41[e]). Claim 34 and dependent claims additionally

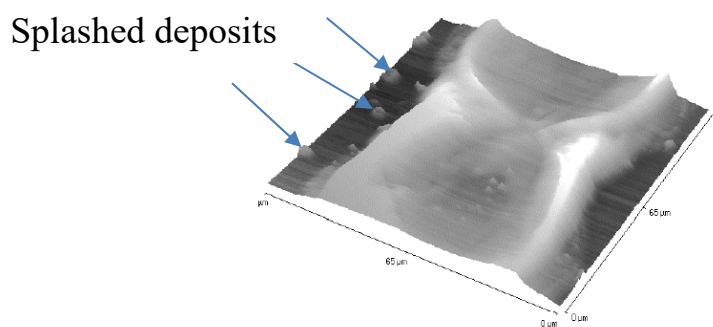
recite “selectively depositing at least one planarization layer upon said devices” (34[b]).

A. Planarization Layer

Petitioner alleges that the added organic 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[.]” Pet. 36, 28-29. But nothing precludes blanket deposition of the organic layer followed by patterned etching of the material, as was commonly done. *See, e.g.*, ‘389, cols. 1-2 (discussing prior art non-selective deposition of PML); EX1006-Ghosh, [0032] (patterning may be achieved by “ablation... following layer formation”); EX2018, ¶50. The Petition provides no reason for why a POSITA would have elected to “selectively deposit” the organic layer in modified Kijima. Pet., 36. Dr. Subramanian likewise only alleges that “the additional organic sealing layer [of Suzuki] ... *could be* readily deposited using the same selective deposition methods already used in Kijima.” EX1004, ¶83. But obviousness concerns not only what “could have” been done, but also what “would have” been done. *Belden, Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015). The Petition therefore has made no showing that a POSITA *would* have selectively deposited the newly added organic layer as required for Ground 1.

As to Grounds II-III, there is no analysis whatsoever whether the resulting deposition would have necessarily avoided removal of materials after deposition,

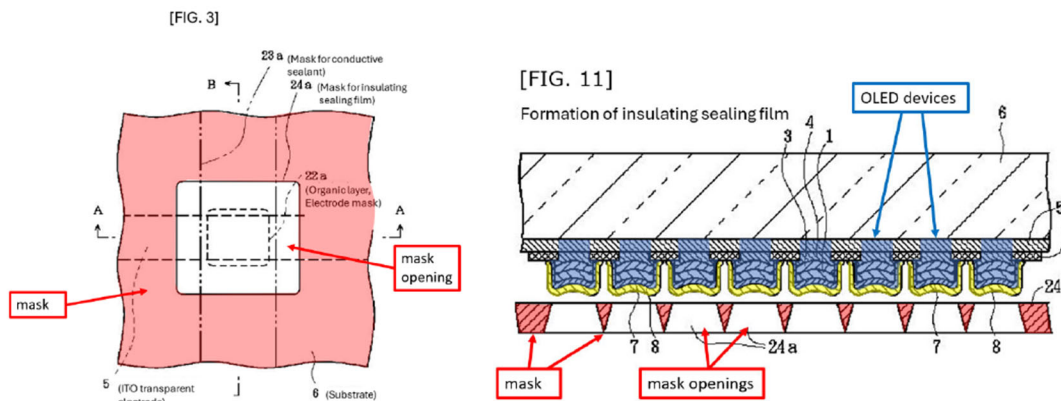
especially when multiple OLED device are involved. Thus, there is an absence of analysis for “selectively depositing” under Petitioner’s own interpretation of the term. Contrary evidence exists. For instance, Dr. Subramanian acknowledged in 2003 that the splash wave associated with inkjet process resulted in coffee-ring and donut structures, which despite their efforts to optimize were never fully eliminated under conditions suitable for OLED device encapsulation (*e.g.*, at substrate temperatures below 130-160°C). EX2023; EX2018, ¶51. The existence of strayed deposits can be detrimental to subsequent depositions as the residue would affect the materials’ adhesions and film growth. *Id.* As such, a post-deposition process would be needed to remove these spots. *Id.*



(EX2023, Fig. 2)

B. Barrier Layer

The Petition expressly relies on Kijima's shadow mask deposition technique as disclosing the "selectively depositing" barrier layer limitation.



Pet., 37-38.

A shadow mask is a mask having apertures through which material is deposited onto a substrate. *E.g.*, EX1010-Kijima, Fig. 5, [0040]-[0041]; EX1004, ¶96 (“a POSITA would have understood that Kijima’s masks are shadow masks”); *see also id.*, ¶¶94-96; EX2021_2025-05-31-Final, 111:21-112:1.

While Petitioner contends that shadow masks restrict deposition to only the areas exposed by the mask openings, and hence “selectively deposit[]” material (Pet., 28, 37-38), Petitioner presents no evidence in support of that theory, other than Dr. Subramanian’s conclusory opinion. In contrast, Petitioner’s own prior art, shows that shadow masking does not “selectively deposit[]” material under Samsung’s construction in the district court and as applied by Dr. Subramanian in this IPR. *See supra*, Section III.B.

For example, Fujimori purports to describe mask designs that could improve the adhesion between the mask and the substrate by magnetic force. *See* EX1014, [0029]. According to Fujimori, “[t]his effect reduces the proportion of the area where the deposited material or other material wraps around, i.e., the portion deposited from the mask opening that bleeds to the shadow portion of the mask, achieving fine pattern processing *not conventionally possible*.” *Id.* In other words, Fujimori discloses that traditional masks could not avoid having deposited materials bleed under the shadow mask. EX2018, ¶54.

Fujimori further discloses that “[t]his is a major problem that can cause a short in the elements and crosstalk due to increased leakage current.” *Id.*, [0008]; *see id.* (Fujimori is “to provide a method to achieve adequate adhesion between the mask and the substrate, which is necessary to achieve fine pattern processing with the mask, *which has heretofore been impossible*.”).

Regarding fine patterns, Fujimori explains that “a pattern pitch of 2 mm is a suitable example for the mask.” EX1014, [0035]; *see also id.*, [0024] (“Although the shape and size of pixel varies depending on the display method, such as segmental or dot matrix, a pixel size of 2 mm square or smaller is preferable.”). Kijima likewise patterns with a pixel “size of 2 mm x 2 mm using a deposition mask 22 as depicted in FIG. 3.” EX1010-Kijima, [0040]. Thus, a POSITA would understand that Kijima’s shadow mask would suffer from the bleed effect described in Fujimori.

EX2018, ¶55. Indeed, for Ground IV, the Petitioner and Dr. Subramanian specifically argue that Kijima would benefit from Fujimori's invention given the similar pixel sizes disclosed in Kijima and Fujimori, and "[g]iven the need for precision used in the pixels of Kijima" Pet., 54; EX1004, ¶¶129-131.

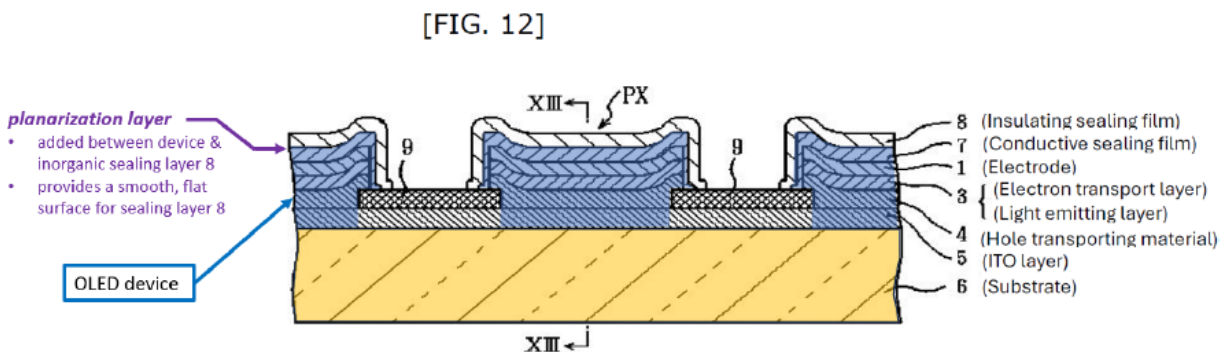
For Grounds I-III, Petitioner does not purport to replace Kijima's shadow mask with Fujimori's magnetic mask, however. The record evidence, including Fujimori, indicates that Kijima's unmodified shadow mask is unable to "selectively deposit[]" material, as Samsung and Dr. Subramanian understand that term (*supra*, Section III.B), because conventional shadow masks with a 2mm-by-2mm fine patterning could not avoid material being deposited in undesired areas. EX1014, [0008], [0029]; EX2018, ¶56.

At his deposition, after discussing with the counsel of redirect topics and in response to leading questions by Petitioner's counsel, Dr. Subramanian suggested that the barrier layer could also be deposited by ink-jetting. EX2021_2025-05-31-Final, 213:1-216:1, 219:10-15. Even if this new theory is considered, there is no evidence that inkjet printing would have yielded a suitable barrier layer as discussed further in Section VII.C below. Nor is any reason offered for why a POSITA *would have* used inkjet to deposit the insulating sealing film 8 in light of Sturm. Pet., 45; EX1004, ¶107. Additionally, like the shadow-mask technique, Petitioner provides no evidence that inkjet printed barrier layer would have avoided removal of materials

landed in unwanted areas in the inkjet printing process. *See supra*, Section III.B. Consequently, Petitioner has not established that the references disclose “selectively depositing” a barrier layer under its own interpretation.

VI. A POSITA Would Not Have Carried out the Proposed Modification of Kijima Based on Suzuki’s Organic Barrier Layer (All Grounds)

All grounds require modifying Kijima by adding an organic layer between Kijima’s conductive sealing film 7 and insulating sealing film 8, to serve as the claimed planarization layer. Pet. 32-36.



(Pet. 37)

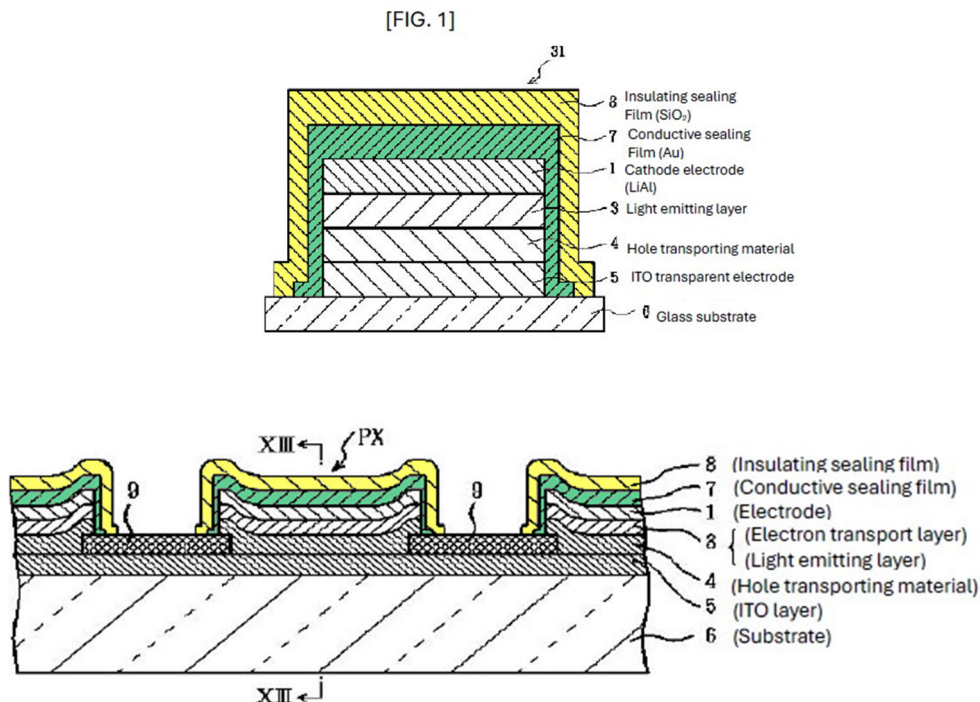
However, for multiple independent reasons, a POSITA would not have been motivated to make such a modification.

A. Kijima’s Conductive Sealing Film is a Protective Barrier Layer

A fundamental flaw exists in Petitioner’s theories for why a POSITA would allegedly construct what it characterizes as a “protective double layer.” The flaw is Petitioner’s mischaracterization of Kijima’s conductive sealing film 7 as only being part of the device, and not as also being a protective barrier layer for the device. This

is reflected in the blue annotation added by Petitioner to Kijima's Fig. 12, as shown above. *See* Pet., 25, n. 4. That characterization ignores Kijima's express disclosure that the conductive sealing film 7 also functions as a barrier layer for "protecting the underlying organic layer and electrode and preventing oxidation of the electrode 1" EX1010-Kijima, [0055].

Kijima explains that both "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 [EL] element," and that this is done for both films "using a vacuum deposition device." EX1010-Kijima, [0038].



EX1010-Kijima, FIGs. 1, 12.

That conductive sealing film 7 may be applied as a stripe while the insulating sealing film 8 is deposited as “islands” does not change the fact that both films cover all sides of the electrode 1 and the device, and are therefore structurally substantially the same from the perspective of the electrode and device. EX2018, ¶¶57-58.

Kijima also teaches that its sealing films 7 and 8 perform the same function. *Id.*, ¶59. For instance, Kijima discloses that the function of the conductive sealing film 7 is “protecting the underlying organic layer and electrode and preventing oxidation of the electrode 1.” EX1010-Kijima, [0055]. In the very next sentence, Kijima states that the insulating sealing film 8 has that same function, i.e., “further enhanc[ing] the effects of preventing oxidation of the electrode 1 and degradation of the organic layer.” *Id.*² Dr. Subramanian agrees that the “functions or benefits” of the conductive sealing film 7 include “protecting the underlying organic layer and electrode and preventing oxidation of the electrode.” EX2021_2025-05-31-Final, 152:14-24; *see also id.*, 149:6-19; 151:10-16 (testifying that Kijima “identifies two sealing layers which are layers 7 and 8.”).

² The conductive sealing film 7 may also provide the important independent function of dissipating radiant heat during vapor deposition of the insulating sealing layer 8. EX1010-Kijima, [0056]-[0057], [0074]-[0075].

Kajima consistently and repeatedly describes the conductive sealing film 7 as being as much of a protective barrier layer as is the insulating film 8. For example, as noted above, Kijima describes how both the “conductive sealing film 7 and [] insulating sealing film 8 are successively *formed on the electrode 1* so as *to cover the side surfaces of the element.*” EX1010-Kijima, [0038], [0050] (“form a conductive sealing film 7 so as to cover the surface of the laminate body of the organic layers 4, 3 and the electrode 1”), [0055] (“the conductive sealing film 7 provided on the electrode 1”), Claim 1; EX2018, ¶60.

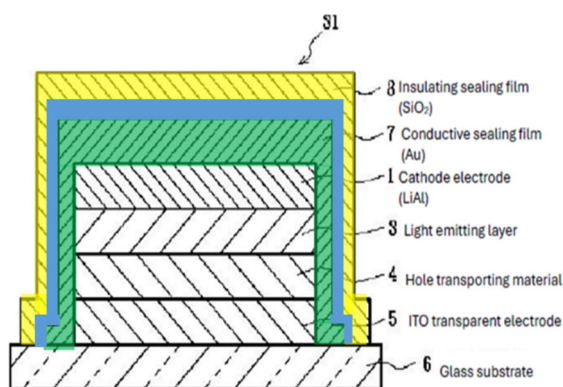
Petitioner’s refusal to recognize Kijima’s conductive sealing film as a protective layer directly ignores Kijima’s express disclosure that the *conductive sealing film 7 is the only required barrier layer* needed for “protecting the underlying organic layer and electrode and preventing oxidation of the electrode 1.” EX1010-Kijima, [0055]. The insulating film 8 is optional. *See* EX1010-Kijima, [0030] (Kijima describing the method of the present invention as “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).”); [0097] (“the electrode is formed under vacuum film-forming conditions, and *then at least a conductive sealing film is formed thereon* while maintaining the vacuum.”); Claim 1 (reciting the “conductive sealing film” but not the “insulating sealing film”); EX2021_2025-

05-31-Final, 145:2-13 (Dr. Subramanian agrees that insulating sealing film 8 is not mandatory).

Thus, a POSITA would understand that Kijima's conductive sealing film 7 acts as a protective barrier against oxygen and moisture, irrespective of its other functions. EX2018, ¶¶57-63. Therefore, Petitioner's attempt to engineer a reason to create an organic-inorganic barrier layer structure over the Kijima's gold film by characterizing it as part of the device should be rejected.

B. The Prior Art Does Not Suggest the Need for the Proposed Triple-Layer Structure

As noted above, all grounds are based on Petitioner's proposed modification of Kijima to intersperse Suzuki's organic layer between Kijima's existing conductive sealing film 7 and its insulating sealing film 8. This arrangement is shown in the annotated version of Kijima's FIG. 1 below in which the conductive sealing film 7 is shown in green, the insulating sealing film 8 in yellow, and the proposed added organic layer from Suzuki shown in blue.



EX1010-Kijima, FIG. 1 (annotated); Pet., 33; EX2018, ¶¶66.

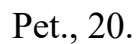
This modification is necessary because, as Dr. Subramanian admits, Kijima does not disclose the planarization layer. EX2021_2025-05-31-Final, 146:22-147:3 (“I’m not pointing to Kijima on its own for providing the planarization layer.”).³ But to justify that modification, Petitioner has to downplay Kijima’s conductive sealing film 7’s role as a barrier layer against oxygen and moisture. *See* EX1004, ¶¶67, 72, 122 (repeatedly contending that “Kijima uses a single inorganic layer for its insulating sealing film”). This is because the prior art’s benefits and Petitioner’s motivation theories apply to how Suzuki’s **double-layer** barrier structure improves the performance over a single inorganic barrier, and not to **triple-layer** barrier structures in which an organic barrier layer is inserted between Kijima’s conductive barrier layer and inorganic barrier layer, as discussed in this section and Section VI.C below.

For example, as Dr. Subramanian acknowledges, Kijima “doesn’t talk about using three sealing layers[,] it wouldn’t identify benefits therewith because it’s not even talking about three layers.” EX2021_2025-05-31-Final, 151:17-152:1.

³ This applies even when the conductive sealing film 7 is an organic material.

2025-05-31-Final, 21:3-12.

FIG. 1



- 33 -

Similarly, Komatsu discloses a protective film comprising a “stacked layer structure of double layer, i.e. an organic material layer and an [inorganic] SiON.” EX1017, 10:13-15; *see also* Pet., 35 (stating that “Komatsu closely tracks Suzuki’s disclosure of a ‘protective double layer made of an organic barrier and an inorganic barrier layer’”); EX2018, ¶70.

Dr. Subramanian testified that he has “done a lot of gold deposition within [his] past research.” EX2021_2025-05-31-Final, 30:3-5, 61:3-6. Despite that, he has never seen an OLED device that uses his proposed triple-layer protective structure, nor could he recall ever seeing in the literature a smoothing layer being on top of a gold film, with another inorganic barrier layer on top of the organic smoothing layer. *Id.*, 66:5-67:14, 71:11-19; *see also id.*, 67:1-14 (testifying that his group has “done planarization layers on top of gold But in our work I’m positive we did not put a third layer on top of that.”). In fact, even to this day, more than two decades after the invention, Dr. Subramanian has not seen the structure he contends would have been obvious at the time of the invention. *Id.*, 71:11-72:2 (“Q. ... 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.”).

Thus, nothing in the prior art nor in Dr. Subramanian’s extensive experience before or after the invention suggests that a POSITA would have constructed the

proposed triple-layer barrier. That is objective evidence of what a POSITA would have done.

Petitioner's failure to acknowledge the conductive sealing film 7 as a protective layer presents an evidentiary quandary for Petitioner. Despite advocating for the creation of a triple-layer protective structure, the Petition is silent on any motivation tied to converting a double protective barrier into a triple protective barrier, or any alleged benefit thereof. Instead, the Petition focuses exclusively on only the alleged benefits of a double layer approach. *See e.g.*, Pet., 28 ("It would have been obvious to further use a selectively deposited organic planarization layer in view of EX1012-Suzuki, which teaches the ***benefits of a protective double layer*** made of an organic barrier layer and an inorganic barrier layer."); 32 ("Suzuki presents experimental results demonstrating that, ***its protective double layer approach*** yielded a device in which dark spots were prevented from enlarging compared to a device that is protected only with an inorganic barrier layer."); 35 ("In fact, Komatsu closely tracks Suzuki's disclosure of a ***protective double layer*** made of an organic barrier and an inorganic barrier layer, in that Komatsu discloses a protective film comprising a stacked layer structure of ***double layer***") (internal citations and quotation marks omitted). What is missing is any evidence that a POSITA would have had a reason to add an inorganic-organic protective layer over

a thick gold sealing film, whether for added protection against oxygen and moisture or some other benefits.

As noted above, Dr. Subramanian confirmed that neither Kijima nor Suzuki suggests the use of a triple barrier layer. EX2021_2025-05-31-Final, 150:14-17(“Q. Does Suzuki suggest the use of triple barrier layers? A. No, I don't think Suzuki addresses that.”), 151:17-152:1 (Kijima “doesn't talk about using three sealing layers”).

Thus, there is a fundamental disconnect between Petitioner’s motivation arguments and its actual proposed modification. This disconnect is the by-product of Petitioner’s mischaracterization of Kijima’s conductive sealing film 7 as being only part of the device instead of what Kijima describes—one barrier layer of Kijima’s double-layer sealing/barrier system. *See supra*, Section VI.A.

Thus, Petitioner has not established a motivation to create the proposed **triple** layer barrier system because its arguments are misplaced on evidence that relates to alleged benefits of **double** layer barrier systems.

C. Petitioner’s Motivation Arguments Do not Support Adding Suzuki’s Organic Layer On Top of Kijima’s Conductive Sealing Film

Petitioner contends that adding Suzuki’s organic layer would allegedly “help ‘cover defects’ and smoothen surface irregularities of the underlying conductive element, and would ... flatten the contours of Kijima’s conductive layer 7 prior to

depositing the insulating layer 8.” Pet. 33-34; EX1004, ¶81. But Dr. Subramanian admitted that Kijima says nothing about defects or surface roughness in its electrode 1 or conductive sealing film 7. EX2021_2025-05-31-Final, 129:9-130:2, 16:13-17, 144:8-145:1.

Instead, the “defects” and “surface irregularities” described in Suzuki are on the cathode 18 (equivalent to Kijima’s electrode 1), and not on a protective layer over the cathode 18. *See* EX1012, 5:41-45 (“it is inevitable that some pinholes or defects be formed during the course of the formation of the cathode 18, through which moisture in air is adsorbed on the organic layer structure”), 5:52-54 (“defects or pinholes inevitably formed particularly in the uppermost cathode layer 18”), 5:62 (“the relatively irregular surface of the cathode 18”); EX2018, ¶74. Thus, at best Suzuki suggests to a POSITA to use a double-layer barrier approach when using a cathode like Suzuki’s in order to fill in pinholes and other defects or irregularities in the cathode’s surface.

Petitioner, however, does not propose to apply Suzuki’s organic layer to Kijima’s cathode 1 made of similar materials to Suzuki’s cathode 18. Instead, Petitioner proposes to add an organic layer on *top* (not beneath) of Kijima’s existing conductive sealing layer 7 covering the cathode. Rather than engaging on this critical difference, the Petition misdirects the Board’s attention by announcing, without reasoning or competent evidence, that Kijima’s conductive sealing film 7 “would be

vulnerable to the known problems associated with the cathode surface discussed in Suzuki.” Pet., 33. But objective evidence shows that Kijima’s gold film differs from Suzuki’s cathode: whereas a single inorganic layer is insufficient to prevent dark spots when applied directly to Suzuki’s cathode, it is sufficient when applied to Kijima’s gold film. *Compare* Suzuki, Fig. 4 (inorganic layer alone insufficient) *with* Kijima, [0055]-[0072] (inorganic layer applied to gold film sufficient to protect against dark spots); EX2018, ¶¶75, 105-106.

The types of cathode defects described in Suzuki are pinholes or other defects “through which moisture in air is adsorbed on the organic layer structure.” EX1012, 5:41-46; EX1004, ¶80. But Dr. Subramanian admits that “for a one micron thick gold film,” “pinhole defects will be almost nonexistent.” EX2021_2025-05-31-Final, 61:16-22. In EX1010-Kijima, the gold film is about 1 micron in thickness in order to protect the OLED organic layers during deposition of the insulating film. *E.g.*, EX1010-Kijima, [0056]; EX2021_2025-05-31-Final, 15:4-23. Thus, Kijima’s gold film does not have pinhole defects that would have benefited from the organic layer as in Suzuki. *See* EX1012-Suzuki, 5:49-62; EX2018, ¶¶77-80.

As to “defects ... mainly *caused by foreign matter* ...,” (EX1012-Suzuki, 5:54-58), there is no evidence that such defects, which are formed on Suzuki’s cathode 18 made from harder metals Al, Mg, In, Sn, Zn, Ag, or alloys of Al-Li, Mg-Ag and Ag-Li, also exist on Kijima’s soft gold (Au) films. Dr. Subramanian

acknowledged that when properly controlled, the surface roughness of the gold film may be as little as 10 nm, indicating that defects caused by foreign matter can be minimized. EX2021_2025-05-31-Final, 62:17-64:9; EX2018, ¶44. Kijima's gold film (about 1 micron) is also considerably thicker than Suzuki's cathodes (*ca.* 150 nm)⁴ and "should therefore be more than sufficient to cover any surface irregularities and roughness of the cathodes." EX2018, ¶41.

While Dr. Subramanian suggests that the soft gold films would also suffer from asperities due to buckle defects, he has not presented any evidence that, at the time of the invention, such defects were known to be an issue when gold was used to seal OLED devices or that a POSITA would have known to use a planarization layer to address this problem. EX2021_2025-05-31-Final, 62:17-64:9, 67:1-69:3, 72:3-74:12. At any rate, Kijima does not indicate there are any issues with its gold conductive film, and in fact discloses that its gold film is the only required layer for "protecting the underlying organic layer and electrode and preventing oxidation of the electrode 1." EX1010-Kijima, [0055]; *see also id.*, [0030], [0097], Claim 1. As Mr. Humphrey observes, "[t]his would suggest that buckle defects, if even present, do not generate sufficient permeation paths for oxygen or moisture." EX2018, ¶45.

⁴ See EX1012-EX1012-Suzuki, 8:11, 8:47-48, 8:64-65, 9:13-14, 9:27-29; 2025-05-31-Final, 61:11-15 (pinhole more likely for thinner gold films).

In any event, buckle defects are not the type of defects disclosed in Suzuki that benefits from the use of an organic layer. EX1012-Suzuki, 5:51-58.

The Petition also argues that its proposed modification is justified by the fact that “Kijima’s conductive film 7 has a visibly uneven surface as illustrated in Figure 12.” Pet. 33; EX1004, ¶80. But Dr. Subramanian conceded that Suzuki’s organic layer 20 in FIG. 1 also “has an uneven surface” and that “just because a layer has an uneven surface as that term is used in paragraph 80 of [his] declaration doesn’t mean that there would be a reason to add a planarization layer or smoothing layer on top of it.” EX2021_2025-05-31-Final, 136:18-137:24.

And Kijima does not suggest that surface roughness or smoothness is good or bad for its intended use. *Id.*, 144:18-145:1. Indeed, the fact that Dr. Subramanian has never heard of putting a smoothing layer on top of a gold film, then another inorganic barrier layer on top of the organic smoothing layer (*supra*, Section VI.B) directly undercuts his contention that a POSITA would construct the proposed triple-layer sealing structure. Conclusory expert testimony is not substantial evidence. *See TQ Delta, LLC v. Cisco Sys., Inc.*, 942 F.3d 1352, 1359-61 (Fed. Cir. 2019) (“conclusory expert testimony is inadequate to support an obviousness determination on substantial evidence review”).

In sum, Petitioner has failed to establish that a POSITA would have combined Kijima and Suzuki in the proposed manner because none of the cited prior art or

evidence (1) motivates putting an organic layer on top of a soft and flexible gold film, then another inorganic barrier layer on top of the organic layer to create a triple-layer barrier structure (EX2018, ¶¶65-72), or (2) suggests that Kijima's conductive film 7 suffers from the same vulnerabilities as a cathode, such as pinholes, or other defects which would benefit from the addition of an organic smoothing layer (*Id.*, ¶¶42-47, 73-80).

D. Kijima's Existing Protective Double Layers Already Prevents Dark Spot Growth Better Than Suzuki's Approach

Petitioner's proposed combination is a solution in search of a problem. Suzuki used its organic-inorganic double layer structure to mitigate the dark spots. Unfortunately for Petitioner, Kijima already solved the perceived problem and did so in a better way than Suzuki, as explained below. *See, e.g., Ex Parte Allen*, 2020 WL 3819948, at *3 (Jul. 1, 2020) (reversing examiner for failure to provide a sufficient reason based on rational underpinnings to combine the teachings of the references where base reference already disclosed an effective solution).

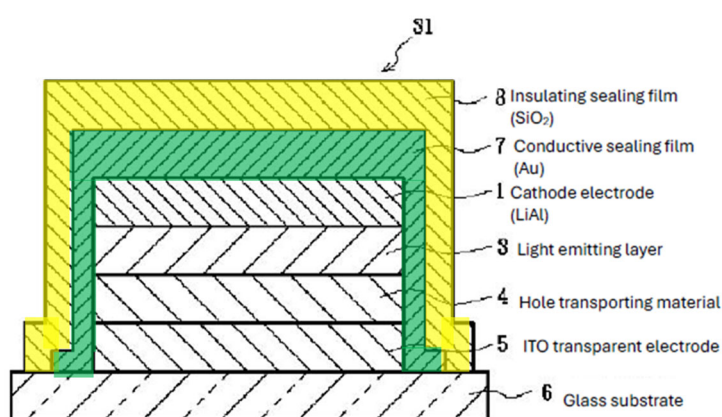
1. Kijima's Protective Double Layers Approach Already Effectively Prevents Dark Spots

Kijima relates generally to producing an optical device that exhibits good stability even when exposed to moisture and oxygen. *See* EX1010-Kijima, Abstract. In particular, Kijima observes that conventional OLEDs suffer from "a major problem" of "degradation." EX1010-Kijima, [0026]. Kijima states that "the causes

of this degradation are thought to include thermal degradation of the organic materials due to heat degradation accompanying light emission, the effects of moisture and oxygen contamination during production, and peeling of the organic layer due to oxidation of the cathode electrode.” *Id.* Kijima’s solution to this problem is “[a] conductive sealing film 7 and an insulating sealing film 8 [being] successively formed on the electrode 1 so as to cover the side surfaces of the element.” EX1010-Kijima, [0026]. According to EX1010-Kijima, the result of this approach was that “*almost no dark spots* were observed, and the sealing effect of the sealing films 7 and 8 was *remarkable*.” *Id.*, [0054]; EX2018, ¶¶81-83.

Kijima recognized a second problem. Namely, that “if the insulating sealing film is deposited in a vacuum deposition device, the effect of radiant heat during deposition of the insulating sealing film will be large, raising concern about the effect on organic layers” *Id.*, [0028]. To solve this latter problem of radiant heat during deposition, for the inner sealing film 7 Kijima proposes to use a conductive material “with good thermal conductivity,” which can provide for “efficient dissipation of the radiant heat” and prevent “degradation of the organic layer due to radiant heat during vapor deposition of the insulating sealing film 8.” EX1010-Kijima, [0057], [0056]; *see also*, [0075] (emphasizing the importance of “providing the conductive sealing film *adjacent to and below* the insulating sealing film”); EX2018, ¶¶84-85.

Thus, Kijima proposes using “at least a conductive sealing film” 7 on the top electrode (such as the cathode 1) “while maintaining the vacuum (and preferably further forming an insulating sealing film thereon).” *Id.*, [0030]. In the figure below, the conductive sealing film 7 is colored green and the insulating sealing film 8 is colored yellow.

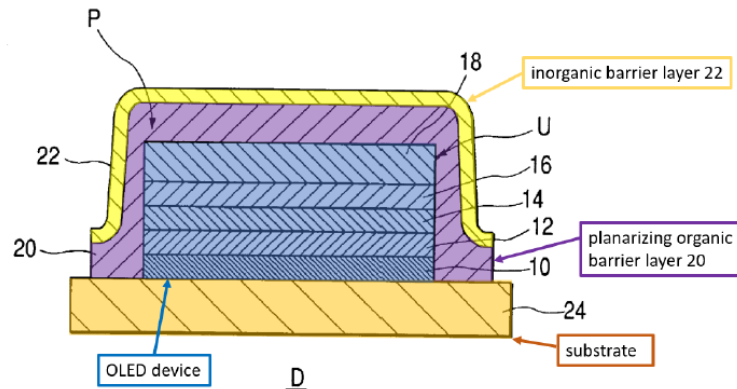


In Kijima, after depositing a 2k angstrom (or 0.2 μm) thick cathode made of LiAl or SrAl (*see* EX1010-Kijima, [0049], [0061], [0065], [0069]), a 10k angstrom (or 1 μm) thick gold-based conductive sealing film 7 is deposited under vacuum (*id.*, [0031]-[0032], [0050], [0062], [0066], [0070], [0052]). Thereafter, without breaking vacuum, a 2k angstrom (or 0.2 μm) thick SiO_2 or Al_2O_3 -based insulating sealing film 8 is deposited on the gold sealing film 7. *Id.*, [0031]-[0032], [0051], [0052], [0063], [0067], [0071]. The resulting devices exhibit the same performance after one month in air with “almost no dark spots [] observed.” *Id.*, [0054], [0064], [0068], [0072]; EX2018, ¶¶86-91.

In short, Kijima already solved the dark spot problem mentioned in Suzuki—the same problem Petitioner relies on as the reason to modify Kijima (Pet, 32)—and therefore Petitioner has not established a motivation to undertake the proposed combination. *See Arctic Cat Inc. v. Polaris Industries, Inc.*, 795 Fed.Appx. 827, 833 (Fed. Cir. 2019)(nonprecedential) (“Although a challenger to a patent is not required to prove there was a known problem with the prior art, the Board did not misapply the law by requiring Arctic Cat to prove the facts that it alleged.”) (internal citation omitted).

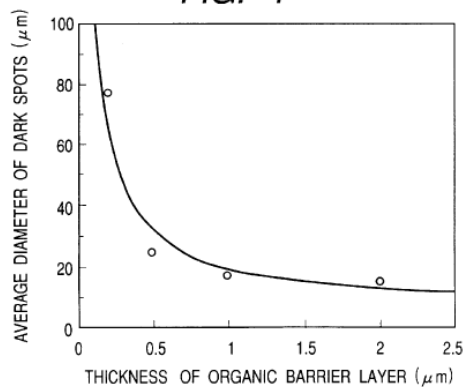
2. Suzuki’s Thin Organic Film Is Less Effective Against Dark Spot Growth Than Kijima

Like Kijima, Suzuki attempts to address the problem associated with “shortage of stability” and “dark spot[s]” in OLEDs. EX1012, 1:41-49. Suzuki believes that dark spots are caused by “moisture entering from defective portions” of the OLEDs. *Id.*, 1:50-52. Suzuki’s solution is to provide a protective layer consisting of “an organic barrier layer 20 and an inorganic barrier layer 22.” *Id.*, 2:26-29, 2:60-62, Fig. 1.

FIG. 1

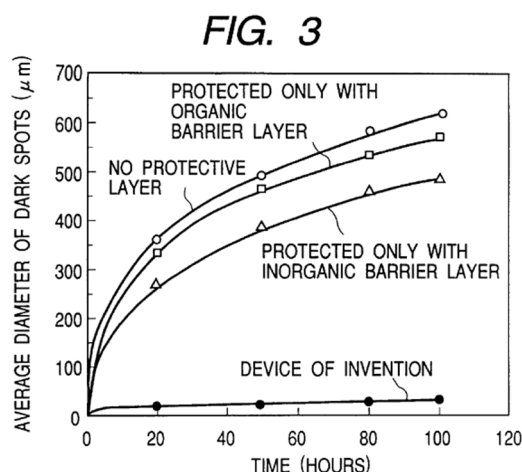
(annotated by Petitioner, Pet. 20)

Unlike Kijima's devices, Suzuki's devices still have observable dark spots, although the sizes are significantly reduced when the organic layer 20 is sufficiently thick, *e.g.*, above 1 μm . *See* EX1012, Fig. 4 (average diameter of dark spots approaches a plateau of slightly below 20 microns when the thickness of the organic barrier layer is 1 μm and above); EX2018, ¶96.

FIG. 4

Suzuki also makes clear that its organic layer 20 alone provides little protection against moisture and oxygen. *See* EX1012, Fig. 3 below (little

improvement in dark spots' sizes when "Protected Only With Organic Barrier Layer" over "No Protective Layer"); EX2018, ¶¶97-98.



The synergy observed between Suzuki's organic layer and inorganic layer that results in much improved protection against dark spots is due to the fact that the organic layer 20 can allegedly cover the pinholes and other defects in cathode 18 to provide a smoothing surface for a defect-free and dense inorganic layer 22. See EX1012-Suzuki, Fig. 3 (comparing performance of "Device of Invention" with the double layer structure with other plots), 5:59-67; EX2018, ¶99. But as explained above, there is no reason to believe that Kijima's gold film suffers from the same defects as Suzuki's cathode 18. And Petitioner provides no evidence that the addition of the organic layer would have further protected against dark spots compared to Kijima's existing double-layer sealing structure, such that a POSITA would have been motivated to make the proposed modification despite the added processing steps and the associated complications (*see* Section VI.E below).

Moreover, if Petitioner's theory is that a POSITA would have been motivated by even a small improvement, that argument presupposes that Suzuki's organic layer 20 could improve upon Kijima's existing double-layer barrier structure. But there is no record evidence that suggests that is the case. Suzuki's experimental results do not compare the performance of the inorganic-organic-gold triple protection layer structure in modified Kijima with that of the inorganic-gold double protection layer structure in unmodified Kijima. EX2018, ¶¶99-101

Thus, even if "Kijima does not indicate that its method completely eliminates dark-spot concerns" (DI, 13), the relevant inquiries are (1) whether Petitioner has presented any evidence demonstrating that Suzuki's thin organic film would improve upon Kijima's already "remarkable" results; and (2) whether this organic layer would be a planarization layer. On those inquiries, the challenge falls flat.

E. Kijima and Knowledge in the Art Would Discourage a POSITA From Adding Suzuki's Organic Layer to Kijima

As described above, "*almost no dark spots were observed*" in Kijima's devices made according to Kijima's double layer method and "the sealing effect of the sealing films 7 and 8 was remarkable." EX1010-Kijima, [0054], [0064] (same), [0068] (same), [0072] (same). In that context, Petitioner does not explain why a POSITA would have incurred cost to include an additional organic layer when no non-speculative benefits have been demonstrated. Pet., 32-36. For example, as Mr.

Humphrey explains, a POSITA would understand that they should avoid additional layers whenever possible. EX2018, ¶¶41, 103. “This is because every time a layer is added, not only an additional processing step needs to be added, but one has to be concerned with issues such as

- Interfacial properties, including adhesions of the additional layer, to the layer immediately above and below (so it won’t cause delamination)
- Stresses and associated failure caused by property mismatches between the new layer and the layer above and below, which can cause film stress; and the mismatched properties can be due to mismatches in thermal coefficients of expansion,
- the cohesion strength of the additional layer so it won’t be the point of failure
- whether the deposition process of the additional layer is compatible with the already deposited layers and whether the deposited additional layer is compatible with the layer to be deposited, *e.g.*, whether there would be chemical reactions between layers
- how it would affect light transmission, for example, whether it is sufficiently transparent to let through the desired wavelengths, how different or similar its refractive index is compared to the layer above

or below, how thick it needs to be in order to provide the needed mechanical strength as well as resistance to moisture and oxygen, the incident light's angles and wavelengths

- added risk of contamination and defects with each additional deposition step.”

EX2018, ¶103. As Mr. Humphrey concludes based on his decades of industry experience, “a POSITA would not have incurred the risks and expenses for additional process steps and materials, with no apparent benefits.” EX2018, ¶104; *cf. ActiveVideo*, 694 F. 3d at 1373 (“[k]nowledge of a problem and motivation to solve it are entirely different from motivation to combine particular references”).

As Mr. Humphrey observes, “even if an OLED device without the thick gold layer could have defects on the cathode surface and could thus require a thick organic layer to attain the optimized protection against dark spots, Kijima’s device—with its thick gold layer in combination with an insulating sealing film 8—does not suffer from the same problem and does not need an organic layer between the insulating sealing film 8 and the conductive film 7.” EX2018, ¶105; EX1010-Kijima, [0030], [0056]-[0057], [0062]-[0064], [0066]-[0068], [0070]-[0072]. The Petition provides no competent reason for why a POSITA would have had a reason to modify Kijima in order to solve a problem that does not exist in Kijima.

That is, in contrast to Suzuki where depositing only an inorganic barrier layer over an electrode that does not already have a protective layer is purportedly insufficient to prevent dark spots, (*see* EX1012-Suzuki, Figs. 3-4),⁵ Kijima's inorganic layer is sufficient to prevent dark spots when deposited over a cathode that is already coated with a thick gold sealing layer (*see* EX1010-Kijima, [0030], [0056]-[0057], [0062]-[0064], [0066]-[0068], [0070]-[0072]). Hence, even if the use of an organic layer was a known solution for addressing the dark spots caused by irregularity on Suzuki's unprotected electrode surfaces, Petitioner has not shown that the solution applies to Kijima's already-covered electrode or to the thick gold film. EX2018, ¶106.

A POSITA would also be deterred from inserting an organic layer between Kijima's conductive sealing layer and the insulating sealing layer because Kijima emphasizes the importance of "providing the conductive sealing film *adjacent to* and below the insulating sealing film[.]" EX1010-Kijima, [0075]; EX2018, ¶¶107-108. For example, as demonstrated by Comparative Example 1, when the conductive

⁵ Figures 3-4 tests were done respectively with a silver and an aluminum inorganic layer. *See* EX1012-Suzuki, 8:15-36, 8:9:2-9. There is no evidence of how a SiO₂ over Suzuki's cathode would perform.

sealing film is omitted, “the organic layer had degraded due to radiant heat generated during deposition of the insulating sealing film 8.” EX1010-Kijima, [0073]-[0075].

Dr. Subramanian states that unlike the heat-sensitive OLED stack, there would be no concern with the stability of the organic sealing layer during inorganic deposition because those organic materials “are thermally polyermized.” *E.g.*, EX2021, 39:4-6. A 2021 review article on TFE observed, however, “[e]xposure to temperature and UV or particle radiation during inorganic deposition can lead to the organic layers’ damage and instability.” EX2030 (on “Manufacuturing of Polymer Planarization Layers”), p.5. The method for avoiding the damages were not reported until years after the invention date. *Id.* (ref. 18 date); EX2018, ¶112.

At any rate, Kijima explains that using “material with good thermal conductivity such as a metal,” “efficient dissipation of the radiant heat can be expected.” *Id.*, [0057], [0073]-[0075]. Kijima emphasizes the importance of gold film’s good thermal conductivity in protecting the OLED organic layer from the radiant heat that reaches the OLED. EX1010 [0075]. “Given this critical feature, a [POSITA] would be extremely hesitant to use a polymer-covered gold film during deposition of Kijima’s insulating sealing film 8.” EX2018, ¶111. “This is particularly the case when Kijima expressly states that the gold film should be ‘adjacent to’ the insulating sealing film 8. EX1010-Kijima, [0075].” *Id.* As Mr. Humphrey observed, a POSITA “with the skill level defined by Dr. Subramanian

would not have enough experience in the displays, deposition techniques or heat transfer to make an independent assessment, but would instead follow the express instruction by Kijima.” *Id.*

Dr. Subramanian downplays the importance about “good thermal conductivity,” arguing Kijima is only concerned about “radiant heat” and therefore reflectivity is most important. EX2021_2025-05-31-Final, 159:14-160:15. That is incorrect. Kijima mentions “radiant heat” because heat that is generated during vacuum deposition of the insulating conductive film would be transferred from the heat source (*e.g.*, the evaporator) to the OLED substrate mostly through radiation that does not require a medium (as needed for conduction and convection). EX2018, ¶109. But once that heat reaches the OLED, a heat conduction path to remove that heat becomes important. *Id.* That is why Kijima emphasizes the need for “a material with good thermal conductivity,” but says nothing about reflectivity of the conductive sealing film. *Id.*, ¶110. There is no analysis on how the ability of heat conduction changes between an uncovered gold film versus one covered with polymers that are known to be poor heat conductors; and importantly, how a POSITA as defined would have viewed the problem. EX2018, ¶¶110-111.

To justify deviation from Kijima’s express warning, Petitioner must do more than simply announce that a POSITA would have inserted an organic layer between Kijima’s conductive sealing film 7 and inorganic sealing film 8. Specifically,

Petitioner must demonstrate that the POSITA would recognize that effective dissipation of the radiant heat that reached the OLED is still possible. But Petitioner has not done that, and therefore has not demonstrated that a POSITA would have incurred the additional cost to add the extra layer when there was no apparent concomitant benefit. *See, e.g., Henny Penny Corp. v. Frymaster LLC*, 938 F.3d 1324 (Fed. Cir. 2019) (upholding the Board’s non-obviousness finding based on balancing tradeoffs with benefits, especially in light of the fact that the primary reference already included an oil quality sensor that performed the same function as the oil sensor in the secondary reference, though with a different mechanism);⁶ *In re Anova Hearing Labs, Inc.*, 809 F. App’x 840, 843 (Fed. Cir. Apr. 7, 2020) (vacating the Board’s finding that a hearing aid invention was obvious, noting, *inter alia*, that the Board failed to explain why a POSITA would have been motivated to modify the primary reference in view of a secondary reference disclosing vents when the primary reference already had vents); *South-Tek Sys., LLC v. Engineered Corrosion*

⁶ *Henry Penny* is consistent with *Virtek Vision Int’l ULC v. Assembly Guidance Sys.*, 97 F.4th 882, 886-87 (Fed. Cir. 2024), where the Federal Circuit held that it was not enough that two alternative arrangements for computer controlled aiming system were known, but a reason must be provided to explain why a POSITA would have substituted one system with another.

Sols., LLC, 748 F. App'x. 1003 (Fed. Cir. 2018) (affirming the Board's finding that it would not be obvious for a POSITA to combine Wood's condensate drain with Viking's sprinkler system because Viking's system already included a drum drip drain to allow water to drain from Viking's system and a POSITA therefore would not be motivated to include Wood's condensate drain in Viking to perform "redundant functions").

VII. Petitioner Has Failed to Establish that a POSITA Would Use Ink-Jetting to Deposit the Organic Layer Sequence in Kijima (Ground II)

A. Sturm Is Not Analogous Art

Ground II cites Sturm for the inkjet printing limitation of claim 35. But Sturm is about methods "of *fabricating semiconductor devices* using ink-jet printing" (EX1013, abstract), not about "encapsulating" in specific OLED devices. EX2018, ¶114. They are therefore in different fields of endeavor. EX2031-Antoniadis, 141:21-142:19 (technology for printing pixels "is very different" from that for printing thin-film-encapsulation, and "[t]hese are different engines" and "you cannot infer one from the other").

Nor is there any evidence that Sturm is pertinent to the problems to be solved by the '389 patent. *See* Pet. 21, 41-46; EX2031-Antoniadis, 142:20-25 ("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.”); EX2018, ¶ 123(comparing different challenges for inkjet printing pixels versus encapsulation). Thus, Petitioner has not demonstrated that Sturm is an analogous art.

B. Sturm Does Not Teach or Suggest Using Inkjet Printing for Encapsulation Layers

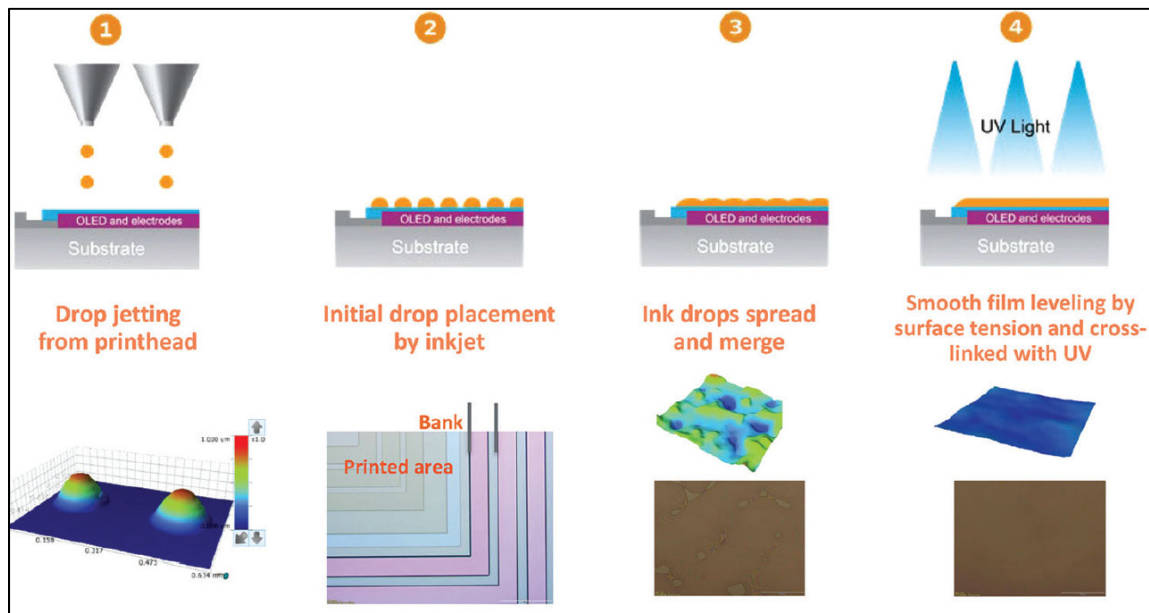
While Petitioner proposes to use ink-jetting to form an OLED organic encapsulation layer, none of the references cited for this ground actually teach or suggest such a usage. For example, Dr. Subramanian agrees that “neither Kijima nor Suzuki hint [at] using inkjetting to apply organic materials.” EX2021_2025-05-31-Final, 114:16-21 (“Q: And we agree that neither Kijima nor Suzuki hint using inkjetting to apply organic materials. Correct? A. Yes, I think that’s right.”). Nor do Kijima or Suzuki suggest that a POSITA should look for another way of depositing the sealing layers than the ones already disclosed. *See* EX1010-Kijima, Suzuki *generally*.

Sturm does not discuss OLED encapsulation, let alone using inkjet for that purpose. EX1013 (Sturm), 4:66-5:2; EX2021_2025-05-31-Final, 82:3-9 (Dr. Subramanian confirming that “it doesn’t appear that there’s any specific discussion of encapsulation within Exhibit 1013,” Sturm). For example, in the figure on Sturm’s cover page, layer 122 is formed by ink-jetting, with 122 being “a polymer semiconducting layer” having source/drain contacts 124/126 then formed over 122.

EX1013, 6:52-67, Figs. 14(a)-(b). As another example, Sturm's Figures 7(a)-(c) show islands 22 and 24 deposited by inkjet, with electrodes 26, 28 then applied over 22 and 24. *Id.*, 5:39-47. Likewise, in Figures 8(a)-(c), electrodes 40, 42, 44 are deposited over ink-jetted islands 34, 36 and 38 containing red, blue and green inks. Figures 9(a)-(c) use inkjet to deposit top and bottom contacts as well as organic materials contacting the contacts. *Id.*, 5:64-6:5. Figure 10 involves ink-jetting top electrodes 60 and 62. *Id.*, 6:6-13; *see also* 6:19-51 (ink-jetting used to deposit organic red/blue/green materials as well as contacts). None of the examples, however, involved using ink-jetting to deposit an organic layer for encapsulation, as Dr. Subramanian acknowledges. EX2021_2025-05-31-Final, 177:10-24 ("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."); EX2018, ¶114.

Just like searching by names or addresses for duplicative entries does not disclose an approach that searched for duplicative entries by telephone numbers (*Arendi*, 832 F.3d at 1365-66), depositing OLED circuit components using ink-jetting does not suggest doing so to encapsulation layers that are not part of the device but instead are used to seal the device. EX2031-Antoniadis, 142:20-143:6 ("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."), 141:25-142:19 ("TFE doesn't qualify you for full color and vice versa, developing full color doesn't qualify you for TFE. These are different engines, right, so *you cannot infer one from the other.*"). For example, the ability to form a contiguous planar film over a large area may not be a concern for Sturm's EL elements, but would be for an encapsulant covering a much larger area. EX2018, ¶123; *see* EX2023, Fig. 2 (film size on the order of 100-microns); EX2039_ams-OSRAM0000167 (pixel sizes on the order of 0.22 m², about 1/1090th the 19.97mm×11.97mm active area of a display). In inkjet-printing based method, the organic film relies on effective ink drop spread and merge as well subsequent film leveling. *See* EX2030, Fig. 2; Ex2034, p.16; EX2018, ¶123. These steps become more challenging as the spreading and leveling areas increase. *Id.* Additionally, as the encapsulant areas increase, the likelihood of solvent trapping and outgassing in subsequent steps becomes higher, which affect the resulting film's smoothness and porosity. *Id.*



(EX2030, Fig. 2)

Duthaler is also of no help. 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, ¶116.

Nor is there any evidence that deposition techniques suitable for electrophoretic displays or “form[ing] electronic components or component arrays” (*id.*, 15:6-8) would also be suitable for OLEDs. As Mr. Humphrey notes, “electrophoretic displays do not share the same degree of sensitivity to moisture and oxygen as is well-known for OLED displays.” EX2018, ¶117. As a recent paper demonstrates, the requirements for oxygen and moisture penetration rates in OLEDs

are at least 1.5-4 orders of magnitude more stringent than other displays and applications. EX2024, Fig. 1; EX2018, ¶117.

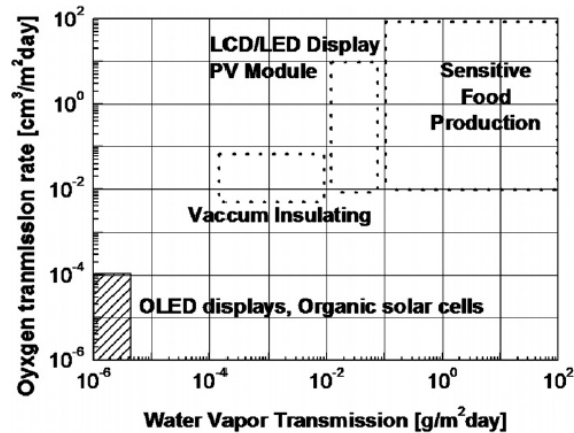


Figure 1. Barrier requirements for different applications.

Duthaler also describes electrophoretic displays as including “a capsule with one or more species of particle that either absorb or scatter light and that are suspended in a fluid.” EX1016, 23:26-27. There is no evidence that any OLED devices would have this form of encapsulation. EX2018, ¶118.

A POSITA would not have considered the inkjetting process described in Sturm as suitable for forming an organic layer as required by Suzuki. As Sturm reports, “[t]he thickness of the dots ranged from 400 to 70 Angstroms,” or about 40-70 nanometers, (EX1013-Sturm, 4:20-24), considerably thinner than the minimum of 500 nanometers needed to provide the needed sealing protection of Suzuki (EX1012-Suzuki, Fig. 4). Multiple passes would therefore be necessary to obtain the required thickness. EX2018, ¶119.

There is also no evidence that inkjet printing a polymer solution (Pet. 45) with multiple passes would provide the planarization property. Dr. Subramanian's 2003 work on gold nanoparticles demonstrates the difficulty in obtaining a planarized film using inkjet printing techniques, especially with materials that do not reflow to coalesce. *See* surface roughness for a gold film below. EX2023, Fig. 2.

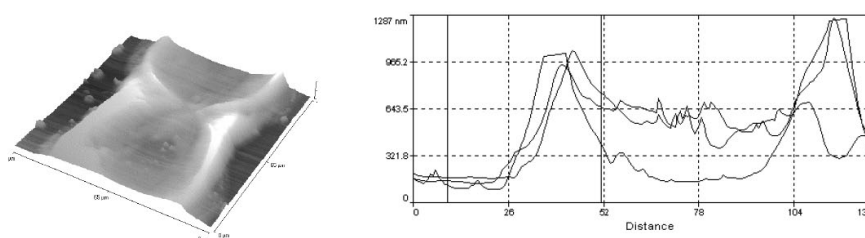


Figure 2: (left) atomic force micrograph showing the characteristics “coffee-ring” structure that results from splashing during droplet deposition, and (right) profilometry of a typical film formed using this process, showing the substantial roughness.

The same would be true for a polymer solution, which does not reflow at suitable temperatures for making OLEDs. EX2018, ¶¶120-121. While Dr. Subramanian was able to mitigate the coffee-ring effects by using elevated substrate temperatures (130-160°C) coupled with lower-evaporation solvents that would not easily evaporate from the nozzles at the elevated temperatures, (see EX2023, H.8.3.3-8.3.4), those conditions would not be suitable for OLEDs which are heat sensitive. *See* EX2021_2025-05-31-Final, 37:16-18 (“the OLED materials are extremely sensitive to heating”); EX1010-Kijima, [0056]-[0057] (using good thermal conductors to dissipate heat and prevent degradation of OLED organic materials); EX2018, ¶121 (OLED organics would often degrade significantly at

temperatures above 100°C so substrate temperatures at 130-160C would be unsuitable).

Dr. Subramanian observed that the coffee-ring effect and the resulting poor planarity was “a known problem inkjet printing.” EX2023, 2 (H8.3.2). It may also explain Sturm’s reported degradation in device performance with inkjet printed OLED devices compared to spin coating. *See* EX1013 (Sturm), 5:13-16 (“FIG. 5 shows the L-I characteristic of the two devices, which shows that the efficiency of ***the ink-jet printed device is about a factor of two less efficient than the spin coated device.***”); *see also id.*, Figs. 4-5 and associated text; EX2021_2025-05-31-Final, 96:25-97:22; EX2018, ¶122. Spin coating is disclosed in Suzuki as a deposition method for its organic layer, as Dr. Subramanian acknowledges. *See* EX1012, 4:34-38, 6:26-27; EX2021_2025-05-31-Final, 115:6-10.

Hence, none of the prior art, including Sturm and Duthaler, supports Petitioner’s motivation arguments for using inkjet to deposit a polymer solution to form an organic planarization layer, as there is no evidence that a planarization could be so obtained under conditions suitable for making OLED devices. EX2018, ¶123. Therefore, Claim 35 has not been shown into be unpatentable under Ground II.

C. Using Inkjet Printing to Create the OLED and Encapsulation Structures Would Be Unsuitable

As noted above, there is no evidence that inkjet would be suitable for applying a polymer solution to obtain a planarization layer under conditions suitable for an OLED device at the time of the invention. Dr. Subramanian argues further that if inkjet printing is used for the planarization layer, it could also be used for other layers. EX2021_2025-05-31-Final, 214:1-216:1. The proposal would not yield an operable structure for additional reasons.

First, as Dr. Subramanian's own paper indicates, before 2003, there were no suitable gold nanoparticles that could be sintered below 200 °C to remove organic materials needed to make a nanoparticle solution, rendering them unsuitable for OLEDs. *See* EX2025 (reporting thiol-derivatized gold nanoclusters suitable for use in printed circuits on plastic); EX2021_2025-05-31-Final, 37:16-18 ("the OLED materials are extremely sensitive to heating"), 40:5-13 (claiming that the inorganic barrier layer was deposited at "barely above room temperature"), EX1010-Kijima, [0075] (radiative heat during Kijima's inorganic layer deposition degrades OLED organic material). Hence, at the time of the invention, inkjet could not be used to form the gold film required to perform the sealing function. EX2018, ¶125.

Second, to form a suitable ink for the insulating inorganic film, the inorganic nanoparticles had to be surface-functionalized with suitable organic molecules in

order to be dispersed in organic solvents. EX2018, ¶126. There are a number of issues with forming these nanoparticle solutions. First, at the time, typical colloidal silica and other particles for typical barrier layer materials—which are metal oxides and/or nitrides—tend to be hydrophilic. *Id.* It was (and still is) extremely difficult to remove water and solvents from the resulting film. *Id.* But given the purpose of the organic sealing layer, their retention of water would not be suitable for the intended use. *Id.*

Third, nanofilms created from solution processes tended to be porous under process conditions suitable for OLEDs. EX2027, 3311-3312 (resulting silica film after oxygen plasma treatment was about 1.0g/cm^3 , compared to $2.2\text{-}2.6\text{ g/cm}^3$ for a normal silica; calcification at $450\text{ }^\circ\text{C}$ was needed to obtain density above 2g/cm^3). A porous film would not be suitable as a barrier layer to keep out oxygen and moisture. EX2018, ¶¶129-130; EX1012-Suzuki, 5:63-66 (inorganic barrier layer 22 should be “substantially defect-free and dense”). The protection against moisture would be further weakened if the surface functional group contains hydrophilic groups such as amine, amino acids, alkoxides, that would attract water. *See* EX2028, abstract; EX2018, ¶130. Put another way, Petitioner has not demonstrated that inkjet printing could produce a dense barrier layer needed for protecting against oxygen and moisture.

D. Kijima Dissuades the Proposed Modification

Kijima emphasizes “the importance of forming all of the films under vacuum conditions.” EX1010-Kijima, [0087]. Dr. Subramanian acknowledges that inkjet is not done under vacuum. EX2021_2025-05-31-Final, 106:8-13 (“Q: And do you apply the inkjet in a vacuum? A. No.”); EX2018, ¶¶131-132; *see also* EX1013-Sturm, 1:58-60 (describing drawbacks of vacuum depositing organic layers), 4:59-61 (describing use of a vacuum chamber only “*After* ink-jet printing”); EX1016, 3:15-17 (contrasting “ink jet printing step” with “a printing step involving a vacuum based process”). While Petitioner purports to explain why a POSITA would use Sturm’s ink-jet method, Petitioner fails to explain why that POSITA would ignore Kijima’s express warning and expose the device to non-vacuum condition before completing the entire encapsulation process.

To backfill this gap, during his deposition Dr. Subramanian contended that a POSITA could performed the inkjet process under nitrogen in a glove box. EX2021_2025-05-31-Final, 106:8-107:7. That is a new argument, since the Petition proposes “to use *depositing by ink jet as taught in Sturm*,” which says nothing about using nitrogen or glove box.

The new argument—if considered—presumes that the reason for using vacuum is to exclude oxygen and moisture, but Kijima does not state that was the reason failure occurred. EX1010-Kijima, [0076]-[0081] (a comparative example to

demonstrate “the adverse effects of exposing the element [OLED device] to the atmosphere before the formation of the conductive sealing film 7” without saying why), [0082]-[0087].

Nor has Petitioner demonstrated that deposition under inert atmosphere would be suitable—for example, the residual oxygen or moisture in nitrogen is not an issue. Pet., 41-46. And unlike the ’389 patent which contemplates using inkjet to apply monomers that will be subsequently cured (see ’389, 6:61-63 (using UV-curable liquids for inkjet)), Petitioner/Sturm proposes using “polymer solutions.” Pet. 45. While monomers, such as acrylate monomers, are often liquids that can be dispensed without solvents, large amounts of solvents would be needed to formulate polymers into solutions of 100cP or less for inkjetting. EX2018, ¶137; Duthaler, 15:9-10. In addition to coffee-rings, outgassing of trapped solvents in the resulting polymer film (especially one that is slow evaporating as Dr. Subramanian suggested in his paper) in subsequent processes or overtime would be a major concern; and such outgassing would create voids susceptible to oxygen/moisture penetration as well as surface defects that creates non-planarity. EX2018, ¶137. As such, there is no competent evidence that a POSITA would have deviated from Kijima’s express warning to use inkjetting. EX2018, ¶138. This is particularly the case given Sturm’s report that inkjet-printed OLEDs are 50% less efficient than spin-coated ones. EX2018, ¶139; EX1013-Sturm, 5:13-16.

VIII. Petitioner Has Failed to Establish that a POSITA Would Use Screen-Printing to Deposit the Organic Layer Sequence in Kijima (Ground III)

As with the ink-jetting process, screen-printing would also break the vacuum before completing the encapsulation process. EX2018, ¶142; EX2021_2025-05-31-Final, 177:25-178:18; EX1016, 3:18-20. While offering a generic reason for why screen printing would be beneficial, Dr. Subramanian does not explain why a POSITA would have performed the proposed modification specifically in the context of Kijima. *ActiveVideo*, 694 F.3d at 1328 (rejecting expert testimony that “fail[ed] to explain why a person of ordinary skill in the art would have combined elements from specific references *in the way the claimed invention does*”)

For example, there is no evidence that screen printing would have improved Kijima’s throughput or lowered its cost compared to spin coating, casting or vacuum deposition (the methods used by Suzuki), as asserted. Pet., 48. Instead, Kijima observes that its method of forming the various layers “continuously in the same vacuum deposition device” provides “high” “productivity” while precluding “effect of oxygen in the atmosphere during production.” EX1010-Kijima, [0058]. But there is no evidence that screen-printing could be carried out in the same “vacuum deposition device.” Pet., 46-49. Yet, Petitioner fails to engage on why this disruption would improve the already high productivity of Kijima or lower its cost; and Mr. Humphrey concluded that it “would actually increase cost by requiring a new set of

equipment beyond the vacuum deposition chambers that Kijima already has and would lower the productivity” by having to remove the devices from the vacuum deposition device to screen-print the organic layer, dry the organic layer and then put the devices back into the vacuum deposition device. EX2018, ¶146.

Solvent trapping and the subsequent voiding and non-planarity due to outgassing would be an even bigger concern than inkjet printing because screen printing requires much higher viscosity compositions than inkjetting and it does not have the benefit of solvent drying during drop flight. EX2018, ¶147; EX2021_2025-05-31-Final, 119:19-22 (screen printing viscosity in the range of “thousands to tens of thousands of millipascal seconds” or thousands to tens of thousands cP); Duthaler, 15:6-10 (suitable viscosities for inkjet is “below approximately 100 cP”); Subramanian 2003 paper (discussing solvent drying during flight).

Because Petitioner has not established that a POSITA would have used screen-printing in lieu of Kijima’s vacuum evaporation method, Claim 36 has not been shown into be unpatentable under Ground III.

IX. Petitioner Has Failed to Establish That the Combination of EX1010-Kijima, EX1012-Suzuki, and Fujimori Renders Claims 41-46 Obvious

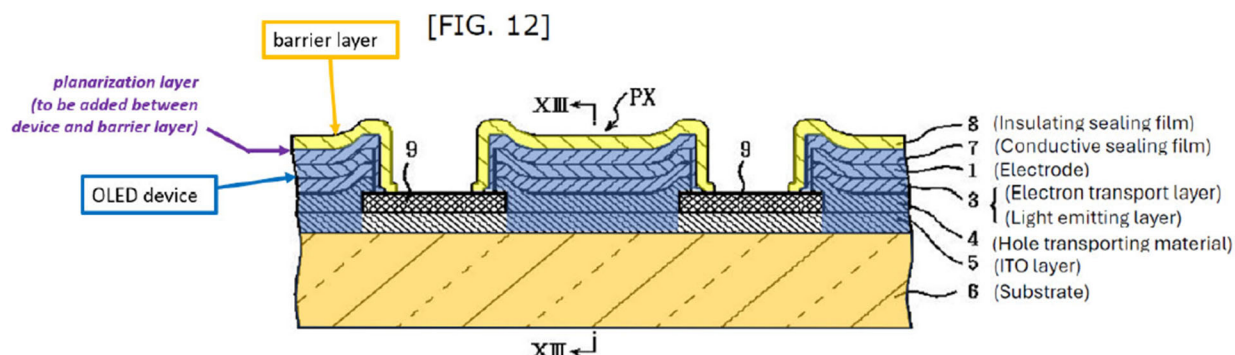
A. Ground IV is Defective for the Same Reasons as Ground I

Ground IV challenges only claims 41-46 and proposes to combine the same Kijima and Suzuki references as relied on for Grounds I-III, in further combination with Fujimori. See Pet., 9.

In addition to reciting steps similar to independent claim 34 of providing a substrate (Element 41[a]), depositing a planarization layer (Element 41[c]) and depositing a barrier layer over the planarization layer (Element 41[e], independent claim 41 further recites certain limitations relating to depositing a mask (Element 41[b] and removing a mask (Element 41[d])). Fujimori is relied on for the mask-related limitations (Element 41[b] and 41[d]); and the planarization and barrier layer limitations (Element 41[c] and 41[e]) are still allegedly satisfied by the same proposed modification of Kijima with Suzuki as with Ground 1. See Pet., 50 (Elements 41[pre] and 41[a] allegedly satisfied by Kijima for the same reasons as 34[pre] and 34[a] in Ground I); Pet. 51 (asserting “[i]t would have been obvious to further use a selectively deposited organic planarization layer in view of Suzuki”), 58 (“The modified Kijima method would satisfy this element [41[c]] because it would entail depositing at least one planarization layer (the organic sealing layer added in view of Suzuki) upon said mask ... and said plurality of devices (Kijima’s

OLED devices))”, 60 (“[T]he modified Kijima method entails adding an inorganic insulating sealing film 8 on top of the organic sealing layer, as discussed for example in Element 34[c] for Ground I above.”).

As such, Ground IV suffers from the same flaws as Ground I that result from interposing Suzuki’s organic layer between Kijima’s conductive sealing film 7 and the insulating sealing film 8, as the Petition illustrates below.



Pet., 61.

Thus, for at least the same reasons stated for Ground I, Petitioner has not established for Ground IV that a POSITA would have had a motivation to make the proposed modification shown above, or that a POSITA would have had a reasonable likelihood of success in doing so to achieve the claimed arrangement. *See supra*, Section VI. Also, because Ground IV is based on the same proposed modification of Kijima using Suzuki’s organic layer, the proposed combination does not yield the recited planarization layer for the reasons described in Section IV.

B. A POSITA Would Not Have Been Motivated to Modify a Kijima-Suzuki Method of Encapsulating OLED Devices Based on Fujimori

Petitioner has also not demonstrated a POSITA would have used Fujimori's mask in Kijima. The problem that Fujimori attempts to address is that the deposited material would wrap around the shadow of finely patterned masks such that deposited conductive films are not sufficiently separate and thus "cause a short in the elements and crosstalk." EX1014, [0008]; EX2018, ¶149.

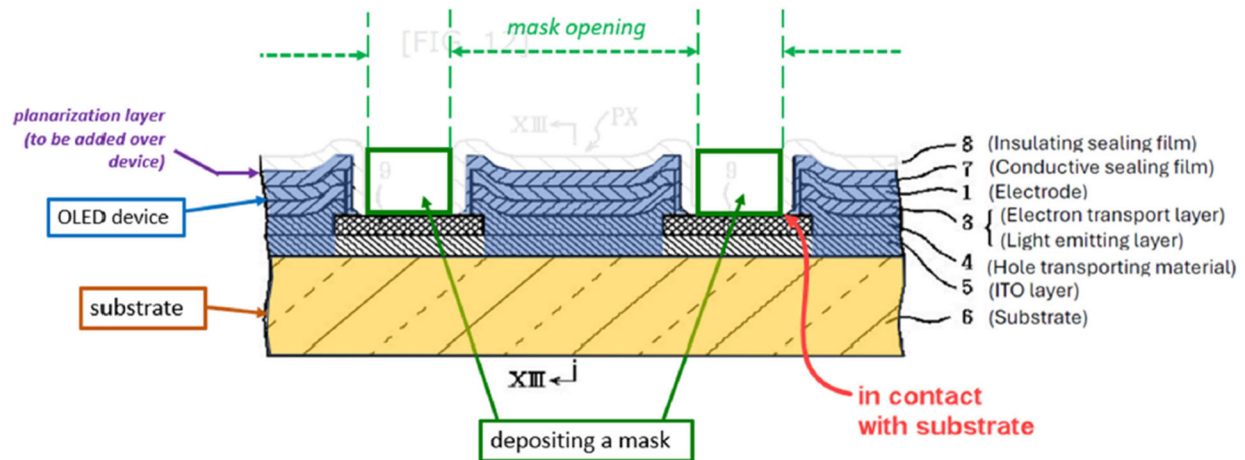
But Fujimori as a whole does not disclose or suggest using its magnetized masks for depositing encapsulation layers, be it an organic planarization layer or an inorganic barrier layer. *See* EX1014 *generally*; EX2018, ¶150. Instead, it uses the magnetized masks to deposit (1) electrodes, in particular the electrodes above the (OLED) organic layers, *see* EX1014, [0026], [0041]-[0042], [0044], [0047], [0048]; (2) materials to create closely spaced blue, green and red multicolor regions, *see* EX1014, [0050]; and (3) non-emission regions such as the black matrix that blackens the gaps between the light-emitting region to improve contrast or pixel define layers that surround/define emission regions and insulate electrodes from one another, *see id.*, [0027]; EX2018, ¶150. Notably, for the non-emission regions such as the black matrix, in the actual examples, no masks were used to develop the black matrix. *See id.*, [0049]. Instead, "spin-coating" followed by "conventional photolithography method" was used "to form a black layer ... that served as both a spacer and a black

matrix.” *Id.* Thus, if a POSITA would have used the same method that Fujimori uses for forming the non-emitting region to deposit Kijima’s encapsulation layer, that person would not have used a magnetic mask. EX2018, ¶151.

Fujimori therefore does not teach or suggest using a magnetized mask for depositing insulating protection layers for OLED devices. This makes sense because such insulting layers won’t “cause a short in the elements” or “crosstalk,” which is the problem that led to Fujimori’s invention. EX1014, [0008]; EX2018, ¶152. And Dr. Subramanian provides no reasoning or supporting evidence tending to show that shorts or crosstalk are issues when depositing insulating protection layers, or any other reason why a POSITA would be motivated to use Fujimori’s magnetic mask. Instead, the only teaching in the record of using a magnetically held mask for depositing insulating protection layers is found in the ’389 patent itself, and Petitioner’s reliance on Fujimori is clearly the product of impermissible hindsight.

X. The Proposed Combination of Ground IV Fails to Satisfy the Additional Limitations of Claim 43.

Claim 43 further recites that the “the step of depositing said mask further comprises depositing said mask such that said mask is in contact with said substrate.” The Petition provides the annotated version of Kijima’s FIG. 12 below to argue that the mask for the planarization layer would be in contact with Kijima’s substrate.

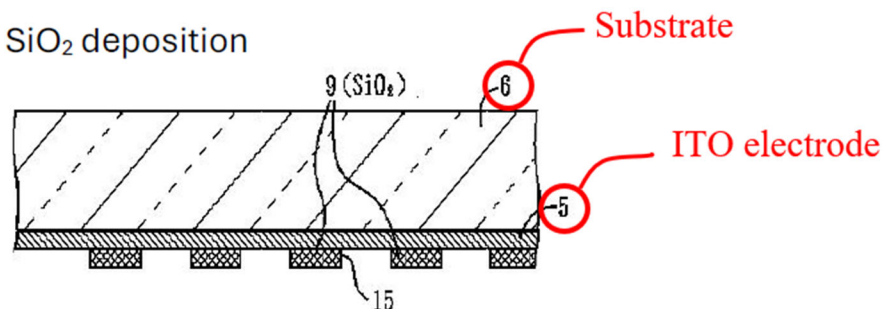


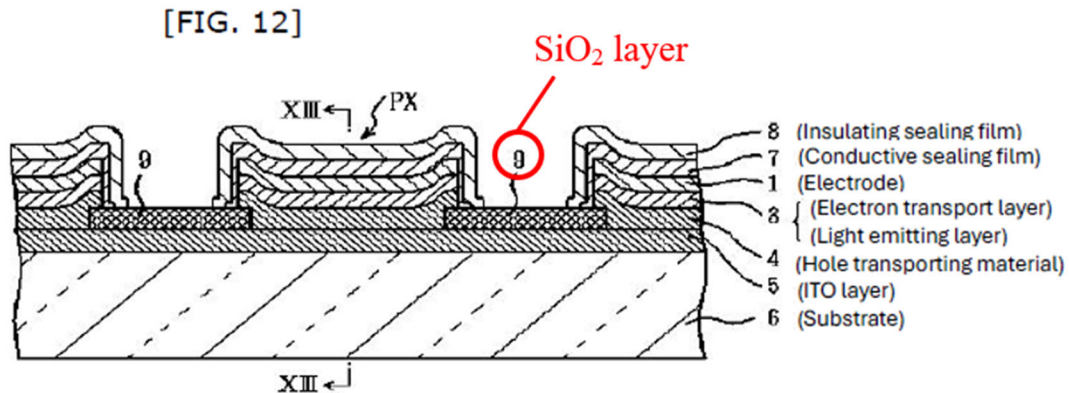
Pet., 63.

But that annotation shows that mask is deposited in contact with the shadowed area 9 which is above the ITO layer 5. *Id.*; EX2018, ¶¶153-157 Dr. Subramanian agreed that the ITO electrode 5 is part of the device, not the substrate, and that “Region 9 is not part of substrate 6.” EX2021_2025-05-31-Final, 189:3-190:4. As such, the combination does not show that the mask is “in contact with” the identified substrate 6. *See also:*

[FIG.8]

SiO₂ deposition





EX1010-Kijima, Figs. 8 & 12 (SiO₂ and ITO layers separate the substrate 6 from the (green) mask in the annotated version of Fig. 12 above); *id.*, [0040] (after the ITO electrode 5 is deposited on the glass substrate 6, “then SiO₂ 9 is deposited on the entire surface, which is then etched into a prescribed pixel pattern to form a large number of openings 15, through which the transparent electrodes 5 are exposed.”).

XI. Conclusion.

For the foregoing reasons, the Petitioner has failed to show that any claim of the '389 patent is unpatentable.

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Respectfully submitted,

By: / Hong Zhong /

H. Annita Zhong. (Reg. No. 66,530)
IRELL & MANELLA LLP
1800 Avenue of the Stars, Suite 900
Los Angeles, CA 90067
Tel: (310) 277-1010
Fax: (310) 203-7199
Email: hzhong@irell.com

Jonathan Lindsay (Reg. No. 45,810)
IRELL & MANELLA LLP
840 Newport Center Drive, Suite 400
Newport Beach, CA 92660
Tel: (949) 767-5220
Email: jlindsay@irell.com

CERTIFICATE OF WORD COUNT

I hereby certify, pursuant to 37 C.F.R. section 42.24, that the foregoing Patent Owner Response contains 13,924 words, excluding the words in the table of contents, table of authorities, exhibit list, this certificate of word count, signature block and certificate of service. The word count is based on the word count of the Microsoft Word program used to prepare the Patent Owner Response.

/Susan M. Langworthy/
Susan M. Langworthy

CERTIFICATE OF SERVICE

I hereby certify, pursuant to 37 C.F.R. section 42.6, that on June 20, 2025, a complete copy of the foregoing **PATENT OWNER RESPONSE and EXHIBITS 2018-2032, 2034-2046 and 2100** were served by electronic mail, as agreed to by the parties, upon the following:

COVINGTON & BURLING LLP

David A. Garr (Reg. No. 74,932)

dgarr@cov.com

Scott C. Weidenfeller (Reg. No. 54,531)

sweidenfeller@cov.com

SDC-Pictiva-IPR@cov.com

/Susan M. Langworthy/

Susan M. Langworthy