

IN THE 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

**DECLARATION OF VIVEK SUBRAMANIAN, PH.D.
IN SUPPORT OF PETITIONER'S REPLY**

TABLE OF CONTENTS

I.	MATERIALS CONSIDERED	1
II.	RELEVANT LEGAL STANDARDS	1
III.	PLANARIZATION LAYER REQUIREMENT (ALL GROUNDS).....	4
IV.	SELECTIVELY DEPOSITING REQUIREMENTS (GROUNDS I-III)	7
	A. Selectively Depositing the Planarization Layer (Element 34[b])	7
	B. Selectively Depositing the Barrier Layer (Element 34[c])	11
V.	OBVIOUSNESS OF MODIFYING KIJIMA TO ADD A PLANARIZATION LAYER AS TAUGHT BY SUZUKI (ALL GROUNDS).....	13
	A. Kijima’s Conductive Sealing Film Protects Against Radiant Heat During Manufacturing, not Exposure After Manufacturing	13
	B. A POSITA Would Have Recognized the Additional Protection Provided by Suzuki’s Organic Barrier Layer.....	15
	C. Pictiva and Mr. Humphrey Misunderstand the Results of Kijima’s Experiments.....	18
	D. A POSITA Would Have Added Suzuki’s Organic Barrier Layer to Kijima.....	19
VI.	OBVIOUSNESS OF CLAIM 35 BASED ON KIJIMA IN VIEW OF SUZUKI AND STURM	20
VII.	OBVIOUSNESS OF CLAIM 36 BASED ON KIJIMA IN VIEW OF SUZUKI AND DUTHALER	27
VIII.	OBVIOUSNESS OF CLAIMS 41-46 BASED ON KIJIMA IN VIEW OF SUZUKI AND FUJIMORI	28
IX.	JURAT	28

Declaration of Vivek Subramanian, Ph.D. in Support of Reply

1. I, Vivek Subramanian, have been retained by counsel for Petitioner Samsung Display Co, Ltd. to provide my expert opinions concerning the patentability of certain claims of U.S. Patent No. 6,949,389 (“’389 patent”).
2. In my original declaration (Ex. 1003) I provided my opinion that claims 34-37 and 40-46 of the ’389 patent would have been obvious to a person of ordinary skill in the art based on the disclosures of the prior art.

I. MATERIALS CONSIDERED

3. In forming the opinions expressed in this Declaration, I relied upon my education and experience in the relevant field of the art and have considered the viewpoint of a person having ordinary skill in the art (POSITA) at the time of the alleged invention.
4. In addition, I have considered the materials referenced herein.

II. RELEVANT LEGAL STANDARDS

5. I am not an attorney. For the purposes of this declaration, I have been informed about certain aspects of the law that are relevant to forming my opinions. I have applied the following understanding of the law:
6. Petitioner’s counsel has informed me that a patent claim is “anticipated” if each element of that claim is present either explicitly or inherently in a single prior art reference, with the elements arranged in the reference in the same manner as in the claim. Petitioner’s counsel has informed me that for a claimed limitation to

Declaration of Vivek Subramanian, Ph.D. in Support of Reply

be inherently present, the prior art need not expressly disclose the limitation, so long as the claimed limitation necessarily flows from a disclosure in the prior art.

7. Petitioner's counsel has informed me that a patent claim is "obvious" if the differences between the subject matter in the prior art and the subject matter in the claim would have been obvious to a person of ordinary skill in the art at the time the application was filed. I have been informed whether a claim would have been obvious involves consideration of (1) the level of ordinary skill in the art at the time the application was filed, (2) the scope and content of the prior art, (3) what differences, if any, existed between the claimed invention and the prior art, and (4) any secondary considerations of nonobviousness.
8. Petitioner's counsel has informed me that a single reference can render a patent claim obvious if any differences between that reference and the claim would have been obvious to a person of ordinary skill in the art. Alternatively, a claim can be rendered obvious where the teachings of two or more references may be combined in the same way as disclosed in the claim, if such a combination would have been obvious to one having ordinary skill in the art. In determining whether a combination based on either a single reference or multiple references would have been obvious, it is appropriate to consider, among other factors:

Declaration of Vivek Subramanian, Ph.D. in Support of Reply

- whether the teachings of the prior art references disclose known concepts combined in familiar ways, and when combined, would yield predictable results;
 - whether a person of ordinary skill in the art could implement a predictable variation, and would see the benefit of doing so;
 - whether the claimed elements represent one of a limited number of known design choices, and would have a reasonable expectation of success by those skilled in the art;
 - whether a person of ordinary skill would have recognized a reason to combine known elements in the manner described in the claim;
 - whether there is some teaching or suggestion in the prior art to make the modification or combination of elements claimed in the patent;
 - whether the innovation would have been obvious to try, i.e., involving a choice from a finite number of identified, predictable solutions, with a reasonable expectation of success; and
 - whether the innovation applies a known technique that had been used to improve a similar device or method in a similar way.
9. Petitioner's counsel has informed me that one of ordinary skill in the art has ordinary creativity and is not an automaton. Petitioner's counsel has informed me

Declaration of Vivek Subramanian, Ph.D. in Support of Reply
that in considering obviousness, it is important not to determine obviousness
using the benefit of hindsight derived from the patent being considered.

10. Petitioner's counsel has informed me that secondary considerations of nonobviousness can include a long-felt but unmet need for the claimed invention, failure of others, copying, unexpected results, commercial success, skepticism, or industry praise. I understand that it is generally the patent owner's burden to present evidence of secondary considerations if the patent owner contends that any apply. I am not aware of any evidence of secondary considerations of nonobviousness that would apply to the claims at issue.

III. PLANARIZATION LAYER REQUIREMENT (ALL GROUNDS)

11. As I explained in my initial declaration, Suzuki teaches a protective double layer barrier including "organic barrier layer 20." Suzuki, 5:51-54. Suzuki teaches that its organic barrier layer 20 is planarizing. Specifically, Suzuki teaches that its organic barrier layer 20 "cover[s] defects or pinholes" that are "inevitably formed particularly in the uppermost cathode layer 18." Suzuki, 5:51-54. Suzuki also teaches that its organic barrier layer 20 "makes a smooth surface on the relatively irregular surface of the cathode 18," Suzuki, 5:59-67.
12. A POSITA would have understood from these teachings of Suzuki that its organic barrier layer 20 does not follow the underlying topology, because Suzuki teaches that this layer smooths out the irregular surface beneath it. Thus, it does

Declaration of Vivek Subramanian, Ph.D. in Support of Reply
not follow the underlying topography. Additionally, Suzuki teaches that this layer covers defects, including pinholes, that may be formed in the underlying layers. Suzuki thus teaches that its organic barrier layer 20 prevents defects from propagating to other layers.

13. I understand that Pictiva and Mr. Humphrey have criticized my opinions regarding how Suzuki's organic barrier layer 20 would be incorporated into Kijima because I did not show the topography of the resulting organic layer. But as I explained in my initial declaration, a POSITA would have incorporated Suzuki's layer consistent with Suzuki's teachings. In particular, a POSITA would have incorporated Suzuki's barrier layer such that it would "make[] a smooth surface on the relatively irregular surface of the cathode 18," and "cover defects or pinholes" that are "inevitably formed particularly in the uppermost cathode layer 18." Suzuki, 5:51-67. Thus, when incorporated into Kijima, this layer would be planarizing.

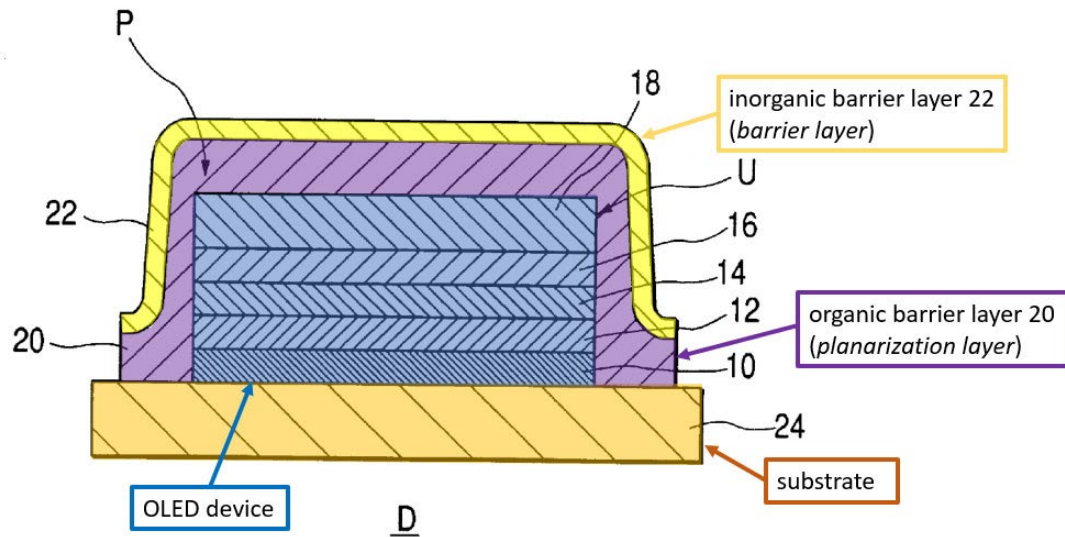
14. I understand that Pictiva and Mr. Humphrey have suggested that the organic layer would instead follow the topography of Kijima's sealing film 7. POR at 18. But this assertion is apparently based on the topography of Kijima's layers, rather than the topography of Suzuki's organic barrier layer 20. As I previously explained, in my opinion a POSITA would have implemented Suzuki's organic barrier layer 20 in Kijima consistent with Suzuki's teachings. I see no reason why

Declaration of Vivek Subramanian, Ph.D. in Support of Reply
a POSITA would have deviated from these teachings to instead follow Kijima's
underlying topography.

15. I understand that Pictiva and Mr. Humphrey similarly suggest that a POSITA would not incorporate the shape of Suzuki's organic layer when applying it to Kijima. POR at 19. This again appears to run contrary to Suzuki's express teachings. For example, Suzuki teaches that its organic barrier layer 20 prevents dark spots. Suzuki, 1:41-52. However, Mr. Humphrey suggests that Suzuki's organic barrier layer 20 "in all likelihood does not reduce dark spots, but may introduce additional problems." POR at 19. I do not agree. A POSITA would have understood the benefits taught by Suzuki for its organic barrier layer 20, and would have sought to apply that layer as taught by Suzuki to obtain those benefits in Kijima, as I explained in my previous declaration.

16. Pictiva and Mr. Humphrey also argue that "even if the organic layer can cover local defects in Kijima's sealing film 7 and provide a smooth surface," it would still not be a planarization layer. This argument appears to be based on the suggestion that this layer would reproduce the topography of the underlying layer. POR at 20. Pictiva and Mr. Humphrey also appear to draw some distinction between "defects" that are intentional and unintentional. POR at 20. I do not agree. These arguments again run counter to Suzuki's teachings that the organic barrier layer 20 makes a smooth surface "on the relatively irregular surface of the

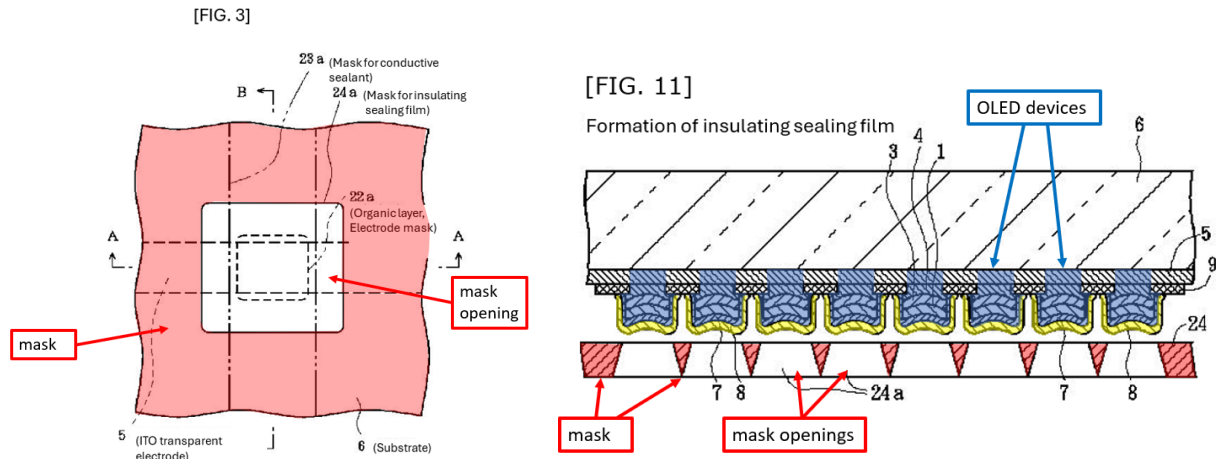
Declaration of Vivek Subramanian, Ph.D. in Support of Reply cathode,” or in other words does not reproduce the topography of the underlying layer. Suzuki, 5:59-67. Additionally, that Suzuki’s organic barrier layer (purple) is planarizing is further confirmed by Suzuki’s Figure 1, which shows that layer smooths out the corners of the underlying OLED device.

FIG. 1

IV. SELECTIVELY DEPOSITING REQUIREMENTS (GROUNDS I-III)

A. Selectively Depositing the Planarization Layer (Element 34[b])

17. As I explained in my opening declaration, Kijima teaches selectively depositing its sealing film 8. For example, Kijima explains that the insulating sealing film 8 is deposited via a “vacuum deposition device 11” using a “mask 24” (red) having “openings 24a.” *Id.*, [0040]-[0041]. Because the sealing film is restricted to the areas exposed by the mask openings 24a, the film is selectively deposited upon the OLED devices, as shown in Figure 11. *Id.*, [0051].



Kijima, Figs. 3, 11 (annotated).

18. I understand that Pictiva and Mr. Humphrey have argued that “nothing precludes blanket deposition of the organic layer followed by patterned etching.” POR at 22. However, as noted above, Kijima teaches that its sealing film 8 is deposited selectively. And Kijima does not discuss any subsequent removal step to remove unwanted material, nor does it discuss any issue with unwanted material as part of depositing its insulating sealing film. A POSITA would thus understand that Kijima’s sealing film 8 would be deposited without the need for any subsequent removal step.

19.A POSITA would similarly understand that Suzuki’s organic barrier layer 20 would be selectively deposited on top of the OLED device in Kijima, in the same way Kijima’s other layers are deposited. A POSITA would have recognized this would have been a straightforward, simple way to apply Suzuki’s organic barrier layer 20 to Kijima’s device. Thus, a POSITA would have understood that

Declaration of Vivek Subramanian, Ph.D. in Support of Reply
Suzuki's organic barrier layer 20 would be selectively deposited without the need
for a subsequent removal step.

20. Similarly, the methods taught by the prior art for Grounds II and III would also not require a subsequent removal step after depositing the planarization layer and barrier layer. For example, and as I explained in my opening declaration, the prior art, including Sturm, teaches the deposition of layers using inkjet printing. Duthaler similarly teaches the use of screen printing for depositing layers. A POSITA would have recognized that inkjet printing can be used to deposit material only where intended, without the need for a removal step. Indeed, ink jet printing was a known "suitable printing technology" for selectively depositing cited by the '389 patent. '389 patent, 4:53-55. Nothing in the '389 patent nor the prior art suggests there would be the need for a subsequent removal step, nor would a POSITA understand that these techniques would require one.
21. Additionally, I note that the potential of extraneous material being deposited can also be readily accounted for and controlled for with these known methods for depositing layers. For example, bleeding under a shadow mask can be controlled by designing the mask to take into account potential bleeding.
22. Pictiva and Mr. Humphrey also point to a paper from 2003 I co-authored involving the use of inkjet printing for multilevel interconnects for RFID circuits and related inductive components. POR at 22-23. The paper discusses how to

Declaration of Vivek Subramanian, Ph.D. in Support of Reply
prevent a “splash” effect resulting in a formation of a coffee-ring or donut structure using inkjet printing. Ex. 2023 at 2. From this article Pictiva and Mr. Humphrey draw broad and incorrect conclusions assertions about the applicability of inkjet printing for depositing encapsulation layers for an OLED, or the need for subsequent removal of unwanted deposited material. POR at 22-23.

23. As an initial matter, the Figure in the article Pictiva references describing a splash effect relates to deposition of a gold conductor film, not an organic planarization layer. Moreover, as the paper describes in detail, by controlling the temperature of the substrate and the solvent used, any coffee-ring effect from inkjet printing can be eliminated. Pictiva relies on the unsupported assertions of Mr. Humphrey that the temperatures discussed in Ex. 2023 for removing the coffee-ring effect would not be “suitable” for OLED device encapsulation. POR at 22-23. But this is incorrect, as it was known that OLED layers could be deposited at the temperatures described in the article, or even higher. In general, OLEDs are limited in temperature excursions to the glass transition temperature of the materials used; but even by 1999, OLEDs had been demonstrated that could survive 150°C processing. See, e.g., Ex. 1034 at 4 (“On the one hand, amorphous hole transport layers containing up to 50 wt% TPD in A435, a high Tg host polymer, have been demonstrated to be rather stable upon annealing even at

Declaration of Vivek Subramanian, Ph.D. in Support of Reply
temperatures as high as 150°C. On the other hand, bright devices are obtained for
TPD contents as low as 50 wt% and higher TPD contents do not seem to have a
large influence on the luminance of the devices”).).

B. Selectively Depositing the Barrier Layer (Element 34[c])

24. I understand that Pictiva and Mr. Humphrey argue that the shadow mask technique taught by Kijima for depositing its layers would necessarily result in a “bleeding” effect under the mask that would require a subsequent removal step. I do not agree. It was well known at the time of the ’389 patent to selectively deposit material only where wanted through a shadow mask. Any such bleeding effects can be readily compensated for, by creating the mask to take any such bleeding into account.
25. Additionally, I note that this argument appears to be based on a misreading of Fujimori. Fujimori is focused on “fine pattern processing,” and describes that its adhesion techniques for its shadow masks resulted in improved precision for such fine pattern processing. Pictiva takes Fujimori’s general assertion that “a pattern pitch of 2 mm is a suitable example for the mask,” Fujimori, [0035], and based on this statement, Pictiva asserts that there would necessarily be a bleeding effect that could not be accounted for with any 2mm shadow mask.
26. However, Fujimori continues to explain that: “and 500 μm is even more favorable.” Fujimori, [0036]. Fujimori further explains, for example, that “[t]he

Declaration of Vivek Subramanian, Ph.D. in Support of Reply
present invention is particularly effective for fine patterning, and 500 μm is an example of a more favorable pitch pattern.” Id., [0036]. Accordingly, and as a POSITA would recognize, Fujimori does not suggest that there was an unavoidable bleeding effect for 2mm shadow masks. Nor does Fujimori suggest that any bleeding effect would be substantial enough to require a subsequent removal step. Instead, Fujimori merely describes that its techniques were particularly beneficial for even smaller masks for fine patterning. As a POSITA would have understood, in the 2mm x 2mm mask contemplated by Kijima, bleeding effects could be effectively accounted for and controlled, such that no subsequent removal step would be necessary.

27. Additionally, I note that, if anything, Fujimori’s teachings would have motivated a POSITA to use Fujimori’s improved shadow mask, rather than turning to a different solution (i.e., a non-selective method followed by a removal step) that is not suggested anywhere in Kijima or Suzuki or Fujimori.
28. I also note that, as I explained in my deposition, a POSITA would have recognized that inkjet printing would have been another way to selectively deposit such a barrier layer. This is confirmed by the teachings of the prior art; for example, Sturm teaches that ink-jet can be used for selectively depositing patterned insulators. See, e.g., Sturm, 7:3-12. A POSITA would thus have had a

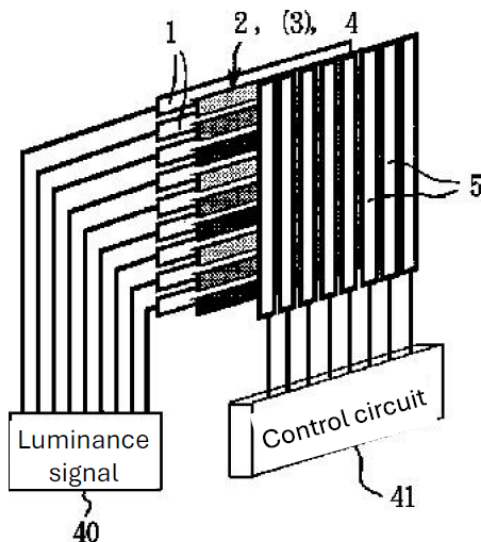
Declaration of Vivek Subramanian, Ph.D. in Support of Reply
reasonable expectation of success in using inkjet printing for depositing the
barrier layer.

**V. OBVIOUSNESS OF MODIFYING KIJIMA TO ADD A
PLANARIZATION LAYER AS TAUGHT BY SUZUKI (ALL
GROUNDS)**

**A. Kijima's Conductive Sealing Film Protects Against Radiant Heat
During Manufacturing, not Exposure After Manufacturing**

29. As I explained in my initial declaration, in Kijima, conductive film 7 functions together with electrode 1 to serve as a “negative electrode” to drive the OLED. In particular, conductive film 7 is formed as a stripe, and is what carries charge to electrode 1. Thus, for example, in Figure 24 of Kijima, conductive film 7 would be part of the striped “negative electrode 1:”

[FIG. 24]



Accordingly, conductive sealing film 7 is part of the device that is encapsulated in Kijima. A POSITA would have thus understood that encapsulation techniques

Declaration of Vivek Subramanian, Ph.D. in Support of Reply
like those taught by Suzuki and other references, would be used to encapsulate
the device – including conductive film 7.

30. I understand that Pictiva and Mr. Humphrey have suggested that my opinions overlook that conductive sealing film 7 provides some protection in Kijima. But as I explained in my initial declaration, Kijima teaches that its conductive sealing film 7 serves to prevent “degradation of the organic layer due to radiant heat during vapor deposition of the insulating sealing film 8.” See, e.g., Kijima, [0055]. Thus Kijima teaches that “the conductive sealing film is made of a material with good thermal conductivity such as a metal, efficient dissipation of the radiant heat can be expected,” thereby demonstrating the “degradation of the organic layer due to radiant heat ... is prevented.” Kijima, [0056]-[0057]. Kijima thus explains that its conductive sealing film 7 protects the device from radiant heat during the deposition of subsequent layers.
31. In contrast, conductive sealing film 7 does not provide adequate protection from exposure after manufacturing. For example, Kijima’s Comparative Example 3 explains that after depositing the conductive sealing film 7 in a vacuum, the vacuum conditions were temporarily removed, and then returned before depositing the insulating sealing film 8. Kijima, [0084]. Kijima explains that the EL element produced in this manner showed the “adverse effects of exposing the element to the atmosphere,” including an “increase in dark spots. Kijima, [0086]-

Declaration of Vivek Subramanian, Ph.D. in Support of Reply [0087]. In other words, conductive sealing film 7 alone, even deposited in vacuum conditions, did not protect the underlying EL device from subsequent atmosphere exposure. This means that the conductive sealing film 7 did not provide the protection of an encapsulating layer. A POSITA would have readily understood that additional encapsulation layers, like Suzuki's organic barrier layer 20, would provide necessary protections to the underlying EL element that are not provided by the conductive sealing film 7.

32. Thus, as a POSITA would have understood, while would provide some protection from oxidation as Kijima describes, it does not provide sufficient protection from exposure to atmosphere. I also note that the '389 patent never mentions radiant heat generated during manufacturing. And as Kijima's other teachings make clear, the primary protection provided by conductive sealing film 7 provides is to protect against radiant heat during the deposition of insulating sealing film 8.

B. A POSITA Would Have Recognized the Additional Protection Provided by Suzuki's Organic Barrier Layer

33. I understand that Pictiva and Mr. Humphrey have also argued that adding Suzuki's organic barrier layer 20 to Kijima results in a "triple-layer structure" that would not be necessary because the prior art describes only double-layer structures. POR at 31-36. In my opinion this misses the point. As I explain above, Suzuki teaches that its dual-layer encapsulation provides improved protection

Declaration of Vivek Subramanian, Ph.D. in Support of Reply from exposure to atmosphere. Adding Suzuki's organic barrier layer 20 to Kijima along with Kijima's insulating sealing film 8 results in a dual-layer encapsulation of planarization layer and barrier layer, as was known in the prior art. Picitva and Mr. Humphrey appear to argue that because the device of Kijima also includes its conductive sealing film 7, that the result of adding Suzuki's organic barrier layer 20 is a "triple-layer" structure. But a POSITA would have recognized the benefits provided by Suzuki's organic barrier layer 20, and the resulting dual-layer encapsulation of planarization layer and barrier layer, and would have been motivated to provide that layer in Kijima for the reasons I explained in my initial declaration.

34. As I explained above, for example, Kijima teaches that its conductive sealing film 7 is insufficient to protect against atmosphere exposure, including the effects of oxygen and moisture. A POSITA would have understood that Suzuki's organic barrier layer 20 would have provided additional, beneficial protection. As I explained in my initial declaration, Suzuki teaches that its encapsulation prevents growth of dark spots that may result from such exposure. Suzuki, 1:41-52. And as Kijima's Comparative Example 3, for example, teaches, Kijima's conductive sealing film 7 does not protect from exposure to atmospheric conditions that lead to dark spots. Thus, a POSITA would have recognized the benefits of using a multi-layer encapsulation for the OLED device as Suzuki teaches, and would

Declaration of Vivek Subramanian, Ph.D. in Support of Reply

have been motivated to add Suzuki's organic barrier layer 20 to obtain those benefits.

35. Pictiva and Mr. Humphrey also argue that Suzuki's organic barrier layer 20 would not be necessary in Kijima because there would be no defects in the surface of Kijima's conductive sealing layer 7. POR at 37-42. But as I explained in my initial declaration, a POSITA would have understood that defects occur, such as those taught by Suzuki that are "inevitably" formed, Suzuki, 5:51-54, and a planarizing layer such as Suzuki's organic barrier layer 20 would create a smooth surface and cover such defects.

36. Relatedly, I understand that Pictiva and Mr. Humphrey have argued that there would be no such defects because they would only exist in a layer like Suzuki's cathode 18, not Kijima's conductive sealing layer 7. Pictiva points to my deposition testimony that 1 micron thick layer of gold would not be likely to have pinhole defects specifically. However, I also explained that even if conductive sealing layer 7 were made of gold, there would be other types of defects a planarization layer like Suzuki's organic barrier layer 20 would cover, such as buckling. And a POSITA would have understood that such defects would be covered through the use of Suzuki's organic barrier layer 20.

C. Pictiva and Mr. Humphrey Misunderstand the Results of Kijima's Experiments

37. I understand that Pictiva and Mr. Humphrey have argued that Kijima describes improved protection of the device such that no additional encapsulation layers would be necessary. I do not agree. Kijima describes that its approach produced devices with “good stability” that had no observable dark spots “for one month after production.” *See, e.g.*, Ex. 1010 ¶¶ 54, 58, 64, 68, 72. In contrast, the OSRAM product cited by Pictiva and Mr. Humphrey, for example, has a lifespan of 10,000 hours at 25 degrees Celsius. Ex. 2039 at 1. Kijima also does not focus on the efficacy of the encapsulation of the device for preventing oxygen/moisture penetration during the full lifespan of an OLED device. Thus, as I explain above, as well as in my initial declaration, a POSITA would have recognized that the addition of Suzuki's organic barrier layer 20 would have provided improved dark spot reduction over Kijima's approach alone.

38. Additionally, I note that comparing the experiments and results described by Suzuki and Kijima is at best of limited value. Suzuki and Kijima have significant variance with respect to the materials used and structures formed. Additionally, the experimental conditions in each reference vary significantly, both with respect to temperature and humidity. Kijima's focus was on oxidation by radiant heat generated during the manufacturing process, and were limited to one month. Suzuki, in contrast, was focused specifically on the benefits of encapsulation

Declaration of Vivek Subramanian, Ph.D. in Support of Reply structures. Suzuki's results are clear that its multilayer encapsulation structure of organic and inorganic barrier layer is superior to an encapsulation structure consisting of a single inorganic barrier layer, as in Kijima. A POSITA would have thus recognized that the benefits taught by Suzuki would be readily applicable to Kijima, and would have yielded improved results over Kijima's approach alone.

D. A POSITA Would Have Added Suzuki's Organic Barrier Layer to Kijima

39. I understand that Pictiva and Mr. Humphrey have argued that a POSITA would not have added Suzuki's organic barrier layer 20 to Kijima because additional layers should be avoided where not necessary. POR at 47-48. But as I explain above, a POSITA would have understood the benefits of a dual-layer encapsulation (i.e., the addition of Suzuki's organic barrier layer 20 to Kijima's insulating sealing film 8). As I explain above as well as in my initial declaration, the use of and benefits of such an encapsulation were well known, and would have been well within the skill of a POSITA to implement.

40. I understand that Pictiva and Mr. Humphrey have also argued that adding Suzuki's organic barrier layer 20 to Kijima goes against Kijima's teachings regarding radiant heat dissipation. POR 50-54. However, as I explained in my initial declaration, a POSITA would add Suzuki's organic barrier layer 20 on top of Kijima's conductive sealing film 7. Thus, the conductive sealing film 7 would

Declaration of Vivek Subramanian, Ph.D. in Support of Reply

dissipate radiant heat in the same way Kijima describes. The addition of an insulating sealing film 8 on top of Suzuki's organic barrier layer 20 would not impact the conductive sealing film 7's ability to dissipate heat in the same way Kijima teaches. Indeed, for example, Example 4 of Suzuki describes that inorganic barrier layer of SiO₂ was vacuum deposited on the organic barrier layer, and the resulting device "having the protective layer of the invention was remarkably improved in storage stability." Suzuki, 9:13-23. And even if there were some theoretical concern with the organic barrier layer 20 impacting the ability of conductive sealing film 7 to dissipate heat during the deposition of the insulating sealing film 8 on top of Suzuki's organic barrier layer 20, such concerns could be controlled for, such as by reducing the deposition temperature. And a POSITA would have readily understood the benefits of applying Suzuki's organic barrier layer 20 to improve the encapsulation of the device.

VI. OBVIOUSNESS OF CLAIM 35 BASED ON KIJIMA IN VIEW OF SUZUKI AND STURM

41. As I explained in my initial declaration, a POSITA would have recognized that there were known methods for selectively depositing encapsulation layers, each of which had their own benefits and considerations. One such known method was deposition by ink jet. As the '389 patent acknowledges, "many manners" could be used for depositing its organic planarization layer, including ink jet. '389

Declaration of Vivek Subramanian, Ph.D. in Support of Reply
patent, 4:48-55; *see also* 7:3-5 (“In fact, generally any printing techniques
suitable to deliver the desired planarization layer material can be used.”).

42.As I noted in my initial declaration, the ’389 patent presumes that a POSITA
would know how to employ ink jet technology, because it provides no detail as
to use that technology. And prior art references, including Sturm and Duthaler
demonstrate that deposition by ink jet was among the known methods for
depositing layers like the ’389 patent’s organic planarization layer. A POSITA
would have recognized certain benefits from using ink jet deposition as taught by
Sturm, for example, including increased precision, minimized risk of
contamination, and material efficiency.

43.I understand Pictiva and Mr. Humphrey have argued that Sturm is “not analogous
art,” because it does not discuss specifically depositing encapsulation layers.
POR at 54. But I referred to Sturm for its description of ink jet printing, not any
teachings relating to depositing specific layers. As I explained in my initial
declaration, it would have been obvious to use Sturm’s ink-jet deposition method
to deposit the organic barrier layer in Kijima. That Sturm does not disclose OLED
encapsulation specifically does not diminish a POSITA’s knowledge that ink jet
printing would have been a straightforward method for depositing encapsulation
layers, and would have provided the benefits I noted in my initial declaration,

Declaration of Vivek Subramanian, Ph.D. in Support of Reply including increased precision, minimized risk of contamination, and material efficiency.

44. Pictiva and Mr. Humphrey also suggest that deposition of the OLED layers is significantly different than depositing an encapsulation layer, such that Sturm's techniques may not be applicable to depositing an encapsulation layer. However, they do not explain any particular difficulties they believe would prevent depositing encapsulation layers via ink jet, other than that the size of the encapsulation may be larger or thicker than the EL layers Sturm describes. POR at 54-57. But in the combination of Kijima and Sturm, I point to Sturm's ink jet deposition for depositing the encapsulation layers on individual OLED devices (i.e., pixels), not a larger area like the film Pictiva points to. Thus, while inkjet would be suitable for depositing a larger layer, the concerns noted by Pictiva and Mr. Humphrey in the combination of Kijima and Sturm are unfounded for this additional reason.

45. Similarly, while Sturm's disclosures relate to forming OLED layers, it was known that inkjet could be used to deposit thicker layers in a single pass, including, for example, by tuning the ink to increase viscosity. Additionally, even at Sturm's stated thickness, it would have been well within the skill of a POSITA to make any additional passes necessary to generate an appropriately thick layer. Pictiva again points to Ex. 2023 to suggest Sturm's ink jet method would not be

Declaration of Vivek Subramanian, Ph.D. in Support of Reply appropriate for depositing encapsulation layers, but Ex. 2023's discussion of gold nanoparticles is not applicable for the reasons I described above. Additionally, and as I previously explained, the coffee-ring effect can be suppressed as the article itself explains. Further, the temperatures discussed in Ex. 2023 would be suitable for depositing OLED layers, as it was known to deposit OLED layers at such temperatures.

46. Pictiva and Mr. Humphrey also make a number of arguments relating to the applicability of inkjet printing to deposit the other layers of Kijima. POR at 62. I do not agree with these arguments for the same reasons I have explained above regarding the applicability of inkjet printing to deposit encapsulation layers. The argument that there were challenges with forming nanoparticle solutions or that inkjet printing could not produce a dense barrier layer are similarly inaccurate. For example, Pictiva and Mr. Humphrey suggest that nanofilms created from solution processes tend to be porous under process conditions suitable for OLEDs, and point to an article describing the preparation of silica nanofilms in support. POR at 63. But while this may be true of silica, which is known to not densify at such temperatures, there are other materials that do create dense films at such temperatures, including for example, printed gold nanoparticles and polymers. In other words, Mr. Humphrey is incorrectly ascribing a limitation of silicon particles to all materials, which is simply incorrect.

47. Again, the '389 patent teaches that inkjet printing was a suitable method for forming its encapsulation layers, and raises no such concerns. As I previously explained, a POSITA would have understood that Kijima's layers would similarly be formed using inkjet printing, and would have understood the benefits of using inkjet to form these layers.

48. I also understand that Pictiva and Mr. Humphrey argue that Kijima's teachings regarding forming films under vacuum conditions would suggest that inkjet printing would not be suitable for the encapsulation layers. POR at 64-65. But as I previously explained, ink jet printing is routinely done under nitrogen. In particular, for decades it has been known to have an evaporator connected to a glove box, which is under nitrogen, with an inkjet printer inside the glove box, so that there is no exposure to atmosphere. A POSITA would have been well aware of this standard approach to ink jet printing, and such a process is fully consistent with Kijima's teachings relating to not exposing the device to atmosphere until it is protected by an insulating sealing film.

49. Finally, I understand that Pictiva and Mr. Humphrey cite to a 2003 paper that I co-authored, Exhibit 2025, to argue that "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." POR 62 (citing Ex. 2025, "Plastic-Compatible Low Resistance Printable Gold

Declaration of Vivek Subramanian, Ph.D. in Support of Reply
Nanoparticle Conductors for Flexible Electronics,” D. Huang, F. Liao, S. Moles, D. Redinger, and V. Subramanian, *J. of the Electrochemical Soc’y*, Vol. 150, pp. 412, 2003). This is not correct.

50. As the Exhibit 2025 paper explains, my co-authors and I had demonstrated “a thiol-derivatized gold nanocluster technology suitable for use in printed circuits on plastic,” based on “a plastic-compatible gold nanocrystal technology with a *temperature excursion of less than 150°C.*” Ex. 2025 at PDF page 2. Moreover, this is technology that we had published by and presented by April 2002, before the ’389 patent was filed. In “Inkjetted gold conductors for electronics on plastics,” D. C. Huang, F. Liao, and V. Subramanian, *Proceedings of the Materials Research Society Spring 2002 Meeting* (April 2002), we explained in our article abstract that “Low resistance gold conductors can be produced by inkjetting or screen-printing gold clusters on arbitrary substrates and heating to *temperatures below 150 degrees Celsius*, fully compatible with conventional plastic substrates.” Ex. 1031.¹

¹ Ex. 1031 contains the abstract of the article that we published and presented at the Materials Research Society Spring 2002 Meeting, April 1–5, 2002. An archived web capture of the online meeting program explains that “the PDF version of the Abstracts [i.e., Ex. 1031] was posted on March 6, 2002. Ex. 1030, “2002 MRS

51. Therefore, a POSITA at the time of the '389 invention would appreciate that a conductive sealing layer made of gold (as discussed in Kijima) may be readily applied by ink-jetting, based on the technology that we demonstrated in our April 2002 article.²

Spring Meeting Program,” *available at* <https://web.archive.org/web/20020802113232/http://www.mrs.org/meetings/spring2002/program/symposia>.

² Although Exhibit 2025 did state that “the melting/sintering temperatures for all gold nanocrystals reported to date are greater than 200°C,” this statement was referring to work that had been reported prior to the thiol-derivatized gold nanocluster technology that my co-authors and I demonstrated. Indeed, the list of “References Cited” in Exhibit 2025 includes the April 2002 article (*see* Ex. 1031) in which we explained that “low resistance gold conductors can be produced by inkjetting or screen-printing gold clusters at temperatures below 150 degrees Celsius.” Ex. 2025, at PDF page 7. Thus, a POSITA with access to our published work would recognize that such technology was available by April 2002, prior to the '389 patent's filing date. In fact, this would have been known by at least March 6, 2002, when the abstract of our article was published (as discussed in the prior footnote).

52. Finally, I note that claim 35 of the '389 patent would be satisfied regardless of whether ink-jetting is used for Kijima's conductive sealing film. Thus, to the extent there is any question whether ink-jetting could be used for depositing this film, the deposition methods described in Kijima may of course still be used for depositing the conductive sealing film, while using ink-jetting for the planarization layer. Although this would involve multiple deposition methods, it would be obvious to a POSITA nevertheless, as it would allow for realizing the advantages of ink-jetting for the planarization layer that I discussed in my previous declaration, including a high degree of control over precision printed patterns, cost efficiency, and lower risk of contamination.

VII. OBVIOUSNESS OF CLAIM 36 BASED ON KIJIMA IN VIEW OF SUZUKI AND DUTHALER

53. I understand that Pictiva and Mr. Humphrey have suggested that a POSITA would not have used screen printing as taught by Duthaler to selectively deposit Suzuki's organic barrier layer. As I explained in my initial declaration, a POSITA would recognize the benefits taught by Duthaler for its screen printing technique, including low-cost and high throughput. Duthaler, 14:13-23. A POSITA would have further recognized that Duthaler's screen printing method had the ability to deposit relatively thick organic layers, as I also previously explained. And as with inkjet printing, it was well known to perform screen printing under nitrogen, as I explain above.

VIII. OBVIOUSNESS OF CLAIMS 41-46 BASED ON KIJIMA IN VIEW OF SUZUKI AND FUJIMORI

54. I understand that Pictiva and Mr. Humphrey also argue that a POSITA would not have used Fujimori's shadow mask to deposit encapsulation layers because Fujimori uses its shadow mask for depositing EL layers instead. I do not agree. Kijima teaches the use of a shadow mask to selectively deposit its layers. And Fujimori teaches an improved method for using shadow masks. As I explained in my initial declaration, a POSITA would have been motivated to use Fujimori's shadow masking technique, including to improve accuracy and enable smaller pixel size. Pet. at 54.

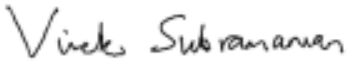
55. I also understand that Pictiva and Mr. Humphrey have argued that the limitations of claim 43 are not met, because the mask is not in contact with the substrate, but instead on an SiO₂ film. But the SiO₂ film is the topmost layer on the substrate, and the shadow mask is in direct contact with it. The shadow mask is thus in contact with the substrate through the SiO₂ film, as opposed, to example, being separated by an air gap.

IX. JURAT

56. I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements

Declaration of Vivek Subramanian, Ph.D. in Support of Reply
and the like so made are punishable by fine or imprisonment, or both, under
Section 1001 of Title 18 of the United States Code.

Date: October 9, 2025



Vivek Subramanian, Ph.D.