

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. IPR2024-01222
Patent No. 6,949,389

DECLARATION OF MR. KURT HUMPHREY

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Patent Trial and Appeal Board
U.S. Patent and Trademark Office
P.O. Box 1450
Alexandria, VA 22313-145

I, Kurt Humphrey, declare as follows:

I. Introduction

1. I have been retained as an independent expert on behalf of Pictiva Displays International Ltd. (“Patent Owner”) to provide certain technical background regarding U.S. Patent Application No. 2003/0206332 (“Yamazaki”), U.S. Patent Application No. 2002/0140347 (“Weaver”) and Japanese Published Application No. H10-1069 (“Fujimori”) that form the basis for the Grounds of unpatentability in the Petition for IPR2024-01222.

2. I am being compensated for my time at my normal consulting rate. My compensation does not depend on the outcome of any matter or on any of the opinions provided below. I have no financial interest in this matter.

3. My testimony herein is based on my technical background, my years of experience in the field of microelectronics, photonics, and display technologies, the associated fabrication and deposition technologies, and my review of the materials cited herein.

4. I provide my testimony from the perspective of a person of ordinary skill in the art at the time of the invention (further addressed below). I am familiar with the knowledge and skill level of these people based on my decades of experience in the display technology and frequent interactions with such people.

For example, in the 2001-2002 time frame, I served as Engineering Director at TAEUS International Corporation, and was the primary technical contributor on display technology projects including LCD, LED, plasma and OLED, as well as other photonics and optoelectronics assignments. Before then, between 1986-1989, I assisted in setting up the state-of-the-art semiconductor fab (WAX) that would become a key LCD display research and pilot production facility for the Flat Panel Display (FDC) Company consortium led by Philips.

II. Qualification and Experience

5. I am the founder and principal technologist of IP Engenuity LLC, an entity that provides engineering consulting to high-tech companies, inventors, patent holders and intellectual property professionals. I am also an Adjunct Professor in the College of Engineering at Colorado Technical University in Colorado Springs, specializing in instruction of general organic and inorganic chemistry for engineers. A copy of my CV is attached as Appendix A.

6. I obtained my Bachelor of Science and Master of Science degrees in Ceramic Engineering from the University of Missouri-Rolla (now Missouri University of Science and Technology), in Rolla, Missouri, in 1978 and 1980, respectively.

7. I worked as an engineer and engineering manager in the microelectronics industry for 20 years including positions with General Motors,

AT&T Technologies, Philips Research Laboratories (Eindhoven, NL), United Technologies Microelectronics Center, and Rockwell Semiconductor Systems.

8. After serving as Director of Engineering for TAEUS International from 1999-2005, I launched IP Enginuity LLC to provide comprehensive technical expert consulting and engineering services to high-tech companies, inventors, patent holders and intellectual property professionals.

9. In addition to my extensive experience in developing microelectronics fabrication processes, materials characterization, and failure analysis methods for a variety of microelectronic products and components including CMOS digital logic and memory integrated circuits (ICs), smart power devices, complementary bipolar silicon-on-insulator (SOI) ICs, CMOS image sensors, automotive sensors and micro-electrical-mechanical systems (MEMS) gyroscopes, I have investigated and reverse-engineered several commercial OLED displays used in a variety of applications from smartphones and smart watches to medical devices.

10. I have been engaged by multiple major flat panel developers, users, OEMs and/or patent owners to investigate display IP and commercial OLED displays dating back to 2011. The OLED IP investigations required comparison of published OLED utility patents to commercially available displays in terms of their physical, material and electrical design and construction. Subsequent engagements have also involved technical investigations of sub-pixel design and construction as

well as overall display layout including peripheral circuitry used to communicate touch sensor output with the specific microprocessors and microcontrollers used to interpret and execute the various product operations and functions associated with the touchscreen.

III. Skilled Artisan

11. I understand that Samsung defines a person of ordinary skill in the art at the time of the invention as someone with “a bachelor’s degree in Electrical Engineering, Materials Science, or a related field, and at least one year of experience in display technologies.” Petition at 14-15.

12. I have degrees in Ceramic Engineering, a branch of Materials Science, and collaborated on flat panel display (FPDs) technology at Philips in the 1980s as well as multiple FPD projects involving plasma, LED and OLED display technologies for TAEUS clients in the 1999-2003 time frame. Since 2005, I have worked on several projects involving LCD, electrophoretic (E-ink) and OLED technologies.

13. I was at least a person of ordinary skill in the art, if not one with above average skills, at the time of the invention (2001), under Samsung’s definition of a person of ordinary skill in the art.

IV. Ground I

14. I am informed that in the district court action, Samsung has proposed to construe “planarization layer” as “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 at 6-7. I am also informed that Samsung has proposed that “selectively depositing” means “depositing a material in only desired areas, such that no additional processing must be performed for removing unwanted material.” *Id.* at 7. I have been asked to apply those definitions in my analysis.

A. Whether a Person of Ordinarily Skill in the Art Would Have Started with Yamazaki

15. I understand that Samsung has proposed to combine Yamazaki’s with U.S. Patent Application No. 2001/0052752 (“Ghosh”). I have been asked to comment on whether a person of ordinary skill in the art would have started with Yamazaki to encapsulate a plurality of OLED devices, given the state of the art. My answer is no. As a preliminary matter, it is my view that because the publication date of the Yamazaki application was not until Nov. 6, 2003, it is highly unlikely that the inventors of the ‘389 patent would have even been aware of the existence of Yamazaki’s disclosures.

1. Not Depositing Cover Layer under Vacuum Condition

16. Yamazaki discloses applying its cover layer “using the inkjet method” (*e.g.*, cover layer 1105) or an electric field application method (*e.g.*, cover layer 1407). EX1005, [0178]; [0202]-[0203] & [0188] (using the same application method as the EL layer and the EL layer is applied using the electric field application layer). Yamazaki discloses that, in ink-jet printing, “pressure is applied to the material chamber 1207 ... whereby the organic resin liquid provided in the material chamber 1207 is pushed out and then applied.” *Id.*, [0182]. Yamazaki also discloses that the electric field application method involves dissolving the cover layer material in a solvent to form an application liquid, atomizing the application liquid to create charged particles or droplets, controlling the application liquid by the electric field, and forming the cover layer over a substrate at the application position. *Id.*, [0012]-[0013] and [0038] (describing electric field application method in reference to EL layer, and “[t]he cover layer is formed by an application method that is similar to that for the formation of the EL layer”). Yamazaki further discloses using inert gas or “an atmosphere of the solvent” when applying the EL layer to minimize exposure of an OLED device to oxygen and moisture. EX1005, [0087]. To the extent that inert gas or “an atmosphere of the solvent” is also used when applying the organic cover layers, the organic cover layer would also be deposited under the same atmospheric conditions rather than

under vacuum. That is, OLED devices are exposed to gaseous atmospheres when the organic layer is deposited.

17. Yamazaki discloses several examples. In the first embodiment, Yamazaki uses an aluminum (“Al”) cathode protective layer, an inorganic barrier layer with materials such as silicon nitride or tantalum oxide, and an organic resin-based cover layer deposited using electric field application method. In the second embodiment, Yamazaki uses an aluminum (“Al”) cathode protective layer, an inorganic barrier layer with sputtered tantalum oxide, and an organic resin-based cover layer deposited using electric field application method. In the third embodiment, a relatively thin 10nm to 300nm organic resin is first deposited with ink-jet printing over the cathode and then a diamond like carbon (DLC) film is sputtered over the cover layer. In the fourth embodiment, after cathode deposition a protective cathode layer is formed by evaporative deposition of an aluminum alloy, followed by sputtered silicon nitride and an organic resin (optionally doped with barium oxide), is deposited using electric field application method. In the fourth embodiment, the order of the inorganic barrier layer and the organic resin layer may be switched. The fifth through the seventh embodiments are similar to the first through the third embodiments, but with some differences in the emission layer materials.

18. Kijima (the primary reference at issue in IPR2024-01223) warns, however, exposing the OLED device to ambient atmosphere [0081] and thereby ambient atmospheric pressure [0071] before forming protective layers would lead to severe performance degradation over time and formation of “a large number of dark spots.” *See* EX1010, [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”). Kijima offers no data or evidence, e.g. information on the venting process used to bring the devices from a vacuum to ambient atmospheric conditions or additional data to explain whether the severe performance degradation is due to exposure to atmospheric pressure, ambient atmospheric composition, or a combination of the two. Therefore, it is left to the reader (POSITA) to speculate as to the key variable(s) resulting in Kijima’s reported severe performance degradation associated with a temporary change from a vacuum to ambient atmospheric conditions. This warning and the associated uncertainty as to the actual causal factors for the catastrophic failure of Kijima’s devices would dissuade a person of ordinary skill in the art from using inkjet printing or the electric field application method to apply the organic layer on the cathode except under low pressure and controlled atmospheric conditions even when the cathode has other protective layers.

19. This is consistent with Suzuki, which used vacuum to deposit both the organic and inorganic protective layers for protecting OLED devices. *See* EX1012, 8:48-55 (vacuum depositing TPAC as an organic barrier layer over an electroluminescent unit, followed by thermal treatment and vacuum deposition of an inorganic barrier layer), 8:64-9:3 (same); 9:13-17 (same), 9:26-34 (same).

20. But as noted above, Yamazaki taught “form[ing] the EL layer, the cathode, the barrier layer, and the cover layer in the same multi-chamber in succession without releasing them to the atmosphere.” EX1005, [0244]. A person of ordinary skill in the art would not have run such risks given Kijima’s and Yamazaki’s warnings. In fact, the risk of performance degradation would increase after depositing the top electrode:

In forming an OLED, a layer of metal is typically utilized as the cathode to ensure efficient electron injection and low operating voltages. However, metals and their interface with the organic material are *susceptible to oxygen and moisture*, which can severely limit the lifetime of the devices. Moreover, moisture and oxygen are also known to increase “dark spot areas” in connection with OLEDs.

EX1008-Weaver, [0004]. The top electrodes are deposited after the emission (EL) layer. *E.g.*, Yamazaki, [0177] (“Provided on the EL layer 1103 is a cathode 1104” followed by formation of organic cover layer 1105), [0198]-[0199] (top electrodes formed after EL layer formation). Hence, a person of ordinary skill in the art

would recognize that, even if inkjet and the electric field application method that typically use atmospheric pressure may be suitable for depositing organic light emitting EL layers, the encapsulation steps after depositing the top electrodes should still take place under vacuum in order to obtain a suitable and operable OLED device. *See* EX1010-Kijima, [0076]-[0081] (comparative example 2, showing the “adverse effects of exposing the element to the atmosphere before the formation of the conductive sealing film 7”), [0082]-[0087] (comparative example 3, showing “[t]he adverse effects of exposing the element to the atmosphere before the formation of the insulating sealing film 8,” that is, the barrier layer). Hence, a POSITA would not have started with Yamazaki’s embodiments that would have deposited the first encapsulation/protective layer under pressure, *e.g.* atmospheric pressure.

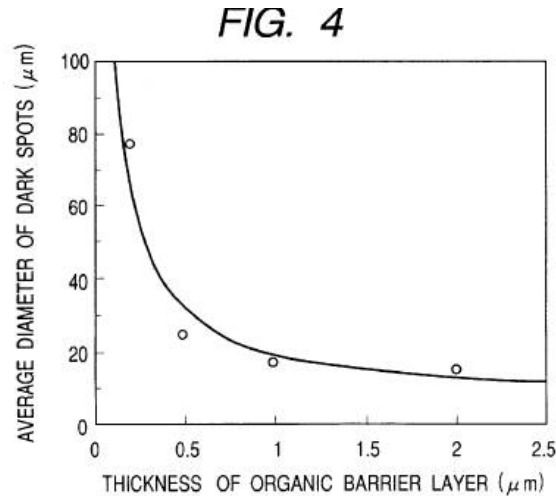
21. That is, in light of the state of the art, as reflected in Kijima and Suzuki, a POSITA would not have expected that OLED devices made in accordance with Yamazaki’s embodiment 3 or Figure 14 would have provided acceptable performance and would not have started with the method to begin with. And unlike Kijima and Suzuki, Yamazaki did not provide any experimental data to show that the resulting devices would be suitable for their intended purposes.

2. Too Thin an Organic Layer for Effective Protection

22. Yamazaki discloses that the organic barrier layer, i.e., “cover layer,” has preferably a thickness range “between 10 nm and 300 nm.” EX1005, [0177]. This may be a result of Yamazaki’s solution-based process. Unlike vacuum evaporation, Yamazaki’s ink-jetting method and electric field application method both involve dissolving the organic material in a solvent and applying the solvent to the desired positions. Yamazaki, [0182], [0012]-[0013]. The solvent would then be removed to leave behind the organic material. To the extent that several passes are made to build up the organic materials (something that Yamazaki does not disclose), each time the solvent would dissolve a bit of the deposited materials from the previous pass, changing the topologies and increasing the risk of defects as well as the risk of the material spreading onto undesired parts. Hence, it may not be practical for Yamazaki’s ink-jetting and electrical field application method to build up a thick organic layer.

23. Suzuki discloses, however, large dark spots would form if the organic barrier layer in contact with the electrodes is below 0.5 micron (or 500 nm). *See* EX1012, Fig. 4, 7:11-14 (“The organic barrier layer 20 should preferably be form[ed] in a thickness of 0.5 μm or over in order to ensure good coverage of the unit U and to effectively intercept moisture therewith.”). In fact, according to the figure below, the thickness of the organic layer should be 1 μm or over because at

a thickness of 0.5 μm , the curve is still in the rapidly decreasing range, while at 1 μm or over, the size of the dark spots approaches a limit.



(EX1012, Fig. 4)

24. Suzuki discloses that, an organic layer of sufficient thickness is needed because allegedly defects in cathodes would form due to “foreign matter inevitably deposited on the electroluminescent unit U during the course of the fabrication thereof” EX1012, 5:54-58. Suzuki also states that these defects are addressed by an organic layer that is at least 0.5 μm (500nm) in thickness, that is, thicker than the 10-300nm thickness provided by Yamazaki.

25. Notably, Suzuki suggests using the same type of resins as Yamazaki. *Compare* EX1005-Yamazaki, [0178] (Yamazaki’s resins include “epoxy resin, acrylic resin, polyimide, polyamide, and silicon[e] resin”) *with* EX102-Suzuki, 6:7-25 (preferred resins include those formed from trimethylol acrylates, long-chain

acrylates, epoxy acrylates, urethane acrylates, ether acrylates) & 6:56-64 (preferred examples include TPAC, polymethyl methacrylate, polyethylene terephthalate and the like). Thus, to the extent that Petitioner's theory is that the effect of organic layer in Suzuki is universal and would have inspired a person of ordinary skill in the art to use a similar organic layer – an assumption underlying Samsung's reasoning to apply Suzuki's disclosures to Kijima, a person of ordinary skill in the art would recognize from Suzuki's disclosure that Yamazaki's organic layer, such as that disclosed in EX1005, [0177] is too thin and would not be effective in preventing oxygen and moisture intrusion or dark spot growths.

26. That is, in light of Suzuki's experimental data and Yamazaki's organic layer thickness, a person of ordinary skill in the art would recognize that Yamazaki's organic layer would not be suitable for an OLED devices and therefore would not started with Yamazaki's organic deposition method. This conclusion is further reinforced by the fact that Yamazaki did not report device lifetime results, suggesting that Yamazaki's methods were probably not effective in preventing exposures to oxygen and moisture or growth of dark spots.

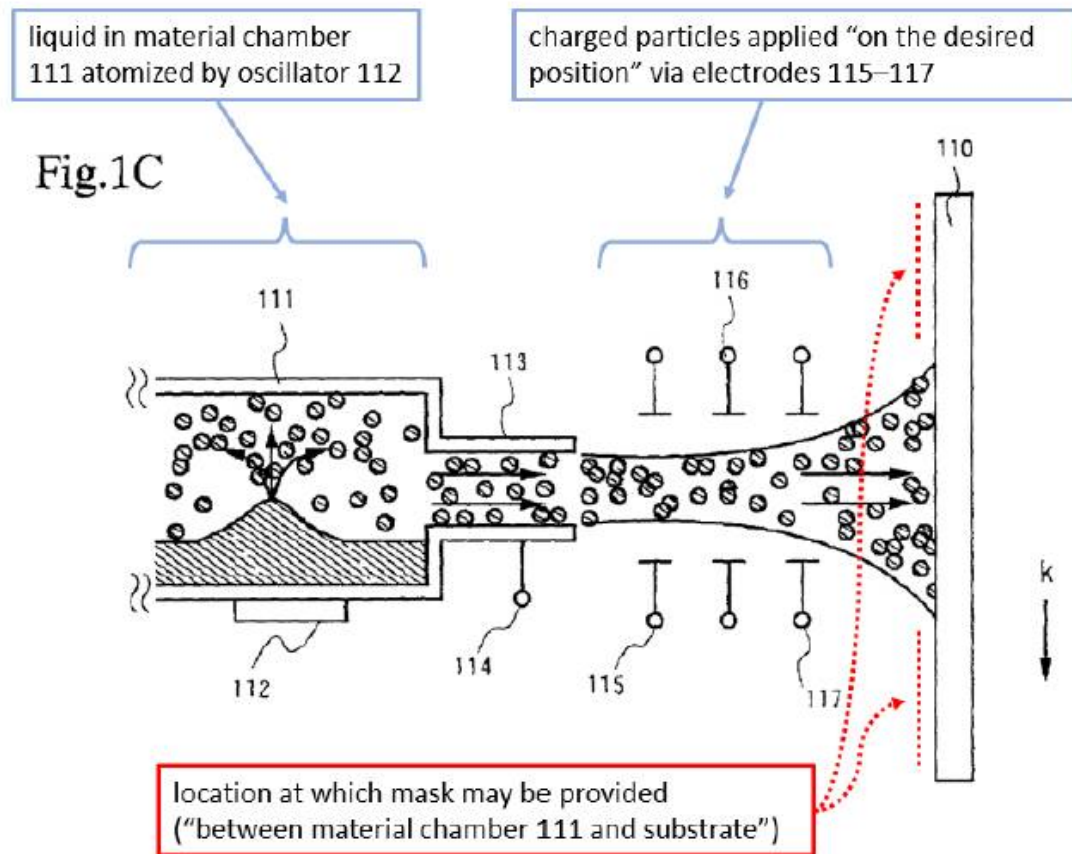
B. Whether a Person of Ordinary Skill in the Art Would Have Used a Shadow Mask with Yamazaki's Ink-Jetting or Electric Field Application Method

27. **Claim 37** requires depositing the planarization layer by “depositing an organic layer through a shadow mask.” Yamazaki deposits its organic layer using

ink-jetting. *See* EX1005, [0178]. The inkjet method described for Embodiment 3 (Figure 11) does not mention the use of a mask. *See id.*, [0179]-[0182].

28. Yamazaki's paragraph 86 of embodiment 1, where Yamazaki describes depositing an EL layer using the electric field application method, does state, however, "although ***not used herein***, a mask may be provided" EX1005, [0086]. This would indicate to a person of ordinary skill in the art that the EL in embodiment 1 is formed without using a mask. Hence, to the extent any of the organic cover layers are deposited using the method described for embodiment 1, they would also not be deposited using a mask. This is consistent with Yamazaki's description that "the application liquid for the EL layer is controlled by an electric field to thereby form the EL layer, resulting in making it possible to control the application position." *Id.*, [0198]. In other words, electric field rather than mask controls where the application liquid will land or be applied to.

29. For that reason, even if a mask is used in the electric field application method, the mask is not a shadow mask because, as Samsung's own annotation demonstrates, electrodes 115-117 define the positions at which the liquid is applied and the mask does nothing to further define that position:



(Pet. 34)

30. I have been asked to comment on whether Yamazaki's reference to Seiko-Epson's proposed application of EL using an electric field or an ink-jet makes Yamazaki's ink-jet and electric field application methods "known" methods. Inkjet printing and deposition techniques, and to a lesser extent electric field application methods, were "known", but not as yet applied to commercial OLED display production. Circa 2000, evaporation and spin-coating were still the dominant deposition methods under development for commercial OLED displays. At the time of the '389 invention and the purported art, a POSITA would have

approached the application of ink-jetting, and its electric field variant, to commercial OLED manufacturing with trepidation. Furthermore, use of a mask for the inkjet or electric field depositions would have further dissuaded a POSITA from experimenting with Yamazaki's deposition methods. Vapor deposition, *e.g.*, evaporation, was the dominant method of depositing small molecule organic EL materials circa 2000 while solution-based depositions, *e.g.* spin-coating, were used for macromolecules like polymers whose vaporization temperatures are too high and even vaporization under vacuum could lead to material degradation. For example, "While *crystalline organic materials require vacuum deposition* onto a glass substrate, it may be possible to layer polymers over this flexible TFT substrate using spin-casting or other inexpensive techniques such as ink-jet printing. The spin-cast process is expected to produce OLED arrays no thicker than a sheet of paper in about two to three hours—much less than the fabrication time of an equivalent inorganic structure." *See* EX2017

[<https://www.laserfocusworld.com/lasers-sources/article/16556776/back-to-basics-organic-leds>, July 2001].

31. Second, the novel aspect of Yamazaki is to use the same chamber to apply EL and the organic cover layer, "the EL layer, the cathode, the barrier layer, and the cover layer can be formed in the same multi-chamber in succession."

Yamazaki, abstract. This would improve the process efficiency. This would

suggest that applying the same EL application methods of ink-jetting and electric field application to organic cover layer is a novel aspect of Yamazaki, not known in the prior art. Moreover, even if Seiko-Epson's field application method and ink-jetting method were known, nothing indicates that they involve the use of a mask and Samsung does not so assert.

32. I have also been asked to comment whether a person of ordinary skill in the art would have interpreted Ghosh's references to "well-known, conventional" means would have inspired a person of ordinary skill in the art to include a shadow mask in Yamazaki's ink-jetting or electric field application. The obvious answer is no. Ghosh expressly teaches away from the use of shadow masks, and wet-processing such as ink-jetting in general. According to Ghosh, "[s]ince these devices are extremely moisture sensitive, any kind of wet processing directly on the OLED stack is normally not possible. Use of shadow masks during evaporation of organic materials to pattern the colors is not feasible for high resolution displays." Ghosh, [0025].

33. First, Ghosh deposits its organic layer via "forming vapor phase monomer species able to condense and polymerize on the first dielectric oxide encapsulation layer." EX1006, [0018]; *see also* [0032] (forming patterned first encapsulation layer 21 via a polymer layer using "shadow masking"); Pet. 36 (arguing that shadow masking allows use of "flash evaporation"). Ghosh clearly

includes laser ablation as a “well-known, conventional means” following layer formation. Ghosh [0032]. In fact, Ghosh implies that no shadow mask, nor any other mask, was used to pattern the first encapsulation layer. Ghosh also states in [0032], “The first encapsulation layer 21 is formed of a polymer layer and is patterned” indicating that the deposition of the first encapsulation was completed prior to patterning by removing unwanted polymer material post-deposition by another technique such as “ablation, (e.g. laser ablation) following layer formation.”¹ Ghosh, [0032]. There is no indication that Ghosh, claiming priority to an April 2000 provisional application, even knew about Seiko-Epson’s ink-jetting or electric field application proposal to have included it as one of the referenced “well-known, conventional” means.

34. The terms ink-jetting or electric field application methods and the like never appear in Ghosh. *See* EX1006 *generally*. Instead, Ghosh’s method involves “ablation ... following layer formation.” EX1006, [0032]. Yamazaki never mentions such ablation steps in its electric field application method or ink-jet method; and a person of ordinary skill in the art would not have linked Yamazaki’s

¹ Ablation is part of the well-known, conventional method mentioned by Ghosh. And this ablation method would involve removal of unwanted material.

electric field application method or ink-jet method with Ghosh's laser ablation method.

35. A person of ordinary skill in the art would not have replaced Yamazaki's electric field application method or ink-jet method with Ghosh's evaporation method, given that those are Yamazaki's points of novelty.

36. Yamazaki is certainly aware of evaporation as a way of depositing materials. For example, Yamazaki uses evaporation to deposit cathodes but it does not suggest making the organic layer via evaporation. EX1005, [0011]. Yamazaki therefore makes a deliberate choice of using ink-jetting and electric field application methods for depositing the organic cover layer (a process that does not involve the use of a shadow mask). A person of ordinary skill in the art would not ignore those express design decisions and replace those application methods with a shadow-mask based evaporation method.

V. Ground II: Combining Yamazaki's Electric Field Application Method with Fujimori's Magnetized Mask Would Result in an Unpredictable and Hence Unreliable/Unsuitable Deposition Method

37. Samsung states that a person of ordinary skill in the art would have used Fujimori's magnetized mask in Yamazaki's electric field application method. Pet. 38 (Samsung alleging that "it would have been obvious to use this magnetic masking approach when applying Yamazaki's method to encapsulate a plurality of OLED display panels in batch manufacturing"), Pet. 41 (citing Yamazaki

[0086] to justify combining Yamazaki with Fujimori, [0086] is part of embodiment 1 that uses electric field application method). Of note here, Samsung does not assert that a person of ordinary skill in the art would have used a mask in connection with ink-jet printing. Yamazaki itself never suggests using a mask in ink-jet printing, which makes sense because ink-jet printing is a patterned printing method whose deposition positions are controlled by printing head instead of an external mask. I am not aware of any ink-jet printing method that also used a shadow mask in the 2001-2002 time frame or even today. Shadow masks are to be avoided whenever possible as they are notorious particulate defect generators due to unavoidable excess deposition material that builds up on the shadow mask and the frequent cleaning or replacement of the used shadow masks.

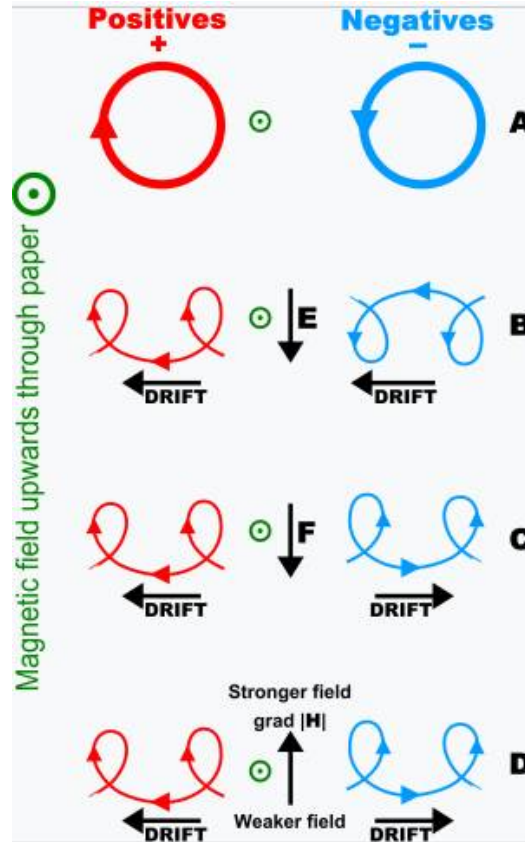
38. Fujimori proposes using “a mask attached to a substrate with magnetic force” to improve adhesion between the mask and the substrate in order “to achieve fine pattern processing with the mask.” EX1014, [0009]-[0010]. Despite the proposed benefits of using a magnetically adhered mask, which was known in the art since the 1970s, I have never known of an instance where a magnetically attached shadow mask was used in connection with an electric field application method, such as that described in Yamazaki. Similarly, electrostatic chucks commonly used in the display industry to accurately align and secure substrates,

especially for masked film deposition processes, are not commonly used in conjunction with magnetic masks to my knowledge.

39. Consistent with my experience and knowledge, Fujimori uses a traditional evaporative deposition technique that does not utilize electric field to control the flight path of charged particles and deposition positions, as in Yamazaki. *E.g.*, EX1014, [0041] (Al deposited “with the resistance heating deposition method” under vacuum); [0046] (lithium vapor was deposited followed by Al deposition); [0050] (under vacuum, organic materials for the emission layer were deposited under vacuum, and lithium vapor as well as Al was vapor-deposited).

40. This is not surprising because the addition of a magnetic field to the back of the substrate (in order to hold the masks) would have a complicated and unpredictable effect on the flight path of the charged particles of the organic materials to be deposited. For instance, Samsung states that the “electromagnet” used to adhere the mask “can electrically control the switching of the magnetic field.” Pet. 52. But that electromagnet and the associated force would be expected to alter the force operating on the charged particles. The electromagnet would affect the trajectory of the charged particles to be deposited on the substrate and there is no indication that the resulting combined forces could be controlled to reliably deposit the cover layer to the selected spots.

41. For instance, according to Lorentz force law, the force on a particle of charge q moving with a velocity v in an electric field E and a magnetic field B experience a force of $F = q(E + v \times B)$. That is, the force on the moving charged particle is a combination of (1) a force in the direction of the electric field E (proportional to the magnitude of the field and the quantity of charge), and (2) a force at right angles to both the magnetic field B and the velocity v of the charge (proportional to the magnitude of the field, the charge, and the velocity). Thus, as the charge approaches the magnetic field, it veers off the path set by the electrodes 115-117 in Yamazaki Figure 1C. For instance, below are trajectories of a charged particle (A) in a homogenous field with no additional force; (B) in a homogenous field with an electric field; (C) with a non-EM force such as gravity; and (D) in an inhomogeneous field with gradient H .



(https://en.wikipedia.org/wiki/Lorentz_force)

42. The strength of a magnetic field experienced by a particle would vary depending on its distance from the magnet as well as its velocity (for instance, the particle may move at an accelerated velocity as it approaches the substrate). Thus, the Lorentz force on a charged particle would vary depending on the particle's distance from the magnet as well as the angle. As a result, there would not only be particle-to-particle variation within a material stream but also a time-dependent variation as the particles fly from the material chamber towards the substrate, to the back of which a magnetic is attached at certain places. This would introduce unpredictable change in the particles' trajectories, making it impractical to control

the positions at which the particles will be deposited. This is particularly problematic given the fine scales on which the pixels are distributed.

43. That is why Fujimori does not disclose or suggest that its magnetic mask and the attendant magnets used to adhere the mask would be suitable for any and all deposition methods. In particular, Fujimori never mentions electric field application method or ink-jet method as a suitable deposition method with its modified masks. *See* EX1014, [0041] (evaporation), [0044] (same), [0046] (same), [0050] (same). Thus, a person of ordinary skill in the art would not view applying the magnetic mask to Yamazaki's electric field application method as applying a known method to a similar application case with predictable results.

44. I further note that Fujimori does not use its magnetic masks for depositing encapsulation layers: it was only used for depositing electrodes and emission layers. Fujimori, [0041] (Al electrode), [0044] (Al electrode), [0046] (lithium doping and Al electrode), [0050] (emission layer and electrode), [0049] (despite disclosure in [0027], non-emitting black matrix region was applied using spin-coating followed by photolithography without the use of the magnetic mask). This makes sense because finer pitches and higher accuracies are generally required for deposition in the active areas or pixel positions. In contrast, encapsulating multiple devices in an active area of the substrate while leaving the electric contact pads and scribe lines free of encapsulant materials generally does

not require such higher resolutions. As a result, need for good adhesions to ensure very fine resolutions is absent in encapsulation at the time of the inventions and there would therefore be no market or design need for a person of ordinary skill in the art to use a mask with good adhesions, such as a magnetized mask as disclosed by Fujimori, for encapsulation processing, especially when its usage would cause unpredictable interfere with the electric field controlled charged particle flight path.

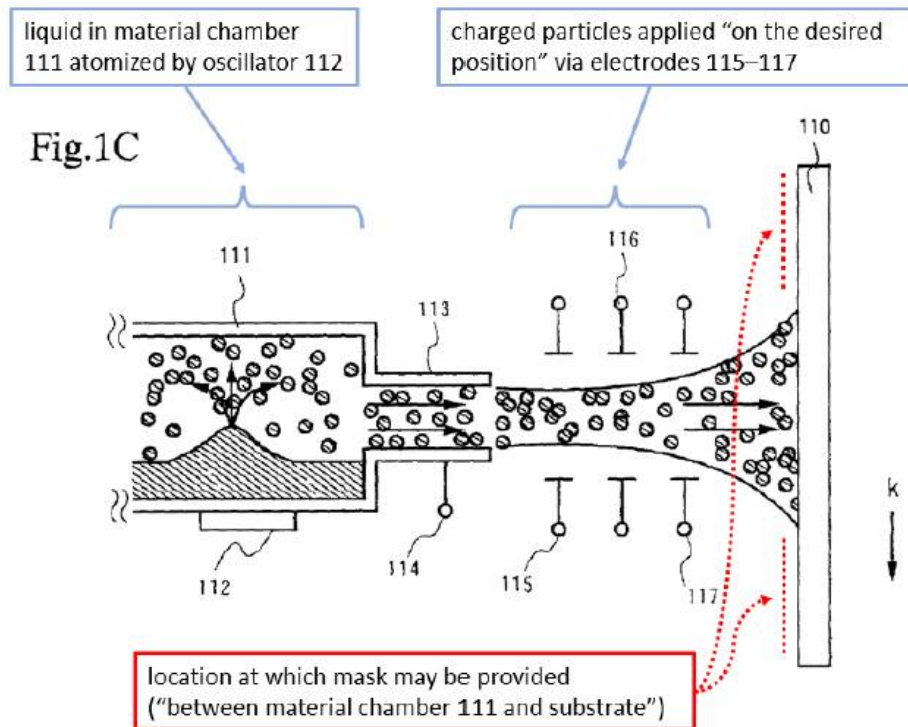
45. Fujimori's limited disclosure on the use of magnetic masks is consistent Fujimori's reason to use the magnetic mask, which is to prevent "a short in the elements [or] cross-talk" caused by the deteriorated adhesion of the mask to the substrate. EX1014, [0008]. Depositing an insulating organic layer would not cause a short in the element or cross-talk. Fujimori [0049] (not using masks for depositing insulating spacer and black matrix), [0050] (not using magnetic masks to deposit hole transport layer). Therefore, Fujimori also does not suggest the need to deposit magnetic masks for depositing encapsulation layers. Indeed, other encapsulation patents cited by Petitioner do not mention the use of magnetic masks for depositing encapsulation layers.

46. I have also been asked to comment on whether Yamazaki's disclosure that "a mask may be provided *between* the material chamber 111 and the substrate to thereby control the positions on the substrate at which the application liquid is

via the mask” in [0086] would suggest depositing the mask “on top of [the] substrate” as require by element 41[b] or “in contact with said substrate” as required by claim 43.²

47. A person of ordinary skill in the art would not understand placing a mask “between the material chamber ... and the substrate” as requiring the mask to be placed in physical contact with the substrate as Samsung suggests. Pet. 42-45 (arguing for the use of Fujimori’s magnetized mask for added adhesion between the substrate and mask). In fact, Samsung’s own figure shows that in Yamazaki, if a mask is used, the mask would not be in contact with the substrate. *See* Pet. 34 (reproduced below). If Yamazaki does not even intend its mask to be in contact with the substrate, then there would be no reason to use a mask in order to have the mask adhere to the substrate.

² The difference between 41[b] and 43 is that the mask is in direct contact with the substrate in claim 43, but may be indirectly on the substrate for element 41[b].



(Pet. 34)

48. In that case, the concerns expressed by Fujimori—that material would bleed below the mask due to warpage and other factors—would not apply to Yamazaki’s electric field application method (or the ink-jetting method) because the mask was not intended to adhere to the substrate in the first instance. As such, a person of ordinary skill in the art would not have modified Yamazaki to ensure that its mask adheres to the substrate as suggested.

49. I also note that in the above annotation by Samsung, electrodes 115-117 control the trajectory of the charged particles. The stream of the materials is shown to be narrower than the opening of the mask such that there is no deposition of the organic materials on the mask. But element 41[c] recites “*depositing at*

least one planarization layer upon said mask and said plurality of devices.” In Samsung’s own annotation, the organic materials is deposited on the devices, but not also “upon said mask.” And Samsung’s own depiction also does not show that the organic material is deposited “over the entire mask” as recited in claim 46.

50. Furthermore, in the above annotated figures by Samsung, because the mask is a distance away from the substrate, there would be no “removing said mask *from* said substrate” as recited by element 41[d] because the mask was never in contact with the substrate and there therefore would be no removal “from” the substrate.

51. Samsung argues that the mask “would need to be removed after forming the cover layer, in order to subsequently deposit the barrier layer.” Pet. 51. That is not necessarily true. For example, the distance between the mask and the substrate can be adjusted to control the area of coverage in a manner similar to that disclosed in Weaver. EX1008, Fig. 9, [0060] (“[A]s shown in FIG. 9, each deposition source can have the same aperture. However, in this embodiment, each source 221b-c and 222 a-c is provided at a larger distance from the substrate than is the adjacent upstream source ... such that the material being deposited from each source again covers a progressively wider area as the substrate proceeds downstream”).

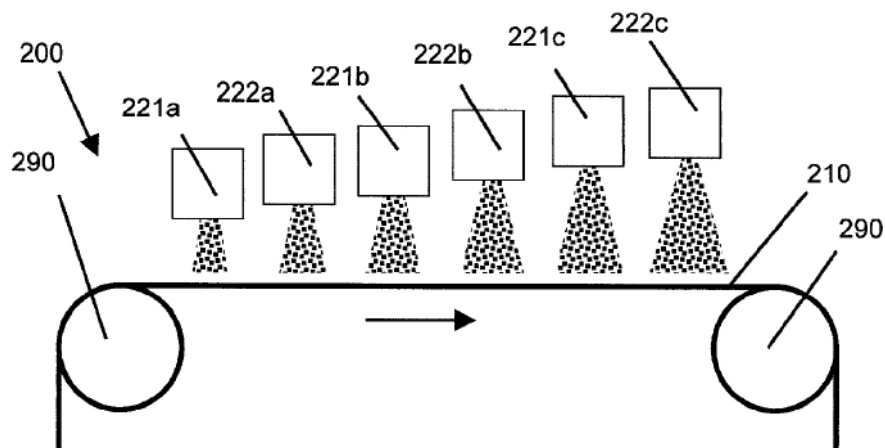


Fig. 9

52. Weaver's deposition also results in a subsequent layer wrapping around a previously deposited layer, just as in Yamazaki, as shown below.

Yamazaki	Weaver
Fig.11 Fig.14 (Yellow barrier layer surrounding the purple planarization layer)	Fig. 6 (barrier layer 151b surrounding the planarization layer 151a)

53. And because Yamazaki's mask is not in contact with the substrate, there is no need for the material to be non-sticking to the OLED substrate over the areas in between the active areas, as required by claim 44.

VI. Weaver-Based Grounds III-V

A. Weaver's "Planarizing Layer" Largely Follows the Topology of the Underlying Layers

54. Weaver describes its "planarizing material" as "a material that forms a smooth planar surface upon application, rather than forming a surface that reflects irregular contours of the underlying surface." EX1008, [0035]. But Weaver actually follows the topology of the underlying layers.

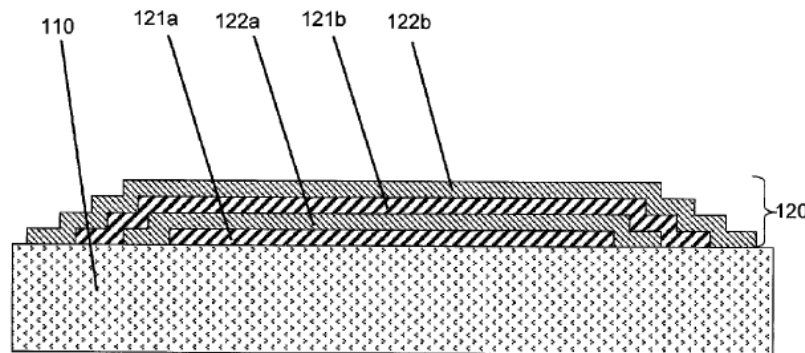


Fig. 5

55. For example, in Figure 5 above, planarizing layer 121a follows the surface topology of the underlying substrate 110 and the planarizing layer 121b follows the topology of high-density layer 122a. For instance, where the high-density layer 122a has steps along the edges the deposition, so does 122a. And where the substrate has a general flat topology (except for unintentionally created

surface irregularity), the planarizing layer also has that topology. In other words, Weaver's "planarizing layer" reproduces the topology of the underlying layer. Similarly in Figure 6 below, layers 151a-c follow the topology of the underlying layers 140, 152a-b respectively.

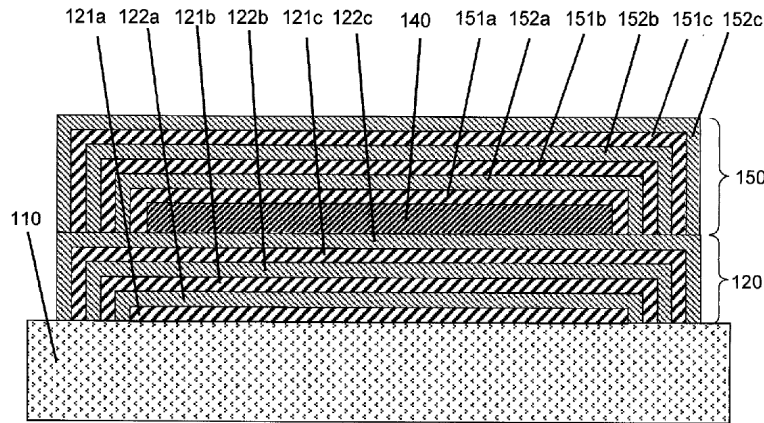


Fig. 6

B. Weaver Controls the Deposition Area by Controlling the Amount of Materials to be Dispensed

56. I have been asked to explain how Weaver controls its area of coverage. The answer is that Weaver controls the coverage area by controlling the amount of material deposited. *E.g.*, [0059] ("In FIG. 8, each deposition source is provided with an aperture that is larger than that of the adjacent upstream source ... such that the material being deposited from each source progressively covers a wider area as the substrate proceeds downstream"). In other words, Weaver does not intentionally create a patterned deposition as in ink-jet printing or masked deposition of encapsulation layers.

C. A Person of Ordinary Skill in the Art Would Not Have Used Ink-Jet in Weaver

57. Conspicuously, Weaver does not mention ink-jet printing. Instead, in connection with the Figure 8 embodiment, Weaver discloses that the preferred sources for depositing the planarization layer are “thermal evaporation, organic vapor phase deposition (OVPD), chemical vapor deposition (CVD), spraying and flash evaporation sources.” EX1008, [0057]. Ink-jetting is conspicuously absent among the broad list of deposition techniques disclosed. *Id.*

58. I understand that Samsung argues that a person of ordinary skill in the art would have used ink-jet printing in Weaver’s Figure 8 embodiment because ink-jetting is a non-contact deposition method that can minimize the risk of contamination. Pet. 79. But Weaver’s web-based process shown in Figure 8 already uses a “non-contact deposition technique,” so it also would have a minimized contamination risk under Samsung’s theory.

59. Samsung also argues that a person of ordinary skill in the art would have used ink-jetting because it is “a directed deposition technique.” Pet. 79. Again, Weaver’s web-based process in Figure 8 also uses nozzles to direct material to the deposition area. That is, it is also a directed deposition technique. Again, it is worth noting that Weaver includes “spraying” in his list of deposition techniques but there is no mention of inkjet deposition. In conventional inkjet deposition, the heads move while the substrate remains fixed. Weaver’s web-based deposition

process is the exact opposite as shown in Fig. 8 below where the spray nozzles are fixed and the substrate moves.

60. And to the extent that ink-jetting is “conducive to depositing multiple coats, allowing for the deposition of thicker layers,”³ so can Weaver’s existing method that uses multiple nozzles, each depositing one layer of materials. *See* Fig. 8 (annotation by Petitioner below). As to alleged scalability, so can Weaver’s methods by ganging together large numbers of nozzle heads to “rapidly print over large areas.” Pet. 79. For example, Figure 8 shows just one nozzle array for one cross-sectional area, and in practice, there are other cross-sectional areas (not shown) with similar nozzle arrays.

³ As explained above, because ink-jetting involves depositing materials dissolved in solutions, multiple coats would increase the risk of the solution re-dissolving a portion of already deposited and dried ink material and the risk of the materials seeping to adjacent regions.

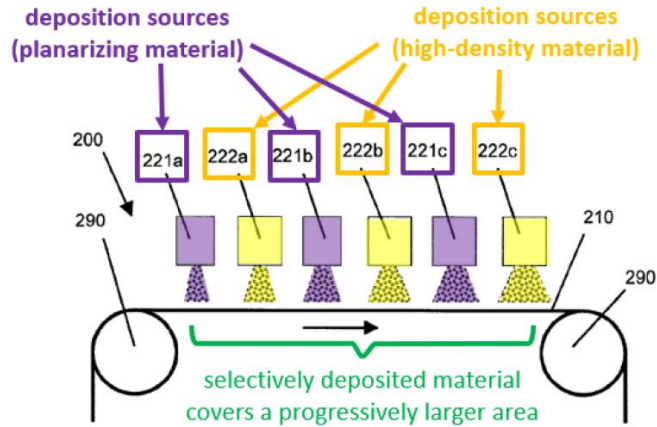


Fig. 8

61. Thus, in the above annotated figure, the nozzles are above the substrate and do not contact the moving substrate, and therefore have a minimal risk of contamination. In addition, each nozzle in the nozzle array directs the desired amount of materials to the substrate to add one coated layer to form multiple coats as illustrated in Weaver Figures 4-6, and there can be multiple nozzle arrays for scalability. Put another way, Weaver's method already provides the same alleged benefits as ink-jetting, but does so without using an ink-jet head. A person of ordinary skill in the art would not have substituted Weaver's method with ink-jetting that does not seem to have any added benefits, but would require an ink-jet printer that adds costs, but no associated benefits.

62. Ink-jetting is also not "one of a finite number of predictable solutions for 'selectively applying an organic passivation material' for OLEDs." *Contra* Pet. 80. Weaver itself gives many other specific examples of suitable techniques for

depositing the planarization layers—ranging from dipping, spin coating, spraying to various evaporation techniques (OVPD, CVD, flash evaporation) and sputtering. EX1008, [0035], [0057]. No ink-jetting is mentioned. *Id.* The existence of many other choices indicates that ink-jetting is not just one of a finite number of choices, but that it is one of a large number of choices.

D. A Person of Ordinary Skill in the Art Would Not Have Used Screen-Printing in Weaver (claim 36)

63. Weaver also does not mention using screen-printing for depositing its planarizing layer or high-density layer. *See* EX1008, [0035], [0057]. Screen-printing also would not be suitable for web-based process used in Weaver’s Figure 8. For instance, screen printing does not use nozzles depicted in Figure 8 and it is not clear how screen printing could yield the “progressively larger cooperative barrier layers” that are at the heart of Weaver. Pet. 81-85.

64. Samsung argues that a person of ordinary skill in the art would have used screen printing because it allegedly provided for “rapid processing time at lower temperatures,” and “enabl[ed] a range of material viscosities to be used for Weaver’s planarizing layer 151a.” Pet. 83 (cleaned up). Samsung cites to Palanisamy for these alleged benefits. But Palanisamy does not involve depositing multiple layers successively. *See* Palanisamy, [0024]-[0026]. And while Weaver’s method allows for continuous deposition of the successive layers as the substrate moves through the process line, in screen-printing, a new screen would need to be

set down and then removed for each successive layer. This would add process steps and reduce, rather than increase, the process speed. The Petition also does not explain why being able to use a range of material viscosities is a desirable or even suitable choice for Weaver’s continuous process. Pet. 82-84.

65. Like ink-jetting, screen-printing is not “one of a finite number of predictable solutions for ‘selectively applying an organic passivation material’ for OLEDs.” Weaver itself gives many other specific examples of suitable techniques for depositing the planarization layers—ranging from dipping, spin coating, spraying to various evaporation techniques (OVPD, CVD, flash evaporation) and sputtering. EX1008, [0035], [0057]. No screen-printing is mentioned. *Id.* The existence of many other choices indicates that ink-jetting is not just one of a finite number of choices, but that it is one of a large number of choices.

E. A Person of Ordinary Skill in the Art Would Not Have Used a Shadow Mask in Weaver (claim 37)

66. Samsung argues that because Weaver’s nozzles have respective apertures, Weaver would suggest the use of a shadow mask, because “[a] ‘shadow’ mask is a mask having apertures” Pet. 85 (emphasis in original). But an aperture in *nozzles* has nothing to do with an aperture size in *masks*, and the reference to one would not suggest the other to a person of ordinary skill in the art.

67. Samsung has not provided any cogent reason for why a person of ordinary skill in the art would have substituted Weaver’s existing nozzle-based

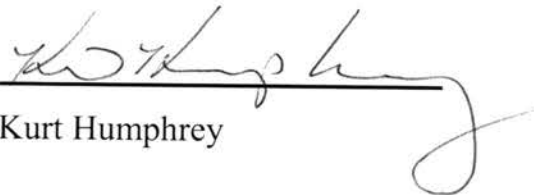
approach that does away the use of a mask with one that uses a shadow mask. Pet.

85-89. Samsung argues that Weaver's Figure 8 apparatus for web-based processing of OLED devices is allegedly "ready for improvement." Pet. 89. But it is unclear what those improvements are or even what their drawbacks are.

68. In my opinion, Burrow's method would be more costly than Weaver's with no clear advantages. For example, Weaver's Figure 8 apparatus could deposit progressively larger cooperative barrier layers without the use of shadow masks and different work stations. *See* EX1008, Fig. 8, [0057]-[0059]. In contrast, Burrow's method needs not only additional equipment (shadow masks and process stations), but also additional process steps to align the masks with the substrate, to remove the masks in order to deposit barrier layers that cover a larger area, and to move the substrate through different processing stations. *See* Burrows, 8:10-47. Thus, replacing Weaver with Burrow's method would not be an improvement but a step-back.

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 and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed on December 11, 2024 in Colorado Springs, Colorado


Kurt Humphrey