

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 IPR2024-01095
U.S. Patent No. 11,828,425

PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE

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EXHIBIT LIST

Exhibit No.	Description
1001	U.S. Patent No. 11,828,425
1002	File History for U.S. Patent No. 11,828,425
1003	Declaration of Dr. Russell J. Holmes
1004	Certified Translation of International Patent Application Publication No. WO 2008/040323 A2 (“Diekmann”)
1005	International Patent Application Publication No. WO 2008/040323 A2 (“Diekmann”)
1006	Certified Translation of Japanese Patent Application Publication No. JP 2007-277631 A (“Suzuki”)
1007	Japanese Patent Application Publication No. JP 2007-277631 A (“Suzuki”)
1008	U.S. Patent Application Publication No. 2005/0146267 (“Lee”)
1009	U.S. Patent Application Publication No. 2006/0214892 (“Harada”)
1010	J.W. Ma et al., <i>Organic light-emitting diodes based on new n-doped electron transport layer</i> , Synthetic Metals 158 (2008) (“Ma”)
1011	U.S. Patent Application Publication No. 2003/0159910 (“Caldwell”)
1012	U.S. Patent Application Publication No. 2008/0211395 (“Koshihara”)
1013	M. A. Baldo et al., <i>Highly efficient phosphorescent emission from organic electroluminescent devices</i> , 395 Nature 151 (1998).
1014	M. A. Baldo et al., <i>Very high-efficiency green organic light-emitting devices based on electrophosphorescence</i> 75 Appl. Phys. Lett. 4–6 (1999)
1015	Chihaya Adachi et al., <i>Confinement of charge carriers and molecular excitons within 5-nm-thick emitter layer in organic electroluminescent devices with a double heterostructure</i> , 57 Appl. Phys. Lett. 531–533 (1990)
1016	Martin Pfeiffer et al., <i>Electrophosphorescent p-i-n organic light-emitting devices for very-high-efficiency flat-panel displays</i> , 22 Adv. Mater. 14 (2002)

Exhibit No.	Description
1017	L. S. Hung et al., <i>Enhanced electron injection in organic electroluminescence devices using an Al/LiF electrode</i> , 70 Appl. Phys. Lett., 152–154 (1997)
1018	Zugang Liu et al., <i>Improved electron injection in organic LED with lithium quinolate/aluminium cathode</i> , 128 Synthetic Metals 211–214 (2002)
1019	Gufeng He et al., <i>Very high-efficiency and low voltage phosphorescent organic light-emitting diodes based on a p-i-n junction</i> , 95 J. Appl. Phys., 5773–5777 (2004) (“He”).
1020	L. Moro et al., <i>Process and design of a multilayer thin film encapsulation of passive matrix OLED displays</i> , Proceedings of SPIE Vol. 5214 (2004)
1021	Anna B. Chwang et al., <i>Thin film encapsulated flexible organic electroluminescent displays</i> , 83 Appl. Phys. Lett. 413–415 (2003)
1022	V. Bulovic et al., <i>Transparent light-emitting devices</i> , 29 Nature 380 (1996)
1023	INTENTIONALLY LEFT BLANK
1024	U.S. Patent No. 6,879,319 (“Cok”)
1025	File History for U.S. Patent Application No. 13/139,514
1026	File History for U.S. Patent Application No. 15/651,508
1027	File History for U.S. Patent Application No. 16/790,198
1028	U.S. Patent Application Publication No. 2011/0260201 (“Klein”)
1029	Harald Gross et al., <i>High Power Efficiencies at Record Lifetimes: NOVALED’S PIN-OLEDs</i> , FPD Yokohama 2005
1030	Gufeng He et al., <i>High-efficiency and low-voltage p-i-n electrophosphorescent organic light-emitting diodes with double-emission layers</i> , 85 Appl. Phys. Lett. 3911–3913 (2004)
1031	A. G. Werner et al., <i>Pyronin B as a donor for n-type doping of organic thin films</i> , 82 Appl. Phys. Lett. 4495–4497 (2003)
1032	U.S. Patent No. 5,594,469 (“Freeman”)
1033	M. H. Lu et al., <i>High-efficiency top-emitting organic light-emitting devices</i> , 81 Appl. Phys. Lett. 3921–3923 (2002)
1034	First Amended Complaint, <i>Pictiva Displays International Ltd. v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:23-cv-00495, Dkt. #17 (E.D. Tex. Mar. 1, 2024)

Exhibit No.	Description
1035	Docket Control Order, <i>Pictiva Displays International Ltd. v. Samsung Electronics Co., Ltd., et al.</i> , Case No. 2:23-cv-00495, Dkt. #40 (E.D. Tex. Apr. 17, 2024)
1036	Declaration of Rachel Garland
1037	District Court Stipulation
1038	Curriculum Vitae of Russell J. Holmes
1039	Jeffrey Lerner Declaration
1040	Kee Young Lee Declaration
1041	Patent Owner's Response (IPR2024-01095)
1042	Patrick B. Shea et al., <i>Solution-processed polycrystalline copper tetrabenzoporphyrin thin-film transistors</i> , <i>Synthetic Metals</i> 157 (2007)
1043	Transcript of July 25, 2025 Deposition of Dr. P. Morgan Pattison
1044	Reply Declaration of Dr. Russell J. Holmes
1045	IPR2024-01094, Paper 19 (Patent Owner Response)
1046	IPR2024-01094, Ex.2041 (Declaration of Processor Kirk S. Schanze)
1047	IPR2024-01094, Ex.2024 (Web of Science: Organic light-emitting diodes based on new n-doped electron transport layer)]
1048	Web of Science: Organic light-emitting diodes based on new n-doped electron transport layer (Full)
1049	Jun Endo et al., <i>Organic Electroluminescent Devices Having Metal Complexes as Cathode Interface Layer</i> , <i>Jpn. J. Appl. Phys.</i> Vol. 41 (2002)
1050	Sung Hoon Choi et al., <i>Improved Efficiency and Lifetime of Organic Light-Emitting Diode with Lithium-Quinolate-Doped Electron Transport Layer</i> , <i>Jpn. J. Appl. Phys.</i> 48 (2009)
1051	Kaushik Roy Choudhury et al., <i>LiF as an n-Dopant in Tris(8-hydroxyquinoline) Aluminum Thin Films</i> , <i>Adv. Mater.</i> 2008, 20
1052	Xinyou Zheng et al., <i>Efficiency improvement of organic light-emitting diodes using 8-hydroxy-quinolinato lithium as an electron injection layer</i> , <i>Thin Solid Films</i> 478 (2005)
1053	Gregor Schwartz et al., <i>Reduced efficiency roll-off in high-efficiency hybrid white organic light-emitting diodes</i> , <i>Appl. Phys. Lett.</i> 92, 053311 (2008)

Exhibit No.	Description
1054	Gregor Schwartz et al., <i>High efficiency white organic light emitting diodes combining fluorescent and phosphorescent emitter systems</i> , Proc. of SPIE Vol. 6192, 61920Q (2006)
1055	Lumtec, Liq, https://www.lumtec.com.tw/products-view.php?ID=327
1056	Lumtec, LiF, https://www.lumtec.com.tw/products-view.php?ID=371
1057	Commission on Isotopic Abundances and Atomic Weights, Barium, https://www.ciaaw.org/barium.htm
1058	Commission on Isotopic Abundances and Atomic Weights, Cesium, https://www.ciaaw.org/caesium.htm
1059	Eugene Hecht, <i>Optics</i> , Chapter 3 (4th ed. 2002)

I. INTRODUCTION

Petitioner demonstrated that each of the '425 patent's claims is unpatentable as obvious over Diekmann (Ex.1004) or Suzuki (Ex.2006), alone or in combination with one other reference. Pictiva responded by disclaiming claim 1 and eleven dependent claims—each of which was taught by Diekmann or Suzuki alone.

The remaining dependent claims add little to the disclaimed independent claim, reciting a grab-bag of such well-known features as Liq in the electron transport layer (ETL), a multi-layer encapsulation having different volume structures and amorphicity, integrated touch sensors, and gesture control. Pictiva does not dispute these additional features were known, and offers no secondary considerations of non-obviousness. Each claim is obvious in view of Diekmann or Suzuki with a single additional reference. Pictiva disputes only whether POSITAs would have been motivated to combine the references with reasonable likelihood of success. Pictiva's arguments fail.

II. CLAIMS 2 AND 17: DIEKMANN OR SUZUKI IN VIEW OF MA

A. Ma Is Prior Art

As set forth in the Petition, Ma (Ex.1010) was publicly available at least as of August 29, 2008, when it was published online in Synthetic Metals. Pet. at 5. Ma is a peer-reviewed article published by Elsevier, an established publisher of scientific journals. Ma at 810. Ma states on its face that it was “[a]vailable online 29 August

2008” and bears a 2008 copyright date, and includes hyperlinks to online sources for the journal and article. *Id.*

Pictiva’s own evidence filed in IPR2024-01094 conclusively establishes Ma was publicly available via the Web of Science at least by December 1, 2008. Ex.1045 at 34; Ex.1046 at 71-73. An exhibit “captured” by Pictiva’s expert shows Ma was “Indexed 2008-12-01” (Ex.1047), more than one year before the U.S. application date (December 9, 2009) and before the earliest claimed priority date (December 11, 2008). Ma is indisputably prior art under 35 U.S.C. §§ 102(a)-(b).¹ Pet., 5.

Further, while “indexing is not ‘a necessary condition for a reference to be publicly accessible,’” *Voter Verified, Inc. v. Premier Election Sols., Inc.*, 698 F.3d 1374, 1380 (Fed. Cir. 2012), the Web of Science index included keywords directly relevant to the ’425 patent, confirming the interested public could search for it. Ex.1047 (“Organic light-emitting diodes; Doping concentration; Carrier transport; Conductivity”); Ex.1048 (same).

¹ Pictiva’s response in IPR2024-01094 was filed on the same day as its response here. Thus, Pictiva possessed evidence showing Ma was indexed before the ’425 patent’s priority date, but withheld that information here, disingenuously alleging there was not “any evidence of indexing and searching.” POR, 23.

Moreover, as the Board found at institution in IPR2024-01094, “Ma’s abstract would have been available online...permitting an interested entity to find the abstract and then, if necessary, gain access to Ma’s full text.” *Samsung Display Co., Ltd. v. Pictiva Displays Int’l Ltd.*, IPR2024-01094, Paper 11 at 18 (PTAB Jan. 23, 2025). As the Board explained there, “Elsevier is an established publisher” and “Ma itself indicates the website on which Ma abstract would have been available.” *Id.*, 18-19. “When there is an established publisher there is a presumption of public accessibility as of the publication date.” *VidStream LLC v. Twitter, Inc.*, 981 F.3d 1060, 1065 (Fed. Cir. 2020).

Synthetic Metals was a reputable journal accessible to the relevant public at the time of the ’425 patent. Dr. Holmes, who actively worked on OLEDs, Ex.1003, ¶¶4-6, 64-65, explains “Synthetic Metals [was] certainly a journal that [he] read” in August 2008, Ex.2019, 235:2-9. Pictiva’s expert’s testimony reinforces POSITAs published articles relevant to the ’425 patent’s subject matter in Synthetic Metals around that time. Ex.1043, 113:16-116:21, 141:7-144:13; Ex.1042 at 190. Dr. Holmes further explains that by August 2008, he and other researchers read articles as soon as they became available online, Ex.2019, 235:2-236:4, and he “use[d] things like Web of Science, Science Direct”—which were “common ways”—to “search for those papers,” *id.*, 236:6-11. Dr. Holmes also explains that “journals send out table of contents alerts when issues are available.” *Id.*, 237:19-21. *Palo Alto*

Networks, Inc. v. Finjan, Inc., IPR2015-01979, Paper 62 at 28 (PTAB Mar. 15, 2017) (reference “published in a journal...and distributed to subscribers” is publicly accessible).

Pictiva offers no evidence that places in doubt Ma’s prior art status. Pictiva speculates some different “version” of Ma could have been published online (POR, 25-26) but offers no evidence of any such version. Pictiva notes missing Internet Archive records for the Synthetic Metals webpage in 2008-2009. POR, 26. But the Internet Archive page “maps the number of times www.elsevier.com/locate/synmet was crawled by the Wayback Machine, *not* how many times the site was actually updated.” Ex.2029 at 1. That no Internet Archive record is available does not mean the website did not exist or could not be found. Further, Synthetic Metals had a practice of indicating on the face of its articles when revised versions were received, and Ma has no such indicia. *Compare* Ex.1042 at 190, *with* Ma at 810; Ex.1043, 144:14-146:16, 193:20-195:2.

Pictiva’s procedural arguments are meritless. Contrary to Pictiva’s assertion (POR, 17-18), a petitioner may submit additional post-petition evidence to respond to a patent owner’s challenge to a reference’s status as a printed publication. *Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039, Paper 29 at 14-15 (PTAB Dec. 20, 2019) (precedential). Pictiva’s argument that new issues about prior art status cannot be raised in reply (POR, 18) is misplaced, as “[t]he issue has not

changed.” *Hughes Network Systems, LLC v. California Institute of Technology*, IPR2015-00059, Paper 42 at 35-36 (PTAB Apr. 21, 2016). “The issue, has, from the beginning, been whether or not [the asserted reference] is a ‘printed publication’ within the meaning of 35 U.S.C. § 311(b) and whether its publication date is early enough that it is citable against the [challenged patent].” *Id.* Petitioner has consistently maintained since the Petition that Ma is a “printed publication” whose publication date qualifies it as prior art. Pet., 5.

Pictiva argues the Garland declaration (Ex.1036) should be excluded or given no weight. POR, 18-19. While Petitioner disagrees, even without it, other evidence establishes Ma is prior art.

B. POSITAs Would Have Been Motivated to Combine Diekmann or Suzuki with Ma with a Reasonable Expectation of Success

It would have been obvious to modify Diekmann by using Liq as the n-dopant in Diekmann’s n-doped ETL. Pet., 36-38; Ex.1003, ¶¶139-147. Likewise, it would have been obvious to modify Suzuki by using Liq as the n-dopant in Suzuki’s n-doped ETL. Pet., 69-70; Ex.1003, ¶¶224-229.

Pictiva does not dispute that these combinations meet every limitation of claims 2 and 17. Pictiva further does not dispute that Diekmann and Suzuki each teaches every limitation, other than the requirement that “the electron transport layer comprises” Liq. Ex.1001, cls. 2, 17. Pictiva also does not dispute that Ma teaches

that Liq is an n-dopant, and that Ma shows conductivity improvements when Liq-doping its ETL. Ex.1043, 187:19-188:7. The proposed combinations involve straightforward use of a known n-dopant material, Liq, known to have favorable characteristics, in known OLEDs contemplating n-doped ETLs.

The prior art motivates using Liq as an n-dopant in Diekmann's and Suzuki's ETLs. Pet., 37-38, 70. Ma shows experimentally that Liq-doping the ETL results in increased current density and reduced driving voltage compared to the undoped device. Ma, 813; Ex.1003, ¶143. Diekmann explains "doping advantageously increases the conductivity of the doped organic layer," and "the dopant preferably has a low diffusion constant...as is usually the case with large atoms or molecules." Diekmann, 10; Ex.1003, ¶144. Suzuki contemplates n-doping for "efficient carrier injection" and "highly conductive" ETLs. Ex.1019, abstract (cited in Suzuki, [0333]). POSITAs would have recognized that Liq increases ETL conductivity, has good electron injection and transport properties, and has a larger molecular weight suitable for use as an n-dopant, consistent with Diekmann's and Suzuki's conceptions of n-doping. Ex.1003, ¶¶35-36, 144, 227; Ma, 813-814; Ex.1018 at 212-214; *compare* Ex.1055, *with* Exs.1056-1058.

POSITAs would also have reasonably expected success in using Liq as the n-dopant in Diekmann's and Suzuki's ETLs. Pet., 38, Ex.1003, ¶¶145-146; Pet., 70, Ex.1003, ¶228. Both Diekmann and Suzuki already contemplate n-doped ETLs, and

using Liq as the n-dopant merely involves incorporating another n-dopant with known desirable properties into the ETL. Such modifications were routine techniques well within the ability of POSITAs and would be expected to yield successful results. Ex.1003, ¶¶145-146, 228.

Pictiva's kitchen-sink attempts to dispute the motivation to combine Diekmann or Suzuki with Ma with reasonable expectation of success fail.

1. Liq's n-doping mechanism is not incompatible with that of Diekmann's or Suzuki's n-dopants

Pictiva argues, incorrectly, that POSITAs would not use Liq as an n-dopant in Diekmann or Suzuki because Liq is an "electron-hopping" dopant that allegedly operates differently from Diekmann's and Suzuki's "electron-donor" dopants. POR, 28-31.

Initially, Pictiva's attempt to divide n-dopants into purportedly incompatible types lacks support Ex.1044, ¶¶18-21. The purpose of doping is to increase conductivity, which may be achieved by increasing the number or mobility of charge carriers. Ex.1044, ¶¶22-24; Ex.2018, ¶23. POSITAs would understand increasing electron concentration and increasing electron mobility to be related mechanisms for improving ETL conductivity, and would not view "electron-hopping" and "electron-donor" n-dopants as disparate species. Ex.1044, ¶¶23-25.

Ma supports this understanding. Ma teaches its p-dopant involves charge transfer that increases charge carrier concentration in the hole transport layer. Ma,

812-813. Ma also teaches its n-dopant likely involves “short hopping length for electron transport.” Ma, 813. Significantly, Ma refers to **both** as instances of dopants. Ex.1044, ¶¶26.

Further, both Liq and Pictiva’s examples of “electron-donor” n-dopants are used in functionally equivalent, analogous contexts, supporting their interchangeability. Liq was used as both ETL dopant and electron injection layer (EIL). Ex.1044, ¶30; Ma, 813 (Liq-doped ETL); Ex.1049 at L800 (Liq-doped ETL); Ex.1050 at 062101-1-062101-2 (Liq-doped ETL); Ex.2027 at 3019 (Liq as EIL); Ex.1018 at 212-214 (Liq as EIL). Similarly, LiF and Barium (which Pictiva argues are “electron-donor” n-dopants) were used as both ETL dopant and EIL. Ex.1044, ¶¶30-31; Diekmann, 5, 10 (LiF and Barium listed as both EIL materials, preferred ETL dopants); Ex.1051 at 1460, Fig. 4 (comparing LiF as EIL and ETL dopant). Thus, POSITAs would have considered Liq and Pictiva’s “electron-donor” n-dopants to operate similarly. Ex.1044, ¶¶30-31.

Indeed, Pictiva ignores that Liq’s mechanism for improving electron injection is analogous to LiF’s, and Pictiva calls LiF an “electron-donor” n-dopant. POR, 31. Ex.1044, ¶32; Ex.1018 at 213 (lithium released from LiF/Liq dopes organic layer); Ex.1052 at 254 (electron injection enhancement with Liq and LiF “very similar”). POSITAs would have understood that Liq would act as an “electron-donor” n-dopant in the ETL of OLEDs the same way as LiF, and that modifications to use Liq

in place of n-dopants like LiF in Diekmann and Suzuki would be likely to succeed. Ex.1044, ¶32; Ex.1043, 135:3-140:14.

Pictiva also errs by characterizing n-dopants as “electron-donor” or “electron-hopping” without considering context. As POSITAs recognize, the same n-dopant material can increase electron density, electron mobility, or both depending on its use, as illustrated by Liq’s uses as ETL n-dopant and EIL. Ex.1044, ¶28; Ma, 813 (Liq-doped ETL improves transport); Ex.1049 at L800 (Liq-doped ETL improves injection); Ex.1018 at 211 (Liq EIL improves injection); Ex.2027 at 3018-3019 (same).

Pictiva’s argument that Liq does not act as an electron donor “in Ma” (POR, 29) fails to consider Liq’s function when used in Diekmann or Suzuki. In Ma, increased current due to Liq doping could be attributed to increased conductivity in the ETL rather than electron injection because Ma used a separate EIL. Ex.2019, 291:16-293:13; Ex.1044, ¶29. When Liq is used in Diekmann’s or Suzuki’s device, the Liq-doped ETL abuts the cathode. Ex.1044, ¶29; Diekmann, Fig. 2 (layer 402); Suzuki, Fig. 9 (layer 7); Ex.1003, ¶¶41-42. POSITAs would understand, with subsequent cathode deposition, Liq would dissociate, facilitating injection of electrons from the cathode. Ex.1049 at L801-L802 (Liq doping activated by cathode); Ex.1018 at abstract, 212-214 (lithium release from Liq improves electron injection).

Thus, even Pictiva's purported requirements for an "electron-donor type n-dopant" (POR, 31; Ex.2018, ¶¶24-25) are met. Ex.1044, ¶29.

Pictiva's argument that Liq was not considered a "suitable molecular n-dopant" (POR, 30) is incorrect. Liq was an art-recognized n-dopant for the ETL, known for facilitating electron transport and injection since at least 2000. Ex.1044, ¶27; Ma, 813 (Liq-doped ETL has "high electron mobility"); Ex.1049 at L800 (Liq dopant has "electron-transporting ability," facilitates "electron injection"); Ex.1050 at 062101-1-062101-2 (Liq-doped ETL "assist[s] electron injection"); Ex.2027 at 3019 (Liq has "good electron injection and electron transport properties"); Ex.1018 at 212-214 ("Liq is an electron transporting material").

Pictiva does not dispute that Liq acts as an n-dopant in Ma. POR, 28 ("Liq's Electron Hopping Dopant"); 31 ("Ma's Liq dopant"). Dr. Pattison concedes that Liq-doping increases ETL conductivity. Ex.1043, 187:19-188:7. The proposed combinations substitute one known n-dopant for another to further the same goal of improving ETL conductivity. Such modifications do not alter the "principle of operation" of Diekmann's or Suzuki's OLED. Ex.1044, ¶33; *In re Mouttet*, 686 F.3d 1322, 1332 (Fed. Cir. 2012).

2. Direct comparative evidence of expected benefits is not needed, and Liq had expected benefits

Pictiva argues there is no direct evidence of reduced diffusion or higher efficiency and lower driving voltages with Liq. POR, 31-32. Such direct evidence is

not required. *Everstar Merch. Co. v. Willis Elec. Co.*, No. 2023-1686, 2025 WL 1501940, at *3 (Fed. Cir. May 27, 2025) (patent challenger need not “quantify the precise amount of benefit achieved by their proposed combination”).

The prior art motivated using Liq as the n-dopant in the ETL. Diekmann teaches “large atoms or molecules” usually have “low diffusion constant[s],” Diekmann, 10, and Liq has a larger molecular weight than Diekmann’s preferred n-dopants, Ex.1003, ¶144; Ex.2002, ¶82; *compare* Ex.1055, *with* Exs.1056-1058. POSITAs would have recognized Liq is advantageous for reducing dopant diffusion, Ex.1003, ¶144; Ex.1044, ¶34, and more stable and easier to process than Diekmann’s n-dopants. Ex.1044, ¶35; Ex.1052, 252-253.

Pictiva argues there are no direct comparisons between Liq and other dopants. POR, 32-33. But head-to-head comparisons are not required; a combination need not “be the preferred, or the most desirable, combination described in the prior art in order to provide motivation.” *Honeywell Int’l Inc. v. 3G Licensing, S.A.*, 124 F.4th 1345, 1355 (Fed. Cir. 2025). Diekmann teaches an n-doped layer and explains large dopant size is favorable. Diekmann, 10. Liq has such large size, and offers additional advantages. That other potentially suitable dopants exist does not make Liq non-obvious. Diekmann is not limited to its preferred dopants, and does not teach away from others. Diekmann, 91 (“dopant 410 can be *for example* cesium, barium or lithium fluoride”). Likewise, Suzuki prescribes no preferred n-dopants. Suzuki,

[0333]. POSITAs would not need data showing Liq's superiority to Diekmann's or Suzuki's dopants to be motivated to use Liq. Ex.1044, ¶36.

Pictiva cites studies from years after the priority date (POR, 33), which do not reflect the knowledge or expectations of POSITAs at that time. *Bristol-Myers Squibb Co. v. Teva Pharms. USA, Inc.*, 752 F.3d 967, 974 (Fed. Cir. 2014) (post-invention discovery not known to POSITA at time of invention does not negate obviousness); *Ex Parte Jochen G. Salfeld et. al*, APPEAL 2015-007511, 2017 WL 2132356, at *17 (PTAB May 15, 2017). Contrary to Pictiva's claim (POR, 33), these studies do not show reduced performance with Liq-doped ETLs. The studies closest to 2008 show Liq-doped ETL **improved** efficiency and operating voltage, consistent with POSITAs' expectations based on Ma. Ex.1044, ¶¶37-39; Ex.2024 at 7998; Ex.2003 at 53; Ex.1003, ¶¶140-143; Ma, Fig. 3, 812-813.

Pictiva asserts there is no evidence that charge balance could be achieved with an Liq-doped ETL, especially for multiple emissive layers or white OLEDs. POR, 34-35. The claims do not require optimized charge balance. Optimized charge balance is unnecessary for an operational OLED, and identifying optimal doping concentrations for good charge balance is routine optimization within POSITAs' skill. Ex.1044, ¶¶40-41; Ma, 813 (experimentally identifying optimal Liq concentration); Ex.1050 at 062101-2-062101-3 (same); Ex.1053 at 053311-1, Fig. 1

(same for white OLED); Ex.1054 at 61920Q-1-61920Q-2, Fig. 1 (same); Ex.1043, 190:6-193:19.

POSITAs would not pursue Novaled's proprietary n-dopant over Liq, as Pictiva suggests (POR, 35). Liq's structure was known and its mechanisms studied; Novaled's n-dopant structure was unknown, thus undesirable. Ex.1044, ¶42. "[J]ust because better alternatives exist...does not mean that an inferior combination is inapt." *Moultet*, 686 F.3d at 1334.

3. Liq had known benefits motivating its application beyond Ma's structure

Pictiva argues Liq-doped OLEDs were not well-studied and Liq had no known benefits. POR, 35-36. This is incorrect. Dr. Holmes showed Liq-doped ETLs were well-known and Liq was known to have good electron injection properties. Ex.1003, ¶¶140-145, 225-228, 35-36, 42; Ex.2019, 16:17-18:8. As early as 2002, Liq-doped ETLs were shown to have better electron injection and reduced driving voltage, Ex.1049 at L800, L802, consistent with Ma's 2008 results, Ma, 810, 813; Ex.1044, ¶44. Liq's electron-injection properties and doping effect were also well-known. Ex.2027 at 3012, 3018-3019; Ex.1018 at 211, 213-214; Ex.1044, ¶44.

Pictiva's assertion that POSITAs would not have extended Ma's Liq teachings beyond Ma's OLED (POR, 37) is incorrect. POSITAs apply promising teachings in literature to improve their devices. Ex.2019, 211:3-212:4. Thus, POSITAs have applied the same dopant to different charge-transport materials (and vice versa) in

different OLEDs. Ex.1044, ¶¶45-47. For example, prior art taught both Liq-doped BPhen (Ma's ETL) and Liq-doped Alq₃ (identified as ETL in Diekmann and Suzuki). Ex.1044, ¶48; Ex.1049 at L800-802. POSITAs would have been motivated to dope Diekmann's and Suzuki's ETLs with Liq given its benefits and expected success. Ex.1044, ¶48.

Pictiva's only support for how POSITAs would purportedly apply Ma is conclusory testimony from Dr. Pattison, who never personally guided OLED design. Ex.1043, 98:10-99:15, 104:1-105:22, 107:13-108:12, 109:12-15; 110:17-113:7; 119:7-122:10. Dr. Pattison's testimony is unhelpful because he applies a materially lower skill than the POSITA definition—"not someone designing experiments," but some "person operating the machine under the direction" of another researcher. Ex.1043, 223:13-224:18. But those with bachelor's degrees in chemistry or physics with three years of research or industrial experience with OLEDs (Ex.1003, ¶64; Ex.2002, ¶30) are not mere lab assistants. Dr. Pattison's application of the level of skill is at odds with the Supreme Court's admonition that "[a] person of ordinary skill is also a person of ordinary creativity, *not an automaton*." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007).

POSITAs (properly understood) review experimental data, synthesize literature, and make decisions about next steps for experimental research. Ex.2019, 209:14-212:4. Unlike Dr. Pattison, Dr. Holmes' detailed explanations are supported

by literature and extensive experience designing OLEDs. Ex.1044, ¶¶8-15; Ex.1003, ¶¶4-6, 64-65. He has trained students who developed into POSITAs, and is more qualified to opine on POSITAs' capabilities and expectations.

4. Potential quenching problems would not have dissuaded using Liq with Diekmann or Suzuki

Pictiva's assertion that POSITAs would not use Liq in Diekmann or Suzuki because they were phosphorescent OLEDs (PHOLEDs) and Ma was fluorescent (POR, 37-38) has no merit. POSITAs routinely applied teachings from fluorescent OLEDs to PHOLEDs and vice versa. Ex.1044, ¶¶49-51. For example, the "p-i-n" architecture developed for fluorescent OLEDs was successfully extended to PHOLEDs using nearly identical layers for both (using Li-doped BPhen). Ex.1044, ¶52; Ex.2101, 1254-1255, Figs. 29-30; Ex.1016, 1633-1634.

N-doped fluorescent and phosphorescent OLEDs using the same n-dopants were known; as were OLEDs with both fluorescent and phosphorescent emitters in the same stack sharing the same layers. Ex.1044, ¶53; Ex.2101, 1254-1255; Ex.1053 at 053311-1, Fig. 1; Ex.1054 at 61920Q-1-61920Q-2, Fig. 1. OLED design was modular, even across emitter types. Ex.1044, ¶52. Thus, POSITAs would naturally have applied n-dopants with favorable performance in fluorescent OLEDs (Ma's Liq) to n-doped PHOLEDs (Diekmann and Suzuki) reasonably expecting success. Ex.1044, ¶52. Multiple emission layers do not create more complexity; one current flows through the OLED, so charge is balanced for the emission layer as one unit in

the same manner as for a single-emitter OLED. Ex.1044, ¶54; Ex.1043, 219:3-21. Identifying Liq concentrations for charge balance was within POSITAs' skill. Ex.1044, ¶54; Ex.1043, 190:6-193:19.

Pictiva argues that Liq could be problematic for PHOLEDs due to quenching. POR, 38-39. Pictiva's post-priority date papers do not reflect POSITAs' knowledge. *Teva*, 752 F.3d at 974. Regardless, many dopants, including Diekmann's preferred n-dopants, could also act as quenchers. Ex.1043, 195:3-196:17; Ex.1044, ¶¶55-56. Potential quenching concerns are not unique to Liq, and would not dissuade POSITAs from using Liq. Ex.1044, ¶¶55-56. As discussed (§II.B.1), Liq's mechanism for dissociation is like LiF's (a preferred dopant for Diekmann), suggesting Liq would also be an effective n-dopant. Diekmann, 10. Ex.1044, ¶56.

Even if Liq is more readily dissociated than LiF, POSITAs would not have expected significant quenching. Ex.1044, ¶57. Blocking layers for mitigating quenching were common as of the '425 patent, including for doped OLEDs. Ex.2019, 38:8-40:10; Ex.1044, ¶57; Ex.1016, 1633-1634, Fig. 1 (blocking layers with Li-doped ETL); Ex.1019, 5773-5774, Fig. 1 (blocking layers with Cs-doped ETL); Ex.1030, 3911-3912, Fig. 1 (same). Blocking layers can provide "nearly complete isolation of the EML from the conductive dopants," even with lithium n-dopant. Ex.1016, 1635; Ex.1044, ¶58. That blocking layers were sufficient to alleviate quenching concerns for elemental n-dopants like lithium and cesium supports

POSITAs' expectation that they would be sufficient for larger, less mobile molecules like Liq, even if dissociated. Ex.1044, ¶¶57-59; Ex.2019, 282:21-284:5.

Diekmann and Suzuki include blocking layers. Diekmann, Fig. 2A; Ex.2019, 185:20-186:5; Suzuki, [0287], [0296]-[0298]; Ex.1044, ¶58. Thus, POSITAs would not have been dissuaded from using the advantageous ETL n-dopant Liq because of a purported possibility of quenching. Ex.1044, ¶59. *E.I. du Pont De Nemours & Co. v. MacDermid Printing Sols., L.L.C.*, 657 F. App'x 1004, 1014 (Fed. Cir. 2016) ("the legally proper question is whether [the modification] would be a suitable option in some respects, not necessarily in every respect").

5. There is no evidence using Liq would create charge imbalance

Pictiva argues Liq doping would result in "charge imbalance due to an electron surplus and undesirable traps." POR, 40-41. Pictiva does not explain why using Liq as n-dopant in Diekmann's and Suzuki's ETLs already contemplating n-doping would suddenly result in charge imbalance. Ex.1044, ¶60. Pictiva cites post-priority date studies not reflecting POSITAs' knowledge. *Teva*, 752 F.3d at 974. These studies also do not analyze Diekmann's or Suzuki's charge balance. Nevertheless, identifying appropriate doping concentrations for charge balance was routine optimization within POSITAs' skill (§II.B.2). Ex.1044, ¶¶60-61; Ex.1043, 190:6-193:19; Ma, 813; Ex.1050 at 062101-2-062101-3; Ex.2101 at 1255, Figs. 6, 18, 27.

Pictiva claims “significant work continued” after the ’425 patent to make Liq-doped systems operable. POR, 41-42. But operable OLEDs with Liq-doped ETLs were known. Ex.1044, ¶62; Ma, 810-811; Ex.1049 at L802, Fig. 1. If anything, Pictiva’s papers confirm it was within POSITAs’ skill to determine optimal Liq concentrations. Ex.2003 at 54-55, 60; Ex.1044, ¶62; Ex.1043, 190:6-193:19. They also underscore POSITAs would have expected success in Liq-doping ETLs, because the experimental OLEDs were functional throughout the Liq concentration ranges tested. Ex.1044, ¶62. Charge balance is not claimed, and the need to identify different doping concentrations to achieve charge balance for different OLEDs does not teach away from Liq-doping.

Pictiva’s argument that Ma’s recognition of the importance of good charge balance teaches away from applying Ma’s teachings is illogical. In Ma, doping the ETL with Liq resulted in *better* charge balance. Ma, Abstract, 812-814; Ex.1003, ¶¶75, 119, 142-143, 204, 226; Ex.1044, ¶63.

6. POSITAs would have reasonably expected success in using Liq to n-dope Diekmann’s and Suzuki’s ETLs.

Pictiva argues designing OLEDs with Liq-doped ETLs requires significant experimentation. POR, 42-44. Pictiva ignores that Diekmann and Suzuki already provide for complete PHOLEDs contemplating n-doped ETLs, and the proposed modification only requires using Liq as the n-dopant. Pet., 36-38; Ex.1003, ¶¶139-147; Pet., 69-70; Ex.1003, ¶¶224-229. POSITAs would have reasonably expected

success in making this modest change. Doped transport layers were mature technology. Ex.1044, ¶¶64-65. Liq was material with known benefits whose doping mechanism was not different from other n-dopants (§§II.B.1-II.B.3), identifying appropriate doping concentrations was within POSITAs’ skill (§§II.B.2, II.B.5), and well-known blocking layers addressed quenching (§II.B.4). Ex.1044, ¶¶64-66.

Pictiva vaguely refers to the “delicate and complicated nature” of OLEDs supported only by Dr. Pattison’s conclusory testimony. POR, 44-45. OLED design was modular, and POSITAs reasonably expected success in swapping out components serving the same function in the same layers (§II.B.4). Ex.1044, ¶¶67-68. Determining doping ranges for PHOLEDs, even for multiple emissive layers or white emission, was within POSITAs’ skill (§§II.B.2, II.B.5). Ex.1044, ¶¶67-69.

Pictiva argues that doping organic semiconductors—especially Liq doping—was unpredictable. POR, 45-46. Not so. The functional results of Liq-doping were known and reported in the literature, and POSITAs were able to dope ETLs with Liq. Ex.1044, ¶¶66-69; Ma, 810-811; Ex.1049 at L800-L802, Fig. 1. *Nalpropion Pharms., Inc. v. Actavis Lab’ys FL, Inc.*, 934 F.3d 1344, 1354 (Fed. Cir. 2019) (finding motivation with reasonable expectation of success where “persons of skill *did combine* the two drugs even without understanding bupropion’s mechanism of action”).

Pictiva asserts that significant experimentation is required to achieve charge balance and avoid quenching. POR, 45-47. But “one must have a motivation to combine accompanied by a reasonable expectation of achieving *what is claimed in the patent-at-issue*.” *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1367 (Fed. Cir. 2016). The claims do not require fully optimized devices without quenching and charge carrier surplus; only an operational OLED. Pictiva ignores that adjusting doping concentrations was within POSITAs’ skill (§§II.B.2, II.B.5), and that Diekmann and Suzuki have blocking layers (§II.B.4). Ex.1044, ¶¶68-69.

Pictiva’s assertions that Ma has no blocking layer and that POSITAs would not use BPhen (POR, 46-47) are irrelevant and incorrect. Suzuki and Diekmann have blocking layers, and n-doping with Liq does not require BPhen. Regardless, BPhen is a common ETL. Ex.2101, 1254-1255; Ex.1016, 1633-1634. Ex.1044, ¶69.

III. CLAIM 4: DIEKMANN OR SUZUKI IN VIEW OF LEE

Contrary to Pictiva’s assertions (POR, 47-48), the Petition explained why Lee’s encapsulation is better than Diekmann’s and Suzuki’s. Lee’s “*semi- and highly-crystalline* parylene-based polymer films” can “themselves help block water vapor and oxygen permeation into the OLED,” in addition to helping to “‘decouple’ adjacent inorganic layers to prevent propagation of defects between inorganic layers.” Pet., 40 (quoting Lee, [0020]), 71. This results in “significantly improved lifetime

compared to prior OLEDs having polyacrylate or *amorphous* parylene barrier layers.” Lee, [0020].

Diekmann’s and Suzuki’s encapsulations would be improved because Lee’s polymer films themselves act as barriers, improving lifetime, whereas Diekmann’s “intermediate polymer layers” and Suzuki’s “buffer films” just prevent pinholes (Diekmann, 15) or relieve stress (Suzuki, [0067]) in adjacent layers, rather than blocking moisture or oxygen. Pet., 40-41, 71-72; Ex.1003, ¶¶148-151, 230-233.

Pictiva’s assertion that Petitioner points to the wrong layers (POR, 48-49) misreads Lee. Lee teaches more crystalline parylene-based polymer films improve on prior encapsulations with amorphous parylene and other organic polymer films by helping block moisture and oxygen—thus acting like barriers themselves. Lee, [0020]. Lee explains prior OLEDs used alternating layers of inorganic moisture/oxygen barriers and decoupling organic films. Lee, [0007]. Diekmann’s and Suzuki’s encapsulations use the same type of alternating layer structure that Lee improves upon. Pet., 40-41, 71-72.

Thus, the analogues of Lee’s parylene-based polymer films are the interlayers *between* adjacent barrier layers, i.e., Diekmann’s “intermediate polymer layers” and Suzuki’s “barrier films.” Pet., 40, 71; Ex.1003, ¶150, 233. Pictiva does not dispute that applying Lee’s more crystalline films for these interlayers would improve Diekmann’s and Suzuki’s encapsulations. Pictiva’s assertions about whether

Diekmann's "barrier layers" or Suzuki's "barrier film" could be modified based on Lee (POR, 49-51) are irrelevant.

Diekmann and Suzuki use alternating multilayer encapsulations similar to Lee's and other prior art's structures, so replacing Diekmann and Suzuki's encapsulations with Lee's was within POSITAs' abilities, and POSITAs would reasonably expect success. Pet., 41, 71-72; Ex.1003, ¶¶150-151, 232-233; Ex.2019, 105:10-106:22. "The greater the structural similarity...the greater the motivation to combine and reasonable expectation of success." *Anacor Pharms., Inc. v. Iancu*, 889 F.3d 1372, 1385 (Fed. Cir. 2018).

Pictiva mistakenly argues reasonable expectation of success was not shown because Petitioner did not address certain parameters. POR, 52-53. None of those are claimed. *Illumina*, 821 F.3d at 1367. In any case, these extraneous factors are a matter of routine optimization for a POSITA. Ex.2019, 121:22-125:10.

Pictiva's purported concerns about heat applied to the OLED are unfounded; Lee teaches OLED encapsulation and methods to "avoid[] delivering unwanted energy to the organic layers." Lee, [0033]-[0035]; Ex.2019, 108:21-110:12, 115:16-117:2. Further, making one layer more crystalline does not make the encapsulation brittle; it leads to improved barrier properties while maintaining flexibility. Lee, [0020]; Ex.2019, 98:11-100:7, 101:17-104:16.

Finally, significant portions of Dr. Pattison’s declaration appear to have been copied from Pictiva’s Response near-verbatim. *Compare* Ex.2018, ¶¶71-84, with POR (Ex.1041), 47-53; Ex.1043, 33:18-52:12. Dr. Pattison’s declaration should be given no weight.

IV. CLAIMS 9-11: DIEKMANN IN VIEW OF KOSHIHARA AND SUZUKI IN VIEW OF CALDWELL

Pictiva argues there is no motivation to add touch sensors to Suzuki or Diekmann. POR, 54-56. Suzuki and Diekmann use OLEDs in devices like displays and lighting that require control, Pet. 17-18, 51-52, and Koshihara and Caldwell teach touch sensors—well-known input devices—as desirable control means, Pet., 43-45, 74; Koshihara, [0002], [0004]; Caldwell, [0004], [0007]. Incorporating touch sensors would “‘allow[] a user to manually input instructions’ intuitively by touch.” Pet., 45. Koshihara and Caldwell teach that integrated touch sensors are particularly desirable, further motivating adding those touch sensors to Suzuki’s and Diekmann’s devices. Pet., 45, 74.

Pictiva argues Diekmann has no need for touch sensors because it already has manual user controls (POR, 56), but ignores undisputed evidence that touch input would allow for more intuitive control. Pet., 45; Koshihara, [0004], Ex.1003, ¶165. Pictiva does not dispute Suzuki has a need for touch sensors.

Pictiva asserts, without contrary evidence, that Petitioner’s expectation of success showing is “conclusory.” POR, 57-59. Dr. Holmes explained integrated

touch sensors were known in the art and applications for controlling OLED displays and light sources already existed before the '425 patent, with citations to evidence. Ex.1003, ¶¶167, 243. This explanation is undisputed. As the Board found, this testimony is consistent with evidence confirming the prior art already includes OLEDs with integrated touch sensors. Paper 12 at 24-25; Koshihara, [0030]-[0031]; Suzuki, [0004]-[0007]; *Regents of Univ. of California v. Broad Inst., Inc.*, 903 F.3d 1286, 1295 (Fed. Cir. 2018) (proper to consider “examples in the prior art of the success or failure of similar systems” for reasonable expectation of success).

Pictiva asserts OLED design is “complicated” (POR, 58) but offers no evidence or argument why that means a POSITA could not integrate touch sensors with Suzuki’s or Diekmann’s OLEDs, as demonstrated by Koshihara and Suzuki.

V. CLAIM 12: DIEKMANN OR SUZUKI IN VIEW OF HARADA

Pictiva admits claim 12 requires the “device” (not the “organic light-emitting diode”) be drivable by gesture control, yet argues the claim is not met because Harada does not drive the “OLED device.” POR, 59-60. Diekmann and Suzuki teach devices, such as displays and lighting, incorporating OLEDs, Pet., 17-18, 51-52, and Harada teaches processing in response to recognized gestures to control the devices. Pet., 49-50, 77. Since Diekmann teaches changing the “operating state” of the OLED, such as on/off (Diekmann, 45-46) and brightness/color (Diekmann, 48-50, 70), based on user input (Diekmann, 53, 70, 139), modifying Diekmann to use Harada’s

gesture control results in gesture control driving the OLEDs. Indeed, Harada teaches driving an OLED display to display images according to detected gestures. Harada, [0039], [0076]-[0078]. Since OLEDs form pixels on the OLED display, Harada drives the OLEDs. Harada, [0078], [0080].

Pictiva asserts Harada's gesture control operates "a separate personal computer," not a device comprising an OLED. POR, 60-61. As explained, Harada is not so limited. Pictiva also asserts it is unclear what "more natural ways" means, POR, 60-61, but it means what it says; gesture control is more natural than physical interfaces, like Diekmann's "control device" or Pictiva's "keyboard or mouse."

This more natural interface motivates adding Harada's gesture control to Diekmann and Suzuki. Pictiva argues Diekmann has no need for it because it has "robust user controls," POR, 62, but "robust" controls still benefit from being natural. Diekmann's control device could be an electrical circuit. Diekmann, 48, 53. Adjusting an electrical circuit is not natural. Pictiva's argument for Suzuki, POR, 62-63, ignores the Petition's explanation that incorporating Harada's gesture control allows users to operate Suzuki's device more naturally. Pet., 77.

Pictiva calls Petitioner's showing of expectation of success "conclusory," but does not dispute it or offer contrary evidence. POR, 63-64. Harada itself applies gesture control to OLEDs. Dr. Holmes explained gesture control of displays was

already known, with citations to evidence. Ex.1003, ¶¶178, 252; Ex.1032, abstract, Fig. 1. This explanation is undisputed. *Broad*, 903 F.3d at 1295.

VI. PICTIVA’S MISCELLANEOUS ARGUMENTS

Contrary to Pictiva’s assertion (POR, 64), Koshihara’s and Caldwell’s touch sensors are “integrated into” the OLED. Pet., 43-47, Ex.1003, ¶¶162-167, 170-171 (Koshihara); Pet., 73-76, Ex.1003, ¶¶240-243, 245-246 (Caldwell). Koshihara’s touch electrodes are integrated with Diekmann’s encapsulation forming the OLED’s “radiation exit area.” Pet., 45-47, 20-21. Caldwell’s touch electrodes are integrated with Suzuki’s substrate forming the OLED’s “radiation exit area.” Pet., 74-76, 53-54.

Contrary to Pictiva’s assertion (POR, 65), Diekmann’s and Suzuki’s emissive layers cover the entire infrared-to-UV spectrum. Pet., 23-24, Ex.1003, ¶¶103-105, Diekmann, 76 (“ultraviolet to infrared”), 91 (“white light”), 92 (“visible light”); Pet., 55-56, Ex.1003, ¶¶192-193, Suzuki, [0096] (“visible light range of 380-800 nm”), [0319] (“any desired light emission color,” including “[w]hite light”); Ex.1043, 76:1-14. Pictiva’s numeric wavelengths correspond to POSITAs’ understanding of the approximate visible-infrared and visible-UV boundaries, Ex.1059 at 77, and are taught by Diekmann’s and Suzuki’s “ultraviolet to infrared” and “[w]hite light” emission.

Pictiva's argument also fails under the district court's construction requiring only "one or more wavelengths" in the infrared-to-UV spectrum. Ex.2031, 47-48.

VII. CONCLUSION

Petitioner respectfully requests the Board cancel all challenged claims.

Date: August 11, 2025

Respectfully submitted,

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CERTIFICATION UNDER 37 C.F.R. § 42.24(D)

I certify that the foregoing complies with the type-volume limitation of 37 C.F.R. § 42.24 and contains 5,594 words based on the word count indicated by the word-processing system used to prepare the paper, and excluding those portions exempted by § 42.24(a).

Date: August 11, 2025

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. § 42.6, I hereby certify that the foregoing Petitioner's Reply to Patent Owner's Response, and supporting exhibits, was served by electronic mail on the following counsel of record for patent owner:

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