

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

PATENT OWNER SUR-REPLY

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EXHIBIT LIST

Exhibit	Description
2001	Disclaimer, U.S. Patent 11,828,425 (filed Oct. 25, 2024)
2002	Declaration of P. Morgan Pattison, Ph.D.
2003	Kim, H. M., Seo, J. H., Han, W. K., Lee, K. H., Kang, H. J., Yoon, S. S., & Kim, Y. K. (2011), Improvement of Mixed Electron Transport Structure Red Phosphorescent Organic Light-Emitting Diodes, Molecular Crystals and Liquid Crystals, 538(1), 53–60
2004	Arunandan Kumar, Ritu Srivastava, Priyanka Tyagi, D. S. Mehta, M. N. Kamalasanan, Effect of doping of 8-hydroxyquinolinatolithium on electron transport in tris(8-hydroxyquinolino)aluminum, J. Appl. Phys. 1 June 2011; 109 (11): 114511
2005	Chan Seok Oh, Jun Yeob Lee, High triplet energy n-type dopants for high efficiency in phosphorescent organic light-emitting diodes, Organic Electronics, Volume 16, 2015, Pages 34-39
2006	Sunwoo Kang, Sang Ho Jeon, Taekyung Kim, Unraveling the complexation effect of electron transporting materials with Liq on the charge transport properties: A theoretical perspective, Chemical Physics Letters, Volume 810, 2023, 140207
2007	T. Sasaki, T. Oono, T. Shimizu, H. Fukagawa, Effects of Energy-Level Alignment on Operating Voltages of Blue Organic Light-Emitting Diodes. Adv. Mater. Interfaces 2023, 1, 2201925
2008	Vadim I. Adamovich, Steven R. Cordero, Peter I. Djurovich, Arnold Tamayo, Mark E. Thompson, Brian W. D’Andrade, Stephen R. Forrest, New charge-carrier blocking materials for high efficiency OLEDs, Organic Electronics, Volume 4, Issues 2–3, 2003, Pages 77-87
2009	Björn Lüssem, Chang-Min Keum, Daniel Kasemann, Ben Naab, Zhenan Bao, and Karl Leo, Doped Organic Transistors, <i>Chemical Reviews</i> 2016 116 (22), 13714-13751

Exhibit	Description
2010	U.S. Patent No. 11,585,504
2011	U.S. Patent No. 10,605,422
2012	U.S. Patent No. 9,797,567
2013	Federal Court Management Statistics for U.S. District Courts, available from https://www.uscourts.gov/statistics/table/na/federal-courtmanagement-statistics/2024/06/30-1
2014	Samsung Invalidity Contentions in the parallel district court case
2015	2024-12-16 Email from Samsung to Pictiva re “IPR2024-01095 – Stipulation”
2016	Deposition Transcript of Dr. Schubert with Ex. 1 of the deposition (Schubert Declaration)
2017	Intentionally omitted
2018	2025-05-05 Declaration of P. Morgan Pattison, Ph.D.
2019	2025-04-24 Holmes Transcript
2020	2025-04-18 Holmes Transcript
2021	Yang, Kwangmo et al., <i>Interfacial Exciton-Polaron Quenching in Organic Light-Emitting Diodes</i> , Physical Review X 14, 041009 (2024)
2022	Screen shot of https://www.ossila.com/products/8-quinolinolato-lithium (last visited 05/04/2025)
2023	Jun Yeob Lee, <i>Efficient electron injection in organic light-emitting diodes using lithium quinolate/Mg:Ag/Al cathodes</i> , Journal of Industrial and Engineering Chemistry 14, 676–678 (2008)
2024	Kim, B. Y. et al., <i>Efficient Green Phosphorescent Organic Light-Emitting Diodes Depending on Concentration of Lithium Quinolate in Electron Transport Layer</i> , Journal of Nanoscience and Nanotechnology, Vol. 13, 7998-8001 (2013)

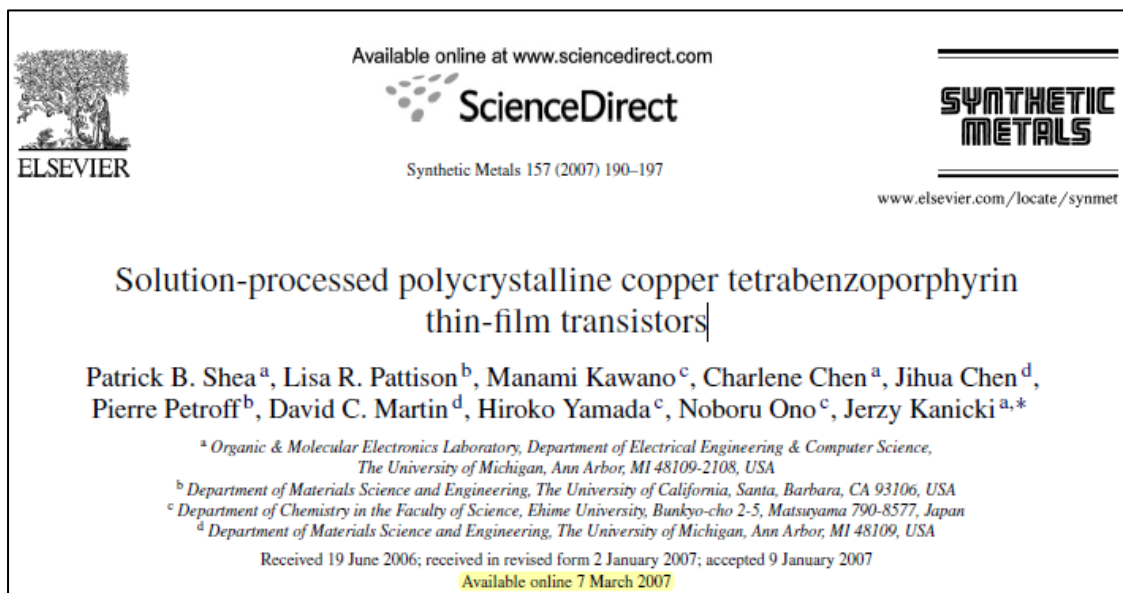
Exhibit	Description
2025	Le, T. N. et. al. <i>Suppression of Initial Degradation via an Interfacial Charge-Induced Overshooting Effect in Solution-Processed Organic Light-Emitting Diodes</i> , ACS Applied Materials & Interfaces 16, 69636-69644 (2024)
2026	Tanaka, I. et al., <i>Energy-transfer dynamics of blue-phosphorescent iridium and rhodium complexes doped in fluorescent molecules</i> , Journal of the SID 16/6, 695-701 (2008)
2027	C. Schmitz et al., <i>Lithium-Quinolate Complexes as Emitter and Interface Materials in Organic Light-Emitting Diodes</i> , Chem. Mater., 12, 3012-3019 (2000)
2028	Reineke, Sebastian et al., <i>Triplet-exciton quenching in organic phosphorescent light-emitting diodes with Ir-based emitters</i> , Physical Review B 75, 125328 (2007)
2029	printout of https://web.archive.org/web/202500000000000*/www.elsevier.com/locate/synmet (last visited 05/03/2025)
2030	[UNDER SEAL] Excerpt of Katona Rebuttal Report
2031	District Court Claim Construction Order
2032	[UNDER SEAL] 2025-09-03 Holmes Deposition Transcript
2100	U.S. Patent No. 7,911,129
2101	K. Walzer et al., <i>Highly Efficient Organic Devices Based on Electrically Doped Transport Layers</i> , 107 Chem. Rev. 1233-71 (2007)
2102	U.S. Publication No. 2008/0116536 to Forrest
2103	Felipe A. Angel et al., <i>Silver-induced activation of 8-hydroxyquinolinato lithium as electron injection material in single-stack and tandem OLED devices</i> , Organic Electronics 59, 220-223 (2018)

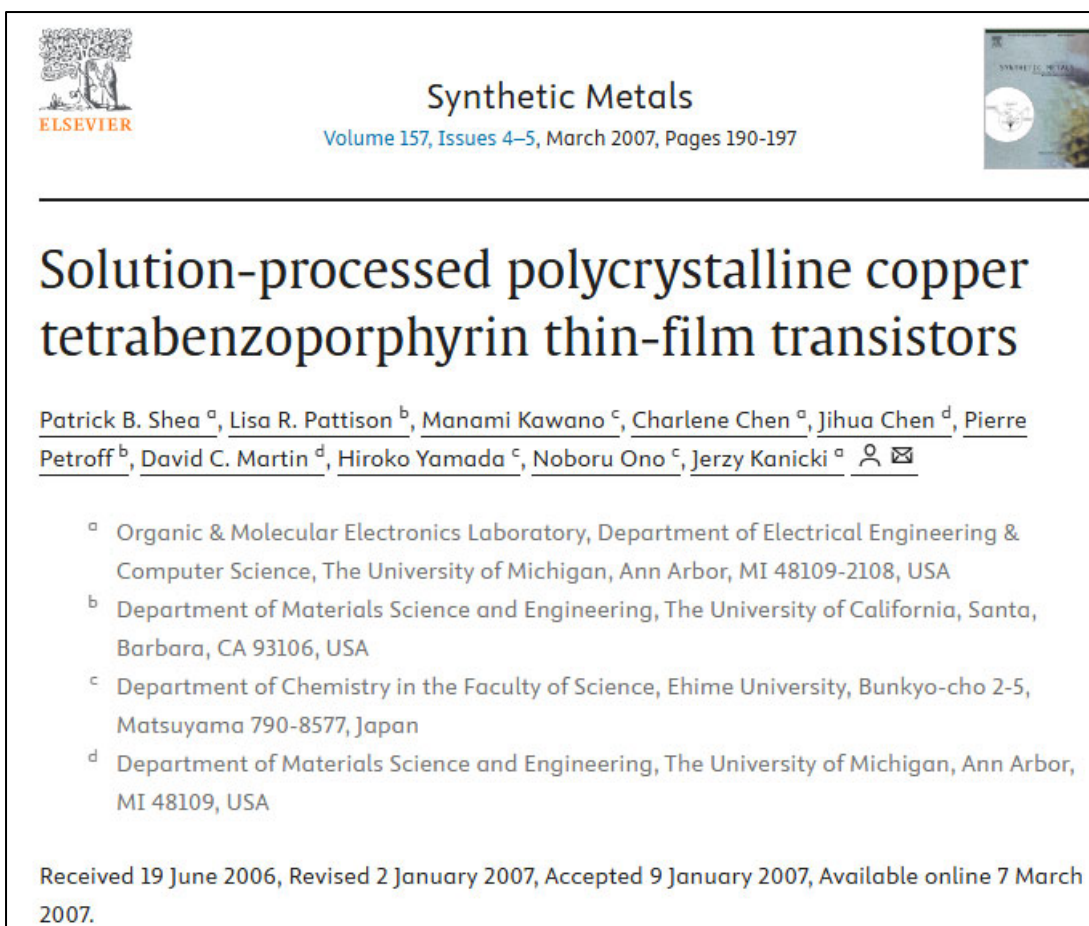
Exhibit	Description
2104	Min Seok Ki et al., <i>Improved Thermal Stability and Operational Lifetime of Blue Fluorescent Organic Light- Emitting Diodes by Using a Mixed-Electron Transporting Layer</i> , ACS Materials Lett. 4, 1676–1683 (2022)
2105	T. Sasaki et al., <i>Effects of Energy-Level Alignment on Operating Voltages of Blue Organic Light-Emitting Diodes</i> , Supporting Information for Adv. Mater. Interfaces 2023, 10, 2201925, available at DOI: 10.1002/admi.202201925 (supporting information for EX2007)

I. Ma is Not Prior Art

Vidstream and its cited cases involve paper publications, and do not support that online-only articles by Elsevier are presumptively publicly accessible. Dr. Holmes' testimony on receiving alerts relates to "issues," a term for published volumes, not online-only articles; and there is no evidence that he ever pulled any pre-publication articles. EX2019, 235-237.

Dr. Schanze testified without rebuttal that Clarivate "did not index online only articles" in 2008 and Ms. Munford identified Ma as an unpublished "Article in Press" as of 12/2/2008. EX1046, ¶¶149-151; IPR2024-01094 EX1037, ¶¶17-19. The 12/1/2008 date may reflect just the month in which, not the date on which, Ma was published and indexed. For instance, EX1042 was posted online on "7 March 2007," so could not be indexed on "2007-03-01." See below.





(<https://www.sciencedirect.com/science/article/abs/pii/S0379677907000392>)

Solution-processed polycrystalline copper tetrabenzoporphyrin thin-film transistors

Associated Data

By
Are you this author?
Shea, PB (Shea, Patrick B.); Pattison, LR (Pattison, Lisa R.); Kawano, M (Kawano, Manami); Chen, C (Chen, Charlene); Chen, JH (Chen, Jihua); Petroff, P (Petroff, Pierre); Martin, DC (Martin, David C.); Yamada, H (Yamada, Hiroko); Ono, N (Ono, Noboru); Kanicki, J (Kanicki, Jerzy)

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Source
SYNTHETIC METALS
Volume: 157 Issue: 4-5 Page: 190-197
DOI: 10.1016/j.synthmet.2007.01.013

Published
MAR 2007

Indexed
2007-03-01

Because Petitioner has no evidence that the December 2008 *Synthetic Metals* issue was published before the 12/11/2008 priority date (EX1003, ¶51), it has not established that Ma is a printed publication.

II. Claims 2 and 17 Are Not Obvious

A. The Reply Does Not Close the Significant Gaps in Petitioner's Obviousness Analysis

The Petition spends barely two pages on why allegedly “[a] POSITA would have been motivated to use an Liq-doped electron transport layer of Ma in the organic layer stack of Suzuki” or Diekmann. Pet. 69-70, 37.

The Petition first alleges the motivation existed “due to the known benefits of an Liq-doped electron transport layer,” such as “increased current density,” “reduced driving voltage” and “improve[d]” “electron transport ability of the co-deposited layer” compared to an undoped device. Pet. 37, 69 (referencing back to Pet. 37-38). The POR showed that Liq-doping does not necessarily lead to those alleged benefits. *E.g.*, POR2-3 (citing EX2007, 2201925-2; EX2105, Fig. S1; EX2103, Fig. 2; EX2104, Figs. 4(a)-(b)). The Reply asks the Board to ignore such evidence because they are post-priority date. Reply 16-17. These results, however, show that the uncertainty in the alleged benefits associated with using Liq continued long after the priority date. If POSITAs could not reasonably expect improvement in 2022, then

they would not have such reasonable expectation or motivation to try 13-14 years earlier when there was significantly less accumulated knowledge on Liq-doping.

Moreover, the proposed modification is not over an undoped device, but over Diekmann's and Suzuki's n-doped OLED devices. POR 33-37. The only reason the Petition offered for making the modification over the existing n-dopants is, according to Diekmann, "the n-dopant for its electron transport layer should be 'suitable for emitting electrons' and 'preferably has a low diffusion constant within the organic layer stack, as is usually the case with large atoms or molecules'." Pet. 37. The Petition states that "Liq was known to have good electron injection and transport properties and has a larger molecular weight than Diekmann's preferred n-dopant[.]" *Id.*; *see also id.*, Pet. 69-70 (the Suzuki ground largely refers back to the Diekmann ground).

But as noted in the POR, Liq in Ma's ETL does not act as an electron donor or emit electrons, and forms easily diffusible lithium ion or metal such that it cannot be assumed to result in lower diffusion than Cs, Ba or LiF used in Diekmann and Suzuki. POR, 1-2, 28-33. The Reply does not genuinely dispute these facts. Reply, 9 (only alleging that Ma's "Liq-doped ETL improves transport," but not that it improves injection or that Liq emits electrons); EX2032_2025-09-03_Holmes, 50:2-5 ("Q: But Endo's theory is that lithium quinolate is going to be reduced to lithium metal? A. Yes."), 76:10-77:17 (not knowing the extent of diffusion for LiF and Liq),

78:2-79:17 (alleging that Liq and LiF operates through similar mechanisms); EX1019 at 5775 (larger Cs atoms have lower probability than Li atoms (allegedly formed *in situ* in Liq-doped ETL) of diffusing into the emission layer to quench the excitons). The Petition therefore fails to make a *prima facie* case of obviousness.

The Petition next argues there would be a reasonable expectation of success allegedly because “using an Liq-doped electron transport layer merely involves using a different dopant.” Pet. 38, 70. But as Dr. Pattison testified, the proposed swapping “could make a stack,” but not necessarily “an OLED,” the subject matter of the ’425 patent. *See* EX1001, 87:62; *see also* POR 2-3.

Petitioner contends “operable OLEDs with Liq-doped ETLs were known,” (Reply 18), but does not deny that the two only pre-priority references that used Liq in ETLs both involved Alq₃-based fluorescent OLEDs.¹ EX2032_2025-09-03_Holmes, 60:11-14. Petitioner therefore attempts to extrapolate observations for fluorescent OLED devices with undoped emissive layer to systems that used low concentrations of phosphorescent Ir-dopants. PHOLEDs have specific concerns. POR 37-40. A 2014 paper notes “Liq dopant can act as a luminance quencher in ... PHOLED because of low triplet energy of Liq (2.0 eV) although there has been no report about the triplet exciton quenching effect by Liq.” EX2005, 34. As the Federal Circuit has observed, “to have a reasonable expectation of success, one must be

¹ EX1051 also used an “emitting Alq₃ layer.” EX1053, 1460.

motivated to do more than merely to vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result.” *In re Stepan*, 868 F.3d 1342, 1347 (Fed. Cir. 2017).

Here, the OLED community allegedly was “fast moving,” and would be “interest[ed]” in integrating “interesting new material or device architecture” “into their own work.” EX1044, ¶14. The first known publication (EX1049) on using Liq in an electron transport layer (“ETL”) came from Professor Kido, “an expert in the area of OLEDs” whose work “the community would follow.” Holmes, 28:17-30:5, 217:25-218:25. But after Kido published his work on Liq-doped ETLs in an Alq₃-based OLEDs (EX1049) in 2002, the only other pre-priority work in the record was Ma in 2008, also on Alq₃-based OLEDs (EX1010). The scarce pre-priority literature on Liq-doped ETL indicates a general lack of interest in such a usage and/or a lack of reasonably expected success beyond its singular usage as a dopant in fluorescent Alq₃-based OLEDs. This belies Petitioner’s assertion of a motivation to use Liq to dope ETL or that “Liq-doped ETLs were [allegedly] well-known.” EX1044, ¶44.

Indeed, the first reported PHOLEDs (required by the claims) with Liq-doped ETLs came three years after the priority date. *See* EX2003 (Kim 2011); EX1044, ¶38 (Holmes acknowledging Kim 2011 was the closest in time to priority date in using Liq in a PHOLED system). That it took an allegedly fast moving community three years after the priority date to report such devices further supports an inference

of a lack of motivation or reasonable expectation of success. The history of development in Liq-doped ETL's provides the objective evidence of non-obviousness.

B. Petitioner's Improper, New Reply Evidence and Incorporated Arguments Do Not Remedy Petition's Fatal Deficiencies

To remedy the fatal deficiencies in its Petition, the Reply spends 15 pages to bridge the evidentiary gaps. Reply 5-20. In the process, Petitioner attempts to incorporate by reference a 47-page Reply Declaration devoted solely to claims 2 and 17 and over a dozen new exhibits. *E.g.*, Reply 7-8 (citing EX1044, ¶¶18-26), 8-9 (¶¶30-32), 9-10 (¶¶28-29), 11-12 (¶¶34-36), 12-13 (¶¶37-42), 13-14 (¶¶44-48), 14-15 (¶¶8-15), 15-17 (¶¶49-59), 17-18 (¶¶60-63), 18-20 (¶¶64-69); EX1042-EX1059. The Board should disregard the improperly incorporated expert testimony. 37 CFR § 42.6(a)(3).

The Reply also raises numerous new arguments. For example, the Petition never explained why Liq would emit electrons or act as an electron donor as Diekmann expressly and Suzuki implicitly required. Pet. 36-38, 69-70. Now faced with undisputed evidence that Liq in Ma does not so operate, (POR, 1-2, 28-33; Reply 7-8), it argues for the first time “increasing electron concentration and increasing electron mobility [are] related mechanisms for improving ETL conductivity” and a POSITA “would not view ‘electron-hopping and ‘electron-donor’ n-dopants as disparate species.” Reply 7. That is a new argument that should

not be considered. *See Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3)); Consolidated Trial Practice Guide at 73 (“petitioner may not submit new evidence or argument in reply that it could have presented earlier, e.g. to make out a *prima facie* case of unpatentability”). Moreover, as explained in the next section, different mechanisms would demotivate a POSITA from making the proposed modification.

Likewise, the Board should disregard Petitioner’s new argument that Liq and Cs, Ba and LiF allegedly operate analogously. Reply 8-9. The fact is, Ma was the only reference the Petition cited for alleged n-doping of an ETL by Liq; and, as disclosed, Ma’s Liq admittedly does not operate in the same manner as contemplated by Diekmann and Suzuki. Reply 7-8 (conceding Ma “teaches its n-dopant likely involves ‘short hopping length for electron transport’ and not contending Ma teaches Liq acts as electron donor or emitted electrons).

Petitioner nevertheless argues that Liq would function differently in Suzuki and Diekmann because the Liq-doped ETL in Diekmann/Suzuki would “abut[] the cathode” while Ma “used a separate EIL” (electron injection layer) between the ETL and the cathode. Reply 9. Yet, the use of an EIL between a Liq-doped ETL and cathode is not unique to Ma, but is also present in Choi (2009),² Kim (2011) and

² Petitioner apparently has been in possession of the article since at least June 5, 2024 and sandbagged Patent Owner. *See* EX1005, p.1; Holmes, 12:12-13:12. Dr. Holmes conceded EX1050 is not prior art. Holmes, 13:9-21.

Kim (2013) that were some of the earliest references using Liq with non-Alq₃ ETLs. *See* EX1050, Fig. 1 (a Liq EIL between cathode and Liq-doped ETL), EX2003, Fig. 1 (a 2nm Liq EIL layer between Liq-doped ETL and cathode); EX2024, Fig. 1 (“Liq/Al” next to ETL doped with Liq); Holmes 238:10-239:18. Given this common feature in OLEDs with Liq-doped ETLs that were made closest in time to the inventions, Petitioner does not explain why a POSITA would have deviated from that trend and abutted the Liq-doped ETL next to cathode instead.

The Board should also disregard the Reply’s new allegations of Liq’s “additional benefits” of being “more stable and easier to process than Diekmann’s n-dopants” that are absent from the Petition and not in response to the POR. EX1044, ¶35; EX2032_2025-09-03_Holmes, 236:15-237:9; Reply 11. The underlying article relates to using Liq as an EIL and not as an ETL. EX1052, 252-253.

Similarly, the Reply argues for the first time that Kido-Endo (EX1049) used Liq to dope Alq₃, that Alq₃ is an ETL disclosed by Diekmann and Suzuki, and that a POSITA would have used Liq with Alq₃ with a reasonable expectation of success. Reply 14. In addition to being untimely, the Reply does not dispute Dr. Pattison’s view that Alq₃ may not be suitable for PHOLEDs because its triplet state energy may be too low to confine the triplet excitons of phosphorescent emitters. EX2018, ¶42; *see also* EX2020, 308:1-8 (need to select materials with high-lying triplet levels to

avoid quenching the triplet state of the phosphorescent emitter). Petitioner has also not presented any evidence of PHOLEDs made with Liq-doped Alq₃.

In the end, despite the various new arguments noted above and alleged cross-development between fluorescent and phosphorescent OLEDs (also improperly raised for the first time on Reply), the objective evidence shows a general lack of interest, if not certainty, in using Liq-doped ETLs. For example, Dr. Holmes considers himself “to be a pretty good researcher as far as locating the relevant literature” and thinks of himself as “effective in finding literature.” EX2032_2025-09-03_Holmes, 220:3-19. Yet, he only managed to locate two references (Ma and EX1049) that used Liq-doped ETLs before the priority date. *Id.*, 222:1-20. Dr. Holmes also characterizes Kim 2011 and Kim 2013 as the two references “the closest to the priority date” that involved Liq-doped PHOLEDs (required by claims 2 and 17). EX1044, ¶¶38-39. Those are nearly 3-5 years after the priority date. The lack of evidence for simultaneous inventions in an allegedly “fast moving” community supposedly interested in integrating “interesting new material and device architecture” “into their own work” provides objective evidence of non-obviousness.

For instance, Dr. Holmes acknowledges that Liq can be “reduced to lithium metal.” EX2032_2025-09-03_Holmes, 50:2-5, 49:10-22, 53:11-13. Yet, he does not know the extent of reduction. *Id.*, 49:23-50:1. This confirms Dr. Pattison’s opinion that there is no evidence that Liq-doping would lead to lower diffusion than Cs, Ba

or LiF, undermining Petitioner’s alleged motivation to replace Diekmann’s and Suzuki’s preferred n-dopants with Liq. EX2018, ¶¶31, 43, 49. The Reply continues to ignore diffusion due to reduced lithium metal species, even though Dr. Holmes concedes that Diekmann tried to “move away from more diffusive atomic species like lithium.” EX2032_2025-09-03_Holmes, 235:14-17.

Lithium diffusion and associated quenching would be particularly problematic for PHOLEDs, a fact that Petitioner does not deny. EX2018, ¶¶46-53. The Reply argues instead that quenching could be addressed by blocking layers. Reply 16. But Kido-Endo, Ma and Choi—the three references before and around 2008—did not include blocking layers. EX1010, 811 (Liq-doped Bphen next to pure Alq₃ emissive layer); EX1049, Fig. 1b (Liq-doped ETL next to pure Alq₃ emitting layer); EX1050, Fig. 1 (Liq-doped layer next to emission layer ABH034:SD1). He noted that in a Cs-doped OLED devices, “the driving voltage of the OLEDs rapidly increases with the thickness of [an] undoped buffer layer” EX1019, 5775. Given that an alleged motivation to use Liq is to reduce driving voltage, (Pet. 37), Petitioner should have but did not present evidence that the alleged benefits would remain if a blocking layer of sufficient thickness to isolate lithium was placed between n-doped ETL and the EML. EX2018, ¶33; POR 33. The Reply does not remedy this deficiency. Reply 15-17.

In addition, as noted above, Petitioner proposes to abut a Liq-doped ETL next to the cathode, even though the four references involving Liq-doped ETLs closest to the invention date all included a separate electron injection layer. *See* EX1010_Ma (2008), 811 (LiF EIL); EX1050 (2009), Fig. 1 (Liq EIL), EX2003 (2011), Fig. 1 (Liq EIL); EX2024 (2011), Fig. 1 (Liq EIL); Holmes 238:10-239:18. The salient structural differences between Ma and Diekmann/Suzuki are summarized below.

	Ma	Diekmann/Suzuki														
OLED structure	<table><tr><td>cathode</td></tr><tr><td>EIL</td></tr><tr><td>Doped ETL</td></tr><tr><td>Alq3 (neat)</td></tr><tr><td>Hole transport layer</td></tr><tr><td>P-doped hole injection layer</td></tr><tr><td>anode</td></tr></table>	cathode	EIL	Doped ETL	Alq3 (neat)	Hole transport layer	P-doped hole injection layer	anode	<table><tr><td>cathode</td></tr><tr><td>Doped ETL</td></tr><tr><td>Blocking layer</td></tr><tr><td>3 emitter-doped emission layers</td></tr><tr><td>Hole transport layer</td></tr><tr><td>hole injection layer</td></tr><tr><td>anode</td></tr></table>	cathode	Doped ETL	Blocking layer	3 emitter-doped emission layers	Hole transport layer	hole injection layer	anode
cathode																
EIL																
Doped ETL																
Alq3 (neat)																
Hole transport layer																
P-doped hole injection layer																
anode																
cathode																
Doped ETL																
Blocking layer																
3 emitter-doped emission layers																
Hole transport layer																
hole injection layer																
anode																
Separate EIL	Yes	No														
Blocking layer	No	Allegedly yes														
dopant function in ETL	assisting electron hopping	electron donor														
emission layer	Neat fluorescent Alq3	Ir-doped (e.g., 15%) phosphorescent emissive layer plus two other emissive layers for white light emission (EX1005, 91; Pet. 56, EX1019, Fig. 1)														

Simply put, the structural features around the doped ETL are completely different between Ma on the one hand and Diekmann and Suzuki on the other hand. Given these critical differences, the scarce literature on Liq-doped ETLs, and the lack of evidence of simultaneous inventions, the objective evidence once again points to non-obviousness.

C. Differing Mechanisms Demotivate POSITAs from Using Liq in Diekmann's and Suzuki's PHOLEDs and There Was No Reasonable Expectation of Success

The Reply acknowledges that a material may “increase electron density, electron mobility, or both depending on its use.” Reply 9. The question is therefore how Liq manages to affect an ETL's conductivity. Ma is the only reference the Petition cited for Liq-doped ETLs. EX2019, 16:11-16. The Reply acknowledges that in Ma, “Liq-doped ETL improves transport” through “short hopping length for electron transport.” Reply 9, 8. Yet, Diekmann expressly states that the n-dopants in its OLEDs “act as an electron donor” and the Petition acknowledges that “Diekmann teaches that the n-dopant for its electron transport layer should be ‘suitable for emitting electrons’” EX1005, 91, 10; Pet. 37.

Yet, the Petition made no effort to show that Liq was “suitable for emitting electrons” or “act as an electron donor” as Diekmann expressly states and as Suzuki implicitly requires given Suzuki's example of n-doped ETL (*see* EX1019, Fig. 1) and the Petition's referencing back to Diekmann for reasons to modify Suzuki. *Id.*

Instead, it relied solely on Ma's reported increase in ETL conductivity, without regard to the mechanism. Pet. 36-38, 69-70; Reply 10 ("The proposed combinations substitute one known n-dopant for another to further the same goal of improving ETL conductivity).

As Dr. Pattison explained, whether a POSITA could swap one material for another "really would depend on the level of how well the material's known and if the materials that you're talking is actually operating by the same physical mechanism." EX1043, 132:1-134:10, 134:17-135:2 (a POSITA could make a stack by switching a material but not necessarily an OLED).

Here, Petitioner's own evidence establishes that Liq-doped ETLs were not well known, since even Dr. Holmes, supposedly "effective in finding literature," managed to locate only two references (Ma and EX1049) on Liq-doped ETLs before the priority date. EX2032_2025-09-03_Holmes, 220:3-19, 222:1-20. And Petitioner does not assert that the conductivity improvement in Ma was due to Liq acting as an electron donor or emitting electrons. Reply 9-10. Thus, even if Liq could donate electrons in some context, Ma does not suggest that Liq would be acting as an electron donor when serving as a dopant in ETL. *See* Ma, 813; Ex. 1 to EX2032, 132:4-9 (when asked whether a Liq blend is necessarily n-doped, Samsung expert testified "Liq can be an n-dopant and also cannot be"); *ActiveVideo Networks, Inc. v. Verizon Comm'ns, Inc.*, 694 F.3d 1312, 1327-28 (Fed. Cir. 2012) (rejecting expert

testimony that stated conclusory of what a POSITA allegedly “would have known, based on the ‘modular’ nature of the claimed components, how to combine any of a number of references to achieve the claimed inventions”).

As to Kido-Endo, its theory of Liq’s operation is based on Liq’s LUMO level being allegedly higher than that of Alq₃. EX1049, L800-L801. But Kido’s reported Liq LUMO level, 2.5eV, differs greatly from values reported by others, including Ma. *See* EX1050, 062101-1 (3.15eV); EX1010, 813 (3.10eV). With a LUMO of 3.1-3.15eV, the LUMO of Liq is not higher than that of Alq₃ (3.0eV), and Kido-Endo’s theory does not necessarily follow. EX1049, L800-L801; EX2032_2025-09-03_Holmes, 52:2-23. That may explain why, between 2002 and 2008, there was no report of others doping ETLs with Liq, even though allegedly “[w]hen an interesting new material or device architecture emerges, there is interest from POSITAs to integrate it into their own work.” EX1044, ¶14.

The Reply argues that Liq in an ETL adjacent to a cathode would serve as an electron donor because it aids electron injection. Reply 8-9. But a 2011 study on Liq-doped Alq₃ concluded that injection barrier actually increased with increasing Liq content (EX2004, 114511-7), and the increase in observed conductivity was due to “the decrease in energetic disorder of Liq doped Alq₃ matrix” because “Liq is a more ordered organic semiconductor as compared to Alq₃” (*id.*, 114511-7, 114511-4). Dr. Holmes does not dispute this conclusion, or argues the same is true for other

ETLs. *See* EX1044. Thus, Kumar’s study undermines Petitioner’s assertion that Liq would “facilitat[e] injection of electrons from the cathode” to serve as an electron donor. *Contra* Reply 9-10.

D. Petitioner Has No Evidence of Expected Benefits Over Diekmann’s or Suzuki’s n-Doped OLEDs

The Reply effectively concedes that it has no evidence of “[d]irect comparative evidence of expected benefits.” Reply 10-11. Yet Petitioner continues to argue that Liq would be expected to reduce diffusion because of its allegedly larger molecular weight. *Id.* Petitioner does not explain why higher molecular weight necessarily leads to larger molecules. *Id.* And Dr. Holmes does not dispute that LiF exists in aggregates of six. EX2002, ¶81. A LiF hexamer has a molecular weight of about 156 g/mole (25.94×6 , Holmes 199:18-200:12), heavier than Liq (EX1055). Under Dr. Holmes’ theory, Liq would be more diffusible than LiF.

Moreover, elsewhere in the Reply, Petitioner argues that “Liq would dissociate.” Reply 9. One dissociated species is supposedly lithium metal. EX2032_2025-09-03_Holmes, 49:19-22. Lithium is known to have a higher diffusion constant than cesium and barium, and Liq dissociates more readily than LiF to create more diffusible lithium. EX1019, 5775 (“Compared to Li atoms, Cs atoms have larger size, which reduces the probability of Cs diffusing into the emission layer to quench the excitons.”); EX2023, 677 (Liq more readily dissociated than LiF). Petitioner has thus not shown that Liq would result in less diffusion than

Cs, Ba or LiF to have motivated a POSITA to use Liq, as Pictiva explained. POR 33.

Unable to show that Liq has lower diffusion than Cs, Ba or LiF, Petitioner makes a new argument that Liq is allegedly “more stable and easier to process than Diekmann’s n-dopants.” Reply 11. Not only is this an improper new argument (EX2032_2025-09-03_Holmes, 236:15-237:9), the evidence (EX1052) relates to using Liq in EIL, not in ETL. *See* EX1052, 252-253.

Petitioner then argues that because “[t]he studies closest to 2008 show Liq-doped ETL improved efficiency and operating voltage,” that somehow indicated that a POSITA would have made the modification it proposed. The references it cites are EX2024 (2013), EX2003 (2011) and Ma (2008), (Reply 12), two of the three references being years after the inventions. Moreover, they all included a separate EIL layer between the cathode and the Liq-doped ETL, as explained in Section C above. Thus, these studies would not suggest an OLED structure proposed by Petitioner, i.e., one in which “Liq-doped ETL abuts the cathode” (Reply 9) because any alleged improvement was obtained with a separate EIL and these studies do not show that alleged improvement could be obtained without the EIL in general.

Petitioner then makes the strawman argument that charge balance could be achieved through routine optimization. Reply 12-13. But Dr. Holmes acknowledged, “p- and n-doping was something that was still emerging in the early 2000s.” Holmes,

220:11-13; *see also* POR 27-28 (complexity in OLED designs). The issue is whether there is any evidence to indicate to a POSITA that such routine optimization could have yielded a Liq-doped OLED in Suzuki and Diekmann with the alleged benefits of reduced voltage, improved current and higher luminance that supposedly would have motivated a POSITA to make the changes. That optimization might be achieved in some systems involving “one well-known material for another well-known material that’s performing the same –same function with the same physical mechanism” says nothing about whether the same would be expected when replacing Diekmann’s and Suzuki’s n-doped ETLs with Liq-doped ETLs that were not well known and operated through a different mechanism and different structures. EX1043, 136:5-12, 134:17-135:2. As the Federal Circuit noted, “to have a reasonable expectation of success, one must be motivated to do more than merely to vary all parameters ... until one possibly arrived at a successful result.” *In re Stepan*, 868 F.3d at 1346-47 (cleaned up).

Petitioner also argues that a POSITA would not have pursued Novaled’s proprietary n-dopant over Liq because “Liq’s structure was known and its mechanisms studied.” Reply 13. Yet, the Reply does not dispute Kumar’s characterization that even as of 2011, “the reason for the enhanced electron transport property of [Liq] molecules was not well understood.” EX2004, 114511-1. And even if POSITAs sometimes explored poorly understood new materials, here, there were

but two reported studies on using Liq-doped ETLs in fluorescent OLEDs (note even PHOLEDs) before priority. That demonstrates a general lack of interest in Liq-doped ETLs. *See* EX1010, EX1049.

E. Evidence of Record Shows a Lack of Interest in Liq-Doped ETLs

As already noted, Dr. Holmes was only able to locate two studies on Liq-doped ETLs before the priority date (EX1010, EX1049). That does not show that Liq-doped ETLs were well-known or well-studied. Reply 13. Moreover, both studies were limited to Alq₃-based OLEDs, (EX2032_2025-09-03_Holmes, 60:11-22), again showing a lack of interest in expanding its usage into *e.g.*, PHOLEDs, the subject of the claims. As also noted above, Kido-Endo's conclusions on Liq's doping mechanism was based on a seemingly incorrect LUMO level for Liq, (see page 15 above), and the 2011 study by Kumar actually found that Liq increased injection barrier of the doped Alq₃, a fact that Petitioner does not deny or contravene. EX2004, 114511-8 ("the effective injection barrier will be 0.11, 0.15, 0.17, 0.19, and 0.22 eV for 0, 15, 33, 50, and 100 wt. % Liq doped Alq₃, respectively."). Thus, the alleged benefits, if any, were not well-known, and recent reports of reduced performance in Liq-doped OLEDs compared to undoped ones underscores the unpredictability. *E.g.*, EX2104, Figs. 4(a)-(b); EX2105, Fig. S1.

Petitioner also mischaracterizes Dr. Pattison's testimony regarding the skill level of a POSITA. Dr. Pattison has evaluated and managed hundreds of OLED-

related proposals for DOE and knows the capability of POSITAs well (perhaps more so than Dr. Holmes who has been a professor since 2006). EX1043, 58:14-62:5. The cited testimony reflects Dr. Pattison's objective assessment of the type of tasks that a POSITA as defined by Petitioner was capable of doing at the time of the invention. EX1043, 223:13-224:18. Tellingly, Petitioner does not contend that any of the relevant work was performed solely by a POSITA without involving an expert or a large team. *E.g.*, EX2032_2025-09-03_Holmes, 28:21-30:5 (Professor Kido of EX1049 is an expert in the OLED field); 61:8-16 (Professor So of EX1051 an expert in the field); EX1050 (nine named authors for a 4-page paper); EX1004 (11 inventors).

F. A POSITA Would Not Have Been Motivated to Extend Scarcely Studied Liq-Doped ETL from an Alq₃-OLED to PHOLEDs

As already noted, the only two pre-priority references that used Liq-doped ETLs were both Alq₃-based OLEDs. EX2032_2025-09-03_Holmes, 60:11-14. Petitioner proposes to extend those limited disclosures to PHOLEDs having Ir-dopants rather than undoped fluorescent Alq₃. Petitioner does not contend that before the priority date, it was even known that Liq-doped ETLs could be used in fluorescent OLEDs having a doped emissive layer (as opposed to neat Alq₃), let alone in a more complex Ir-based PHOLED system. EX1010, EX1049; EX2032_Holmes, 60:11-14.

Petitioner argues that “OLED design was modular.” Reply 15, 19. The Federal Circuit has rejected precisely that type of arguments. *ActiveVideo*, 694 F.3d at 1327-28 (rejecting expert testimony on obviousness that was “based on the ‘modular’ nature of the claimed components”). The design is also not modular. The Petition relies on white OLEDs with three stacked emissive layers, which Dr. Pattison explained would involve “a complicated kind of balancing act” in order not to have “mostly blue and just a little bit of red or green.” EX1043, 219:3-21. Dr. Pattison analogized the act of charge balancing in a single light OLED (such as Endo’s and Ma’s Alq₃-based OLED) and that in a white OLED (as in the proposed structures) as “a Ferrari versus a model T,” and is “different.” *Id.*, 219:22-220:7.

Petitioner argues that it has demonstrated a reasonable expectation of success because later studies showed “experimental OLEDs were functional throughout the Liq concentration ranges tested.” Reply 18. But the two Kim articles did not appear until **3-5 years** after the priority date; and the lack of simultaneous inventions supports non-obviousness. For instance, if it took another research group 3-5 years after the priority date to successfully make a claimed device, it would show a lack of motivation to make the proposed modification and/or a lack of reasonable expectation of success such that many trial-and-errors were needed in order to finally arrive at an operable OLED device.

Petitioner acknowledges the risk of quenching due to released lithium, but argues that the issue can be addressed by blocking layers, asserting that “[b]locking layers can provide ‘nearly complete isolation of the EML from the conductive dopants,’ even with lithium n-dopant.” Reply 16-17. If that is the case, Petitioner still has not explained why alleged lower diffusion would have motivated a POSITA to substitute named n-dopants with Liq. POR 40; EX2018, ¶32.

Moreover, Ma, Kido-Endo, and Choi—the three earliest references on Liq-doped ETLs—did not include blocking layers. *See* EX1010, 811; EX1049, Fig. 1; EX1050, Fig. 1. Petitioner has not presented any evidence that the alleged benefits (namely lower voltage, higher density and brighter luminance) associated with using Liq-doped ETLs would remain after using a blocking layer that sufficiently address the quenching issue. *Cf.*, EX1019, 5775 (“the driving voltage of the OLEDs rapidly increases with the thickness of the undoped buffer layer”).

Petitioner argues that the claims do not require an optimized OLED, just a functional one. Reply 20. Yet, the Petition argues that a POSITA would have made the substitution because of the alleged known benefits. Pet. 36-38, 69-70. And now it is suggesting that a POSITA would have made the modification even if none of those benefits would materialize. Petitioner has not presented any evidence on why a POSITA would have incurred the cost and spent the time if the resulting device would have had worse performance or that at those performance levels, the device

would still be suitable for use in OLED applications. *Cf.*, EX2005 at 34-35 (noting that a blocking layer “increases the driving voltage of the device due to low electron mobility of the non-doped exciton blocking layer” and the need to develop a suitable n-dopant).

It is Petitioner’s burden to show that, at the time of the invention, a POSITA would have had a motivation to incur expenses to extend Ma’s and Kido-Endo’s experimental Alq₃-based OLEDs to Diekmann’s and Suzuki’s PHOLEDs. Petitioner does not meet that burden when there was no certainty in obtaining any benefits in return or even an OLED device as required. *Henry Penny Corp. v. FryMaster LLC*, 938 F.3d 1324, 1332 (Fed. Cir. 2019) (“The benefits, both lost and gained, should be weighed against one another.”) (cleaned up); *see also*, EX1043, 134:17-135:2 (“Q: Just as a matter of being able to make the new stack by replacing one type of material for another, I mean, the capability exists for a POSITA to do that, not thinking about, you know, motivations for doing so? A: You could make a stack. I’m not sure if you would make an OLED.”) (objections omitted); 135:21-22 (“I’d say other materials are possible and can be exchanged, but the -- the implications -- *you'd need to have some motivation to pursue them and to understand the -- the implications of OLED performance.* you could try anything. The question would be why.”); 207:17-210:18 (OLED implies some threshold operating voltage and light output); EX1001, cl. 1 (reciting an OLED); EX1014 (poor quantum

efficiency of 6% Ir(ppy)₃ in Alq₃ or 6% Ir(ppy)₃ in CBP without a blocking layer).

Obvious-to-try is predicated on “a finite number of identified, predictable solutions.”

KSR Int’l Co. v. Teleflex Inc., 127 S. Ct. 1727, 1742 (2007).

III. Claim 4 Is Not Obvious

Claim 4 requires “a first encapsulation layer and a second encapsulation layer,” which Petitioner mapped respectively to Diekmann’s barrier layers 601 and 602 and to Lee’s “semi-crystalline parylene-based polymer layer[s] 38” and 32. Pet. 38-39. In its Reply, Petitioner argues that the modification is to replace Diekmann’s intermediate polymer layers 604 with “Lee’s more crystalline films.” Reply 21. Under that alternative, Petitioner has not shown why the volume structure of Diekmann’s second encapsulation layer 602 has a higher amporphicity than the volume structure of Diekmann’s first encapsulation layer 601. *See* Pet. 42-43 (analysis based solely on Lee’s structures).

Nor has Petitioner shown that a POSITA would have made the modification. Lee does not mention doped OLEDs or presented data to show it is suitable for n-doped PHOLEDs. *See* EX1008 *generally*.

Petitioner does not deny that its expert did not consider the effect of annealing on dopant diffusion. POR 52-53, Reply 22. Instead, it claims that because those features are not claimed, they are irrelevant. Not so: Petitioner does not deny that n-dopant diffusion and quenching are a concern in PHOLEDs. EX2020, 315:4-316:2.

Petitioner has not shown that, the annealing needed to induce crystallinity in parylene would not cause excessive dopant diffusion to make the method unsuitable for PHOLEDs. For example, Lee expressly claims that “the semi-crystalline parylene-based polymer layer is annealed at 350 to 400° C for a duration between approximately 2 and 30 minutes.” EX1008, cl. 9. This is the only claim reciting the annealing temperature; and this would signal to a POSITA that this would be the temperature range needed to obtain semi-crystalline parylene. There is no evidence that n-doped PHOLEDs would remain operable or suitable for OLED application after such annealing. Simply put, Petitioner has not shown that Lee’s encapsulant would be suitable to n-doped PHOLEDs in particular, as opposed to some generic OLEDs.

Petitioner’s attack on Dr. Pattison’s credibility is unfounded. Reply 23. As Dr. Pattison explained, Pictiva and he collaborated and the POR included his inputs. EX1043, 49:15-52:12. Ultimately, Petitioner does not address any specific testimony from those paragraphs and Dr. Holmes chose not to dispute any of those opinions in the Reply Declaration. Reply 21-23; EX1044.

IV. Claims 9-11 Are Not Obvious

Petitioner reiterates that “[i]ncorporating touch sensors would ‘allow[] a user to manually input instructions’ intuitively by touch.” Reply 23. But the Diekmann and Suzuki devices relied on for modification are for white light OLEDs, not

displays. *See* EX2019, 192:6-16 (“Diekmann is for solid state lighting...”); EX1003, ¶104 (white light emission); Pet. 56 (noting Suzuki’s disclosure of “[w]hite light emission”). Petitioner does not explain why a POSITA would have wanted to add a touch sensor to a solid-state lighting device. POR 56. In that regard, Patent Owner does dispute the need for touch sensors in Diekmann or Suzuki. POR 55-56.

V. Claim 12 Is Not Obvious

The Reply belatedly explains why gesture control would allegedly make the control of an OLED display more natural, which was unexplained in the Petition. Reply 25. But as noted in the section above, the relied-on Diekmann and Suzuki devices are for solid state lighting, not displays. *See also* POR 59. The Reply does not explain why a motivation existed to use gesture control for solid state lighting at the time of the invention.

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CERTIFICATE OF WORD COUNT

I hereby certify, pursuant to 37 C.F.R. § 42.24, that the foregoing Patent Owner Sur-Reply contains 5,585 words, excluding the words in the table of contents, table of authorities, this certificate of word count, certificate of service or exhibit list. The word count is based on the word count of the Microsoft Word program used to prepare the Patent Owner Sur-Reply.

/Hong Zhong/
H. Annita Zhong

CERTIFICATE OF SERVICE

I hereby certify, pursuant to 37 C.F.R. § 42.6, that on September 17, 2025, a complete copy of the **PATENT OWNER SUR-REPLY** and **EX2032** were served upon the following, by ELECTRONIC MAIL:

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