

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAMSUNG DISPLAY CO., LTD.,
Petitioner,

v.

PICTIVA DISPLAYS INTERNATIONAL LTD.,
Patent Owner.

Case No. IPR2024-01094
Patent No. 8,558,223

PETITIONER'S REPLY IN SUPPORT OF ITS PETITION

PROTECTIVE ORDER MATERIAL

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1001	U.S. Patent No. 8,558,223
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1003	Declaration of Barry P. Rand, Ph.D.
1004	<i>Curriculum Vitae</i> of Barry P. Rand, Ph.D.
1005	PCT Application Publication No. WO 2005/086251 ("Werner") (English translation)
1006	PCT Application Publication No. WO 2005/086251 ("Werner") (Original German)
1007	J.W. Ma et al., <i>Organic light-emitting diodes based on new n-doped electron transport layer</i> , Synthetic Metals 158, 810-814 (2008) ("Ma")
1008	Max Shtein et al., Micropatterning of small molecular weight organic semiconductor thin films using organic vapor phase deposition, J. Appl. Phys. 93, 4005-4016 (2003) ("Shtein")
1009	U.S. Patent Application Publication No. 2007/0249148 ("Werner II")
1010	U.S. Patent Application Publication No. 2008/0258610 ("Ikeda")
1011	U.S. Patent Application Publication No. 2007/0181876 ("Itai")
1012	F. Albert Cotton et al., <i>Studies of Tetrakis(trifluoroacetate) Dirhodium. 2.† A Pi Complex of Hexamethylbenzene with Tetrakis (trifluoroacetate) Dirhodium(II,II)</i> , 18 Organometallics 2724-2726 (1999) ("Cotton 1999")
1013	Abhishek P. Kulkarni et al., <i>Electron Transport Materials for Organic Light-Emitting Diodes</i> , 16 Chem. Mater. 4556-4573 (2004)
1014	U.S. Patent Application Publication No. 2005/0129978 ("Nakashima")
1015	Bernard Geffroy et al., <i>Organic light-emitting diode (OLED) technology: materials, devices and display technologies</i> , 55 Polym Int 572-582 (2006)
1016	Amended Complaint (First), <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)
1017	Docket Control Order, <i>Pictiva Displays International Ltd. v.</i>

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1020	Reply Declaration of Barry P. Rand, Ph.D.
1021	Deposition Transcript of Kirk S. Schanze, dated July 21, 2025
1022	Torben Menke, et al., <i>In-situ conductivity and Seebeck measurements of highly efficient n-dopants in fullerene C₆₀</i> , 100 Appl. Phys. Lett. 093304 (2012)
1023	Christopher Schmitz, et al., <i>Lithium-Quinolate Complexes As Emitter and Interface Materials in Organic Light-Emitting Diodes</i> , 12 Chem. Mater. 3012 (2000)
1024	DE102008056391B4
1025	Certified English Translation of a complaint for German proceeding, Munich Regional Court, Ref. 21 O 2603-24 (formerly 21 O 13746-23)
1026	Prof. Schanze Expert Opinion, Anlage PS 15 (September 18, 2024)
1027	Barry P. Rand, et al., <i>Organic Solar Cells With Sensitized Phosphorescent Absorbing Layers</i> , 10 Organic Electronics 1015 (2009)
1028	Fan Yang, et al., <i>Efficient Solar Cells Using All-Organic Nanocrystalline Networks</i> , 19 Adv. Mater. 4166 (2007)
1029	Z.R. Hong, et al., <i>Improved Efficiency of Zinc Phthalocyanine/C₆₀ Based Photovoltaic Cells Via Nanoscale Interface Modification</i> , 90 Appl. Phys. Lett. 203505 (2007)
1030	Sunwoo Kang, et al., <i>Unraveling The Complexation Effect of Electron Transporting Materials With Liq On The Charge Transport Properties: A Theoretical Perspective</i> , 810 Chem. Phys. Lett. 140207 (2023)
1031	Min Seok Ki, et al., <i>Supporting Info: Improved Thermal Stability and Operational Lifetime Of Blue Fluorescent Organic Light Emitting Diodes By Using A Mixed Electron Transporting Layer</i> , for Ex. 2050
1032	Certified English Translation of 21 O 2603-24, Reply 18.09.2024

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1033	Hong Li, et al., <i>First-Principles Theoretical Investigation of The Electronic Couplings in Single Crystals of Phenanthroline-Based Organic Semiconductors</i> , 126 J. Chem. Phys. 164704 (2007)
1034	M. Y. Chan, et al., <i>Efficient Organic Photovoltaic Devices Using a Combination of Exciton Blocking Layer and Anodic Buffer Layer</i> , 100 J. Appl. Phys. 094506 (2006)
1035	Certified English Translation, WO2007054345A1
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1039	21 O 2603-24, Reply 18.09.2024

I. GROUND I: WERNER

Werner teaches the elements of claim 1 along with other Challenged Claims elements, as the Petition explains. Pictiva's primary response is that, despite Werner's listing of $W_2(hpp)_4$ and BPhen as "candidate" materials, Werner does not specifically link them. POR,¹ 2. But Pictiva ignores the claims' wording (e.g., claim 1 requires no specific metal complex or organic compound) and Werner's broader teachings.

Contrary to Pictiva's assertions, this is not a case where the Petition combines "individual elements ... known in some context" or "var[ies] all parameters or try each of possible choices until one possibly arrived at a successful result." POR, 6-7. Rather, Werner is expressly directed to doping an organic compound with a metal complex with central metal atoms to create an electron conducting layer ("ECL"), as summarized in the abstract:

(57) Abstract: The invention relates to the use of a *metal complex* as n-dopant for doping an *organic semiconducting matrix material* [i.e., organic compound] for modifying the electrical properties of the same.... [to] *achiev[e] high conductivities*.... [A] ... *metal complex having a central atom* ... is used as the dopant. At least one ligand [of the metal complex] ... can be a bridging ligand, *especially hpp*

¹ Patent Owner Response (Paper 19).

Werner, Abstract (emphasis added); *id.*, 1:14-16, 55:2-17, 11:26-29.

Further, Werner discloses, among eight specific classes of metal complexes, the class of “paddlewheel complexes” with “central metal atoms,” and “hpp” the only explicitly called-out ligand in the Abstract. Werner, 11:7-14:5; *id.*, Abstract. Werner discloses and claims “ M_2hpp_4 with M equals Cr, Mn, Fe, Co, Ni, Cu, Zn, Mo, or W” as a metal complex. Werner, 60:20-21, claim 22 (emphasis added). For the organic compound, Werner discloses “[p]henanthrolines, which can be substituted or unsubstituted, in particular aryl-substituted” and specifically calls out “BPhen” (one of only a handful of specifically identified matrix materials). Werner, 55:3-6, 54:11-13; *id.*, 55:6-17 (disclosing aryl-substituted heteroaromatics, including TAZ).²

Werner also discloses jointly vaporizing a metal complex and an organic compound, from separate crucibles into an ECL. Petition, 26; Werner, 61:10-11, 56:12-18. Werner discloses that the metal complex matrix material ratio can be varied, and these ratios can result in different conductivities. Werner, 58:6-15. These

² Pictiva admits that the POSA knew BPhen as a common matrix material. Ex.2041, ¶72 (citing Ex.2043, 10:50-54); Ex.1021, 22:9-13 (“Q. And BPhen has been used as [an] electron transport layers in OLEDs since at least 2005. Is that right? A. Yes.”).

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ECLs can be used to create “electronic devices”, in particular, OLEDs. Werner, 58:21-60:14, 2:21-30.

A. Werner Directly Teaches Using the Metal Complex $W_2(hpp)_4$ for Doping the Organic Compound BPhen

As the Petition explained, Werner directly teaches an electron-conducting layer that is obtained by joint vaporization of metal complexes including $W_2(hpp)_4$ and organic compounds including BPhen. By disclosing these elements as arranged in the claims, Werner would satisfy them even under an anticipation standard. Indeed, this case is analogous to *Syngenta Crop Protection AG v. UPL Ltd.*, PGR2023-00017, Paper 58 (P.T.A.B. July 26, 2024)), where the Board explained:

[S]electing specifically identified components from more than one list, on its own, is not fatal to Petitioner's anticipation challenge. For example, in *Kennametal [Inc. v. Ingersoll Cutting Tool Co.]*, 780 F.3d 1376 (Fed. Cir. 2015)], the claims-at-issue involved a metal with a coating. 780 F.3d at 1379. ***The prior-art reference did not explicitly disclose the specific metal and coating combination; instead, it disclosed different classes of metals with multiple options for coating.*** *Id.* at 1379–80. Nonetheless, the Federal Circuit agreed with the Board that the reference anticipated each of the numerous possibilities that resulted from the permutations of the options disclosed in the reference. *Id.* at 1382–83.

PGR2023-00017, Paper 58, at 48 (emphasis added). And as in *Syngenta*, “Petitioner's alleged ‘picking, choosing, and combining’ [in this case] are of

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disclosures not separate and distinct, but directly related to each other.” *Id.* at 49.

Werner specifically identifies $W_2(hpp)_4$ and BPhen as among the combinable metal complexes and organic compounds.

Additionally, Werner satisfies the claims even though it identifies other metal complexes and organic compounds:

‘For the purposes of whether they are anticipatory,’ however, ‘lists and genera are often treated differently.’ *In re Gleave*, 560 F.3d [1331] at 1337 [(Fed. Cir. 2009)].... ***[W]hen the species is clearly named, the species claim is generally anticipated no matter how many other species are additionally named.*** *Id.* at 1338. This is so even when the anticipated item appears in the list ‘without special emphasis.’ *Id.*

PGR2023-00017, Paper 58, at 46 (emphasis added). *See also Kennametal* at 1382-83 (finding reference anticipatory because it “effectively teaches” the specific combination; that other possibilities were included “would not remove the resulting composition from the broad reach of [the claim]”). So too for Werner.

Further, while the Petition highlighted $W_2(hpp)_4$ and BPhen as exemplary compounds, they are not the only ones that satisfy the claims. For example, all of Werner’s metal complexes satisfy claim 1, as do many of Werner’s matrix materials (e.g., aryl-substituted phenanthrolines). Ex.1020, ¶¶5-8.

B. Using $W_2(hpp)_4$ to Dope BPhen Would Have Been At Least Obvious

In any event, under a preponderance standard, Werner's disclosures are sufficient to render obvious using a metal complex such as $W_2(hpp)_4$ to dope an organic compound such as BPhen.

1. A POSA would be motivated to combine $W_2(hpp)_4$ and BPhen with a reasonable expectation of success

Pictiva disputes whether the Petition demonstrated a motivation to combine $W_2(hpp)_4$ with BPhen. POR, 6-9. It did: Werner specifically identifies $W_2(hpp)_4$ as a suitable metal complex for n-doping its matrix materials (Petition, 22), and teaches that “[i]n particular, BPhen can be used as a matrix material” (Petition, 24, quoting Werner, 55:3-6). This constitutes an express teaching, suggestion, or motivation for using the materials together.

Pictiva argues that one must be motivated to do more than “merely to vary all parameters or try each of numerous possible choices.” POR, 7 (citing *In re Stepan*, 868 F.3d 1342 (Fed. Cir. 2017)). But that is not the issue here. *Stepan* addressed whether an open-ended suggestion to use “the surfactant component compris[ing] any combination of surfactants” would make it a matter of “routine optimization” to arrive at the claimed formulation with specific surfactant concentration ranges and properties that the reference did not disclose. *In re Stepan*, 868 F.3d at 1345-47. Conversely, Werner discretely identifies $W_2(hpp)_4$ and BPhen as suitable for use in

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its ECL which is sufficient to disclose the claimed elements, without any need for further “optimization.” *Id.*

That Werner discloses *other* options does not mean that it would not be obvious to combine $W_2(hpp)_4$ and BPhen if there is no teaching away. *Syntex (U.S.A.) LLC v. Apotex, Inc.*, 407 F.3d 1371, 1379-80 (Fed. Cir. 2005). In *Syntex*, the claimed formulations included octoxynol 40 (a known nonionic surfactant), and the prior art formulations had a nonionic surfactant without specifically disclosing octoxynol 40. *Id.* at 1380. Although the class of “nonionic surfactants” presumably includes millions of examples (listed and unlisted), the Federal Circuit found that “the fact that octoxynol 40 was not one of the surfactants mentioned does not, *without more*, support the contention that the use of octoxynol 40 is nonobvious.” *Id.* (emphasis added). Here, Werner expressly lists $W_2(hpp)_4$. And, as discussed below (**Section I.B.2**) Pictiva fails to provide “more” to rebut obviousness. POR, 10-15. *Id.*

Further, Pictiva's position—that the Petition needs to present a reason to combine $W_2(hpp)_4$ specifically with BPhen (POR, 6-9), even though Werner lists both in the same reference—contradicts Federal Circuit precedent. *Gen. Elec. Co. v. Raytheon Tech. Corp.*, 983 F.3d 1334, 1352 (Fed. Cir. 2020) (holding that the Board erred in requiring a motivation to combine elements “present together in a reference.”). Such an “analysis unduly dissects prior art references into collections

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of individual elements, requiring a party showing obviousness to re-do the work already done in the prior art reference.” *Id.*

The POSA would have had a reasonable expectation of success in the outcome of combining $W_2(hpp)_4$ and BPhen, and it would not have been unpredictable. POR, 10. Pictiva's citation to Dr. Rand in support of purported unpredictability (Ex.2042, 147:10-148:4) shows Dr. Rand was asked *how many* of the metal complex/organic compound combinations would be electronically conductive; not whether the combination of $W_2(hpp)_4$ and BPhen would be electronically conductive. *Id.*

Pictiva suggests that the Petition's citation to the '223 Patent's example of BCP and $W_2(hpp)_4$ represents improper hindsight. POR, 14. Not so. That a $W_2(hpp)_4$: BCP (a phenanthroline) ECL results in improved conductivity over an undoped BCP ECL confirms a POSA's reasonable expectation of BPhen (a phenanthroline) and $W_2(hpp)_4$. Ex.1020, ¶15. For example, Ex.2044³ provides data showing that $W_2(hpp)_4$ -doped BPhen results in a 4000x conductivity improvement over pristine BPhen. Ex.2041, ¶62; Ex.1020, ¶¶10-12. Indeed, Ex.2044 shows that other phenanthrolines (one of Werner's matrix material classes) doped with $W_2(hpp)_4$ also

³ Ex.1035 is an English Translation of Ex.1036, WO 2007/054345, published May 18, 2007, the priority document for Ex.2044 and prior art to the '223 Patent. Ex.1036 contains all cited passages in Ex.2044 in substantially the same form.

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showed significant conductivity, Ex.1020, ¶13, further confirming a POSA's expectation that Werner's $W_2(hpp)_4$ -doped phenanthrolines (including BPhen) would have a high degree of electron conductivity. Werner, 55:3-6; Ex.1020, ¶¶14-16.

2. The prior art does not teach away

Attempting to rebut both motivation to combine and a reasonable expectation of success, Pictiva asserts that the POSA would not have considered $W_2(hpp)_4$ to be an "effective" n-dopant for BPhen in OLEDs. POR, 10-15. Each argument fails.

First, Pictiva suggests that claim 1's required metal complex and organic compound must be selected to "preserve overall conductivity" while "mitigating problems caused by potential crystallinity." POR, 14. But claim 1 requires no such features: claim 1 requires only certain structural characteristics, which $W_2(hpp)_4$ and BPhen meet.

Second, Pictiva's evidence undercuts its assertion regarding $W_2(hpp)_4$'s alleged propensity to destroy organic compounds, POR 13-14, which shows no destruction of any of the $W_2(hpp)_4$ -doped phenanthrolines or C_{60} ; indeed, each of which showed an effective charge transfer. Ex.1020, ¶¶17-19; Ex.2044; Ex.2041, ¶¶81-82 (citing Ex.2003, Ex.2009, Ex.2016).

Third, Pictiva's assertions regarding the purported mismatch between the HOMO:LUMO levels of $W_2(hpp)_4$ and BPhen, POR 10-12, is belied by the prior art.

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Ex.2044 explains that each of the disclosed phenanthrolines' LUMO "falls within the range which means it can be doped with ... in particular $W_2(hpp)_4$ ". Ex.2044, 8:46-53. BPhen's LUMO falls within the same range as the disclosed phenanthrolines. Ex.1020, ¶¶20-28. And there can be no disagreement that regardless of the numerical HOMO:LUMO relationship, all of the $W_2(hpp)_4$ -doped phenanthrolines of Ex.2044 (including BPhen) showed improved electron transfer over undoped BPhen. Ex.1020, ¶¶29-30.

Nor would Ex.2044 dissuade a POSA from using BPhen with $W_2(hpp)_4$. Ex.2041, ¶62. Although Ex.2044 baldly asserts that the BPhen: $W_2(hpp)_4$ film's conductivity is "too low for use in [OLEDs]," 4:44-45, this unsupported assertion is undercut by the POSA's knowledge that (1) Werner's specific disclosure of both BPhen and $W_2(hpp)_4$ for its ECLs for use in OLEDs, Werner, 2:21-30, 55:5-6; and (2) the *data* in Ex.2044 showed a 4000x conductivity improvement of the BPhen: $W_2(hpp)_4$ film over undoped BPhen, Ex.1020, ¶11, which is especially high in light of Ma's assertion that a two to three-fold conductivity improvement over undoped BPhen using a BPhen:Liq ECL is a "significant improvement;" Ex.1020, ¶12, Ex.1007, 810-811. Therefore, the prior art as a whole does not undercut the conclusion that Bphen: $W_2(hpp)_4$ is a suitable option for an ECL. *Cf. Par Pharm., Inc. v. TWI Pharm., Inc.*, 773 F.3d 1186, 1197-98 ("Our precedent, however, does

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not require that the motivation be the *best* option, only that it be a *suitable* option from which the prior art did not teach away.” (emphasis in original)).

The '223 patent further confirms the Petitioner's position. The '223 Patent's goal is “provid[ing] an [ECL with a] high degree of electron conductivity” Ex.1001, 1:49-52, and identifies BPhen (as one of 23 organic compounds) and W₂(hpp)₄ as suitable materials. Ex.2044 already taught a W₂(hpp)₄:BPhen film having a 4000x conductivity improvement over undoped BPhen. Ex.1020, ¶11. That the '223 Patent inventors perceived that such disclosed conductivity is “high” does not make W₂(hpp)₄:BPhen patentable. “It is not invention to perceive that the product which others had discovered had qualities they failed to detect.” *In re Kubin*, 561 F.3d 1351, 1357 (Fed. Cir. 2009).

But even if the POSA would be dissuaded from making a specific BPhen:W₂(hpp)₄ ECL, the other phenanthroline:W₂(hpp)₄ ECLs of Ex.2044 would also demonstrate why Werner meets the elements of claim 1. Ex.1020, ¶¶13-14. And the prior art showed that such phenanthroline:W₂(hpp)₄ ECLs displayed significant conductivity. Ex.1020, ¶¶13-14.

C. Werner Renders Obvious Claims 1-4, 6, and 8-14

1. Claim 1

Pictiva has not raised any genuine dispute that Werner discloses an organic electronic component comprised of a substrate, a first electrode, a second electrode

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and an ECL formed by jointly vaporizing a metal complex and an organic compound with particular structural characteristics, as required by claim 1. POR, 6-18; Ex.1021, 17:21-18:9. Further, as discussed in **Sections I.A-I.B**, a POSA would have combined $W_2(hpp)_4$ and BPhen for an ECL.

Pictiva asserts that Werner does not disclose “joint vaporization” to combine *specifically* $W_2(hpp)_4$ with BPhen. POR, 15-16. Not so. Werner discloses that co-evaporation, i.e., joint vaporization, can be used for combining any of the disclosed metal complexes and organic compounds, which, under a preponderance of the evidence standard, is more than sufficient to disclose “joint vaporization.” Petition, 22-26; Werner, 56:12-18 (“[c]o-evaporation in vacuum with a source for the matrix material and one for the dopant”) 61:10-11, 61:35-62:3, 62:13-16; Ex.1020, ¶31. Unlike Pictiva’s assertion, a motivation is presumed because Werner discloses joint evaporation of the disclosed metal complex and the organic compound. *Realtime*, 912 F.3d at 1372-73; Petition, 19-26.

Pictiva next suggests that Werner’s disclosure of simultaneous evaporation is not specific enough to mean joint vaporization and could mean “sequential” vaporization. POR, 15-17. However, Werner differentiates “co-evaporation” from “sequential evaporation” as separate means of manufacture. Werner, 56:12-22; Ex.1020, ¶¶32-33.

Further, contrary to Pictiva's assertions, POR, 16, Werner does not teach away from joint vaporization of $W_2(hpp)_4$ with BPhen. *Syntex*, 407 F.3d at 1380. Pictiva's assertions regarding $W_2(hpp)_4$ only being used in solution are belied by Pictiva's evidence. Ex.1020, ¶¶34-35.

Under a preponderance standard, Werner renders joint vaporization at least obvious. This is the most straightforward interpretation of Werner's use of "co-vaporization" or "simultaneous evaporation," particularly when nothing indicates that the materials were *not* jointly vaporized. Ex.1020, ¶36; Ex.1021, 38:21-39:24.

Finally, Pictiva contests whether Werner discloses the electrical conductivity of the ECL to the electrodes. POR, 17. It does. Werner discloses "an organic light-emitting diode [OLED]" using the disclosed ECL and a metal cathode Werner, 58:21-60:14, 61:19-22. Presumptively, Werner's ECL is electrically conductive. *Realtime*, 912 F.3d at 1372-73. Moreover, it was known that $W_2(hpp)_4$:BPhen films showed improved conductivity compared to a pristine BPhen film, as disclosed in Ex.2044. Ex.1020, ¶37.

2. Claim 2

Claim 2 (as well as 11 and 14) requires that the metal complex and organic compound “coordinate⁴ due to joint vaporization.” Pictiva’s argument here focuses on whether BPhen would coordinate to the Tungsten metal center. POR, 19-24. But this argument contradicts the ’223 patent’s disclosure.

Werner discloses the limitation of claim 2 by disclosing the same materials and the same processing conditions that the ’223 Patent describes results in “coordination.” Petition, 27-29. The ’223 patent discloses:

By suitable selection of the metal complexes, for example binuclear metal complexes, and suitable selection of the organic compounds such

⁴ In the District Court matter, “coordinate[s]” was construed as “form[s] a chemical bond between two atoms in which a shared pair has been supplied by one of the two atoms.” Ex.2055, 29-30. Neither party has asked the Board to construe this term, and it is not necessary to do so. Because Werner discloses the same materials and conditions that are described in the ’223 patent as causing “interactions, so that the compounds *coordinate*,” Ex.1001, 11:17-23 (emphasis added), Werner teaches coordination as that term is used in the ’223 patent. *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (“[W]e need only construe terms that are in controversy, and only to the extent necessary to resolve the controversy.” (internal quotations and citation omitted)).

as for example the compounds I to XXIII, the joint vaporization of the metal complex with the organic compound ... results in interactions, so that the compounds coordinate to each other.

Ex.1001, 11:17-23 (emphasis added). Indeed, citing to the same part in the equivalent German patent,⁵ Pictiva argues⁶ that “*no additional technical measure is needed* [for coordination between a metal complex and an organic compound] beyond co-evaporation of the compounds provided that the metal complex and the organic compound are suitable for forming coordination bonds.” Ex.1025, ¶108 (emphasis added); *id.*, ¶53 (defining the term “coordinated”).

W₂(hpp)₄ and BPhen are “suitable selections” for coordination according to the '223 patent. Petition, 27-29; Ex.1001, 11:17-23, 3:4-49. In other words, the '223 Patent confirms joint vaporization of W₂(hpp)₄ and BPhen (compound VI in the '223 patent) *will necessarily result in* coordination. Because Werner made the same disclosure of W₂hpp₄ and BPhen years prior to the '223 Patent, coordination is “a structure suggested by the prior art, and, hence, potentially in the possession of the public” that cannot be later patented. *Kubin*, 561 F.3d at 1357 (internal quotations and citation omitted).

⁵ Paragraph [0034] of DE102008056391B4, Ex.1024.

⁶ Filed in Munich Regional Court, Ref. 21 O 2163/24 (hereinafter, “the German proceeding”).

3. Claims 3-4 and 6

Pictiva raises no separate arguments for claims 3-4 and 6 over what is discussed above. Therefore, for the reasons set forth in the Petition, these claims are obvious. Petition, 29-31.

4. Claim 8

The parallel district court matter has construed “chain-like structure” as “a structure in which at least parts of organic compounds bridge exactly two metal complexes together.” Ex.2055, 30-31. $W_2(hpp)_4$ and BPhen, when jointly vaporized, would form a chain-like structure. Petition, 32-48; Werner, 57:20-22 (disclosing that the metal complex: organic compound layer is connected by “lines, such as conductivity paths”).

The same compounds processed with the same conditions would result in the same molecular structure. *Supra* **Section I.C.2.** Werner discloses the same materials (i.e., $W_2(hpp)_4$ and BPhen) and the same processing conditions (i.e., joint vaporization) as the '223 patent. Thus, years prior to the '223 patent, Werner put “a chain-like ... structure” of a metal complex and an organic compound into “the possession of the public.” *Kubin*, 561 F.3d at 1357; Ex.1001, 1:60-62, 11:17-29; Petition, 32.

Pictiva asserts that $W_2(hpp)_4$ and BPhen cannot form a chain-like structure because BPhen will coordinate to only a single metal center. POR, 25. However,

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Pictiva's assertion contradicts the '223 patent's disclosure. *See, e.g.*, Petition, 32-37, 47-48. According to the '223 patent, BPhen has a "delocalized electron system" capable of "transport[ing] further negative charges very effectively (Ex.1001, 11:1-3, 7:56-63), and a chain-like structure "enables additional electrons to be able to be transferred from the metal complexes to the organic compounds" (*id.*, 11:29-31), such as $W_2(hpp)_4$ to BPhen. Thus, the high conductivity shown by a $W_2(hpp)_4$:BPhen ECL (Ex.1020, ¶11; Ex.2044 (table 1, Example 2)) indicates that a chain-like structure between $W_2(hpp)_4$ and BPhen necessarily exists. *Kubin*, 561 F.3d at 1357.

5. Claim 9

Pictiva does not dispute that Werner discloses an OLED but instead argues that Werner does not disclose a $W_2(hpp)_4$ and BPhen OLED. POR, 24. Werner discloses that its metal complexes and matrix materials can be made into an ECL for use in OLEDs. Werner, 58:21-60:14; Ex.2044, 9:15-10:61 (disclosing an OLED formed by combining $W_2(hpp)_4$ and various phenanthroline derivatives). A POSA's reasonable expectation of success does not require that the embodiment be commercially successful because obviousness does not require "conclusive proof of efficacy." *Acorda Therapeutics, Inc. v. Roxane Lab., Inc.*, 903 F.3d 1310, 1333 (Fed. Cir. 2018) (internal quotations omitted).

6. Claim 13

Pictiva does not dispute that “the degree of cross-linking is related to electron conductivity and that the ratio between the metal complex and the organic compound during vaporization affects the electron conductivity of the electron compound during vaporization affects the electron conductivity of the electron conducting layer.” POR, 26-27; Petition, 52-53. Instead, it argues that “[t]he sole source of that knowledge came from the inventors.” POR, 26-27. This argument is misplaced. As shown in the Petition, this was within the POSA’s knowledge before the ’223 patent. Petition, 53-54.

7. Claims 10-12 and 14

Pictiva did not provide separate arguments for claims 10-12 other than “the same reasons stated for claims 1, 2 and 8.” POR, 26. For the same reasons discussed for claims 1, 2, and 8, Werner renders obvious claims 10-12 and 14. *Supra* **Sections I.C.1-I.C.2, I.C.4; Petition, Sections VIII.A.8-VIII.A.10.**

II. GROUND II: MA

A. Ma Is Prior Art

1. Ma’s August 2008 online version was publicly available

Ex.1007 (“Ma”) was publicly available on August 29, 2008, its stated “available online” date. Petition, 1; Ex.1007, 810.

Ma is a peer-reviewed article published by an established publisher of scientific journals, Elsevier. The Rachael Garland Declaration (Ex.1018), explains

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that “Elsevier, publishes and makes available technical articles” through ScienceDirect. Ex.1018, ¶ 6.⁷

“The article and abstract from Science Direct [Ma, the same as Ex.1018 Ex.A] shows the date of publication for the first online version,” Ex.1018, ¶¶ 6, 10 and “was available online on August 29, 2008.” Ex.1018 ¶¶ 8-11. *See, e.g., Voter Verified, Inc. v. Election Sys. & Software, Inc.*, 745 F. Supp. 2d 1237, 1245-46 (M.D. Fl. 2010) (relying on “website ‘maintainer’” declaration to hold a website-based digest a printed publication), *aff’d sub nom. Voter Verified, Inc. v. Premier Election Sols., Inc.*, 698 F.3d 1374, 1380-81 (Fed. Cir. 2012).

Ex.1018 confirms that, when Ma was published online on August 29, 2008, the interested public could download it through Elsevier's ScienceDirect. Ex.1018, ¶¶ 6-7. The Board agreed with this fact. Paper 11 at 18. *See also Palo Alto Networks, Inc. v. Finjan, Inc.*, IPR2015-01979, Paper 62 at 28 (P.T.A.B. Mar. 15, 2017) (finding a reference “published in a journal or periodical ... and distributed to

⁷ Pictiva challenges Ex.1018 because the declarant was unavailable for cross-examination. Petitioner believes Ex.1018 may still be relied upon as further support for the publication date as listed on the reference itself. Moreover, Petitioner now provides Ex.1037, a declaration from librarian June Munford that also confirms Ma's public availability as of August 29, 2008.

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subscribers” publicly accessible); *Voter Verified*, 698 F.3d at 1380 (finding publicly available an article “made available for download through an FTP site maintained by SRI International”).

The Board was correct to find that “this situation differs from that presented in *Blue Calypso*” because “Elsevier is an established publisher, as demonstrated by Dr. Schanze’s testimony” and “Ma itself indicates the website on which Ma abstract would have been available.” Paper 11, 18-19 (citing Ex.2001, ¶116; *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1348. (Fed. Cir. 2016)).

Similarly, Pictiva’s citation to *In re Bayer*, 568 F.2d 1357, 1362 (C.C.P.A. 1978), which concerned an “uncatalogued and unshelved” thesis merely “deposit[ed] ... in the university library,” is inapposite, because “[w]hen there is an established publisher [like Elsevier] 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). Pictiva’s assertions about the purported insufficiency third-party indexing services, POR, 28-35, are not sufficient to rebut the presumption that Ma was available online as of August 29, 2008. Paper 11 at 18 (“the indexing of a website, is not a necessary condition for a reference to be publicly accessible”) (internal citations and quotations omitted); *see also e.g., NearMap US, Inc. v. Eagle View Techs., Inc.*, IPR2022-01009, Paper 28 at 25-27 (P.T.A.B. Dec. 14, 2023) (finding a reference “publicly available before the critical date” based on factors

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including an “established publisher” which created “a presumption of public accessibility as of the publication date”).

The Munford Declaration, Ex.1037, further demonstrates that “the full text” of Ma, in an “In Press, Corrected Proof” version (which is identical to the hard copy except the specific issue number and specific page numbers) “was available to the public as of August 29, 2008” and that ScienceDirect would allow the interested public to find Ma as of that date. Ex.1037, ¶¶11, 27-55.

2. Ex.1007 was the version available in August 2008

Ex.1007 is the version of Ma that was available on August 29, 2008. The Board acknowledged that Ex.1018 demonstrates that “[t]he article and abstract from Science Direct shows the date of publication for the first online version ... embedded in the articles” which “is not changed” once calculated. Ex.1018, ¶10. The Munford Declaration confirms this. Ex.1037, ¶¶9-10, 13-26. Pictiva points to no evidence that there have been any changes to Ex.1007 at any point since it was accepted. Ex.1020, ¶¶38-41; Ex.1021, 71:4-17.

Accordingly, the preponderance of the evidence establishes that Ma qualifies as a printed publication as of August 29, 2008.

B. Ma Renders Obvious Claims 1-2, 6, and 8-14

1. Claim 1

Ma renders claim 1 obvious. Petition, 55-60. The POPR did not challenge this point on the merits. Paper 11, 20. Both of Pictiva's now-raised arguments should be rejected.

a. Joint Vaporization

Ma teaches that its ECL ("electron transport layer" or "ETL") is *obtained by joint vaporization* of its metal complex (Liq) with its organic compound (BPhen). Petition, 59. Pictiva faults Petitioner for not explaining Ma's evaporative deposition set-up. POR, 54-56. Yet Pictiva notes that joint vaporization in the '223 patent means that "the two materials vaporize together." POR, 54. This is what Ma discloses.

Ma describes that "a 50 nm-thick BPhen:LiQ ETL was *co-deposited* on the EML." Ma, 811 (emphasis added). That Ma described the two-component ETL thickness with one value indicates that the two components were vaporized together—as opposed to creating a "macroscopically homogenous form" as Pictiva hypothesizes. POR, 54-55; Ex.2041, ¶¶155-157; Ex.1020, ¶¶42-44. Further, Ma's purpose was to assess current density using different percentages of Liq doping. Ma, 811. Preparing a layer that is "macroscopically homogenous" but potentially microscopically heterogeneous (POR, 54-55) would introduce excessive variability and render the data noncomparable and unreliable, thus undermining the experiment's purpose. Ex.1020, ¶44.

Ma further discloses that that “[t]he deposition rate was *maintained* at 0.5 ± 0.2 Å/s for the organic materials” and that it used “two independent quartz sensors” to monitor the “deposition *rates* for the co-deposition layer.” Ma, 811 (emphasis added). This means that neither BPhen nor Liq vapor stream rates dropped to zero, and thus they were not sequentially deposited. Ex.1020, ¶45. Thus, a POSA would understand Ma’s disclosure to teach (or at a minimum strongly suggest) that the ETL was *obtained by joint vaporization* of Liq and BPhen.

Under a preponderance standard, Ma’s disclosures are sufficient to render joint vaporization at least obvious. This is the most natural interpretation of “co-deposition” for forming a layer, particularly when there is nothing to indicate that materials were vaporized sequentially. Ex.1020, ¶¶46-51. Additionally, a POSA would recognize that vaporizing materials together would best achieve Ma’s objective of assessing the current density using different Liq doping percentages. Ex.1020, ¶51; Ma, 811.

Indeed, in the German proceeding, Dr. Schanze similarly used the terms “co-deposition” and “co-evaporation”, Ex.1026, ¶¶48-50; Ex.1021, 37:12-38:20; Ex.1020, ¶52, which he admitted would be understood to refer to joint vaporization. Ex.1021, 38:21-39:24 (acknowledging that “if one did such a, ... sequential deposition, ... you would expect it to be stated.”)

b. Metal Complex

There is no dispute that Ma discloses a *metal complex* (Liq) under Pictiva's construction—a construction that Petitioner proposed and that the District Court has now adopted. Petition, 58-59; Ex.2055, 25.

There is no authority for Pictiva's assertion that the Board should “proceed under” the different construction proposed (and rejected) in the District Court, because Petitioner purportedly “disagrees with” that construction. POR, 57-58. *Cambridge Mobile Telematics, Inc. v. Sfara, Inc.*, IPR2024-00952, Paper 12 (P.T.A.B. Dec. 13, 2024) (informative), is not analogous, where the petitioner had “indicated that it believes that the claims contain a means-plus-function limitation, thereby implicating 37 C.F.R. § 42.104(b)(3).” IPR2024-00952, Paper 12 at 8 (denying institution because petitioner failed to address MPF requirements of Rule 42.104(b)(3)). On the contrary, Petitioner's approach is consistent with Rule 42.104(b)(3); Pictiva has not argued otherwise. *Cf. 10x Genomics, Inc. v. Bio-Rad Lab'ys, Inc.*, IPR2020-00086, Paper 8 at 18 (P.T.A.B. Apr. 27, 2020).

2. Claim 2

Ma used the materials and the processing conditions that would have led to coordination under Pictiva's infringement theory. Petition, 61-63.

Pictiva argues in the German proceeding (discussed in **Section I.C.2**) that Ki et al. (Ex.2050, “Ki”) provides “direct experimental evidence of the pyridinic

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nitrogen atoms of BPhen coordinating to the LiQ metal complex.” Ex.1026, ¶42. In Ki, “synchronous peak shifts [in a co-evaporated BPhen:Liq film were] observed in N 1s and Li 1s spectra” Ex.1026, ¶41. As Dr. Schanze agreed, Ki’s result “[implies] some chemical interaction between the N atoms (BPhen) and the Li atom (LiQ),”⁸ Ex.1026, ¶41 (citing Ex.2050, 1678); *id.*, ¶39 (citing Ex.1030, 140207) (observing that “the complexation of ETL (BPhen) and LiQ *was proved*” by Ki.) (emphasis added). Dr. Schanze further confirms that “complexation” in Kang “means the same as coordination in the sense of the patent-in-suit.” Ex.1026, ¶40.

Ma and Ki used the same materials and same processing conditions. Ex.1020, ¶¶53-54. Under the Pictiva’s infringement theory, coordination between BPhen and Liq necessarily occurs when they are jointly vaporized under Ma’s processing conditions (*supra* **Section I.C.2**; Ex.1025, ¶108), which is “a structure suggested by the prior art, and, hence, potentially in the possession of the public,” and is unpatentable. *Kubin*, 561 F.3d at 1357.

Pictiva argues that Ma’s speculated “short hopping length” as the reason for Ma’s observed conductivity does not demonstrate coordination. POR, 63 (citing Ma, 813). But, in the German proceeding, Pictiva argued the opposite: that electron

⁸ This disclosure supports “coordination” between Liq and BPhen under the district court’s claim construction. Ex.2055, 29-30.

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hopping only occurs when “two neighboring molecules” “penetrate each other (i.e., overlap).” Ex.1032, ¶10. Citing to German equivalent to Ex.1001, 4:5-16, Pictiva argues that the claimed organic compound “can therefore coordinate more easily to a metal complex. ...[which is] favorable for the hopping process of the electron.” Ex.1032, ¶¶28-29.⁹

3. Claims 8 and 12

A POSA would have had a reasonable expectation that Liq and BPhen would form a chain-like structure under Pictiva's infringement theory.

As discussed in **Section II.B.2**, Liq coordinates to BPhen under Pictiva's infringement theory. BPhen “comprises several coordination sites for metal complexes” and “allows ... for the formation of two-dimensional chains.” Ex.1001, 7:45-51, 11:11-52 (disclosing BPhen as one of the suitable organic compounds). This chain-like structure is “a structure suggested by the prior art, and, hence, potentially in the possession of the public.” *Kubin*, 561 F.3d at 1357.

⁹ Per Pictiva, “electron hopping” is also evidence of a chain-like structure formed between BPhen and Liq (as required by claims 8 and 12), as the chain-like structure “can favor the hopping processes of the electrons.” Ex.1032, ¶11(e) (citing Ex.1024, ¶¶[0033]-[0034])). Thus, per Pictiva, electron hopping in Ma indicates a chain-like structure formed by Liq and BPhen when they are jointly vaporized.

Liq's one central atom does not change this analysis. POR, 64-65. Pictiva provides no evidence that the presence of more than one central atom is "required" to form a chain-like structure—the '223 patent merely discloses that "more than one central atom improves the possibility" of forming such a structure. Ex.1001, 2:42-44; POR, 64-65. Obviousness does not require absolute predictability. *OSI Pharm., LLC v. Apotex Inc.*, 939 F.3d 1375, 1385 (Fed. Cir. 2019) ("we do not hold today that efficacy data is always required for a reasonable expectation of success. Nor are we requiring absolute predictability of success.") (internal quotations omitted).

4. Claim 11

Pictiva did not dispute that Ma discloses Claim 10's simultaneous vaporization.¹⁰ Further, the '223 patent admits that it is "simultaneous vaporization" where "both compounds *are* simultaneously present next to each other in the gas phase" that "enables" coordination. Ex.1001, 13:36-40; Petition, 69. Because Ma discloses simultaneous vaporization of Liq and BPhen, their coordination in the gas phase is "a structure suggested by the prior art, and, hence, potentially in the possession of the public." *Kubin*, 561 F.3d at 1357; *supra* **Section II.B.2**.

¹⁰ Pictiva did not object to Dr. Kymissis's interchangeable usage of "joint vaporization" and "simultaneous vaporization." POR, 55 (citing Ex.2051, ¶1046).

Alternatively, a POSA would have been motivated to have BPhen and Liq interact and coordinate in the gas phase, e.g., by using the OVPD method, to obtain a “more uniform distribution of BPhen and Liq” for better conductivity. Petition, 70-71; Ex.1003, ¶165; Ex.1020, ¶¶55-58. Further, a POSA would reasonably expect coordination in the gas phase when using the OVPD method because joint vaporization in the presence of an inert gas would significantly reduce the molecules' mean free path, which would increase the possibility of productive collisions. Ex.1020, ¶59; Ex.1003, ¶¶108-110; Petition, 70-71. *OSI Pharm.*, 939 F.3d at 1385.

5. Claim 13

Pictiva does not dispute that Ma teaches claim 13. Instead, Pictiva argues that Petitioner's theory is based on the inventor's insight. POR, 70. This argument is misplaced because this was within the POSA's knowledge before the '223 patent. Petition, 72-74.

6. Claims 6, 9-10, and 14

Pictiva presents no arguments with respect to claims 6, 9-10, and 14. As shown in the Petition, Ma renders obvious these claims.

III. CONCLUSION

For the reasons above and in the Petition, Petitioner respectfully requests that the Board cancel the Challenged Claims.

IPR2024-01094
Petitioner's Reply Brief
Date: August 11, 2025

U.S. Patent No. 8,558,223

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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 5,555 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 in Support of the Petition for *Inter Partes* Review of U.S. Patent No.8,558,223, and supporting exhibits, was served by electronic mail on the following counsel of record for patent owner:

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