

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

PATENT OWNER RESPONSE

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TABLE OF CONTENTS

	<u>Page</u>
I. Introduction.....	1
II. Werner Does Not Render Claims Obvious.	6
A. Werner Does Not Disclose or Suggest Elements 1(b)-(c)	6
1. Werner Lists At Least Millions of Unpredictable Combinations	7
(a) Millions of Metal Complexes	8
(b) Millions of Matrix Materials	9
(c) Outcome Not Predictable.....	10
(d) A POSITA Would Not Have Considered W ₂ (hpp) ₄ To Be an Effective n-Dopant for BPhen/TAZ in OLEDs.....	10
2. Petitioner Has Not Shown That A POSITA Would Jointly Vaporize W ₂ (hpp) ₄ with BPhen/TAZ	15
3. Petitioner Has Presented No Competent Evidence for Element 1(a).....	17
B. There is No Evidence that BPhen Would Coordinate to W ₂ (hpp) ₄ (Claim 2)	18
C. Werner Does Not Disclose or Suggest Claims 3, 4, 6 or 9	24
D. Werner Does Not Disclose or Suggest Claim 8	24
E. Werner Does Not Disclose or Suggest Method Claims 10-12 and 14	26
Werner Does Not Disclose or Suggest Method Claim 13.....	26
III. Ma Does Not Render Claims Obvious.	27
A. Ma Is Not Prior Art	27
1. Ma Is Not 102(b) Prior Art	28

(a) Petitioner Has Not Shown That Ma's August 2008 Online Version Was Publicly Accessible.....	28
(b) Petitioner Has Not Shown That EX1007 Was Available in August 2008	35
2. Ma Does Not Qualify as 102(a) Art Because Priority Applications Support The Challenged Claims And Ma's Publication Date Was After the Priority Applications	39
B. Ma Does Not Invalidate Claim 1.....	53
1. Ma Neither Expressly Nor Inherently Discloses Joint Vaporization of Liq and BPhen	53
2. Under Petitioner's Claim Interpretation, Liq Is Not a Metal Complex And Has No Central Metal Atom	56
C. Petitioner Has Not Presented Any Competent Evidence That Ma Discloses Claim 2	58
D. Petitioner Has Not Presented Any Competent Evidence That Ma Discloses Claims 8 or 12.....	64
E. Petitioner Has Not Presented Any Competent Evidence That Ma Discloses Claim 11	67
F. Petitioner Has Not Presented Any Competent Evidence That Ma Discloses Claim 13	70
IV. Conclusion	70

TABLE OF AUTHORITIES**Page(s)****Cases**

<i>Abbott Vascular, Inc. v. FlexStent, LLC</i> , IPR2019-00882, Paper 48 (P.T.A.B. Oct. 2, 2020).....	38
<i>Arendi S.A.R.L. v. Apple Inc.</i> , 832 F.3d 1355 (Fed. Cir. 2016)	14
<i>In re Bayer</i> , 568 F.2d 1357 (CCPA 1978)	35
<i>Belden Inc. v. Berk-Tek LLC</i> , 805 F.3d 1064 (Fed. Cir. 2015)	9
<i>Blue Calypso, LLC v. Groupon, Inc.</i> , 815 F.3d 1331 (Fed. Cir. 2016)	29, 32
<i>Celltrion, Inc. v. Biogen, Inc.</i> , IPR201-01614, Paper 65 (PTAB Feb. 21, 2018).....	36
<i>Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.</i> , 800 F.3d 1375 (Fed. Cir. 2015)	28
<i>Elbit Sys. of Am., LLC v. Thales Visionix, Inc.</i> , 881 F.3d 1354 (Fed. Cir. 2018)	36
<i>EWP Corp. v. Reliance Universal Inc.</i> , 755 F.2d 898 (Fed. Cir. 1985)	16
<i>First Solar, Inc. v. Rovshan Sade</i> , IPR2023-00827, Paper 13 (PTAB Nov. 16, 2023).....	29
<i>Grünenthal GMBH v. Antecip Bioventures II LLC</i> , PGR2017-00022, Paper 50 (PTAB Nov. 14, 2018)	28
<i>Hulu, LLC v. Sound View Innovations, LLC</i> , IPR2018-01039, Paper 29 (PTAB Dec. 20, 2019)	37, 38
<i>In-Depth Geophysical, Inc. v. Conocophillips Co.</i> , IPR2019-00849, Paper 17 (PTAB, Mar. 30, 2020)	29, 38

Page(s)

<i>Leo Pharm. Prods., Ltd. v. Rea</i> , 726 F.3d 1346 (Fed. Cir. 2013)	70
<i>In re Lister</i> , 583 F.3d 1307 (Fed. Cir. 2009)	30, 34
<i>Net MoneyIn, Inc. v. VeriSign, Inc.</i> , 545 F.3d 1359 (Fed. Cir. 2008)	54
<i>Ortho-McNeil Pharm. v. Mylan Labs., Inc.</i> , 520 F.3d 1358 (Fed. Cir. 2008)	7
<i>Otsuka Pharmaceutical Co., Ltd. v. Sandoz, Inc.</i> , 678 F. 3d 1280 (Fed. Cir. 2012)	14, 24
<i>Par Pharm., Inc. v. TWI Pharms., Inc.</i> , 773 F.3d 1186 (Fed. Cir. 2014)	19, 25, 54, 55
<i>Samsung Electronics Co., Ltd. v. Infobridge Pte. Ltd.</i> , 929 F.3d 1363 (Fed. Cir. 2019)	29
<i>Shenzhen Pincan Tech., Co., Ltd. v. The Ridge Wallet, LLC</i> , IPR2024-00340 (P.T.A.B. Nov. 20, 2024)	38
<i>In re Stepan</i> , 868 F.3d 1342 (Fed. Cir. 2017)	7
<i>Virtek Vision Int'l ULC v. Assembly Guidance Sys.</i> , 97 F.4th 882 (Fed. Cir. 2024)	6
<i>Voter Verified, Inc. v. Premier Election Solutions</i> , 698 F.3d 1374	33, 34

EXHIBIT LIST

Exhibit No.	Document Description
EX2042	Declaration of Professor Kirk Schanze
EX2002	K. Walzer et al., <i>Highly Efficient Organic Devices Based on Electrically Doped Transport Layers</i> , 107 Chem. Rev. 1233-71 (2007)
EX2003	Böjn Lüssem et al. <i>Doped Organic Transistors</i> , 116 Chem. Rev. 13714-51 (2016)
EX2004	F. Albert Cotton et al., <i>Multiple Bonds between Metal Atoms</i> , 3d ed., Spring Science and Business Media, Inc. (2005)
EX2005	Dan Wang et al., <i>Highly efficient green organic light-emitting diodes from single exciplex emission</i> , 92 App. Phys. Lett. 053304 (2008), downloaded from https://www.researchgate.net/publication/257949210_Highly_efficient_green_organic_light-emitting_diodes_from_single_exciplex_emission/download?tp=eyJjb250ZXh0Ijp7ImZpcnN0UGFnZSI6Il9kaXJlY3QiLCJwYWdlIjojX2RpcmVjdCJ9fQ
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EX2015	Torben Menke, <i>Molecular Doping of Organic Semiconductors: A Conductivity and Seebeck Study</i> , Dissertation, Technische Universität Dresden (2013)
EX2016	Max L. Tietze et al., <i>Self-passivation of molecular n-type doping during air exposure using a highly efficient air-instable dopant</i> , 210 Physica Status Solidi 2188-2198 (2013), abstract only, available from https://onlinelibrary.wiley.com/doi/10.1002/pssa.201330049
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EX2022	printout of https://www.sciencedirect.com/science/article/abs/pii/S0379677908001653 (Ma reference)
EX2023	Scopus Preview for references citing the Ma reference, available from https://www.scopus.com/results/citedbyresults.uri?sort=plf-f&cite=2-s2.0-57649228487&src=s&imp=t&sid=d32d5ac36b34f63475a939d79b8ad832&sot=cite&sdt=a&sl=0&origin=inward&editSaveSearch=&txGid=504fad81394a3927a1e740526430fa60
EX2024	screen shot of Web of Science Record of Ma
EX2025	Printout of https://web.archive.org/web/20250000000000*/www.elsevier.com/locate/synmet (last visited May 3, 2025)
EX2026	Certified Translation of DE 10 2008 049 286.8
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EX2030	Mudasir et al., <i>DNA Binding of Iron(II)-Phenanthroline Complexes: Effect of Methyl Substitution on Thermodynamic Parameters</i> , 77(3-4) 63b Z. Naturforsch. 37-46 (2008), downloaded from http://www.znaturforsch.com/ab/v63b/63b0037.pdf
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EX2033	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
EX2034	Samsung Invalidity Contentions in <i>Pictiva Displays Int'l Ltd. v. Samsung Electronics Co. Ltd., et al.</i> , Case No. 2:23-cv-000495 (E.D. Tex. Jun. 11, 2024)
EX2035	Amira K. Hajri et al., <i>Synthesis and photophysical properties of new reactive fluorophenanthrenes</i> , 23(4-5) Comptes Rendus Chimie 315-327 (2020), downloaded from https://comptes-rendus.academie-sciences.fr/chimie/articles/10.5802/crchim.29/
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EX2039	2024-12-09 Email from Samsung to Pictiva re “IPR2024-01095 – Stipulation”
EX2040	Deposition Transcript of Dr. Schubert with Ex. 1 of the deposition (Schubert Declaration)
EX2041	Declaration of Professor Kirk Schanze
EX2042	Deposition Transcript of Dr. Barry Rand
EX2043	U.S. Patent No. 7,911,129 assigned to Novaled AG
EX2044	U.S. Patent No. 7,972,541 assigned to Novaled AG
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EX2046	M. T. Rodgers et al., <i>Cationic Noncovalent Interactions: Energetics and Periodic Trends</i> , 116 Chem. Review 5642-5687 (2016)
EX2047	T. Sasaki et al., <i>Effects of Energy-Level Alignment on Operating Voltages of Blue Organic Light-Emitting Diodes</i> , Adv. Mater. Interfaces 2023, 10, 2201925
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EX2051	Kymissis Opening Report (Excerpt)
EX2052	Kymissis Rebuttal Report (Excerpt)
EX2053	Redacted Responsive Claim Construction Brief by Samsung
EX2054	Declaration of Dr. E. Fred Schubert in <i>Pictiva Displays International Ltd. v. Samsung Electronics Co., Ltd.</i> , 2:23-cv-495-JRG (E.D. Tex., Nov. 12, 2024)

EX2100	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)
EX2101	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)
EX2102	Exhibit 2102 of Rand deposition
EX2103	Markman Hearing Transcript in <i>Pictiva Displays International Ltd. v. Samsung Electronics Co., Ltd.</i> , 2:23-cv-495-JRG (E.D. Tex. Feb. 4, 2025)
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I. Introduction

The '223 patent is directed to a novel and nonobvious way of obtaining an electron-conducting layer that has high conductivity, long service life, and uniform properties. As the inventors recognized, one challenge in organic electronic devices like OLEDs “is to provide a layer which has a very high degree of electron conductivity.” EX1001, 1:23-25. While crystallinity can improve conductivity by reducing the number of grain boundaries that can scatter electrons, crystalline layers “disadvantage[ously]” “comprise regions of different conductivity.” *Id.*, 1:33-35. This results in non-uniform electron flow in different regions and can prematurely degrade regions of high electron flows, as well as “inhomogeneous emission” in OLEDs. *Id.*, 1:35-45.

To address these problems, the inventors taught joint vaporization of an organic compound with a metal complex to obtain “macroscopically to nanoscopically amorphous electron-conducting layer.” *Id.*, 11:66-12:4. The organic compound may optionally coordinate to the metal complex and be “able to accept additional charge carriers which are provided by the central [metal] atom.” *Id.*, 12:9-12. Thus, “the mobility of the charge carriers which is reduced in comparison with the crystalline layer is compensated by increasing the number of charge carriers.” *Id.*, 12:13-15. The resulting macroscopically amorphous structure thus maintains high conductivity while enabling homogenous emission. *Id.*, 12:15-21.

To promote coordination, the organic compound preferably comprises “a heteroaromatic compound which is conjugated with an aromatic compound via a C-C bond.” EX1001, 19:20-23. This “has the advantage that it is not so sterically demanding and voluminous, and therefore can coordinate more easily to a metal complex or can coordinate better to several metal complexes simultaneously.” *Id.*, 4:1-13. The joint vaporization feature and the organic compound’s structure are recited in elements 1[b]-1[c] and 10[b]-10[c]. Claims 2 and 8 relate to the coordination requirements.

The challenged claims are not unpatentable in light of Werner or Ma. Werner, indisputably encompasses at least millions of combinations of preferred metal complexes and matrix materials. Yet, nothing specifically links $W_2(hpp)_4$ with BPhen or TAZ, the combination relied on for Ground 1; and Petitioner’s expert concedes that he cannot determine which of those millions of combinations would succeed. EX2042, 147:10-148:4 (“Q. How many of those millions of combinations would they [POSITAs] have a reason[able] expectation of success? A. Again I can’t quantify like a percent value of that because it is very much dependent upon so many factors that go into making an organic electronic device and OLED is one of them, but there are numerous organic electronic devices, numerous criteria that one wants to consider for the processing of that material, for the device application, for the operating condition, that I can’t give an exact figure on the percent of combinations

that might reasonably lead to success because it will be very much dependent on the constraints of the condition of a person of ordinary skill in the art.”).

Thus, this is not a case where there were but a finite number of predictable solutions. Rather, there were at least millions of possible combinations, each requiring consideration of “numerous criteria” that Petitioner did not consider. Instead, Petitioner arrived at the combination by referencing the ’223 patent’s teaching. *See* Pet. 22-27. That is hindsight.

Werner does not link $W_2(hpp)_4$ with BPhen or TAZ for a good reason. Werner relates to n-doping organic matrix materials with electron-rich metal complexes. EX1005-4:9-12. As taught by another patent that names Werner as a co-inventor, to effect n-doping, the ionization potential (“IP”) or Highest-Occupied-Molecular-Orbital (HOMO) energy level of $W_2(hpp)_4$ should be no more than 0.5 eV lower than the electron affinity (“EA”) or Lowest-Unoccupied-Molecular-Energy (LUMO) of BPhen/TAZ. *See* EX2041, ¶¶20-22; EX2043_US7911129, 10:56-63 (“requirement of the doping capability” includes “ $EA(O_2) > IP(D) - 0.5 \text{ eV}$ ” where O_2 is the organic compound and D is the n-dopant).

The reported gas phase ionization potential of $W_2(hpp)_4$ is 3.76 eV, (EX2004-Cotton-textbook, 770), more than 0.5 eV lower than the LUMO energy of BPhen (2.4–3.0 eV) and that of TAZ (~2.7 eV). EX2041, ¶¶23-26, 72-78; §II.A.1(d). Thus, a POSITA would not have expected $W_2(hpp)_4$ to be an effective n-dopant for

BPhen/TAZ, especially for the OLED application at issue in the Petition (Pet. 19, 21-22) and expressly required by claim 9. *Id.*

Petitioner does not consider these compound-specific factors or otherwise provide any competent evidence to establish that a POSITA would have combined W₂(hpp)₄ and BPhen or TAZ to arrive at the inventions.

Ma fares no better. Ma does not even qualify as prior art, because Ma was not indexed until December 2008, after the filing dates of the German priority documents that fully support the challenged claims. §§III.A.1–III.A.2. Moreover, Petitioner fails to show that Ma expressly or inherently discloses the “joint vaporization” limitation. §III.B.1. For example, Ma does not provide any detail on its evaporator such that it cannot be determined whether Liq and BPhen were applied with overlapping plumes that deposited the two materials as a mixture when deposited on the substrate, as opposed to some other types of co-deposition. *Id.* For instance, Ma’s “co-deposition” can refer to a process where the two plumes had no overlap such that the two materials are deposited sequentially at a given location when the substrate was moved translationally or rotated. *Id.*

Petitioner has also failed to present any competent evidence that BPhen would coordinate to Liq or form a chain-like or network-like structure, or that absent the inventors’ teaching, a POSITA would have known about the need to adjust cross-linking density to affect the conductivity of electron-conducting layer. §§III.C-

III.D.

Indeed, Dr. Rand concedes that he has not determined that Bphen interacts with the lithium central atoms, resorting instead to an unreasonably broad interpretation that the term “coordinate[.]” encompasses any interaction between any atom of BPhen with any atom of Liq. EX2042, 93:2-6, 94:10-12, 211:22-212:14. In the district court, however, Samsung limits “coordinate” to dative bonds and argues that even π -interaction between lithium and Bphen’s aromatic rings would not qualify as “coordinate.” EX2103, 84:19-85:14.

Neither interpretation is consistent with the ’223 patent, in which “coordinate” refers to bonding interactions between the organic compound and the central metal atom. ’223 patent, 2:17-18 (“the organic compound coordinates to the metal atom”), 2:19-21 (“coordination of the organic compound to the central atom ...”); 2:45-47 (“each of the two central atoms has a coordination site”).

For these and other reasons stated below, the Board should find the challenged claims patentable. In the discussions below, Patent Owner relies in part on testimony by Professor Schanze, the Robert A. Welch Distinguished University Chair in the Chemistry Department at the University of Texas, San Antonio with over 25 years of experience in OLEDs.

II. Werner Does Not Render Claims Obvious.

A. Werner Does Not Disclose or Suggest Elements 1(b)-(c)

Claim 1 of the '223 patent requires an electron-conducting layer that “is obtained by joint vaporization of a metal complex, ... with an organic compound, wherein the organic compound comprises a heteroaromatic compound which is conjugated with an aromatic compound via a C–C bond.” EX1001, 19:18-23. Petitioner argues that Werner discloses this limitation by listing $W_2(hpp)_4$ as a candidate metal complex, BPhen or TAZ as candidate matrix materials, and joint evaporation as one way to obtain an electron-transport layer. Pet. 22-27.

But Werner does not specifically disclose or suggest combining $W_2(hpp)_4$ with BPhen or TAZ, let alone via joint vaporization. To prevail on an obviousness challenge, it is not sufficient to show that individual elements were known in some context in the art; instead, a motivation to combine must be demonstrated. *Virtek Vision Int'l ULC v. Assembly Guidance Sys.*, 97 F.4th 882, 886-87 (Fed. Cir. 2024).

Here, the Petition provides no reason for picking $W_2(hpp)_4$ from the millions of enumerated metal complexes to combine with BPhen or TAZ, two of the millions of candidate matrix materials. Pet. 22-25. Whether obviousness “is based on ... combining multiple embodiments from a single reference, or selecting from large lists of elements in a single reference, there must be a motivation to make the combination and a reasonable expectation that such a combination would be

successful, otherwise a skilled artisan would not arrive at the claimed combination.” *In re Stepan*, 868 F.3d 1342, 1345–46 n.1 (Fed. Cir. 2017). Furthermore, “to have a reasonable expectation of success, one must be 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.” *Id.* at 1347 (citations omitted).

1. Werner Lists At Least Millions of Unpredictable Combinations

Petitioner’s expert, Dr. Rand, agreed that Werner disclosed “more than one thousand” organic compounds and “[o]ver 2,000” metal complexes. EX2042, 137:3-18, 144:6-17. These would alone result in over 2,000,000 possible combinations. Yet, Dr. Rand does not know how many of those millions of combinations would be reasonably expected to succeed, as there are “numerous criteria,” including processing conditions, device applications, and operation conditions, that one must consider. *Id.*, 146:21-148:4. Thus, this is not a case where there are but a finite number of predictable solutions where it might be “obvious to try” one of the few possibilities. *Ortho-McNeil Pharm. v. Mylan Labs., Inc.*, 520 F.3d 1358 (Fed. Cir. 2008) (KSR’s obvious-to-try requires an “easily traversed, small and finite number of alternatives”).

Moreover, as Dr. Schanze explains, Werner actually discloses millions of metal complexes and organic compounds each, rendering the possible combinations

in the trillions. Samsung never explains why a POSITA would have cherry-picked the BPhen/TAZ:W₂(hpp)₄ combination. Indeed, Dr. Rand asserts that when he “think[s] about what a POSA would do, [he] think[s] about whether one can expect a reasonable likelihood of success” EX2042, 207:6-8. But reasons to combine and reasonable expectation of success are separate analyses. Petitioner’s obviousness analysis is thus legally insufficient.

(a) Millions of Metal Complexes

Over 45 pages, Werner discloses no fewer than ten allegedly “advantageous classes of compounds” having almost all types of ligands under the sun as possible “electron-rich neutral metal complex[es].” EX1005-10 to EX1005-55, EX1005-63 to EX1005-64; EX2041, ¶¶30-32, 40. Dr. Schanze explains that there would be millions of possibilities for just Compound I metal complex and at least hundreds of thousands of possibilities for one of the most preferred embodiments. EX2041, ¶¶33-39.

Dr. Schanze also explains that even the shortened list on EX1005-63 to EX1005-64 would have millions of possibilities. EX2041, ¶¶41-43. Indeed, for just M(L₂)—one of the most preferred examples, where M is one of Fe, Cr, Mn, Co, Ni, Cu, Zn, Mo and W, L is one of compounds 21-24 where R is either H or methyl and E is either C or Ge, there would be nearly 100,000 possibilities. EX2041, ¶¶42-43; EX1005-63:30-64:1.

But Werner does not explain the advantages or disadvantages of these hundreds of thousands possibilities over other short-listed possibilities, including over $W_2(hpp)_4$. EX2041, ¶43. Nor does Dr. Rand give a reason. *See* EX1003; EX2042, 145:5-13 (Dr. Rand asserts that Werner wanted to broadly protect his inventions). Thus, other than pointing to the ‘223 patent’s teaching (Pet. 18-19, 22-24), Petitioner has not explained at all why a POSITA would have picked $W_2(hpp)_4$ from the litany of possibilities listed by Werner, (EX2041, ¶44).

(b) Millions of Matrix Materials

Werner also lists millions of possible matrix materials with numerous substitutions over 4 pages of its specifications. *See* EX1005-55 to EX1005-59; EX2041, ¶¶50-51. As Professor Schanze explains, there are over 3.5 million possibilities for just the metal phthalocyanine compounds, one of the most preferred examples. EX2041, ¶¶47-50. Furthermore, while Werner states that BPhen or TAZ “*can be* used as a matrix material,” he observes “[t]he matrix material preferably consists entirely of a metal phthalocyanine complex, in particular ZnPc, a porphyrin complex, or a Buckminster fullerene, in particular fullerene C60.” EX1005-58. Werner thus suggests only that a POSITA could use BPhen and TAZ, not that they would use these. EX2041, ¶52. Yet, obviousness concerns not only about what could have been done, but also what a POSITA would have done. *Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015).

(c) Outcome Not Predictable

Dr. Rand concedes that he does not know what percentage of Werner's millions (or trillions) of combinations would be reasonably expected to succeed, as there are "numerous criteria," including processing conditions, device applications, and operation conditions, that one must consider. *Id.*, 147:10-148:4. Dr. Rand examined none of these criteria to establish that the cherry-picked combination would be suitable for the OLED application Petitioner focused on (Pet. 19, 21). Thus, Petitioner has not shown that the combination is obvious. Indeed, there is evidence showing the opposite.

(d) A POSITA Would Not Have Considered W₂(hpp)₄ To Be an Effective n-Dopant for BPhen/TAZ in OLEDs

Petitioner relies solely on the '223 patent to justify combining W₂(hpp)₄ with BPhen or TAZ. Pet. 22-26. Petitioner argues that, at the time of the invention, a POSITA would have used W₂(hpp)₄ to n-dope BPhen or TAZ, especially for use in an OLED. Pet. 19, 21-22; *see also* '223, claim 9 (reciting OLED). Yet, as recommended by Werner and his co-workers, when a molecular n-dopant D is used to n-dope an organic matrix O₂, "the electron affinity of the matrix EA(O₂) shall not drop below the value, reduced by 0.5eV, of the ionisation potential of the donor IP(D)." EX2043, field 75 (Werner a co-inventor), Abstract (directed to OLED), 10:56-63 ("EA(O₂)>IP(D)-0.5 eV"); EX2041, ¶20.

$W_2(hpp)_4$ reportedly begins to ionize in the gas phase at about 3.5 eV and has a peak gas phase ionization potential of about 3.76 eV. EX2004-Cotton-book, 770; EX2041, ¶24.

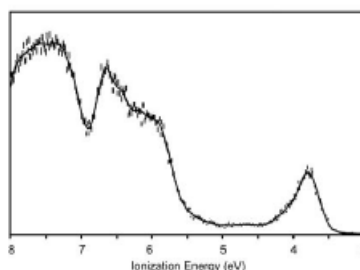
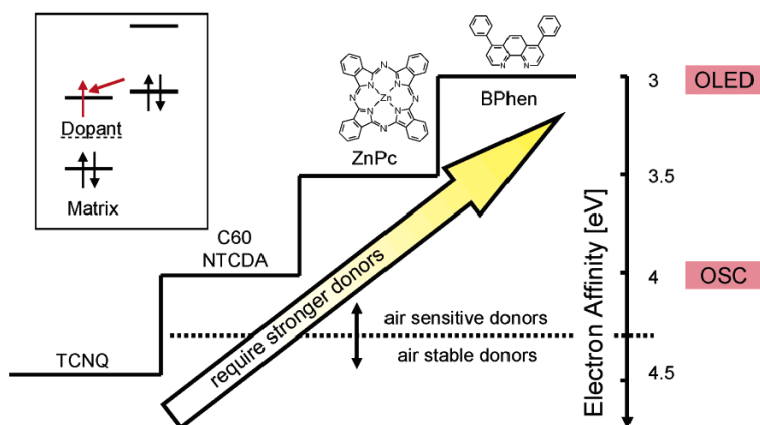


Fig. 16.45. The (He I) PES of $W_2(hpp)_4$, supplied by Prof. D. L. Lichtenberger (University of Arizona).

In contrast, the electron affinity of BPhen was reportedly 2.4–3.0 eV (EX2043, 10:48-54), and the electron affinity of TAZ, as estimated by its LUMO energy level, was about 2.7 eV (EX2007, Fig. 3). EX2041, ¶¶72-75, 77. Thus, the electron affinities of BPhen and TAZ are less than the ionization potential of $W_2(hpp)_4$ (3.76 eV) minus 0.5 eV, not meeting “the requirement of the doping capability” prescribed by Mr. Werner himself. EX2041, ¶¶23-26, 76, 78; EX2043, 10:61-63; *see also* EX2002, 1244, Fig. 14 (reproduced below).



Put another way, the significant mismatch between the ionization potential of $W_2(hpp)_4$ and the electron affinity of BPhen or TAZ “would discourage rather than motivate a [POSITA] to combine $W_2(hpp)_4$ with BPhen or TAZ to obtain an n-doped layer as Samsung suggests.” EX2041, ¶70; *see also id.*, ¶69 (“An energy difference of more than 0.5eV as in the case of BPhen/TAZ and $W_2(hpp)_4$ would be viewed as too energetically unfavorable for electron transfer from $W_2(hpp)_4$ to BPhen/TAZ to occur.”); EX1005, 4:9-12 (using metal complexes to n-dope organic matrix materials).¹

Petitioner has not presented any evidence to the contrary. Indeed, when asked for known examples of n-doping by $W_2(hpp)_4$, Dr. Rand could only come up with C_{60} and ZnPc, the two examples that Pictiva provided in its POPR and whose EAs

¹ Molecular n-dopants and alkali metals (*e.g.*, cesium) have different energy alignment requirements. EX2043, 10:61-64 (“EA(O2)>IP(D)-0.5 eV” for molecular n-dopants and “EA(O2)>1.9 eV” for cesium, where O2 refers to the organic material to be doped and D refers to molecular dopant); EX2041, ¶¶88-90 (alkali metals and molecular dopants operate differently).

are lower than those of BPhen and TAZ. POPR 17;² EX2042, 117:4-18, 124:18-20 (“I’m not aware of an OLED that used the specification combination of tungsten2(hpp)₄ and BPhen as an ETL”); EX2002, 1244, Fig. 14. Thus, the Petition lacks any evidence that a POSITA would have used W₂(hpp)₄ to n-dope BPhen or TAZ for OLED applications with a reasonable expectation of success.

W₂(hpp)₄ was also known to destroy organic compounds. For instance, W₂(hpp)₄ extracts chloride from CH₂Cl₂ and it reduces C₆₀ to intractable reduction products. EX2041, ¶91; EX2008_Inorganic_Chem_Comm, 123-24. Werner, however, purports to have “the object of specifying metal complexes as n-dopants for doping an organic semiconducting matrix material, ... *without adverse effects on the matrix material*, ...” EX1005-5:21-28. As Professor Schanze explains, “[a] reagent that would potentially destroy a small molecule is not one that would be expected to be used ‘without adverse effects on the matrix material.’” EX2041, ¶92. Hence, given Werner’s stated object and W₂(hpp)₄’s known property, Petitioner has not presented any evidence that a POSITA would have used W₂(hpp)₄ to dope BPhen

² EX2003-2016-Chem-Review (2016), 13717-18, Fig. 5 (n-doping of ZnPc by W₂(hpp)₄); EX2015_Torben_Dissertation (2013), iv, Abstract (doping of C₆₀ by W₂(hpp)₄); EX2016-Ref121-abstract (2012), Abstract (n-doping of C₆₀ by W₂(hpp)₄).

or TAZ and to obtain films with sufficiently high conductivity suitable for OLEDs. EX2041, ¶92; *Bright Data Ltd. v. oxylabs*, IPR2023-00185, Paper 26 at 25-26 (PTAB July 11, 2024) (not obvious because proposed modification “would have been a fundamental change in [reference] that would not have been undertaken by a [POSITA]”).

As explained in the Introduction, elements 1(b)-1(c) are material to the invention for preserving overall conductivity while mitigating problems caused by potential crystallinity in the organic materials. Petitioner therefore must show where in the prior art the limitations were taught or suggested. *Arendi S.A.R.L. v. Apple Inc.*, 832 F.3d 1355, 1362 (Fed. Cir. 2016). Petitioner did neither, relying instead on the '223 patent to cherry pick $W_2(hpp)_4$, BPhen and TAZ from the at least millions, if not trillions, of possibilities. Pet. 23 (alleging that $W_2(hpp)_4$ “is the only metal complex used in all the embodiments of the '223 patent”); Pet. 26 (“BPhen is identified in the '223 patent as exemplary Compound VI, and it is recited in claim 6’s list of organic compounds”). Petitioner also used the inventors’ unexpected success with $W_2(hpp)_4$ and compound V (a compound with similar chemical structure to BPhen) to argue a reasonable expectation of success. See Pet. 47-48. This is legally impermissible because an “inventor's own path itself never leads to a conclusion of obviousness; that is hindsight.” *Otsuka Pharmaceutical Co., Ltd. v. Sandoz, Inc.*, 678 F. 3d 1280, 1296 (Fed. Cir. 2012).

The question is not whether a POSITA could have succeeded when following the inventors' footsteps, but whether they would have done so with a reasonable expectation of success without those teachings. This is not about the weight of evidence, but about the lack of any competent evidence on this critical question.

2. Petitioner Has Not Shown That A POSITA Would Jointly Vaporize $W_2(hpp)_4$ with BPhen/TAZ

The Petition cites only Werner and the parroting declaration to argue that a POSITA would have used joint vaporization to combine BPhen or TAZ with $W_2(hpp)_4$. Pet. 26. But Werner makes no such disclosures. For example, in the section "Implementation of doping," Werner lists "[c]o-evaporation" with four other methods. EX1005-59:13-30. In the Section "Application examples," when Werner states that "[t]he provided metal complex is evaporated simultaneously with the matrix material," he notes immediately afterwards, "[a]ccording to the example, the matrix material is phthalocyanine-zinc or fullerene C_{60} ." EX1005-63:16, EX1005-64:10-12. Even then, the example 3 with C_{60} actually used a sequential, not co-evaporation, method. EX2041, ¶97; EX1005-65:24-31 ("cobaltocene was thermally sublimated" and "deposited on the surface of the fullerene layer [to] form[] a thin highly doped layer there"); EX2042, 203:13-19 ("On page 56 in the B section, that includes sequential deposition and that is also one of the examples later on; example 3 on page 62, yes."). Hence, as Professor Schanze explains, "Werner as a whole

suggests that the specific method of deposition would depend on matrix materials and metal complexes, and does not suggest that $W_2(hpp)_4$ should be jointly evaporated with BPhen or TAZ.” EX2041, ¶98. That is, when read in context and as a whole,³ Werner does not disclose joint vaporization of $W_2(hpp)_4$ with BPhen or TAZ. *Id.*, ¶¶96-98.

Reported reaction conditions for $W_2(hpp)_4$ also do not suggest use of joint vaporization. For example, the Cotton group reacted $W_2(hpp)_4$ with reducible species in solutions. EX2008-Cotton-InorgChemComm, 122 (*see* “Experimental” section: CH_2Cl_2 was a common solvent; reaction with C_{60} was carried out in a toluene solution; and reaction with TCQN is in a THF solution); EX2041, ¶99. The Cotton group concluded that $W_2(hpp)_4$ “is a strong reducing agent with an enormous potential for use on organic substrates *in organic solvents*.” EX2008, 124. The Cotton group suggested exploring $W_2(hpp)_4$ for “chemistry in living organisms,” an area involving liquid phase, not gas phase, chemistry. *Id.*; EX2041, ¶100. Simply put, Petitioner has not established that at the time of the inventions, a POSITA would have used joint vaporization, as opposed to *e.g.*, sequential deposition or solution-

³ “On the issue of obviousness, the combined teachings of the prior art as a whole must be considered.” *EWP Corp. v. Reliance Universal Inc.*, 755 F.2d 898, 907 (Fed. Cir. 1985).

based approach, to mix $W_2(hpp)_4$ with BPhen or TAZ. EX2041, ¶100.

3. Petitioner Has Presented No Competent Evidence for Element 1(a)

As noted above, the prior art neither specifically suggested combining $W_2(hpp)_4$ with BPhen or TAZ nor jointly evaporating the two. Petitioner has also not presented any competent evidence that if combined, a POSITA would have reasonably expected to obtain an OLED device in which the combination provides an electron-conducting layer that is “electrically conductively connected to at least one of the electrodes.” Pet. 21-22. For instance, Petitioner has not presented any evidence of the conductivity obtainable by n-doping BPhen/TAZ with $W_2(hpp)_4$ or whether that conductivity would have been suitable for use as an electron-conducting layer in OLED. *See* Pet. 19, 21-22 (OLED application). Instead, because BPhen and TAZ have reported electron affinities more than 0.5 eV above that of the reported ionization energy of $W_2(hpp)_4$, a POSITA would not have expected significant charge transfer from $W_2(hpp)_4$ to occur or sufficient improvement in conductivity. EX2041, ¶¶20-26, 69-70. Hence, there is a complete absence of competent evidence that a POSITA would have had a reasonable expectation of success of obtaining a layer that is “electrically conductively connected to at least one of the electrodes” in OLEDs as required by the claims and Petitioner’s unpatentability theory. *E.g.*, ’223, claim 9 (reciting OLED application); Pet. 19

(referencing OLED application); Pet. 21-22 (referencing “light-emitting diode”); EX2043, abstract (directed to OLEDs), 10:50-54 (listing BPhen as a well-known material for OLEDs); EX2007 (TAZ used for OLEDs).

B. There is No Evidence that BPhen Would Coordinate to $W_2(hpp)_4$ (Claim 2)

Petitioner’s analysis of claim 2 relies nearly exclusively on the disclosure of the ’223 patent and the inventors’ insight. For instance, Petitioner cites ’223, 3:4-8 for the proposition that “W is a preferred central metal atom” due to “the ability to coordinate with additional ligands.” Pet. 28. Petitioner then cites to 7:43-63 to explain why BPhen was a preferred ligand in the inventors’ view, and to 1:60-63 for inventors’ insight that gas-phase reactions would promote coordination of the ligand to the metal center. Pet. 28-29.

Petitioner then argues “[b]ecause $W_2(hpp)_4$ and BPhen are the materials that *can* coordinate when jointly vaporized according to the ’223 patent,” claim 2 was disclosed. Pet. 29. But in addition to the impermissible hindsight, the ’223 patent’s preferred example does not combine $W_2(hpp)_4$ with BPhen, but with a different compound V. *See* EX1005, 16:67-17:3; EX1001-10 (BPhen is Compound VI, not Compound V); EX2041, ¶¶84-85.

Dr. Rand confirms that the type and degree of interactions between a metal complex and the organic compound would depend on the processing conditions.

EX2042, 199:14-200:6. Petitioner, however, provides no evidence that the process conditions in the '223 patent was the same as that in Werner. Hence, Petitioner cannot rely on inherency to argue that Werner discloses this limitation. *Par Pharm., Inc. v. TWI Pharms., Inc.*, 773 F.3d 1186, 1195 (Fed. Cir. 2014) (the concept of inherency when applied to obviousness “is present only when the limitation at issue is the ‘natural result’ of the combination of prior art elements”); Pet. 29 (only asserting that “W₂(hpp)₄ and BPhen ... can coordinate when jointly vaporized according to the '223 patent,” not that they would necessarily coordinate); EX2042, 200:14-201:2 (Dr. Rand unable to confirm joint vaporization would necessarily result in interactions between W₂(hpp)₄ and BPhen)

The crystal structure of W₂(hpp)₄ also suggests no coordination. For example, the crystal structure did not show any molecules, including solvent molecules, coordinated to the axial positions of the tungsten centers. *See* EX2008, 123; EX2041, ¶101.

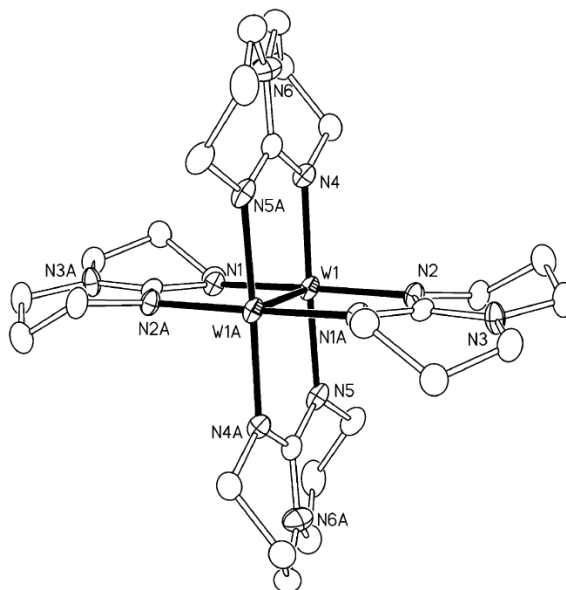


Fig. 1. An ellipsoid plot of $W_2(hpp)_4$, **1**, with atoms drawn at the 30% probability level. All hydrogen atoms have been omitted for clarity.

And upon oxidizing to $W_2(hpp)_4Cl_2$, there is still no evidence of coordination of a ligand to the W center. EX2008, 124. The Cotton group remarked that the “long W...Cl separations” “indicat[e] that there is no significant axial bonding.” *Id.*

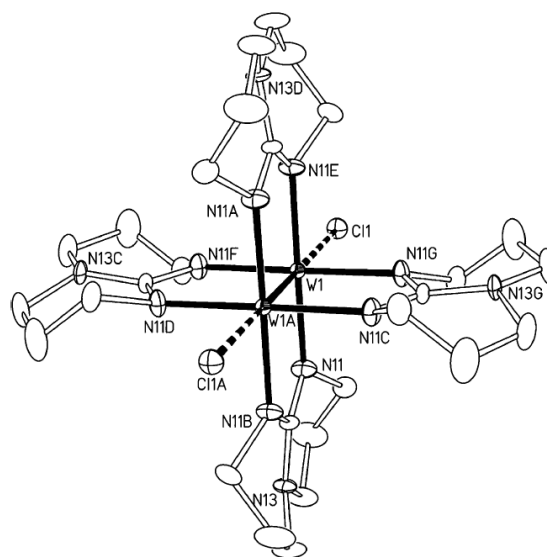


Fig. 2. Displacement ellipsoid plot of one orientation of the disordered $W_2(hpp)_4Cl_2$ molecule in $2 \cdot 4CH_2Cl_2$. Atoms are drawn at the 30% probability level. Hydrogen atoms have been omitted for clarity.

As Dr. Schanze explains, a POSITA would understand from Cotton's finding, that there is effectively no coordination to the empty coordination site of the tungsten atom by another ligand.⁴ EX2041, ¶103. Hence, there is no support in the literature at the time of the invention that a POSITA would have expected that BPhen would coordinate to the tungsten metal center in $W_2(hpp)_4$. *Id.*

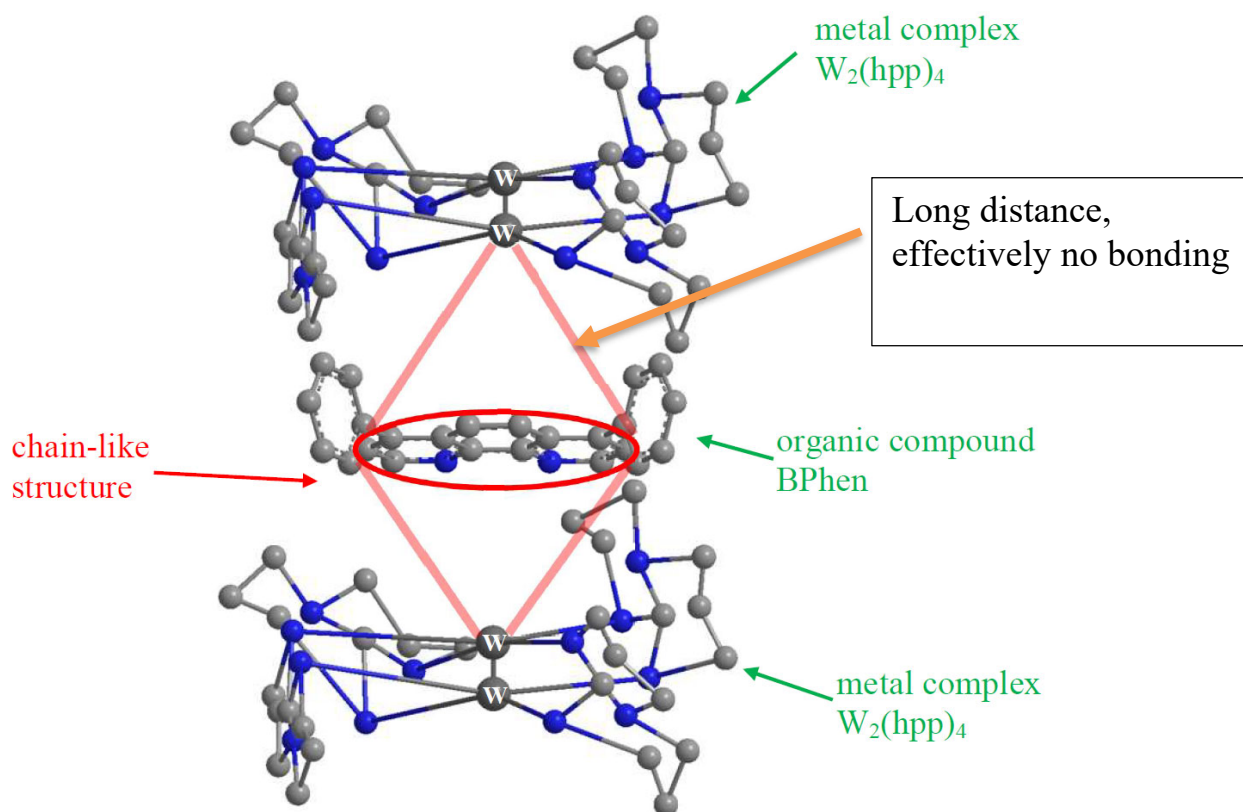
Petitioner's attempt to draw analogy to $Rh_2(O_2CCF_3)_4$ is likewise misplaced. *See* Pet. 33-34. A POSITA would understand that $Rh_2(O_2CCF_3)_4$ and $W_2(hpp)_4$ have completely different electronic and steric properties. EX2041, ¶104. Unlike the "electron-rich" $W_2(hpp)_4$ (EX1005-63:17), the metal centers in $Rh_2(O_2CCF_3)_4$ —coordinated to "highly electron withdrawing" $O_2CCF_3^-$ —are electron deficient. EX2041, ¶105. Thus, the rhodium center would "more readily accept pi-electrons from the aromatic rings." *Id.*; *cf.*, EX2004_Cotton_book, 187-188.

Given their drastically different electronic properties, a POSITA would not view $Rh_2(O_2CCF_3)_4$ as a good model for $W_2(hpp)_4$ coordination. EX2041, ¶108 (Dr. Schanze explaining that a POSITA would not expect the electron-rich $W_2(hpp)_4$ to "coordinate to [an aryl's] pi-bonds to further increase its electron density," in contrast to the electrophilic $Rh_2(O_2CCF_3)_4$).

⁴ Chloride is an example of a halide that Werner lists as a preferred ligand. Pet. 28 (citing Werner 13:16-21).

Moreover, because O_2CCF_3^- is a much smaller ligand than hpp, the Rh center is less crowded, allowing an arene to more easily approach the metal center and to coordinate to it via π -bonding. EX2041, ¶109. The electron-rich $\text{W}_2(\text{hpp})_4$, on the other hand, has a more crowded metal center, as Petitioner's own drawing illustrates. *Id.*; cf., EX2004_Cotton_book, 187, Fig. 5.1 (crystal structure of $\text{W}_2(\text{O}_2\text{CPh})_4$).

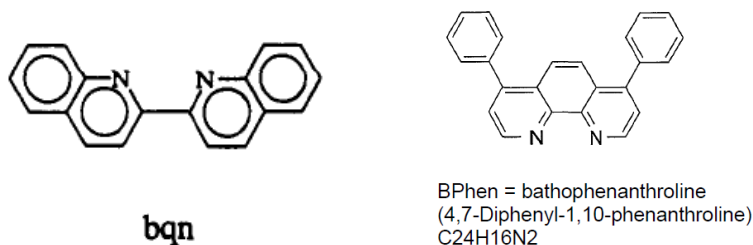
For instance, as Petitioner illustrates, the cyclohexyl groups of the hpp ligand repel the approach of the phenyl ring, therefore increasing the distance between tungsten and the phenyl ring. EX2041, ¶110.



Because the bonding strength between W's π^* -orbital and the aryl ring's π -

electrons decreases exponentially as the distance between the metal center and the aromatic ring increases, a POSITA would understand that the long distance between the phenyl ring and tungsten metal center means there is effectively no coordination between the two. EX2041, ¶111. That is, in addition to electron richness at the tungsten center, the steric hindrance by hpp would also impede the coordination of BPhen to tungsten. *Id.*, ¶¶110-111.

Inability of rigid bqn to coordinate to the axial position of a dirhodium complex also supports the conclusion that BPhen would unlikely coordinate to the paddlewheel ditungsten complex through nitrogen. EX2041, ¶¶125-126; EX2017-1993_Crawford, 3132-33.



Dr. Schanze considers bqn as a good model for the rigid BPhen, and the steric repulsions between the fused rings of bqn and the ligands on the Rh centers provide a good indication of the steric repulsions that BPhen would experience when approaching the W center in W₂(hpp)₄. EX2041, ¶126. Dr. Rand never considered the steric and electronic effects of W₂(hpp)₄. Thus, Petitioner has not presented any competent evidence that BPhen would coordinate to W₂(hpp)₄'s metal center(s),

certainly not in the manner suggested by Petitioner.

C. Werner Does Not Disclose or Suggest Claims 3, 4, 6 or 9

Petitioner's theory's for these claims are again based on cherry-picking $W_2(hpp)_4$ and BPhen from long lists of possibilities. Pet. 29-31, 49. As explained in connection with claim 1, nothing in the prior art suggests this combination.

Moreover, Claim 9 specifically requires that the organic electronic component be "formed as an organic LED (OLED) which additionally comprises an organic emitting layer." '223, 25:5-7. Thus, for this claim, Petitioner has to show that the combination of $W_2(hpp)_4$ with BPhen or TAZ would provide a suitable electron-conducting layer for the OLED application. Petitioner, however, has not provided any evidence that this is the case.

D. Werner Does Not Disclose or Suggest Claim 8

In addition to reasons stated for Claims 1-2, additional reasons exist for why Petitioner has failed to demonstrate Claim 8 is obvious. Petitioner points to '223 patent's teaching to argue likelihood of success, but none of the quoted language discloses that $W_2(hpp)_4$ would necessarily form a chain-like or network-like structures with BPhen, since the examples provided in the '223 patent are between $W_2(hpp)_4$ and Compound V, not with BPhen. Pet. 32-48 (*e.g.*, Pet. 47-48). Additionally, "[t]he inventor's own path itself never leads to a conclusion of obviousness; that is hindsight." *Otsuka.*, 678 F. 3d at 1296. The fact that the

inventors had the unexpected success with BCP and $W_2(hpp)_4$ (*see* EX1001, 16:61-17:12) does not show that a POSITA would have had the motivation or the reasonable expectation that such a process would have worked for the intended purposes.

For example, Dr. Rand concedes that the nature and degree of interactions would depend on process conditions, (EX2042, 199:14-200:6), but Petitioner has not provided any competent evidence that its proposed process conditions would necessarily (or even likely) lead to a chain-like or network-like structure. Pet. 32-48, *PAR Pharm.*, 773 F.3d at 1195 (use of inherency for a missing element in obviousness “must be carefully circumscribed” and the limitation must be the “natural result” of the combination of prior art elements).

Moreover, even if BPhen could coordinate to $W_2(hpp)_4$ (no such showing has been made), it would coordinate to only just one metal center at a time. EX2041, ¶¶128-130, 121-124. Thus, given the state of the art at the time of the invention, when a POSITA needed a ligand to “bridge two [or more] metal complexes together” (EX1001, 24:65-25:4) as required by claim 8, “they would not have chosen BPhen because BPhen, if it coordinates to a metal center, it would coordinate to only a single metal center [.]” EX2041, ¶130.

Having failed to show that Werner necessarily discloses a chain-like or network-like structure, Petitioner also cannot show that the claim is obvious at least

because it does not explain why a POSITA would have been motivated to obtain the claimed structures in the first place. Pet. 32-48. Without that basic showing, Petitioner also cannot show why a POSITA would have modified process conditions to allegedly “allow for $W_2(hpp)_4$ and BPhen to be in close proximity in the gas phase, so as to allow for BPhen to bridge two (or more) $W_2(hpp)_4$ molecules” Pet. 39-46. There is thus a complete failure of proof for both motivation to modify and a reasonable expectation of success.

Simply put, despite Petitioner’s largely speculative proposals, it has not shown why a POSITA would have desired to obtain the structures as recited in claim 8 or that BPhen was known to be capable of coordinating to more than one metal center at a time. Without those insights, a POSITA would not have arrived at the inventions embodied by claim 8.

E. Werner Does Not Disclose or Suggest Method Claims 10-12 and 14

Petitioner references the same analysis for elements 1(b)-1(c) for elements 10(b) and 10(c). Pet. 51. Petitioner references its analysis for claim 8 to argue obviousness for claims 11-12. Pet. 52. Claim 14 depends on claim 10. Thus, for the same reasons stated for claims 1, 2 and 8, claims 10-12 and 14 are not obvious.

Werner Does Not Disclose or Suggest Method Claim 13

Werner does not mention forming chain-like or network-like structures between its metal complexes and matrix materials. Werner also does not mention

cross-linking. Furthermore, neither the Petition nor the parroting expert declaration points to anything in the record that taught “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-conducting layer.” Pet. 53.

The sole source of that knowledge came from the inventors. *See* Pet. 52-53 (citing the ’223 patent’s disclosure for the teaching that “[t]he formation of chain-like or network-like structures enables additional electrons to be able to be transferred from the metal complexes to the organic compounds”). That is hindsight. Without that insight, there would be no reason for a POSITA to control the degree of cross-linking as claimed. Claim 13 is therefore not obvious.

These are not disputes of the weight of the evidence, but an absence of competent evidence. Ground 1 therefore fails.

III. Ma Does Not Render Claims Obvious.

A. Ma Is Not Prior Art

First, Petitioner has not shown that EX1007 as relied on was publicly accessible in August 2008 as Petitioner asserts to qualify as a 102(b) reference. Second, EX1007’s print date of December 2008 was after the filing date of the German applications to which the ’223 patent claims priority. As explained below, the German priority applications fully support the ’223 patent’s claims. Thus, Ma

does not qualify as 102(a) art either.

1. Ma Is Not 102(b) Prior Art

Petitioner bears the burden of “establishing that references relied upon qualify as prior art.” *Grünenthal GMBH v. Antecip Bioventures II LLC*, PGR2017-00022, Paper 50 at 14 (PTAB Nov. 14, 2018) (citing *Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378-81 (Fed. Cir. 2015)). Petitioner has not shown any competent evidence that Ma qualifies as 102(b) prior art.

(a) Petitioner Has Not Shown That Ma’s August 2008 Online Version Was Publicly Accessible

Petitioner acknowledges that “Ma was ... published in the December 2008 issue of *Synthetic Metals*.” Pet. 16 n.5; EX1018, ¶11 (“J. Ma, et. al., ..., was published in *Synthetic Metals*, Vol. 158, Issues 21-24,” which is the December 2008 issue); EX2041, ¶¶150-151 (Web of Science record for Ma); EX2024. This was after the filing dates of the German priority applications (September 26 and November 7, 2008). Petitioner argues, however, the version it submits as EX1007 was “available as of August 29, 2008.” See EX1018, ¶11. Even if true, Petitioner has not shown that the article was publicly accessible in the relevant period, notwithstanding Ms. Garland’s use of the word “available” since there is no indication that she understood the term to mean “publicly accessible” under the US patent law. Nor will we ever know because Ms. Garland refuses to be cross-

examined. EX3102. Ms. Garland has also not demonstrated any “personal knowledge” of Ma or its public accessibility. *See* EX1018.

Her declaration does not demonstrate that “persons interested and ordinarily skilled in the subject matter or art exercising reasonable diligence, c[ould] locate” Ma in the relevant period. *Blue Calypso, LLC v. Groupon, Inc.*, 815 F.3d 1331, 1348 (Fed. Cir. 2016) (explaining the requirement to establish public accessibility, which is the key to find that a reference qualifies as a printed publication as of the critical date). For instance, she does not explain to whom online only *Synthetic Metals* articles would be made available at the relevant time: the general public or only journal’s subscribers. *See Samsung Electronics Co., Ltd. v. Infobridge Pte. Ltd.*, 929 F.3d 1363, 1366-67, 1370-73 (Fed. Cir. 2019) (affirming the Board’s finding that article posted to the JCT-VC website was not publicly accessible because “Samsung could not ‘establish that WD4 was accessible to anyone other than members of JCT-VC’ during the relevant time period”).

Simply put, Ms. Garland does not address Ma’s public accessibility in the relevant period because it provides no information on “how,” “where” or “to whom” the article was made available. *In-Depth Geophysical, Inc. v. Conocophillips Co.*, IPR2019-00849, Paper 17 at 9-10 (PTAB, Mar. 30, 2020); *First Solar, Inc. v. Rovshan Sade*, IPR2023-00827, Paper 13 at 18 (PTAB Nov. 16, 2023) (archive with no evidence of indexing); *Blue Calypso*, 815 F.3d at 1349-50 (no evidence of online

viewing, downloading, indexing, or any roadmap fatal to publication). Thus, even if the Board considers the Garland declaration despite her refusal to be cross-examined (EX3102), it at most shows that Ma “is ***currently available for public download*** from the Elsevier digital library.” EX1018, ¶11. But that says nothing about whether Ma was available to the general public during the relevant period. *In re Lister*, 583 F.3d 1307, 1317 (Fed. Cir. 2009) (the mere existence of a reference today is not *prima facie* evidence that the article was available prior to the critical date).

In its institution decision, the Board posited that Ma’s abstract could somehow be readily located. Paper 11 at 18-19. The Garland declaration says no such things. She testifies generally that “[a]s part of its ordinary course of business, Elsevier, publishes and makes available technical articles” and “[t]hese publications are made available for public download through Elsevier’s digital library, ScienceDirect.” EX1018, ¶6. She also alleges, “[i]t is the regular practice of Elsevier to publish articles and other writings including article abstracts and make them available to the public through ScienceDirect.” *Id.* ¶7.

First, these are generic statements not specific to Ma. *Cf.*, Paper 11 at 16 (dismissing Dr. Schanze’s testimony because it “does not address Ma specifically and does not cite corroborating evidence to support this testimony”). Second, the statements do not explain when articles became available for download by the

general public in the relevant time period: *e.g.*, whether they became available immediately after they were posted online or after they became published in the paper form.

Third, the declaration does not say when Elsevier made abstracts available and searchable, or if not searchable, how an interested person could locate Ma's abstract. Because Ms. Garland does not explain when abstracts in general and Ma's abstract in particular became searchable in the relevant period, the Garland declaration does not support the Board's conclusion that "Ma's abstract would have been available online, such as via an internet search engine, permitting an interested entity to find the abstract and then, if necessary, gain access to Ma's full text." Paper 11 at 18. The Garland Declaration is silent on whether Ma's abstract could be located via a generic search engine or ScienceDirect's own search tool during the relevant period. Thus, even if the general public had known about the journal website (www.elsevier.com/locate/synmet), a fact that the Board inferred from Ma's cover,⁵ there is no evidence that they could find the abstract or the article.

⁵ The Board's reasoning seems circular: the web site is printed on Ma cover page, so if Ma was not publicly available before the critical date, the public would not have access to Ma or known about the web page printed on it. Thus, the web

Furthermore, even if the person could somehow locate the abstract—a mere speculation at this point, that still does not make Ma printed publication because the art relied on is not Ma’s abstract but EX1007 and, at any rate, the abstract does not have the experimental details relied on. Thus, for example, if Ma was limited to the subscribers until after paper publication, Ma itself would not be publicly accessible until after the paper publication date and therefore would not qualify as printed publication until then.

Petitioner also does not present any evidence that if “a person of ordinary skill might have known about the [*Synthetic Metals*] website, ...that such a person would have located the [Ma] reference on the website by exercising reasonable diligence” in the relevant time period. *Blue Calypso*, 815 F.3d at 1348. For example, Petitioner presents no evidence regarding (1) when the Ma online version was first indexed; or (2) the search capability of *Synthetic Metals* website or other search tools during the relevant period to establish that a POSITA exercising reasonable diligence could locate the online version before the critical date. *See* Pet. 16-17 n.5.

For instance, the *Synthetic Metals* website indicates that the Ma article has been cited 12 times and provides a link to the full list of the forward citations.

address included in Ma sheds no light on whether Ma was publicly available before the critical date.

EX2022, 5-6. According to the full list, the earliest citation to Ma was in 2009. EX2023 at 3-4 (items #11-12); *see also* EX2041, ¶148 (Professor Schanze testifying that by 2008/2009, *Synthetic Metals* “had long ceased to be a journal that researchers in optoelectronics would actively monitor for new articles”).

The situation here thus differs from *Voter Verified, Inc. v. Premier Election Solutions*, 698 F.3d 1374, 1380-81 (Fed. Cir. 2012). In *Voter Verified*, the web site in question made all its articles “available worldwide,” those articles were “treated by the community as public disclosures and users can freely and easily copy Risks Digest content,” and as of the critical date, the website “ha[d] included a search tool that would have retrieved the Benson article in response to” relevant search terms. *Id.* No such evidence exists here that (1) Ma was available to the general public before the critical date; (2) that those who could access Ma’s online version treated Ma as freely distributable before Ma was published in the journal; or (3) ScienceDirect’s search tool could have located Ma in response to relevant search terms. As such, Petitioner has not proven that Ma is publicly accessible.

Indeed, Professor Schanze testifies that according to his recollection, in the relevant time, the publisher “often did not promptly index new articles,” “that new articles often could not be located unless one knew the authors’ names or the title of the article,” and the search tool “had limited keyword search capability as it often failed to identify articles of interest.” EX2041, ¶149. Additionally, “during the

relevant time period (2008-2009), indexing services, such as Clarivate Web of Science did not index online only articles, making them difficult or impossible to locate.” *Id.* This is corroborated by Web of Science records, showing that Ma was not indexed until December 2008. EX2041, ¶150.

Organic light-emitting diodes based on new n-doped electron transport layer	
By	Ma, JW (Ma, J. W.) ^[1] ; Xu, W (Xu, Wei) ^[1] ; Jiang, XY (Jiang, X. Y.) ^[1] ; Zhang, ZL (Zhang, Z. L.) ^[1] , ^[2]
Are you this author?	
Source	SYNTHETIC METALS Volume: 158 Issue: 21-24 Page: 810-814 DOI: 10.1016/j.synthmet.2008.05.009
Published	DEC 2008
Indexed	2008-12-01
Document Type	Article
Abstract	Organic light-emitting diodes with 8-hydroxy-quinolinato lithium doped 4'7-diphenyl-1, 10-phenanthroline as electron transport layer (ETL), and tetrafluoro-tetracyano-quinodimethane doped 4,4',4''-tris(3-methylphenylphenylamino) triphenylamine as hole transport layer (HTL) are demonstrated. The conductivity of carrier transport layers with different doping concentration is examined by hole-only and electron-only devices. Compared with the referenced device (without doping), the current efficiency and power efficiency of the p-i-n device are enhanced by approximately 51% and 89%, respectively. This improvement is attributed to the improved conductivity of the transport layers and the efficient charge balance in the emission zone. (C) 2008 Elsevier B.V. All rights reserved.
Keywords	Author Keywords: Organic light-emitting diodes; Doping concentration; Carrier transport; Conductivity Keywords Plus: ELECTROLUMINESCENT DEVICES; HOLE-INJECTION; EFFICIENCY; VOLTAGE; PHTHALOCYANINE
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Categories/ Classification	Research Areas: Materials Science; Physics; Polymer Science Citation Topics: 2 Chemistry > 2.114 Organic Semiconductors > 2.114.321 OLEDs Sustainable Development Goals: 07 Affordable and Clean Energy

Previously, the Federal Circuit held that a manuscript deposited at the Copyright Office “was publicly accessible as of the date that it was included in ... the databases that permitted keyword searching.” *In re Lister*, 583 F.3d at 1316.

Under *Lister*'s reasoning, Ma was not publicly accessible before its indexing date,⁶ because even though indexing is not required in every case, there is no evidence that Ma or its abstract could be located without indexing. If Ma could not be located, then it cannot be said to be publicly accessible or qualify as a printed publication. *In re Bayer*, 568 F.2d 1357 (CCPA 1978) (an uncatalogued and unshelved thesis is not a printed publication even though it was accessible to the graduate committee).

(b) Petitioner Has Not Shown That EX1007 Was Available in August 2008

Petitioner has also not shown that EX1007 was the version posted online in August 2008. Petitioner acknowledges, for example, “[t]he ‘available online’ date refers to a date when ‘*a version*’ of the article was made available online in the journal.” Pet. 16 n. 5. The Petition submits no evidence that EX1007 is the version made available online in August 2008.

The “form” business-record declaration from Ms. Garland submitted after the Petition also does not address that question. For example, the declaration merely confirms that “Exhibit A [attached to the declaration] is a true and correct copy of the Exhibit, *as it existed on or about November 8, 2024.*” EX1018, ¶9. But the

⁶ The public accessible date may be after 12/1/2008, depending on, *e.g.*, when Elsevier made Ma available to the general public.

question is not what Ma—as it existed in November, 2024—disclosed or how persistent the metadata associated with Ma is (*see, id.*, ¶10). The question is, whether EX1007 was what existed in August 2008.

Lacking competent evidence, Petitioner makes an attorney argument that, because “[n]o revisions to the article are indicated between August 29, 2008, and the December 2008 issue date, and the disclosures relied upon in this IPR are central to the article,” the version it submitted was publicly available on August 29, 2008. Pet. 16-17 n.5.

“Attorney argument is not evidence.” *Elbit Sys. of Am., LLC v. Thales Visionix, Inc.*, 881 F.3d 1354, 1359 (Fed. Cir. 2018) (internal quotation marks and citation omitted). Petitioner presents no evidence that *Synthetic Metals* has a policy of indicating revisions between the online version and the version of record in the printed journal, or even that there would be a need to do so given the temporary nature of the initial online version.⁷ *Id.* Without such evidence, Petitioner is merely speculating that EX1007 is the version allegedly made available on August 29, 2008. “However, the legal determination whether a particular reference qualifies as a printed publication is based upon underlying facts and not upon speculation.” *Celltrion, Inc. v. Biogen, Inc.*, IPR201-01614, Paper 65 at 16 (PTAB Feb. 21, 2018).

⁷ That is, in December 2008, there would be a finalized version of the article.

Nor does Petitioner cite any evidence for its assertion that “the disclosures relied upon in this IPR are [purportedly] central to the article.” Pet. 16-17, n.5. For instance, there is no expert testimony explaining why the parts it relied on are “central” to Ma. *Id.* In fact, journal articles describing OLED devices do not necessarily report the deposition conditions. EX2020 (article on OLED devices with Rb₂CO₃-doped BPhen does not provide deposition conditions); *see also* EX2021, abstract (a 2017 article discussing the use of the solution-processed Cs₂CO₃-doped BPhen film in OLED, indicating that co-evaporation is also not a necessary method to dope BPhen). Petitioner therefore has presented no evidence to support its assertion that the August 2008 online version had the disclosures in the final December 2008 version.

This differs from *Hulu*, which did not involve using a later-published version of a reference as evidence that content therein was also available in an earlier online version. Instead, *Hulu* involved determining whether “a textbook from an established publisher” and “a well-known book series” was publicly available in that printed form before a critical date. *Hulu, LLC v. Sound View Innovations, LLC*, IPR2018-01039, Paper 29 at 19-20 (PTAB Dec. 20, 2019) (precedential). The face of the book in *Hulu* bore a copyright date, a printing date and an ISBN date. *Id.* at 19. Based on the totality of evidence, the Board found that there was a reasonable likelihood that the book was available before the critical date. *Id.*

No such evidence is presented here. Instead, this case is more like *In-Depth Geophysical, Inc. v. Conocophillips Co.*, IPR2019-00849, Paper 17 (PTAB, Mar. 30, 2020) cited by *Hulu*, “where the Board ... concluded that a conference paper, bearing a copyright date of 2012 and including a date of September 2012 on its cover, was insufficient to show that the paper had been disseminated prior to the conference (November 2012).” *Hulu*, Paper 29 at 19. As in *In-Depth*, Petitioner relies on nothing more than a date of August 29, 2008 to argue that the content of EX1007 was publicly accessible in August 2008 when EX1007 appears to be the finalized version published in the Journal in December 2008. Petitioner presents no evidence that the August 2008 online version had the relied-on disclosures.

Thus, even if the Board accords any weight to the declaration whose declarant refuses to be cross-examined, EX3102,⁸ Petitioner has not shown that EX1007 was

⁸ *Shenzhen Pinan Tech., Co., Ltd. v. The Ridge Wallet, LLC*, IPR2024-00340

(P.T.A.B. Nov. 20, 2024), Paper 24 (“Because Petitioner has not made Dr.

Cameron available for cross-examination, Petitioner has failed to comply with the applicable rules in this proceeding, to Patent Owner’s detriment...”); *Abbott*

Vascular, Inc. v. FlexStent, LLC, IPR2019-00882, Paper 48 at 34 (P.T.A.B. Oct. 2, 2020) (“[i]t would be manifestly unfair for [Ideahub] to affirmatively rely on the

available in August 2008.

2. Ma Does Not Qualify as 102(a) Art Because Priority Applications Support The Challenged Claims And Ma's Publication Date Was After the Priority Applications

As explained above, Petitioner has not presented any competent evidence that EX1007 or the content it relies on was publicly available online before *Synthetic Metals* published it in its December 2008 issue. But December 2008 was after the two filing dates of the two German priority applications. *See* EX1001, field 30. As demonstrated in the charts below, the challenged claims are fully supported by even the earlier German priority document. Thus, Ma does not qualify as 102(a) art either. EX2041, ¶152, pp. 73-86. Consequently, Ma is not prior art to the challenged claims.

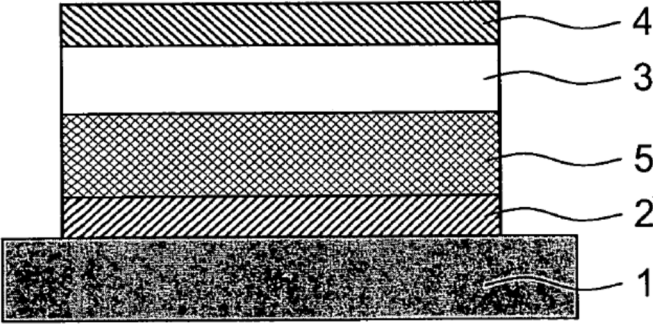
Claim Element ⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
1[pre].	Claim 1: "Organic electronic component, comprising" <i>See also, e.g.,</i> Title: "Organic electronic component and method for its

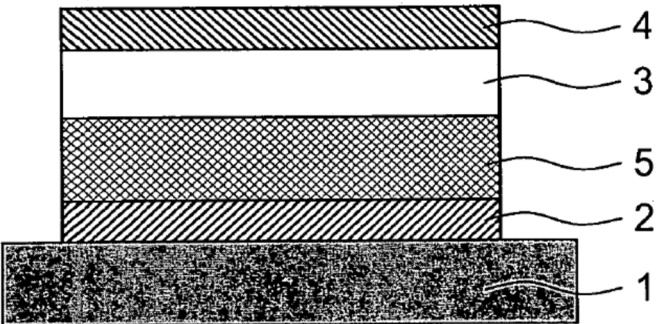
Declaration of [Mr. Lee]...while at the same time contending that it has no control over [Mr. Lee] and refusing to present him for deposition.”).

⁹ Using the same numbering as Petitioner.

¹⁰ Challenged claims only.

Claim Element ⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
	manufacture” Abstract: “Organic electronic component, comprising” 1:5: “An organic electronic component according to Claim 1 is specified.” 2:13-26: “Through the joint evaporation of the metal complex with an organic compound, ... [t]he compounds are deposited in the coordinated state, so that a layer is formed in which short-range order is provided. The term short-range order is understood to mean that not the entire layer per se is crystalline, but that the organic compounds are disposed around the metal complex in its immediate environment according to a specific pattern that depends on the selected metal complex and the organic compound. However, the entire layer itself is amorphous and thus does not have a long-range order. By coordinating the organic compound at the metal complexes and the associated overlap of the orbital, additional electrons can be transferred from the metal to the ligand by a metal-ligand charge-transfer complex. These electrons can be available for electron transportation in the organic electronic component. By increasing the ‘free’ electrons, the electron conductivity in the component is significantly improved. This leads to an increase in the efficiency and serviceable life of the organic electronic component.”
[1a.1]. a substrate, a first electrode, a second electrode,	Claim 1: “Organic electronic component, comprising – a substrate (1), – a first electrode (2), – a second electrode (4), ...” <i>See also, e.g.,</i>

Claim Element ⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
	Abstract: “Organic electronic component, comprising a substrate, a first electrode, a second electrode, ...” 2:8: “An embodiment of the organic electronic component comprises a substrate, a first electrode, a second electrode” 22:4-8: “One variant of the method for manufacturing an organic electronic component comprises the method steps: providing a substrate as method step A), applying a first electrode in process step B), depositing an electron-conducting layer on the substrate as method step C), applying a second electrode in the process step D), wherein the electron-conducting layer is deposited by simultaneous vaporization of a metal complex and an organic compound.” 27:7-8: “Figure 1 shows a layer sequence comprising a substrate 1, a first electrode 2 and a second electrode 4 arranged thereon.” Fig. 1 and associated text: Fig 1 
[1a.2]. an electron-conducting layer which is	Claim 1: “Organic electronic component, comprising ...

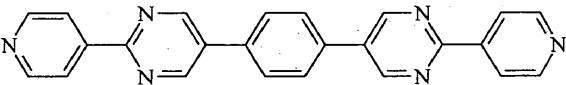
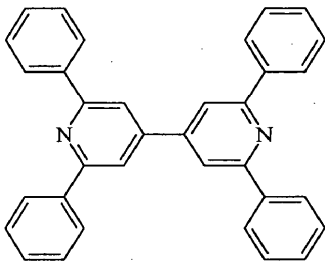
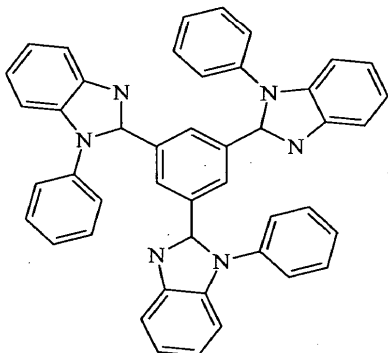
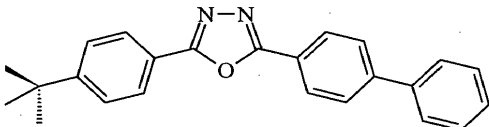
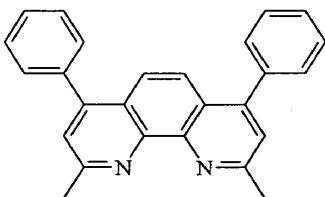
Claim Element ⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
arranged in such a way that it is electrically conductively connected to at least one of the electrodes,	– an electron-conducting layer (3) arranged such that it is electrically conductively connected to at least one of the electrodes, ...” <i>See also, e.g.,</i> Abstract: “Organic electronic component, comprising a substrate, a first electrode, a second electrode, an electron-conducting layer arranged such that it is electrically conductively connected to at least one of the electrodes” 2:8-10: “An embodiment of the organic electronic component comprises a substrate, a first electrode, a second electrode, and an electron-conducting layer arranged such that it is electrically conductively connected to at least one of the electrodes” <i>See also</i> Fig. 1 and associated text Fig 1 
[1b]-[1c].	Claim 1: “Organic electronic component, comprising ... – an electron-conducting layer (3) ..., wherein the electron-conducting layer (3) is obtained by joint vaporization of a

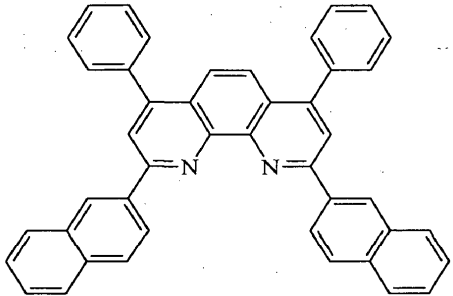
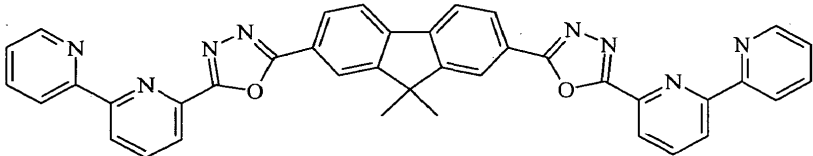
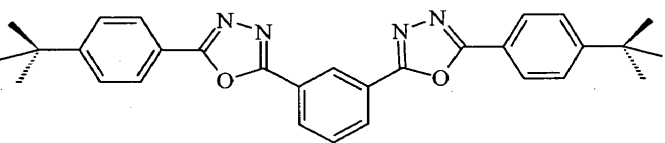
Claim Element ⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
	metal complex with an organic compound, wherein the metal complex comprises a central metal atom.” Claim 5: “Organic electronic component according to any of the above claims, wherein the organic compound comprises a heteroaromatic compound conjugated to an aromatic compound with a C-C bond.” <i>See also, e.g.,</i> Abstract: “Organic electronic component, comprising a substrate, a first electrode, a second electrode, an electron-conducting layer arranged such that it is electrically conductively connected to at least one of the electrodes, wherein the electron-conducting layer is obtained by joint vaporization of a metal complex with an organic compound.” 2:8-11: “An embodiment of the organic electronic component comprises a substrate, a first electrode, a second electrode, and an electron-conducting layer arranged such that it is electrically conductively connected to at least one of the electrodes, wherein the electron-conducting layer is obtained by joint vaporization of a metal complex with an organic compound.” 6:12-13 (“In a further embodiment of the organic electronic component, the organic compound comprises a heteroaromatic compound.”) 6:17-7:1 (“Compared to an aromatic compound, a heteroaromatic compound has the advantage that it can coordinate to a metal complex not only via the aromatic system (π electrons), ..., but that the coordination can also be achieved directly via the heteroatom.”). 7:6-7 (“In a further embodiment of the organic electronic component, the organic compound comprises a heteroaromatic

Claim Element⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
	compound that is conjugated with an aromatic compound via a C-C bond.”). 7:10-13 (“a system of this type, in which the heteroaromatic compound is linked with further aromatic compounds via single C-C bonds, has the advantage that it is not as sterically demanding and voluminous, and can thus coordinate more easily to a metal complex, or better coordinate to several metal complexes at the same time.”). 30:11-12: “This electron-conducting layer can be obtained by joint vaporization of the metal complex with the organic compound.”
Claim 2	Claim 2: “Organic electronic component according to Claim 1, wherein the organic compound coordinates to the metal complex due to the joint vaporization.” <i>See also, e.g.,</i> 2:13-15 (“Through the joint evaporation of the metal complex with an organic compound, these two compounds interact with each other in the gas phase. This interaction causes the compounds to be mutually coordinated.”); 17:6-10 (“By suitable selection of the metal complexes, ..., and suitable selection of the organic compounds, ... the joint vaporization of the metal complex with the organic compound in the gas phase results in interactions, so that the compounds coordinate together. Coordination is also retained when forming the electron-conducting layer.”). 23:7-10 (“there is also the possibility that the metal complexes and the organic compound meet each other first on the surface to be coated or upon contact with the surface and the organic compound coordinates to the metal complex while forming the electron-conducting layer.”).

Claim Element ⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
	19:3-9 (“The problem is mitigated by a macroscopically to nanoscopically amorphous electron-conducting layer. Such a layer can be obtained by the joint vaporization of the organic compound with a metal complex, wherein the organic compound coordinates to the metal complex and thereby prevents crystallization. However, the metal complex must be used to ensure that the now macroscopically to nanoscopically amorphous structure still has effective electron-conducting properties.”). 22:18-19: “In a further method variant, the organic compound coordinates to the metal complex by means of joint vaporization.” DE ’391 [EX2027], 2:13-15 (“When the metal complex vaporizes together with an organic compound, these two compounds interact with each other in the gas phase or when they meet on the substrate surface.”).
Claim 3	Claim 3: “Organic electronic component according to any of the above claims, wherein the metal complex comprises more than one central metal atom.” <i>See also, e.g.,</i> 4:1-6 (“In a further embodiment of the organic electronic component, the metal complex comprises more than one central atom.” [¶] The presence of more than one central atom improves the possibility that several organic compounds will coordinate simultaneously to the metal complex. The metal complex preferably comprises two central metal atoms.”).
Claim 4	Claim 4: “Organic electronic component according to any of the above claims, wherein the central metal atom is, or the central metal atoms are, selected from Cr, Mo, or W.” <i>See also, e.g.,</i>

Claim Element⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
	5:1-2: “In an embodiment of the organic electronic component, the central atom is, or the central atoms are, selected from: Cr, Mo or W.”
Claim 6	Claim 7: “Organic electronic component according to any of the above claims, wherein the organic compound is selected from: [same chemical formula] <i>See also, e.g.,</i> 9:12-13 & 10-12: “In a further embodiment of the organic electronic component, the organic compound is selected from:

Claim Element ⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
	 I  II  III  IV  V

Claim Element ⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
	 XI  XII  XIII
Claim 8	Claim 9: “Organic electronic component according to any of the above claims, wherein at least parts of the organic compounds bridge two metal complexes with one another such that a chain-like structure of the metal complexes is formed and/or at least parts of the organic compounds bridge more than two metal complexes together such that a network-like structure of the metal complexes is formed.” <i>See also, e.g.,</i> 12:5-8: “These compounds I through XIII not only permit the formation of two-dimensional chains, but also the formation of three-dimensional networks by virtue of their plurality of coordination sites. In this case, an organic compound coordinates to more than two metal complexes.”

Claim Element ⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
	16:6-9: “These compounds I, II, XIV through XXV not only permit the formation of two-dimensional chains, but also the formation of three-dimensional networks by virtue of their plurality of coordination sites. In this case, the organic compound coordinates to more than two metal complexes.” 17:1-4: “In an embodiment of the organic electronic component, at least parts of the organic compounds bridge two metal complexes together, so that a chain-like structure is formed and/or at least parts of the organic compounds bridge together more than two metal complexes, so that a network-like structure is formed.” 18:9-14: “This example clearly shows that it is possible to coordinate to several metal complexes simultaneously by means of a suitable choice of organic compound. By the corresponding selection of the metal complexes, more than one organic compound can also coordinate to said metal complexes, thus resulting in chain-like and/or network-like structures in the electron-conducting layer.”
Claim 9	Claim 10: “Organic electronic component according to any of the above claims, formed as an organic LED (OLED) that additionally comprises an organic emitting layer (5).” <i>See also, e.g.,</i> 21:1-2 (“The organic electronic component is preferably formed as an organic LED (OLED), which comprises an electroluminescent layer.”). 27:16-24: “Figure 2 shows an embodiment of the component formed as an OLED. The figure shows a schematic side view of a layer stack of nine layers. A first electrode 2, which is for example transparent and made of ITO (indium-tin oxide), is 30 arranged on a substrate 1, which is for example made of glass. A hole injection layer 13, on which in turn a hole transport layer 14 is arranged, is arranged on this electrode 2. An organic

Claim Element⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
	active layer - the organic emitting layer 5 - is located on the hole transport layer 14. A hole-blocking layer 16 is arranged on said organic emitting layer 5, followed by an electron transport layer 17, and on which an electron injection layer 18 is arranged. A second electrode 4, for example a metal electrode, is located on the electron injection layer 18.” Fig 2 The diagram shows a cross-sectional view of a multi-layered device. A substrate (1) is at the base. Above it is a first electrode (2). A stack of layers follows: hole transport layer (14), organic emitting layer (5), hole-blocking layer (16), electron transport layer (17), and an electron injection layer (18) on top of the electron transport layer. A second electrode (4) is positioned on the electron injection layer (18). The layers are labeled with numbers 1 through 18, with some labels (14, 5, 13, 17, 18) appearing on both the left and right sides of the stack.
Claim 10	Claim 11: “Method for manufacturing an organic electronic component, comprising the method steps of: A) providing a substrate (1), B) applying a first electrode (2), C) depositing an electron-conducting layer (3) on the substrate (1), D) applying a second electrode (4), wherein the electron-conducting layer (3) is deposited by simultaneous vaporization of a metal complex and an organic compound.” Claim 5: “Organic electronic component according to any of the above claims, wherein the organic compound comprises a heteroaromatic compound conjugated to an aromatic compound with a C-C bond.” <i>See also, e.g.,</i>

Claim Element ⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
	Citations for claim 1. 22:4-11: “One variant of the method for manufacturing an organic electronic component comprises the method steps: providing a substrate as method step A), applying a first electrode in process step B), depositing an electron-conducting layer on the substrate as method step C), applying a second electrode in the process step D), wherein the electron-conducting layer is deposited by simultaneous vaporization of a metal complex and an organic compound. [¶] Such a method can, for example, be used to produce an organic electronic component, as claimed in claim 1.” 7:7-9: “In a further embodiment of the organic electronic component, the organic compound comprises a heteroaromatic compound that is conjugated with an aromatic compound via a C-C bond.” <i>see also</i> 7:8-14.
Claim 11	Claim 12: “Method according to Claim 11, wherein, during the simultaneous vaporization, the organic compound coordinates in the gas phase to the metal complex.” <i>See also, e.g.,</i> 2:13-15: “When the metal complex vaporizes together with an organic compound, these two compounds interact with each other in the gas phase or when they meet on the substrate surface. This interaction causes the compounds to be mutually coordinated.” 17:6-9: “By suitable selection of the metal complexes, ..., and suitable selection of the organic compounds, ..., the joint vaporization of the metal complex with the organic compound in the gas phase results in interactions, so that the compounds coordinate together.”

Claim Element ⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
	23:1-3: “Due to the simultaneous vaporization of metal complexes and organic compounds, both compounds are simultaneously present next to each other in the gas phase. This enables the organic compound to coordinate to the metal complex in the gas phase.”
Claim 12	Claim 13: “Method according to any of Claims 11 or 12, wherein the electron-conducting layer (3) is deposited as a chain-like or network-like structure.” <i>See also, e.g., citations for claim 8.</i> 17:11-8:1: “These chains or networks are deposited as such in the vaporization process and are also present as such in the electron-conducting layer in the organic electronic component. The formation of chain-like or network-like structures enables additional electrons to be transferred from the metal complexes to the organic compounds; said electrons are then available for charge transport in the electron-conducting layer.” 18: 11-14: “By the corresponding selection of the metal complexes, more than one organic compound can also coordinate to said metal complexes, thus resulting in chain-like and/or network-like structures in the electron-conducting layer.” 23:12-13: “In a further method variant, the electron-conducting layer is deposited as a chain-like or network-like structure.” 23:15-18: “The coordination of the organic compound to the metal complex in the gas phase allows chain-like or network-like structures to form. These chain-like or network-like structures are then also deposited as such and are also present as such in the electron-conducting layer in the organic electronic component.”
Claim 13.	Claim 14: “Method according to Claim 13, wherein the degree of cross-linking of the electron-conducting layer (3) is

Claim Element ⁹	<u>As-filed DE102008049286 (EX2026)¹⁰</u>
	controlled by the ratio between the metal complex and the organic compound during vaporization.” <i>See also, e.g.,</i> 24:1-3: “In one method variant, the degree of cross-linking of the electron-conducting layer is controlled by the ratio between the metal complex and the organic compound during vaporization.” 24:5-7: “The degree of cross-linking and thus the formation of network-like or chain-like structures can be controlled by the ratio of metal complex to organic compound. Referring to the molar ratio, the organic compound is vaporized in excess compared to the metal complex.”
Claim 14.	Claim 15: “Method according to any of Claims 11 through 14, wherein the organic compound does not coordinate to the metal complex prior to vaporization.” <i>See also, e.g.,</i> 24:13-14: “In a further method variant, the organic compound does not coordinate to the metal complex prior to vaporization.”

B. Ma Does Not Invalidate Claim 1

1. Ma Neither Expressly Nor Inherently Discloses Joint Vaporization of Liq and BPhen

Although Petitioner characterizes Ground 2 as an obviousness ground, it does not assert that any limitation is missing for claim 1. Pet. 54-60. Instead, it proceeds under the obviousness ground only because it disagrees with Pictiva’s claim

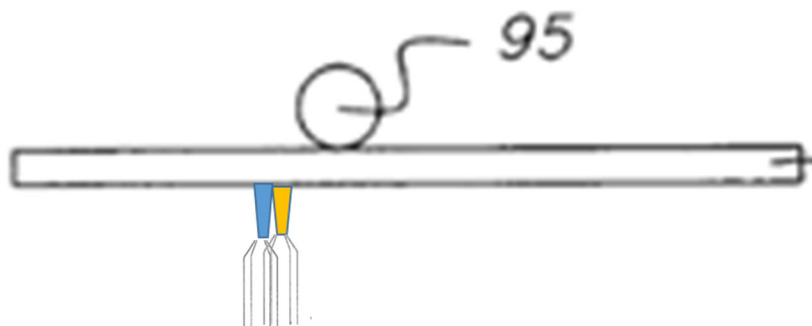
interpretation regarding the term “metal complex” and “central metal atom.” Pet. 58-59. But Petitioner does not set forth any modification. *Id.* Hence, the Petition effectively only presents an anticipation theory. To prevail under anticipation, Petitioner must show that Ma expressly or inherently discloses all elements arranged as in the claim. *Net MoneyIn, Inc. v. VeriSign, Inc.*, 545 F.3d 1359, 1369 (Fed. Cir. 2008). But even under obviousness, for a limitation that is not expressly disclosed, Petitioner must show that the missing element was the “natural result” of the combination of prior art elements. *PAR Pharm.*, 773 F.3d at 1195.

Here, Petitioner argues that Ma discloses joint vaporization of Liq and BPhen because Ma discloses that “BPhen:Liq ETL was co-deposited on the EML.” Pet. 59. There is no analysis, however, that Ma’s co-deposition process is one of joint vaporization of Liq and BPhen. *Id.*

In the context of the ’223 patent, joint vaporization means the two materials vaporize together. *See* EX2026, 2:13-15; EX1001, 1:60-63. Among other things, Ma does not describe how its sources/crucibles are positioned to each other, what the angles of trajectory for each of the two plumes were, or whether the two plumes overlapped with each other. EX2041, ¶¶154-157. Thus, Petitioner has not shown Liq and BPhen were jointly vaporized.

For example, with an evaporative deposition setup as below, at a given time, the two plumes would deposit Liq and BPhen at different positions on the substrate.

EX2041, ¶¶156-157, 157 n. 10 (Samsung in the district court refers to co-evaporation of host and dopant as “sequential co-evaporation,” confirming that “co-evaporation” or “co-deposition) does not necessarily mean joint vaporization).



The substrate can then be moved translationally or rotated to achieve a macroscopically uniformly weighted coating. EX2041, ¶156. This is a type of co-deposition of BPhen and Liq in the sense that both are deposited on the same substrate at the same time (albeit at different spots at a given time) and the end result is a mixed film with both materials in a macroscopically homogenous form. EX2041, ¶157. But this is not joint vaporization because the two plumes do not intersect each other and the two plumes hit the same areas at different times (e.g., due to substrate rotation or movement). *Id.*, ¶¶156-157. Thus, Ma does not expressly or inherently disclose “joint vaporization” in the context of the ’223 patent. .

RPI’s expert in the district court, Dr. Kymissis, asserts that joint vaporization is a complex process, and that to understand how “joint vaporization” or “simultaneous vaporization” is performed, it is “at least necessary to understand basic parameters like: (i) applied temperature ranges, (ii) applied pressure ranges,

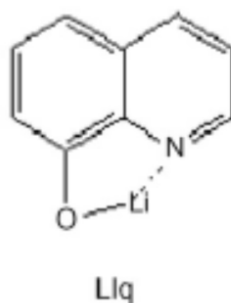
and (iii) duration.” EX2051_Kymissis_Opening, ¶1046. But no applied temperature range is disclosed by Ma. Moreover, in the district court, when discussing Ma, the RPI’s expert stated unambiguously that he “do[es] not agree that this [Ma’s] process constitutes ‘joint vaporization’.” EX2051, ¶¶ 452-453. Thus, Petitioner has not shown that this limitation is met.

2. Under Petitioner’s Claim Interpretation, Liq Is Not a Metal Complex And Has No Central Metal Atom

In the district court, Petitioner also argues that in light of prosecution statements, Liq is not a claimed metal complex because it contains “an oxygen atom.” EX2052, ¶¶77-78.¹¹

More recently, the RPI also argues that Liq has no central metal atom allegedly because (1) “[t]he lithium atom in Liq is not located at the center of the molecule, but rather on an arm on the side,” (2) “Lithium does not Enable Liq to Coordinate with Additional Ligands,” and (3) “Lithium Does Not Enable Liq to Have a High Disposition and Ability to Provide ‘Free’ Electrons.” EX2052 at 49-57.

¹¹ During prosecution, the inventors contrasted the claimed metal complex with “a metal oxide [which] is a compound composed of one or more metal atoms and one or more oxygen atoms.” EX1002, 838.



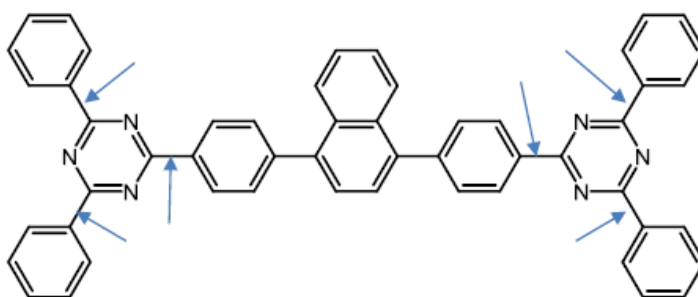
Pictiva disagrees with both claim construction positions. First, the prosecution disclaimer applies to nothing more than metal oxides composed of metal and oxygen atoms. EX1002, 838. Liq, composed of mostly carbon atoms, would not be understood as a metal oxide. Second, “central metal atom” just refers to the metal center of a metal complex, and the metal center need not be centrally located or have the properties discussed in preferred embodiments. *See* ’223, 2:21-27, 3:4-14; *see also* EX2101, 3018 (“A common characteristics for the interface materials such as ... Liq ... is that ***the central atom*** is an electropositive low work function metal”).

But should the Board agree with Petitioner-RPI’s claim construction position, Ground 2 fails. Moreover, Petitioner should have but does not explain the difference in claim construction positions and does not address the Petition’s merits under its district court constructions. *Cf., Cambridge Mobile Telematics, Inc. v. Sfara, Inc.* (majority opinion), IPR2024-00952, Paper 12 (December 13, 2024) (designated informative: March 20, 2025) (denying institution where a petitioner argues for a

means-plus-function construction in district court and a plain and ordinary meaning construction in a petition, but fails to explain the difference in claim construction positions or, alternatively, to provide a means-plus-function construction). A proper remedy is to proceed under Petitioner's claim construction position in the district court. *Id.*

C. Petitioner Has Not Presented Any Competent Evidence That Ma Discloses Claim 2

Petitioner's unpatentability theory for claim 2 rests on mischaracterizations of Pictiva's infringement contentions. *See* Pet. 61-64. Based on reverse engineering, Pictiva believes that Samsung's accused products include a layer formed by joint vaporization of Liq and an organic compound with two triazine rings spaced apart by aromatic moieties via C-C single bonds (see below). In this configuration, there are not only aromatic rings available for pi-bonding with the metal center, (EX2046, Table 20, benzene-Li⁺ bonding interaction on the order of 147-160 KJ/mol, EX2041, ¶¶163-164), but also heteroatoms on the two ends that can bond to lithium (EX2041, ¶¶161-162).



This follows the '223 patent's teaching of a preferred structure for the organic compound:

In a further embodiment of the organic electronic component, the organic compound comprises a heteroaromatic compound which is conjugated with an aromatic compound via C-C bond.

A C-C bond is understood to be a carbon-carbon single bond: the heteroaromatic compound and the aromatic compound are thus not condensed. *In contrast to the condensed systems*, a system of this type, in which the heteroaromatic compound is linked with further aromatic compounds via C-C single bonds, has the advantage that it is not so sterically demanding and voluminous, and therefore can coordinate more easily to a metal complex or can coordinate better to several metal complexes simultaneously.

EX1001, 4:1-15; *see also* 3:52-67.

In contrast to the compound above, where the two triazine rings are separated by C-C single bonds and spacer aromatic rings, BPhen has a single, fused heteroaromatic moiety composed of two pyridyl rings (the six-membered rings with one nitrogen) “condensed” with an aromatic ring. EX2041, ¶165. And BPhen does not contain the triazine rings as in the accused products. “The coordination sphere, such as steric effects of the heteroaromatics[,] are therefore quite different between BPhen and the triazine compound use in the Accused Products.” EX2041, ¶168; *see also id.*, ¶¶165-167 (Dr. Schanze contrasting bistriazine's more flexible structure

with BPhen's rigid, fused ring structure). Thus, Pictiva's infringement contentions does not speak to whether coordination between Liq and BPhen occurs. *Contra* Pet. 61-62.

Petitioner concedes that "Ma does not expressly disclose the structure formed by Liq and BPhen upon vaporization." Pet. 65. Instead, it relies on the teaching of the '223 patent to argue that coordination would occur. Pet. 62. But the quoted statement says, "[t]he coordination of the organic compound to the central atom can be effected directly via a further atom or else also via an aromatic system." EX1001, 2:19-21. Petitioner has not shown that this coordination necessarily or even likely occurs under Ma's reaction conditions. *Cf.*, EX2042, 199:20-200:6 (type and degree of interactions depend on processing conditions).

Petitioner's reliance on $\text{Rh}_2(\text{O}_2\text{CCF}_3)_4$ to prove otherwise is misplaced. As explained above, the trifluoroacetate (O_2CCF_3) ligand was known to be highly electron withdrawing such that rhodium becomes highly electrophilic. EX2041, ¶169. This electrophilicity promotes its acceptance of pi-electrons from the electron-rich C_6Me_6 through its LUMO formed from d_{xz} - d_{xz} and d_{yz} - d_{yz} . *Id.*

In contrast, the lithium center does not have d-orbitals. EX2041, ¶171. And as an n-dopant, Liq is understood to "donate, instead of accepting, electrons." *Id.*, ¶170. Moreover, unlike the highly electron withdrawing O_2CCF_3^- moiety, the hydroxyquinolato unit is overall electron donating. EX2041, ¶171. And unlike

hexamethylbenzene's electron-donating methyl groups that increase the electron density of the pi-system, BPhen's "planar central structure," or the phenanthroline ring, has only the slightly electron-withdrawing phenyl substitution. *Id.* "As a result, the coordination environment for Liq and BPhen is completely different than that for $\text{Rh}_2(\text{O}_2\text{CF}_3)_4$ and hexamethylbenzene." *Id.*

The reaction condition deployed by Cotton for forming $\text{Rh}_2(\text{O}_2\text{CCF}_3)_4$ also differs greatly from that reported in Ma. According to the Cotton paper, the arene adduct was formed over 2 weeks, indicating that the reaction is likely a slow one producing a thermodynamic mixture. EX2041, ¶172; EX1012, 2726 (see synthesis of the dirhodium adduct). In contrast, as Profesor Schanze explains, a POSITA would expect that the thermal evaporation and deposition of Liq and BPhen in Ma to occur on the order of 17 minutes, and yield an admixture of kinetic products. EX2041, ¶172.

Neither Petitioner nor its expert considered the differences between $\text{Rh}_2(\text{O}_2\text{CCF}_3)_4$ and Ma's system both in terms of the chemical structures and the reaction conditions. Moreover, Dr. Rand only concludes that some unspecified atom in Bphen may be interacting with some unspecified atom in Liq, but he has not determined that there is any interaction between lithium and nitrogen atoms or between lithium and a pi-system:

Q: And you did not determine whether the coordination involved lithium nitrogen bonding; correct?

A. Correct. We've already established this previously.

Q: Do you [know] whether Pi complexes are formed at the center of the lithium atom?

A. I don't know that specifically.

Q: Would there be chemical bonds formed between nitrogen and lithium necessarily?

A. Again it's hard to specify the exact atoms within the compounds because these do contain delocalized orbitals, and I'm only offering that the orbitals will interact. Specific atoms is hard to provide an opinion.

Q. And when you say the atoms, the atoms can be the ligand and the organic compound; correct?

A. When I say atoms, I mean any of the atoms in either of the compounds. But I'm not comfortable being specific about the exact nature of the interaction in, between those two compounds.

EX2042, 93:2-6, 94:10-12, 211:22-212:14.

In the context of the '223 patent, "coordinate" refers to coordination of the organic compound to the metal center, and not any non-specific interactions between

any two atoms of two compounds. *E.g.*, EX1001, 2:6-10 (referencing “metal-ligand—charge transfer complex), 2:17-18 (“the organic compound coordinates to the metal atom”); 2:45-47 (“each of the two central atoms has a coordination site”). Thus, while Pictiva disagrees that “coordinates” requires a dative bond—an undisclosed position that Samsung takes in the district court—the term does require bonding between the metal center and the organic compound (be it dative bonds, pi-bonding, sigma-bonding or some other bonding). Because Dr. Rand does not assert that BPhen forms any bond with lithium, Petitioner has not made the requisite showing.

Additionally, Ma’s theory regarding improved conductivity does not suggest coordination. Rather, its improved conductivity is due to “short hopping length for electron transport,” (Ma, 813), a phenomenon that could have resulted from denser packing in a BPhen:Liq film than a pure BPhen film due, for example, to intercalation of Liq or dissociated cations. EX2041, ¶¶182-183. But the shorter molecular distances does not imply a bonding interaction with or coordination to the Li central atom by BPhen. *Id.*

The Petition also does not explain why coordination, if any, is “due to joint vaporization,” which Petitioner-RPI argues in the district court requires the coordination be “directly” attributable to joint vaporization. EX2041, ¶185. That coordination may occur “after” joint vaporization does not mean joint vaporization

is the cause; for example, if the BPhen:Liq layer underwent reorganization in the air and/or in response to electromechanical stress during testing, that would be after, but not due to, joint vaporization. *Id.*

In summary, Petitioner has failed to show that BPhen would coordinate to the lithium ion under Ma's processing conditions.

D. Petitioner Has Not Presented Any Competent Evidence That Ma Discloses Claims 8 or 12

For claim 8, Petitioner again presents no evidence that Ma or the prior art disclose this limitation expressly or implicitly. Pet. 65-66. Instead, it first points to Pictiva's infringement contention, which as explained above, is based on heteroaromatics of a very different structure and property.

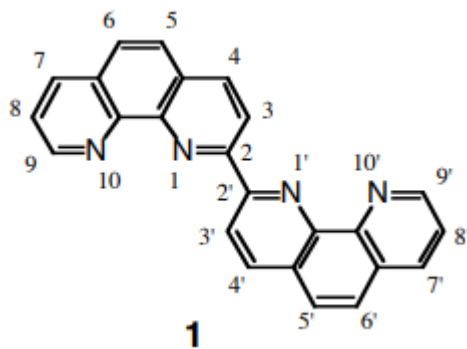
Petitioner then points to the '223 patent's teaching that BPhen "*can* ... form chain-like structures when coordinate to certain metal complexes." Pet. 66. But those disclosures "do[] not say ... that BPhen would form a chain-like structure with every metal complex, including with the lithium center under Ma's reaction conditions." EX2041, ¶173. As explained above, Dr. Rand does not determine that there is any interaction between BPhen and the lithium central atom and therefore there is no showing that BPhen coordinates to Liq, let alone that it forms chain-like and network-like structures with Liq.

Furthermore, the '223 patent teaches that "[t]he presence of more than one

central atom improves the possibility that several organic compounds will coordinate simultaneously to the metal complex.” EX1001, 2:42-44; *see also* EX1001, 2:49-58 (“[m]etal complexes having two central atoms are particularly well suited for the formation of chains”). In contrast, Petitioner does not assert that Liq has more than one central atom. Pet. 65-66

Moreover, when BPhen coordinates to a metal center, it would “coordinate[] in a bidentate fashion to a single metal center given the rigid ring structure.” EX2041, ¶173; *id.*, ¶¶175 (Dr. Schanze not aware of any complexes where BPhen bridged two metal centers), 121-130.

For instance, in a 2005 paper, researchers examined the coordination chemistry of a bis-phenanthroline compound 1 (biphen), among others, with copper(I). BiPhen is a compound where two phenanthroline rings are connected via a C-C single bond (ring with atoms 1-10 is connected to ring with atoms 1'-10' via C-C bond at C2 and C2'):



EX2028 _Heterocycles_2005, abstract, 552; EX2041, ¶122.

The crystallography of the isolated products reveals a structure in which the two nitrogen atoms (*e.g.*, N10, N1) of the same phenanthroline ring coordinate to the same copper center, and the two phenanthroline rings (*i.e.*, rings with atoms 1-10 and rings with atoms 1'-10') in the same molecule coordinate to different single-nuclear copper centers. EX2041, ¶¶ 91; EX2028, 556 (N1 and N2 of the red ligand coordinate to Cu1, and N1' and N2' of the red ligand coordinate to Cu1'). There is also no apparent Cu- π -system interactions in the system. EX2041, ¶¶ 122-123.

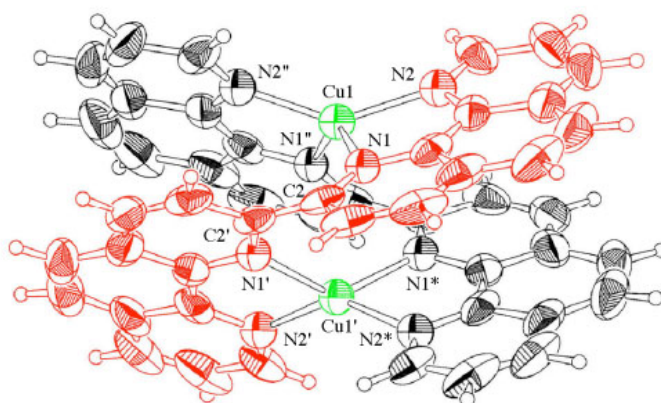


Figure 4. ORTEP drawing of [Cu₂L₂](PF₆)₂. Counter anions are omitted for clarity. Four phen units are all related to symmetric operations.

This supports Pictiva's infringement contentions and the '223 patent's teaching that two heteroaromatic rings linked by C-C bonds can facilitate coordination to different metal centers. EX2041, ¶127. But this does not support Petitioner's theory that the two nitrogen atoms on the same phenanthroline ring (*e.g.*, N1 and N10 or N1' and N10' in the above) would bridge two different metal centers, including to two different Liq molecules. *Id.*

Other studies are consistent, indicating that the two nitrogen atoms in the same phenanthroline ring, if coordinating, would coordinate to the same metal center. *See* EX2029 (<https://pubs.acs.org/doi/10.1021/ja0742030>), abstract (each phenanthroline ring coordinates to the same Mn(II) metal center); EX2030, Fig. 1 (each phenanthroline ring coordinates to the same Fe(II) metal center); EX2031, Fig. 1 (each phenanthroline ring coordinates to a Ni(II) or Fe(II) center); EX2032, Fig. 1 (each phenanthroline ring coordinates to a Ru(II) center); EX2041, ¶¶128-129.

Simply put, Petitioner has not advanced any competent evidence that claim 8 is disclosed or suggested by Ma. Its reliance on Pictiva's infringement contentions that are directed to different systems is completely misplaced as the accused products do not involve BPhen. *See* §§II.B, II.D.

Petitioner references its analysis for claim 8 for claim 12. Pet. 71-72. Hence, for the same reason that claim 8 is not obvious, claim 12 is also not obvious.

E. Petitioner Has Not Presented Any Competent Evidence That Ma Discloses Claim 11

For claim 11, Petitioner again relies on Pictiva's infringement and the inventors' insight to argue that the limitation is met. For the same as reason as stated for claim 2, those arguments are misplaced and Petitioner has not presented any competent evidence that BPhen coordinates to Liq under Ma's process conditions. Pet. 69-70.

Petitioner then argues for modifying deposition parameters to achieve coordination of BPhen and Liq in gas phase. Pet. 70. Petitioner argues that “a deposited layer of coordinated BPhen and Liq will contain a more uniform distribution of BPhen and Liq, than if the BPhen and Liq are individually deposited” *Id.* And a POSA allegedly would be motivated to obtain a deposited layer with more uniform distribution of BPhen and Liq because “[a] POSA would have understood that a more uniform layer of coordinated BPhen and Liq would allow for the more efficient transfer of electrons through that layer.” *Id.* That is the same argument Petitioner advanced for the BPhen:W₂(hpp)₄ combination. *Compare* Pet. 44. But as in Ground 1, the expert provides no underlying facts or reasoning; and the insight came from the inventors. *See* EX1001, 1:60-2:16. That hindsight does not support a *prima facie* case of obviousness.

Moreover, to the extent coordination of BPhen to Liq is possible and coordination increases the uniformity of the film and hence performance, that benefit is equally achievable if the coordination occurs when BPhen and Liq reacts on the deposition surface. *See* EX1001, 11:20-24 (“the joint vaporization of the metal complex with the organic compound in the gas phase or on the deposited surface results in interactions, so that the compounds coordinate to each other”); EX2041, ¶187. Since the deposited films are built molecular layer by molecular layer, the coordination (if any) would not just occur at the top surface as Petitioner seems to

assume (*contra* Pet. 70), but would occur as each molecular layer is deposited,¹² therefore forming a uniform film. EX2041, ¶187; *see also* Ma, 811 (organic layers were deposited at about 0.5 angstroms/s to build up the 50 nm thick Liq:BPhen layer). Petitioner therefore has not shown a reason to force BPhen to Liq to coordinate in the gas phase as proposed.

Second, Petitioner has not presented any competent evidence that a POSITA would have known the conditions under which a substantial amount of BPhen would react with Liq in order to produce a more uniform distribution of BPhen and Liq. Pet. 70. The OVPD method was performed with Alq₃, rather than a mixture of a metal complex like Liq and an organic complex, BPhen. EX1008, Experiment; EX2041, ¶189. Petitioner has also not presented any evidence that OVPD could lead to a uniform film of Liq and BPhen or even that the condition would be conducive to forming coordination in the gas phase. For instance, there is no analysis whatsoever on how the increased collision with inert molecules would affect film quality. EX2041, ¶190. Hence, Petitioner has not shown a reasonable expectation of success of coordinate of BPhen to Liq using OVPD. EX2041, ¶191.

¹² As a molecular layer is put down, that layer becomes the new “deposition surface.”

F. Petitioner Has Not Presented Any Competent Evidence That Ma Discloses Claim 13

Petitioner argues that because Ma teaches an optimum ratio of Liq to BPhen, it teaches that the electron conductivity is controlled by the ratio between the metal complex and the organic compound during vaporization. Pet. 73. Petitioner then argues that because the '223 patent teaches that electron conductivity can be affected by cross-linking, claim 13 is obvious. Pet. 73-74. That theory fails because it is again based on the inventor's insight. Nothing in the record suggests that at the time of the invention, a POSITA would have recognized the relationship between cross-linking density and electron conductivity: after all, Petitioner has to rely on the inventor's insight for that correlation. Pet. 73-74.

Consequently, because there is no evidence that a POSITA would know the relationship between cross-linking density and electron conductivity, they would not have designed a process that involves controlling the degree of cross-linking of the electron conducting layer. *Leo Pharm. Prods., Ltd. v. Rea*, 726 F.3d 1346, 1353 (Fed. Cir. 2013) (“[A]n invention can often be the recognition of a problem itself.”).

IV. Conclusion

The challenged claims are not unpatentable.

Dated: May 5, 2025

Respectfully submitted,

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I hereby certify, pursuant to 37 C.F.R. section 42.24, that the foregoing Patent Owner Response contains 13,953 words, excluding the words in the table of contents, table of authorities, exhibit list, this certificate of word count, signature block and certificate of service. The word count is based on the word count of the Microsoft Word program used to prepare the Patent Owner Response.

/Hong Zhong/
H. Annita Zhong

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I hereby certify, pursuant to 37 C.F.R. section 42.6, that on May 5, 2025, a complete copy of the foregoing document **PATENT OWNER'S RESPONSE AND EXHIBITS 2024-2025, 2041-2054 and 2100-2104** were served by electronic mail, as agreed to by the parties, upon the following:

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