

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZHUHAI COSMX BATTERY CO., LTD.,
Petitioner,

v.

NINGE AMPEREX TECHNOLOGY LIMITED,
Patent Owner.

IPR2025-00431
Patent 11,799,131 B2

Before DONNA M. PRAISS, JOHN G. NEW, and
DEBRA L. DENNETT, *Administrative Patent Judges*.

PRAISS, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

Zhuhai CosMX Battery Co., Ltd. (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1–7, 12, and 14–17 (the “challenged claims”) of U.S. Patent No. 11,799,131 B2 (Ex. 1001, “the ’131 patent”). Ningde Amperex Technology Limited (“Patent Owner”) filed a Preliminary Response. Paper 11 (“Prelim. Resp.”). Patent Owner requested discretionary denial of the Petition (Paper 10), which Petitioner opposed (Paper 13). The Director denied Patent Owner’s request for discretionary denial of the Petition, and referred the Petition to the Board (Paper 14).

We have authority to determine whether to institute an *inter partes* review under 35 U.S.C. § 314 (2018); 37 C.F.R. § 42.4(a). The standard for instituting an *inter partes* review is set forth in 35 U.S.C. § 314(a), which provides that an *inter partes* review may not be instituted “unless the Director determines . . . there is a reasonable likelihood that the petitioner would prevail with respect to at least [one] of the claims challenged in the petition.”

For the reasons set forth below, upon considering the Petition and Preliminary Response, we determine that Petitioner has established a reasonable likelihood of prevailing with respect to at least one challenged claim. Accordingly, we grant the Petition and institute *inter partes* review.

This decision to institute trial is not a final decision as to patentability of claims for which *inter partes* review is instituted. Our final decision will be based on the full record developed during trial.

II. BACKGROUND

A. Real Parties-in-Interest

Petitioner identifies Zhuhai CosMX Battery Co., Ltd. as the real party-in-interest. Pet. 79. Patent Owner identifies Ningde Amperex Technology Ltd. as the real party-in-interest. Paper 3, 1.

B. Related Proceedings

The parties identify *Ningde Amperex Technology Limited v. Zhuhai CosMX Battery Co.*, No. 2:24-cv-00728 (E.D. Tex.) (“the parallel litigation”) as involving the ’131 patent. Pet. 79; Paper 3, 1. Patent Owner states that the parallel litigation involves additional patents that are the subject of additional petitions by the same Petitioner for *inter partes* review of patents at issue, including U.S. Patent No. 11,769,910, which is related to the ’131 patent. Paper 3, 1. The identified proceedings are listed below:

Proceeding No.	U.S. Patent No.
IPR2025-00385	10,964,927 B2
IPR2025-00389	11,923,498 B2
IPR2025-00405	11,769,910 B2
IPR2025-00432	11,575,148 B2

Patent Owner also identifies a Petition for Correction of Inventorship Under 37 CFR § 1.324 pending in U.S. Application No. 17/885,920 (which corresponds to the ’131 patent) which was filed on Aug. 11, 2022. Paper 3, 2.

C. Technology Overview

The technology of the ’131 patent broadly relates to lithium-ion batteries (an electrochemical device containing an electrolyte). Ex. 1001, 1:18–20. A typical lithium-ion battery has a positive electrode (cathode), a negative electrode (anode), a separator, and an electrolyte. Ex. 1003 ¶ 28.

The cathode typically comprises a current collector and a layered active material that in the discharged state contains lithium, while the anode typically comprises a current collector with a layered active material capable of receiving lithium ions. *Id.* The separator prevents physical contact between the cathode and anode, which would cause a short circuit. The electrolyte serves as the medium through which lithium ions travel between the cathode and the anode, and comprises lithium salt, solvent, and optional additives. *Id.*

Lithium ions shuttle back and forth between the anode (negative) and cathode (positive) electrodes during cycling. Ex. 2015 ¶ 41. During the first few cycles of the lithium-ion battery, the electrolyte undergoes reduction at the anode, and oxidation at the cathode, forming a passive protective layer on the anode and cathode called the solid electrolyte interphase (SEI), comprising a mixture of inorganic and organic compounds and especially electrolyte decomposition or other reaction products. *Id.*

The SEI layer inhibits further electrolyte decomposition from side reactions during later cycles. Ex. 1003 ¶ 32. It is electronically insulating but conductive to lithium ions, allowing lithium ions to pass through it but not electrons. *Id.* Higher energy density lithium-ion batteries increase stress on the SEI layer. *Id.* ¶ 33.

In contrast with primary batteries like alkaline batteries, which cannot be recharged because they irreversibly consume chemical energy in the cathode, lithium-ion and other secondary (rechargeable) batteries can be cycled many times. Ex. 1003 ¶ 31. The discharge reaction in lithium-ion batteries can be reversed by forcing a lithium ion to return to the anode,

thereby returning the battery to its original, charged composition and structure for additional cycles. *Id.*

D. The '131 patent

The '131 patent, titled “Electrolyte and Electrochemical Device,” issued Oct. 24, 2023, from U.S. Application 17/885,920, filed Aug. 11, 2022. Ex. 1001, codes (45), (21), (22). The '131 patent is a continuation of U.S. Application No. 17/064,782, filed on Oct. 7, 2020, now U.S. Patent No. 11,522,222, which is a continuation of U.S. Application No. 16/211,853, filed on Dec. 6, 2018, now U.S. Patent No. 10,833,363. *Id.*, code (63). The '131 patent claims priority to China Application No. 201811108529, filed Sept. 21, 2018. *Id.*, code (30).

The '131 patent concerns electrolytes used in electrochemical devices with working voltages above 4.4V. Ex. 1001, 1:30–31. According to the '131 patent, “at high voltages, the oxidation activity of the positive electrode material increases, and the stability decreases, which makes the electrolyte decompose on the surface of the positive electrode easily or cause[s] deterioration of the battery material, resulting in a decrease in battery capacity.” *Id.* at 1:32–37. The '131 patent discloses an electrolyte for use in high voltage electrochemical devices comprising a mixture of a dinitrile compound, a trinitrile compound, and propyl propionate (“PP”), which forms a firm protective film that is not easily decomposed on the surface of the cathode at a high potential. *Id.* at 1:59–60; Ex. 1003 ¶ 34. The '131 patent discloses an electrochemical device comprising electrodes and an electrolyte where the electrode includes a current collector and a coating on the current collector that is a combination of a single-sided coating and a

double-sided coating, formed by applying a slurry on one or two surfaces of the current collector, respectively. Ex. 1001, 2:55–65.

The '131 patent discloses various weight percentages of dinitrile (X), trinitrile (Y), and PP (Z)—based on the total weight of the electrolyte—that purportedly form a durable SEI film. Ex. 1001, 6:1–32. The '131 patent provides four parameters ($X+Y$, X/Y , Z , and Y/Z) whose values are specified by ranges. *Id.* at 6:1–67. The '131 patent measures performance with three metrics: inhibiting rise in internal resistance, reducing expansion rate, and maintaining voltage capacity during high-temperature battery storage and cycling. *See* Ex. 1001, 23:32–24:47.

The '131 patent discloses an electrode compaction density for each of the single-sided current collector coating (D1) and the double-sided current collector coating (D2), wherein the ratio $D1/D2$ falls between or equals about 0.8 and about 1.2. Ex. 1001, 2:65–3:2, 21:10–20. According to the '131 patent, controlling the electrode compaction density of the single-sided and double-sided coating is important to obtain electrochemical devices with high capacity density, and excellent cycle and storage performances. *Id.* at 21:6–9. The '131 patent discloses that a lower compaction density makes the porosity higher, making some of the particles in an insulating state and unable to participate in charge and discharge, thereby resulting in a low specific discharge capacity, affecting performance of the electrochemical device. *Id.* at 20:65–21:2. Conversely, the '131 patent discloses a compaction which is too high may cause difficulty in infiltrability of the electrolyte and decrease in solution retention resulting in the cycle and rate performances which cannot be guaranteed. *Id.* at 20:2–5.

E. Illustrative Claim

Claim 1 illustrates the challenged claims in the '131 patent, and is reproduced below with Petitioner's annotations:¹

- [1.pre] An electrochemical device, comprising
- [1.1] an electrode; and
- [1.2] an electrolyte comprising a dinitrile compound, a trinitrile compound, and propyl propionate, wherein,
- [1.3] based on a total weight of the electrolyte, a weight percentage of the dinitrile compound is X, and a weight percentage of the trinitrile compound is Y; wherein, about $2 \text{ wt}\% \leq (X+Y) \leq \text{about } 8 \text{ wt}\%$, and about $0.1 \leq (X/Y) \leq \text{about } 6$; wherein
- [1.4] the electrode comprises a current collector, a single-sided coating and a double-sided coating;
- [1.5] a first part of the current collector is provided with the single-sided coating and a second part of the current collector is provided with the double-sided coating; and
- [1.6] an electrode compaction density of the electrode corresponding to the first part with the single-sided coating is D1, and, an electrode compaction density of the electrode corresponding to the second part with the double-sided coating is D2, wherein, about $0.8 \leq D1/D2 \leq \text{about } 1.2$;
- [1.7] wherein based on the total weight of the electrolyte, a weight percentage of the propyl propionate is Z; wherein, about $0.01 \leq (Y/Z) \leq \text{about } 0.3$;

¹ Our Decision refers to Petitioner's annotated claim format. Claim 14 is the other independent claim challenged by Petitioner and includes the same ranges expressed in [1.3], [1.6], [1.7] ([14.3], [14.6], and [14.7], respectively), and the same trinitrile group expressed in [1.8] ([14.8]). Claim 14 differs from claim 1 in that claim 14 requires "electrodes" plural, and specifically "a first electrode and a second electrode." Ex. 1001, 35:45, 35:54–55.

[1.8] wherein the trinitrile compound is one selected from the group consisting of 1,3,5-pentanetricarbonitrile; 1,2,3-propanetrinitrile; 1,3,6-hexanetricarbonitrile; 1,2,6-hexanetricarbonitrile; 1,2,3-tris(2-cyanoethoxy)propane; 1,2,4-tris(2-cyanoethoxy)butane; 1, 1, 1-tris (cyanoethoxymethylene)ethane; 1, 1, 1-tris (cyanoethoxymethylene)propane; 3-methyl-1,3,5-tris (cyanoethoxy)pentane; 1,2, 7-tris(cyanoethoxy) heptane; 1,2,6-tris(cyanoethoxy)hexane; 1,2,5-tris (cyanoethoxy)pentane; and any combination thereof.

Ex. 1001, 33:18–53.

F. Asserted Grounds

Petitioner contends that the challenged claims are unpatentable under 35 U.S.C. § 103 based on the grounds presented below.²

Ground	Claims	References
1	1, 2, 4–7, 12, 14, 15, 17	Zeng, ³ Sunose ⁴
2	1, 2, 4–7, 12, 14, 15, 17	Zeng, Sunose, Matsuoka ⁵
3	1, 2, 4–7, 12, 14, 15, 17	Zeng, Sunose, Kim ⁶
4	1, 2, 4–7, 12, 14, 15, 17	Zeng, Sunose, Matsuoka, Kim
5	3, 16	Zeng, Sunose, Su ⁷
6	3, 16	Zeng, Sunose, Matsuoka, Su
7	3, 16	Zeng, Sunose, Su, Kim
8	3, 16	Zeng, Matsuoka, Sunose, Su, Kim

² We separately number each of Petitioner’s grounds and alternative grounds rather than group them with Petitioner’s alpha numeric designations for the base reference combinations and additional references. Pet. 18.

³ CN 106099187 A, published Nov. 9, 2016 (Ex. 1006, “Zeng”).

⁴ JP 2009-252349 A, published Oct. 29, 2009 (Ex. 1010, “Sunose”).

⁵ US 2013/0224535 A1, published Aug. 29, 2013 (Ex. 1007, “Matsuoka”).

⁶ US 2017/0288268 A1, published Oct. 5, 2017 (Ex. 1008, “Kim”).

⁷ CN 108023117 A, published May 11, 2018 (Ex. 1012, “Su”).

Ground	Claims	References
9	1, 2, 4–7, 12, 14, 15, 17	Zhou, ⁸ Sunose
10	1, 2, 4–7, 12, 14, 15, 17	Zhou, Sunose, Kim
11	3, 16	Zhou, Sunose, Su
12	3, 16	Zhou, Sunose, Su, Kim

Petitioner also relies on the Declaration of Brett Lucht, Ph.D. *See* Ex. 1003. Patent Owner relies on the Declaration of Dean R. Wheeler, Ph.D. *See* Ex. 2015.

III.ANALYSIS

A. Principles of Law

In an *inter partes* review, “the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (2012) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). This burden of persuasion never shifts to the patent owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

Obviousness is a question of law based on underlying determinations of fact. *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966); *Richardson-Vicks, Inc. v. Upjohn Co.*, 122 F.3d 1476, 1479 (Fed. Cir. 1997). A claim is unpatentable as obvious, under 35 U.S.C. § 103, if the differences between the claimed invention and the prior art are such that the claimed

⁸ CN 105552439 A, published May 4, 2016 (Ex. 1014, “Zhou”).

invention, as a whole, would have been obvious to a person having ordinary skill in the art, before the effective filing date of the claimed invention. *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) objective evidence of nonobviousness. *Graham*, 383 U.S. at 17–18. Consideration of the *Graham* factors “helps inform the ultimate obviousness determination.” *Apple Inc. v. Samsung Elecs. Co.*, 839 F.3d 1034, 1048 (Fed. Cir. 2016) (en banc), *cert. denied*, 138 S. Ct. 420 (2017). “Obviousness does not require absolute predictability of success[;] . . . all that is required is a reasonable expectation of success.” *In re O’Farrell*, 853 F.2d 894, 903–04 (Fed. Cir. 1988) (citations omitted). But, a petitioner cannot satisfy its burden of proving obviousness by employing “mere conclusory statements.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

We analyze the challenges presented in the Petition in accordance with the above-stated principles.

B. Level of Ordinary Skill in the Art

We review the grounds of unpatentability in view of the understanding of a person of ordinary skill in the art before the effective filing date of the claimed invention. *Graham*, 383 U.S. at 17.

Petitioner contends that, as of the effective filing date,

A person of ordinary skill in the art (“POSITA”) of the ’131 patent . . . would have an advanced degree in chemistry, chemical engineering, materials science, or a related field, and two or more years of experience related to the design, research,

evaluation, preparation, and/or manufacture of electrochemical energy storage devices.

Pet. 16 (citing Ex. 1001, 1:18-20 (“the technical field of energy storage technologies, in particular to an electrolyte and an electrochemical device containing the electrolyte”)). Petitioner states that “[t]his level of skill is approximate, and more experience could compensate for less formal education, and vice versa.” *Id.* Patent Owner “adopts the definition proposed by Petitioner” for purposes of the Preliminary Response. Prelim. Resp. 6.

In light of the record before us, and for purposes of this Decision, we adopt Petitioner’s proposal regarding the level of ordinary skill in the art. Based on our review of the ’131 patent and the prior art of record, we determine that the definition offered by Petitioner comports with the qualifications a person would have needed to understand the ’131 patent and the prior art. We will make any final determination pertaining to the level of ordinary skill in the art, however, on the full trial record.

C. Claim Construction

In interpreting the claims of the ’131 patent, we “us[e] the same claim construction standard that would be used to construe the claim[s] in a civil action under 35 U.S.C. [§] 282(b).” *See* 37 C.F.R. § 42.100(b) (2024). The claim construction standard includes construing claims in accordance with the ordinary and customary meaning of such claims as would have been understood by one of ordinary skill in the art in light of the written description and the prosecution history pertaining to the patent. *See id.*; *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–14 (Fed. Cir. 2005) (en banc).

Petitioner submits that “[n]o claim terms require express construction for purposes of granting this Petition.” Pet. 17. Petitioner states that,

consistent with Patent Owner’s position in the related litigation, an electrode having a current collector with both single- and double-sided coating portions satisfies the limitations of both claim 1 and claim 14, which recites “a first electrode and a second electrode . . . the first electrode comprises . . . a single-sided coating; the second electrode comprises . . . a double-sided coating.” *Id.* (citing Ex. 1027, 12–14); Ex. 1001, 35:54–36:4. Patent Owner contends no construction of any specific claim term or phrase is necessary. Prelim. Resp. 7.

As neither party proposes an express construction for our consideration and because we determine that claim construction is not necessary to decide whether to institute, we do not expressly construe any claim terms. *See Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (holding that “only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy”); *see also Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs.* in the context of an *inter partes* review).

Our determination that claim construction is not necessary is preliminary and we invite the parties to further brief claim construction issues—including alleged inconsistent positions—during trial, if desired. We will base any final claim constructions on the full trial record.

D. Overview of the Asserted Art

1. Zeng (Ex. 1006)

Zeng is titled “Wide-temperature-range homogeneous non-aqueous electrolyte solution.” Ex. 1006, code (54). Zeng discloses an electrolyte solution containing a non-aqueous organic solvent, electrolyte lithium salt,

and an additive combination. Ex. 1006 ¶ 11. The additive combination comprises fluoroethylene carbonate (FEC), adiponitrile (ADN), and at least one other compound that is a dinitrile or a trinitrile. *Id.* ¶¶ 17–19, 24. Zeng discloses preferred mass percentages for EC, FEC, ADN, and the dinitrile or trinitrile compound. *Id.* ¶¶ 20–23. Zeng discloses “[e]xcellent high-voltage cycling performance of the battery is ensured by means of the good film-formation performance of” FEC “on the basis of which a nitrile compound is added to stabilize the structure of the positive electrode material.” *Id.* ¶ 34. Zeng states “[t]he described optimized solution of an electrolyte solution ensures good high-voltage performance of a lithium-ion battery.” *Id.*

Zeng’s two embodiments, Embodiments 4 and 6, include the trinitrile 1,3,6-hexanetricarbonitrile (HTCN, “T4”). *Id.* ¶¶ 44–49. Zeng’s process for preparing the electrolyte solution for Embodiment 1 applies to the all of the embodiments, other than the added content in Table 1, and includes the steps:

in a glove box filled with argon gas, ethylene carbonate, propylene carbonate, diethyl carbonate, fluorobenzene, ethyl propionate, and propyl propionate are mixed at a mass ratio of EC:PC:DEC:FB:EP:PP = 25:10:30:5:10:20; then, lithium hexafluorophosphate of a concentration of 1.0 mol/L is slowly added to the mixed solution, finally, the following are added on the basis of the total weight of the electrolyte solution: 4wt% of fluoroethylene carbonate (FEC), 2wt% of adiponitrile (ADN), 1wt% of succinonitrile (SN), 0.5wt% of 1,2-bis(2-cyanoethoxy)ethane (DENE), 0.2wt% of vinylene carbonate (VC), and 4.0wt% of 1,3-propane sultone; after stirring well, the lithium-ion battery electrolyte solution . . . is obtained.

Id. ¶¶ 37, 44.

2. *Sunose (Ex. 1010)*

Sunose is titled “Electrode Plate for Non-aqueous Electrolyte Secondary Battery and Method for Manufacturing Such.” Ex. 1010, code (54). Sunose discloses single- and double-side-coated cathodes having compaction density ratios which exhibit good adhesion and reduced electrode breakage during rolling/compaction. Ex. 1010 ¶ 44. Sunose describes maximizing the electrode area with a spiral structure that winds a positive electrode plate and a negative electrode plate with a separator interposed therebetween to improve battery performance. *Id.* ¶¶ 4, 5. Sunose discloses that a single-sided active material layer portion has a thinner electrode plate compared to a two-sided active material portion because it is formed only on a single side of the current collector, thus the pressure applied to the single-sided active material layer portion is smaller than the pressure applied to the two-sided active material layer portion. *Id.* ¶¶ 7, 8.

Sunose discloses that if a density for a single-sided active material layer portion is set to prevent the single-sided active material layer from detaching, excessive pressure will be applied to the two-sided active material layer portion, and consequently, excessive load will be applied to the current collector. *Id.* ¶ 10. Sunose discloses that it is preferable for the ratio of the density of active material to be $0.7 < N/M < 1.0$, where the packing density of the single-sided active material portion is M and the packing density of the two-sided active material layer portion is N, because when the ratio is 0.7 or less, the thickness of the of the single-sided active material layer portion becomes larger than the thickness of the two-sided active material portion, resulting in increased pressure on the single-sided active material portion

during rolling, which causes the single-sided active material layer portion to break. *Id.* ¶¶ 10, 12, 14.

3. *Su (Ex. 1012)*

Su is titled “High-energy-density Lithium-ion Battery and Preparation Method Thereof.” Ex. 1012, code (54). Su provides a high-energy-density lithium-ion battery, wherein a negative electrode plate on the outermost layer of a cell of the lithium-ion battery is a negative electrode plate provided with a negative electrode slurry on a single side, with the side without slurry facing outwards. *Id.* ¶ 8.

Su discloses applying a negative electrode slurry on both sides of a negative electrode current collector and drying and compacting to form a double-sided negative electrode plate. Ex. 1012 ¶ 10. Su also discloses applying a negative electrode slurry on one side of a negative electrode current collector and drying and compacting to form a single-sided negative electrode plate. *Id.* ¶ 11. Su discloses cutting a double-sided positive electrode plate, a double-sided negative electrode plate, and a single-sided negative electrode plate into required sizes and assembling them into a cell, wherein the single-sided electrode plate is on the outermost layer with the side without slurry facing outwards. *Id.* ¶ 56. Su discloses examples in which the single-sided and double-sided negative electrode plate both have a compaction density of either 1.8 g/cm³ or 1.5 g/cm³. *Id.* ¶¶ 59–63.

4. *Matsuoka (Ex. 1007)*

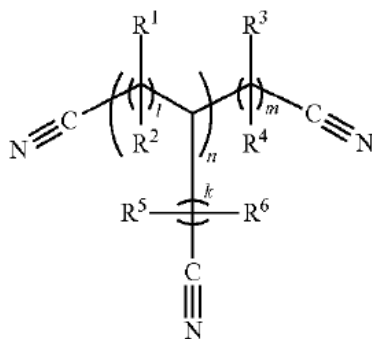
Matsuoka is titled “Non-aqueous Electrolyte Solution and Non-aqueous Secondary Battery.” Ex. 1007, code (54). Matsuoka describes a non-aqueous electrolyte solution that includes the nitrile additive acetonitrile

and a lithium salt, as well as a non-nitrile additive to improve the durability of the SEI layer formed on the electrode surface. *Id.* ¶¶ 56–57, Abstr.

Matsuoka explains that compounds having LUMO (Lowest Unoccupied Molecular Orbital) and HOMO (Highest Occupied Molecular Orbital) energy levels falling in preferred ranges make suitable non-nitrile additives. *Id.* ¶¶ 15, 36, 39. An ideal LUMO level improves reducibility of the non-nitrile additive, helping form the SEI film on the negative electrode while “provid[ing] good effects on . . . a positive electrode and a separator” and suppressing “an increase in internal resistance caused by repeating charge-discharge cycles[.]” *Id.* ¶ 36. An ideal HOMO level distributes the protective effects of the SEI layer to at least the positive electrode. *Id.* ¶ 39.

5. *Kim (Ex. 1008)*

Kim is titled “Electrolyte for Rechargeable Lithium Battery and Rechargeable Lithium Battery Including the Same.” Ex. 1008, code (54). Kim discloses an electrolyte for a rechargeable lithium battery includes an organic solvent including C₃ to C₅ alkyl propionate, a lithium salt, and a compound represented by Chemical Formula 1:



wherein, in Chemical Formula 1, k, l, and m are independently integers of 0 to 20, k, l, and m being selected so that Chemical Formula 1

has an asymmetric structure, n is an integer of 1 to 7, and R^1 , R^2 , R^3 , R^4 , R^5 , and R^6 are independently hydrogen, an alkyl group, an alkoxy group, or a fluoroalkyl group. *Id.*, Abst. Formula 1 includes three or more nitrile (CN) groups and may be asymmetric. *Id.* ¶ 55. The C_3 to C_5 alkyl propionate may include propyl propionate, and may be included in an amount of about 10 volume % to about 80 volume % based on the total amount of the organic solvent. *Id.* ¶¶ 13–14. The lithium salt may include $LiPF_6$, which may be in a concentration of about 0.1 M to about 2.0 M. *Id.* ¶¶ 22–23.

6. *Zhou (Ex. 1014)*

Zhou is titled “Fast charging lithium-ion battery electrolyte.” *Ex. 1014*, code (54). According to *Zhou*, during the fast charging process, lithium-ions quickly escape from the positive electrode into the electrolyte, then pass through the diaphragm and enter the negative electrode for lithium insertion. *Id.* ¶ 3. The rapid migration of a large number of lithium-ions requires the electrolyte to have higher kinetic properties and smaller mass transfer resistance during the mass transfer process, thus the electrolyte needs better wettability, lower viscosity, and lower lithium-ion transmission resistance. *Id.*

Low-boiling-point organic solvents commonly used in the prior art had lower viscosity and could provide a more suitable channel for lithium-ion transmission, but caused challenges with the high temperature performance of the battery. *Ex. 1014* ¶ 4. Poor compatibility of carboxylic acid ester organic solvents with the negative electrode graphite of the battery caused the battery cycle performance to deteriorate. *Id.*

Zhou seeks to address these deficiencies in providing a fast charging lithium-ion battery electrolyte composed of a solvent that preferably

accounts for 70%–88% of the total mass of the lithium-ion battery electrolyte, a lithium salt (preferably accounting for 8%–20% of the total mass of the lithium-ion battery electrolyte), and an additive, wherein the non-aqueous organic solvent includes a mixture of two or more of a low-boiling-point linear carbonate (preferably dimethyl carbonate or ethyl methylcarbonate) and a linear carboxylic acid ester, fluorobenzene and hydrofluoroether. Ex. 1014 ¶¶ 8–11, 18. The additive preferably accounts for 0.1% to 20% of the total mass of the lithium-ion battery electrolyte, includes a first additive for negative electrode film formation, a second additive for improving battery cycle performance, and a third additive (preferably a nitrile compound which may be HTC_N, and accounts for 0.5–5% of the total mass of the lithium-ion battery electrolyte) for improving battery high temperature performance. *Id.* ¶¶ 13–17.

E. Unpatentability Grounds

1. Obviousness over Zeng and Sunose

Petitioner asserts that claims 1, 2, 4–7, 12, 14, 15, and 17 are obvious over Zeng and Sunose under 35 U.S.C. § 103, citing the Declaration of Dr. Lucht for support. Pet. 20–44 (citing Ex. 1003). We have reviewed Petitioner’s arguments and evidence and have found them to be sufficient to meet the threshold of 314(a). Below, we address independent claims 1 and 14 and address the dependent claims collectively.

a) Claim 1

Claim 1 recites as a component in an electrochemical device “an electrolyte comprising a dinitrile compound, a trinitrile compound, and propyl propionate; wherein, based on a total weight of the electrolyte, a weight percentage of the dinitrile compound is X, and a weight percentage

of the trinitrile compound is Y; wherein, about $2 \text{ wt}\% \leq (X+Y) \leq \text{about } 8 \text{ wt}\%$, and about $0.1 \leq (X/Y) \leq \text{about } 6$.” Ex. 1001, 33:19–27.

Petitioner argues that Zeng’s electrolytes in Embodiments 4 and 6 contain a dinitrile compound (adiponitrile or ADN and 1,2-bis(2-cyanoethoxy)ethane or DENE), a trinitrile compound (1,3,6-hexanetricarbonitrile or HTCEN), and propyl propionate (PP). Pet. 29 (citing Ex. 1006 ¶¶ 37, 44–49; Ex. 1003 ¶¶ 104–105), 20–26 (citing Ex. 1006 ¶¶ 11–18, 24, 37, 44–49; Ex. 1003 ¶¶ 64–65, 76–92). Petitioner argues that the dinitrile content in each of the two embodiments is 2.5 wt% and the trinitrile content in each of the two embodiments is 1 wt%, which adds up to 3.5 wt% for the X+Y value and 2.5 for the X/Y ratio recited in the claim. *Id.* at 29–30 (citing 1003 ¶¶ 106–107).

According to Petitioner, these values for X and Y are computed based on Zeng’s Embodiments 4 and 6 each containing as solvent components “ethylene carbonate, propylene carbonate, diethyl carbonate, fluorobenzene, ethyl propionate, and [PP] . . . mixed at a *mass* ratio of EC:PC:DEC:FB:EP:PP = 25:10:30:5:10:20.” *Id.* at 21 (citing Ex. 1006 ¶¶ 37, 44). Petitioner argues that a POSITA would have understood Zeng’s disclosure “then, lithium hexafluorophosphate of a concentration of 1.0 mol/L is slowly added to the mixed solution” to mean “adding (solid) LiPF₆ to the specified EC:PC:DEC:FB:EP:PP solvent mixture to reach a concentration of 1.0 mol/L LiPF₆. Pet. 21 n.4 (citing Ex. 1003 ¶ 80). Petitioner acknowledges that LiPF₆ is commercially available premixed in different solvents to different concentrations. *Id.* Petitioner argues, however, that Zeng already discloses a solvent mixture for its electrolytes and, “[i]n such cases, it is standard practice to mix LiPF₆ in the specified solvent

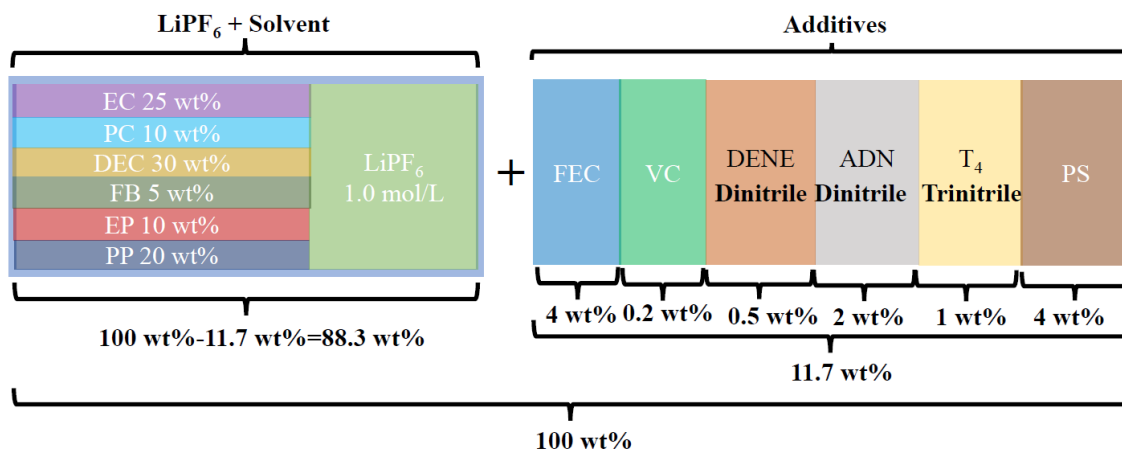
mixture to a target concentration (usually around 1 mol/L)—not add LiPF₆, premixed in a second solvent mixture, to that solvent mixture. *Id.* (citing Ex. 1003 ¶ 80, Ex. 1023 ¶¶ 237, 245, 255; Ex. 1024 ¶ 48; Ex. 1025 ¶ 90).

According to Petitioner, “[b]eyond rendering the ultimate concentration of LiPF₆ and amounts of the solvent components uncertain, this would disrupt the carefully-crafted solvent and additive weight percentages central to Zeng’s invention.” *Id.*

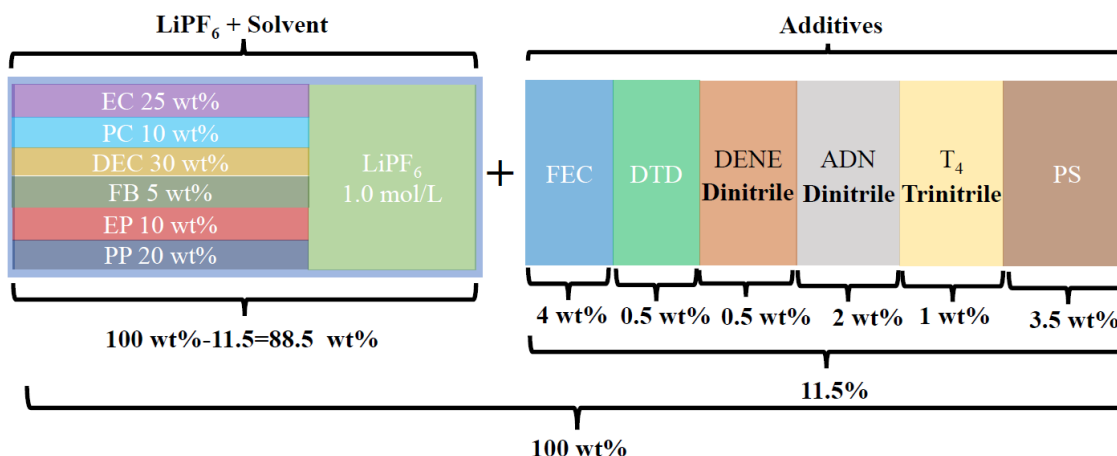
Petitioner contends that, to this base electrolyte, the following are added to Embodiments 4 and 6 on the basis of the total weight of the electrolyte solution: 4 wt% FEC, 2 wt% ADN, 0.5 wt% DENE, 0.2 wt% vinylene carbonate (VC), and 4.0 wt% of 1,3-propane sultone. *Id.* at 22 (citing Ex. 1006 ¶ 37). Embodiment 4 also contains 1% trinitrile 1,3,6-hexanetricarbonitrile (HTCN, T₄) as the Formula I nitrile and Embodiment 6 is identical to Embodiment 4 except that VC in Embodiment 4 is swapped for 0.5 wt% ethylene sulfate (DTD) in Embodiment 6, which also has slightly less PS at 3.5 wt%. *Id.* at 23 (citing Ex. 1006 ¶¶ 44–49, 46; Ex. 1003 ¶¶ 82–82).

Petitioner provides the following illustrations for the compositions of Zeng’s Embodiments 4 and 6:

Embodiment 4 of Zeng



Embodiment 6 of Zeng



Petitioner's illustration above lists each ingredient and its weight percentage separately for the solvent and additives in Zeng's Embodiments 4 and 6. Pet. 23–24 (citing Ex. 1003 ¶ 84). Petitioner calculates ADN and DENE (dinitriles) in Embodiments 4 and 6 as having a combined weight percentage (the claimed X) of 2 wt%+0.5 wt%=2.5 wt% in the total electrolyte. *Id.* at 24 (citing Ex. 1003 ¶ 85). Petitioner calculates HTCEN (a trinitrile) as having a weight percentage (the claimed Y) of 1 wt% in the total electrolyte. *Id.* (citing Ex. 1003 ¶ 86).

For PP (the claimed Z), Petitioner contends that Embodiments 4 and 6 had 20 wt% PP *before* adding LiPF₆ and the remaining additives to the

solvent mixture, and, if LiPF_6 had zero weight, PP would have theoretical upper limit weight percentages in the total electrolytes of Embodiments 4 and 6 as follows:

Embodiment 4: $88.3\% \times (20 / (25 + 10 + 30 + 5 + 10 + 20)) = 17.66 \text{ wt}\%$

Embodiment 6: $88.5\% \times (20 / (25 + 10 + 30 + 5 + 10 + 20)) = 17.70 \text{ wt}\%$

Id. at 24–25 (citing Ex. 1003 ¶ 87). Petitioner argues that, assuming LiPF_6 has a non-zero weight, and Zeng teaches it was mixed in the base solvent to a concentration of 1.0 mol/L before mixing the remaining additives, the weight percentages of Z (PP) in the total electrolyte solutions are $Z < 17.66 \text{ wt}\%$ in Embodiment 4 and $Z < 17.70 \text{ wt}\%$ in Embodiment 6. *Id.* at 26 (Ex. 1003 ¶ 93).

Petitioner contends that “[e]ach Zeng Embodiment is a self-contained, working example providing a complete list of compounds, amounts, and electrolyte preparation instructions.” Pet. 26. According to Petitioner, a POSITA would have been motivated to implement Zeng’s Embodiments 4 and 6 with a reasonable expectation of success because they significantly outperformed Comparative Examples on capacity retention after 500 cycles. *Id.* (citing Ex. 1006 ¶¶ 45–47). Embodiment 6 had the best capacity retention other than Embodiments 2 and 5. *Id.*

Petitioner also contends that it would have been obvious to try Zeng Embodiments 4 and 6. Pet. 26–27. Petitioner asserts that there was a market need for high-energy lithium-ion batteries driven by consumer demand that Zeng addressed with “a well-rounded ‘electrolyte solution that can remain homogeneous and stable over a wide temperature range . . . to ensure that a lithium-ion battery has good high-voltage cycle performance and can perform at high and low temperatures.’” *Id.* at 27 (quoting Ex. 1006 ¶ 8).

Petitioner argues that Zeng disclosed only a finite number of identified, predictable solutions—the nine Embodiments—and a POSITA would have a reasonable expectation of success in pursuing those options, given the Embodiments had better performance than the Comparative Examples. *Id.* at 27–28 (citing Ex. 1003 ¶¶ 98, 99).

Patent Owner contends Petitioner fails to show that a POSITA would have selected or implemented Zeng’s Embodiments 4 or 6 because various components and component amounts of the embodiments are ambiguous as a consequence of an unknown amount of lithium salt solution added to the solvent. Prelim. Resp. 7–8. Patent Owner argues that Zeng is silent as to any benefits that would distinguish Embodiments 4 and 6 over the remaining potential embodiments. *Id.* at 8. Patent Owner points out that Zeng Embodiments 2 and 5—containing no trinitrile compound—had better retention capacity than Embodiment 6 promoted by Petitioner. *Id.* (citing Ex. 1006 ¶¶ 45–46). Patent Owner also points out that Embodiments 1 and 8, with no trinitrile compound, had a better capacity retention rate than Embodiment 4 promoted by Petitioner. *Id.* at 8–9. According to Patent Owner, a POSITA would have interpreted Zeng’s data as teaching away from including trinitrile in an electrolyte solution due to a negative impact on the capacity retention rate. *Id.* at 9 (citing Ex. 1006 ¶¶ 39–42, 45–46).

According to Patent Owner, Petitioner also fails to show that Zeng’s Embodiments 4 and 6 would have been obvious to try. Prelim. Resp. 9. Patent Owner contends that a POSITA would have recognized a large number of potential solutions to the problem of the ’131 patent, each of which requires extensive tradeoffs and careful balance of competing effects in the electrolyte solution. *Id.* at 9–10 (citing Ex. 2015 ¶¶ 84–86). Patent

Owner argues that Petitioner fails to account for the thousands of embodiments which would fit within the ranges described in Zeng. *Id.* at 10. Patent Owner contends that Petitioner does not establish a reasonable expectation of success of implementing Embodiments 4 and 6 due to Zeng's teaching of a comparatively negative impact of the trinitrile compound on capacity retention rates, in addition to Zeng's ambiguous instructions. *Id.* (citing Ex. 2015 ¶¶ 76–81, 87–89).

We first address whether Zeng teaches adding LiPF_6 as a solid to achieve a 1.0 mol/L concentration in the electrolyte solution (Petitioner's argument), or the reference teaches adding a solution of LiPF_6 to achieve a concentration of 1.0 mol/L in the resulting electrolyte-solution-plus- LiPF_6 -solution (Patent Owner's argument).

Petitioner's expert, Dr. Lucht, testifies

[A] POSITA would understand [Zeng's disclosure of "then, lithium hexafluorophosphate of a concentration of 1.0 mol/L is slowly added to the mixed solution"] to mean adding solid LiPF_6 to the specified EC:PC:DEC:FB:EP:PP solvent mixture to reach a concentration of 1.0 mol/L. While LiPF_6 is commercially available premixed in different solvents to different concentrations, Zeng already discloses an EC:PC:DEC:FB:EP:PP solvent mixture for its electrolytes. In such cases, it is standard practice to mix LiPF_6 in the specified solvent mixture to a target concentration—usually around 1 mol/L—not add LiPF_6 , premixed in some second solvent mixture, to the first solvent mixture. . . . Aside from rendering the ultimate concentration of LiPF_6 uncertain, adding some premixed solution of LiPF_6 would disrupt the carefully-crafted solvent and additive weight percentages central to Zeng's invention.

Ex. 1003 ¶ 80, n.6.

In contrast, Patent Owner's expert, Dr. Wheeler, testifies that Dr. Lucht's testimony on the same language "relies on an unfounded and tenuous interpretation of the disclosure of Zeng that is diametrically opposed to the very wording and teaching of the document." Ex. 2015 ¶ 107. Dr. Wheeler emphasizes that Zeng reads "***then, lithium hexafluorophosphate of a concentration of 1.0 mol/L is slowly added to the mixed solution.***" *Id.* Dr. Wheeler testifies

It is immediately apparent from the text of Paragraph [0037] that the inventors of Zeng make a clear distinction as to how certain components are to be added to the electrolyte composition. For example, with respect to the additive components, Zeng explicitly states that their addition is "on the basis of the total weight of the electrolyte solution." Ex. 1006 ¶ [0037]. And with respect to lithium hexafluorophosphate (LiPF₆), Zeng explicitly states that its addition is *at a certain concentration*, such that the POSITA would understand that the lithium hexafluorophosphate salt of Zeng is necessarily added in the form of a solution. That is, the terms "of a concentration" and "mol/L", which are indisputably present in the Zeng specification, necessarily require the existence of a solution with respect to the lithium hexafluorophosphate salt—not a solid. Specifically, Zeng recites that LiPF₆ "***of a concentration of 1.0 mol/L*** is slowly added to the mixed solution." *Id.* (emphasis added).

Id. ¶ 108 (underlining added, italics and bolding in original).

At this stage in the proceeding, we do not find that the text in Zeng leads to the assertedly straightforward interpretation proffered by Patent Owner and Dr. Wheeler. To the extent Patent Owner raises a potential issue of fact, the issue is better addressed at trial.

Dr. Wheeler's conclusion requires a POSITA to interpret Zeng as failing to provide (1) any information as to an undisclosed solvent in which solid LiPF₆ is to be dissolved to a concentration of 1.0 M LiPF₆ before that

unspecified combination is added to the electrolyte solvent, or (2) any information as to how much of such LiPF_6 in solution with the undisclosed solvent is to added to what amount of the electrolyte solvent. For instance, a 1.0 M solution of LiPF_6 in an undisclosed solvent (“the LiPF_6 solution”) would require 1.0 moles of LiPF_6 in 1.0 liter of the undisclosed solvent. Adding 1.0 liter of the LiPF_6 solution (1.0 M LiPF_6 dissolved in the undisclosed solvent) to 1.0 liter of the electrolyte solvent would result in a composition vastly different from that created by adding 1.0 liter of 1.0 M LiPF_6 solution to 99.0 liters of electrolyte solvent. In the first case, the combination would have 1.0 mole LiPF_6 in 2.0 liters total of solute, resulting in an electrolyte solution with a LiPF_6 concentration of 0.5 mol/L. In the second case, the combination would have 1.0 mole LiPF_6 in 100.0 liters total of solute, resulting in an electrolyte solution with a LiPF_6 concentration of 0.01 mol/L. These results would be the same even if the solvent used for diluting the LiPF_6 solid was identical to the starting electrolyte solution.

Dr. Wheeler’s testimony that “the applicant and inventors of Zeng knew what language to use to indicate to a POSITA that lithium salt is added, in solid form, to a solvent mixture to obtain a target concentration of the salt in the solvent mixture, but chose not to” is unavailing because Exhibit 2022 does not support Dr. Wheeler’s interpretation of Zeng. *See* Ex. 2015 ¶ 112 (citing Ex. 2022 as evidence of the intentions of the same applicant (Dongguan City Kaixin Battery Materials Co., Ltd.) and two of the same inventors (YANG Yongjun and WAN Huaping) as in Zeng).

Exhibit 2022, a 2014 Chinese patent application is titled, “A Non-Aqueous Electrolyte, Its Preparation Method, and a High-Voltage Lithium-

Ion Battery.” Ex. 2022, codes (22), (71), (72), (54). Exhibit 2022 discloses as Embodiment 1:

A non-aqueous electrolyte for high-voltage lithium-ion batteries, primarily comprising organic solvents, conductive lithium salts, and additives, where the organic solvent is composed of cyclic carbonate solvents (ethylene carbonate EC), aromatic hydrocarbon solvents (fluorobenzene FB), and linear carbonate solvents (ethyl methyl carbonate EMC) in a ratio of EC:EMC:FB = 3:6:1. The conductive lithium salt LiPF_6 has a concentration of 1.0 mol/L in the organic solvent, and the commonly used additives include 1.0wt.% vinylene carbonate and 1.0wt.% propane sultone. The additive is dipyrindyl disulfide used at a concentration of 0.5wt.%.

Id. ¶ 30. The electrolyte solvent in the Embodiment comprises ethylene carbonate (EC), ethyl methyl carbonate (EMC), and fluorobenzene (FB). *Id.* ¶ 30. Other solvent components include propylene carbonate (PC) and fluoroethylene carbonate (FEC). *Id.* ¶ 14. Comparative Example 1 of Exhibit 2022 discloses

[T]he electrolyte for lithium-ion batteries mainly contains the following ingredients: organic solvents and aromatic hydrocarbon solvents (ethylene carbonate EC, ethyl methyl carbonate EMC, and fluorobenzene FB in a *weight ratio* of EC:EMC:FB = 3:6:1), with the conductive lithium salt LiPF_6 having a concentration of 1.0 mol/L in the organic solvent.

Ex. 2022 ¶¶ 56–57 (emphasis added). Exhibit 2022 describes mixing the organic solvents in the required proportions, using molecular sieves and other compounds to remove impurities and moisture, dissolving the conductive lithium salt (which may be LiPF_6) in the organic solvents such that the concentration of the lithium salt in the organic solvent is between 0.8 and 1.5 mol/L. *Id.* ¶¶ 13, 16, 31–33. Exhibit 2022 discloses additives

selected from vinylene carbonate (VC), ethylene vinyl carbonate, fluorinated ethylene carbonate (FEC), propane sultone (PS), adiponitrile (ADN), and succinonitrile (SN), and that these commonly used additives constitute 0.1–5.0% of the total mass of the electrolyte. *Id.* ¶ 17.

Overall, Exhibit 2022 discloses an electrolyte solvent very similar to that of Zeng, both references disclosing electrolyte solvents comprising EC, PC, FB, and FEC. *Compare* Ex. 1006 ¶¶ 11–18, *with* Ex. 2022 ¶¶ 14, 30. Both references disclose LiPF_6 as a lithium salt that can be used in the electrolyte solution. *Compare* Ex. 1006 ¶ 37, *with* Ex. 2022 ¶ 16. Both references disclose vinylene carbonate (VC), ethylene vinyl carbonate, propane sultone (PS), adiponitrile (ADN), and succinonitrile (SN) as potential commonly used additives. *Compare* Ex. 1006 ¶¶ 37, 45–47, *with* Ex. 2022 ¶ 17.

Dr. Lucht’s interpretation of Zeng’s disclosure leads to information that a POSITA could have employed with confidence to produce Zeng’s Embodiments similar to Exhibit 2022. Given the well-known molecular weight of LiPF_6 in g/mole, a POSITA would have taken any chosen volume of the electrolyte solvent and added sufficient grams of solid LiPF_6 to produce a resulting electrolyte solution that had a LiPF_6 concentration of 1.0 mol/L. This conclusion is not “diametrically opposed to the very wording and teaching” of Zeng. *See* Ex. 2015 ¶ 107. The wording of Zeng—translated from the original Chinese version—could be clearer. However, a POSITA in possession of Zeng would more readily understand that LiPF_6 “of a concentration of 1.0 mol/L is slowly added to the mixed solution” means that a measured weight of solid LiPF_6 is added to a specified volume

of the identified electrolyte solute to create an electrolyte solution that has a resulting concentration of 1.0 M LiPF₆ dissolved in it.

Based on this preliminary record, we do not find that Zeng's "various components and component amounts of the embodiments are ambiguous" as Patent Owner asserts. *See* Prelim. Resp. 7–8; *see also id.* at 11 (criticizing Zeng for failing to provide the total amount of LiPF₆ salt solution that is added as a solution to the electrolyte solvent), 14 ("There is nothing in Zeng indicating an intended final concentration of LiPF₆ in the electrolyte mixtures."), 14 n.3 ("Because Zeng *does* teach using a premixed salt solution, Petitioner admits it cannot ascertain the ultimate concentration of LiPF₆ and the claimed amounts of the solvent components, so its Zeng-based grounds fail."), 16 ("There is simply not enough information in Zeng to reliably perform the calculations needed to reach the conclusions in the Petition.").

Dr. Lucht provides testimony explaining his calculations that purportedly demonstrate that Embodiments 4 and 6 satisfy the claimed mathematical relationships of X, Y, and Z. Ex. 1003 ¶¶ 76–93. Dr. Lucht's calculations are premised on the solvent components in the Embodiments being mixed at a reported mass ratio and solid LiPF₆ then being added to the electrolyte solvent. *See id.* ¶ 80.

Petitioner provides sufficient motivation for a POSITA to implement Zeng's Embodiments 4 and 6 based on these batteries significantly outperforming the Comparative Examples on capacity retention rate, and Embodiment 6 outperformed all but 2 of the nine tested Embodiments. Pet. 26; *see* Ex. 1006 ¶¶ 45–47.

Whether Zeng discloses ranges of components that could possibly cover thousands of embodiments (*see* Prelim. Resp. 8) is of no consequence here, as Petitioner is not relying on broadly taught ranges, but, rather, on specific identified compositions, Embodiments 4 and 6 (*see* Pet. 20). And, as discussed above, Petitioner sufficiently shows that a POSITA would understand Zeng’s data to determine the composition of Embodiments 4 and 6. Zeng reports nine Embodiments that appear to be acceptable and six Comparative Examples that appear not to meet the desired capacity retention rate. Ex. 1006 ¶¶ 45–47. Zeng need not explicitly articulate or express why its teachings are beneficial so long as its teachings are beneficial and a POSITA would recognize that their application was beneficial. *Intel Corp. v. PACTXPP Schweiz AG*, 61 F.4th 1373, 1380–81 (Fed. Cir. 2023) (“There is a motivation to combine when a known technique ‘has been used to improve one device, and a person of ordinary skill in the art would recognize that it would improve similar devices in the same way,’ using the ‘prior art elements according to their established functions.’” (internal citation omitted) (first quoting *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 417 (2007); and then quoting *Intel Corp. v. Qualcomm Inc.*, 21 F.4th 784, 799–800 (Fed. Cir. 2021)). In addition, Petitioner need not select the best option, but rather only a suitable option from which Zeng does not teach away. *Par Pharm., Inc. v. TWI Pharm., Inc.*, 773 F.3d 1186, 1197–98 (Fed. Cir. 2014) (“Our precedent, however, does not require that the motivation be the *best* option, only that it be a *suitable* option from which the prior art did not teach away.”). Our reviewing court has “explained that just because better alternatives exist in the prior art does not mean that an inferior combination

is inapt for obviousness purposes.” *In re Mouttet*, 686 F.3d 1322, 1333 (Fed. Cir. 2012) (citing *In re Gurley*, 27 F.3d 551, 553 (Fed. Cir. 1994)).

To the extent that Zeng discloses some Embodiments without trinitrile having higher capacity retention rates than Embodiments comprising trinitrile, it is insufficient to conclude that Zeng “criticize[s], discredit[s], or otherwise discourage[s] investigation” into use of a trinitrile in the electrolyte solution, and cannot be found to teach away from its use. *Meiresonne v. Google, Inc.*, 849 F.3d 1379, 1382 (Fed. Cir. 2017) (“A reference that ‘merely expresses a general preference for an alternative invention but does not criticize, discredit, or otherwise discourage investigation into’ the claimed invention does not teach away.” (quoting *Galderma Labs., L.P. v. Tolmar, Inc.*, 737 F.3d 731, 738 (Fed. Cir. 2013))). “We will not read into a reference a teaching away from a process where no such language exists.” *Dystar Textilfarben GmbH v. C.H. Patrick Co.*, 464 F.3d 1356, 1364 (Fed. Cir. 2006).

Petitioner sufficiently supports the position that it would have been obvious to try Zeng Embodiments 4 and 6, as Zeng recognized market need for high-energy density lithium-ion batteries driven by consumer terminals demanding ever-higher energy density from batteries. Pet. 27 (citing Ex. 1006 ¶ 3). Zeng need not identify the *same* problem and solution as the ’131 patent does to render an invention obvious. *KSR*, 550 U.S. at 420; *see also Cross Med. Prods., Inc. v. Medtronic Sofamor Danek, Inc.*, 424 F.3d 1293, 1323, (Fed. Cir. 2005) (“One of ordinary skill in the art need not see the identical problem addressed in a prior art reference to be motivated to apply its teachings.”).

Based on the current record, we find Petitioner’s position that Zeng discloses this claim limitation to be supported by evidence.

Claim 1 recites “an electrode . . . the electrode comprises a current collector, a single-sided coating and a double-sided coating; a first part of the current collector is provided with the single-sided coating and a second part of the current collector is provided with the double-sided coating.” Ex. 1001, 33:19, 28–33.

Petitioner argues that Zeng’s Embodiment 4 and 6 electrolytes were used in a lithium-ion secondary battery, which includes electrodes by definition and specifically a positive electrode and a negative electrode and each comprises a current collector. Pet. 29 (citing Ex. 1006 ¶¶ 28–34, 52–53, Abstr; Ex. 1003 ¶¶ 102–103), 30 (citing Ex. 1006 ¶¶ 36–53; Ex. 1003 ¶¶ 108–109; Ex. 1010 ¶ 21, Abstr.). Petitioner argues that it would have been obvious to modify Zeng’s battery with Sunose’s cathode having single- and double-sided coating portions on its current collector. *Id.* at 30–33 (citing Ex. 1010 ¶¶ 7, 10–17, 22–29; Ex. 1003 ¶¶ 112, 113). According to Petitioner, a POSITA would have adopted Sunoses’s electrode configuration because Zeng’s focus is on the electrolyte composition rather than electrode structure and Sunose’s electrode configuration is advantageous because it maximizes electrode area, increasing battery capacity and performance, and rolling the electrode to Sunose’s disclosed compaction density ratios N/M reduces electrode breakage and improves adhesion. *Id.* at 36–38 (citing Ex. 1003 ¶¶ 123–126; Ex. 1010 ¶¶ 4, 5, 10, 12, 16–17, 27–28, 42, 43, Fig. 1).

Petitioner contends:

A POSITA would have had a reasonable expectation of success using Sunose's electrode configuration in Zeng's batteries. Zeng does not disclose any physical requirements for its high-voltage (4.4V) lithium-ion batteries, broadly intended for "the digital, energy storage, power, and military aerospace fields." EX1006, ¶ [0002]; *see also id.* ¶ [0035]. Sunose also generally intends its electrode configuration for batteries of "consumer electronic devices," so the POSITA would have reasonably expected Sunose's electrode configuration to work in Zeng's batteries. EX1010, ¶ [0002]; EX1003, ¶ 127.

Pet. 38.

Based on the current record, we find Petitioner's assertion to be persuasive and supported by evidence.

Patent Owner argues that a POSITA would not have been motivated, and would find no benefit, to combine Sunose with Zeng because "Sunose is focused on trying to overcome documented shortcomings of Sunose's roller mill equipment" while "Zeng is focused on a wide-temperature range homogenous non-aqueous electrolyte solution to provide certain performance advantages for the lithium-ion battery." Prelim. Resp. 22 (citing Ex. 1010 ¶¶ 7–10, 15–18; Ex. 2015 ¶¶ 151, 65–73). Stated another way, Patent Owner argues Zeng's solution for increasing battery performance is chemical in nature while Sunose's solution for electrode compacting operations is mechanical in nature and, thus, "teach remedies to entirely different problems." *Id.* at 22–23 (citing Ex. 2015 ¶ 157).

Patent Owner's argument is unavailing because "[u]nder the correct analysis, any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed." *KSR*, 550 U.S. at 420. It is not

necessary that the benefit afforded by Sunose's electrode structure be the same as the '131 patent or sought specifically and explicitly by Zeng.

Based on the current record, we find Petitioner's position that a POSITA would have had a reason to combine Sunose's electrode configuration comprising a cathode having single- and double-sided coating portions on its current collector with Zeng's battery for the benefit disclosed by Sunose to be supported by evidence.

Claim 1 recites "an electrode compaction density of the electrode corresponding to the first part with the single-sided coating is D1, and, an electrode compaction density of the electrode corresponding to the second part with the double-sided coating is D2, wherein, about $0.8 \leq D1/D2 \leq$ about 1.2." Ex. 1001, 33:34–39.

Petitioner argues that Sunose's Examples 2–4 electrode plates have single- and double-sided electrode compaction densities (packing densities), M and N respectively, corresponding to the claimed D1 and D2. Pet. 33–34 (citing Ex. 1003 ¶ 115; Ex. 1010 31–33, 40, Table 1). Appellant argues that Sunose's packing densities of the active material layer match the claimed density calculation, which excludes the weight and thickness of the current collector. *Id.* at 34 (citing 1003 ¶ 116; Ex. 1010 ¶ 21; Ex. 1001, 20:54–64). Petitioner argues that Sunose's density values result from rolling using a roll press machine. *Id.* (citing Ex. 1010 ¶¶ 31–37, 41–44; Ex. 1003 ¶ 117). Petitioner argues that all Sunose's examples have a packing density for the double-sided portion (D2) of 4.0 g/cm³ and Examples 2–4 have packing densities for the single-sided portion (D1) of 5.0, 4.4, and 4.0 g/cm³, respectively, and that the resulting ratio D1/D2 of 1.25, 1.1, and 1.0 falls within the claimed range because a POSITA would consider 1.25 to be

“*about 1.2.*” *Id.* at 35 (citing Ex. 1010 ¶¶ 29–33, 40; Ex. 1003 ¶ 118; Ex. 1001, 4:12–19 (Defining the term “about” as describing “minor variations” including “less than or equal to $\pm 10\%$ of the stated value.”)). Petitioner’s reasons for combining Sunose’s teachings with Zeng discussed above includes rolling the electrode to Sunose’s disclosed compaction density ratios N/M because Sunose discloses that its electrode assembly improves battery performance by increases adhesion of the electrode layers which mitigating breakage of the electrode plate during rolling. *Id.* at 36 (citing Ex. 1010 ¶¶ 10, 12, 17–18, 21, 24).

Based on the current record, we find Petitioner’s assertion to be persuasive and supported by evidence.

Patent Owner contends that Sunose’s reported values for packing densities cannot be the claimed “electrode compaction density” because they include values that are “physically impossible” as an electrode compaction density. Prelim. Resp. 18–19 (emphasis omitted). According to Patent Owner, the values included in Sunose’s Table 1 exceed 5.1 g/cm^3 , the “true or crystalline density of the LiCoO_2 (LCO) active material of Sunose’s electrode plates.” *Id.* at 19 (citing Ex. 2015 ¶¶ 133–145; Ex. 1010 ¶ 41, Table 1). According to Patent Owner, the porosity of the film only scales the composite density downward from the theoretical upper bound of density with void spaces between solid materials. *Id.* Patent Owner argues that a POSITA would understand that “*none* of the purported ‘packing densities’ . . . correspond to the actual compaction densities of the LCO positive electrode plates” because Sunose’s examples include densities that are not physically realizable. *Id.* at 20 (citing Ex. 2015 ¶ 142). Patent Owner states that “[a]lthough Sunose’s packing densities and ratios thereof (M, N, N/M)

may have some physical origin, they are incommensurable with the claimed electrode compaction densities and claimed ratio thereof.” *Id.* at 21. Patent Owner further contends that Sunose does not mention the criticality of the claimed D1/D2 value range, which the ’131 patent describes has a synergistic effect together with the combined electrolyte additives to obtain a better cycle performance. *Id.* at 21–22 (citing Ex. 1001, 31:53–57; Ex. 2015 ¶¶ 146–149).

Based on the current record, we find Petitioner’s position that Sunose discloses this claim limitation to be supported by evidence. To the extent that Sunose’s Table 1 may include packing densities that exceed the crystalline density of LCO, it is insufficient to conclude that (1) the packing densities identified for Sunose’s Examples 2–4 are not electrode compaction densities and (2) that the ratios (M/N) for Sunose’s identified packing densities for Examples 2–4 are incommensurable with the claimed ratio (D2/D1). Patent Owner acknowledges that “some physical origin” underlies Sunose’s packing densities and ratios. Prelim. Resp. 21. If some physical origin underlies Sunose’s packing densities for Examples 2–4 and these identified packing density values are not challenged as “physically impossible,” then it is not readily apparent that the ratios (M/N) for Sunose’s Examples 2–4 are incommensurable with the claimed ratio (D2/D1) as Patent Owner asserts. In addition, the asserted synergy between the claimed ratio and the electrolyte would be expected to flow from the combination of Sunose’s Examples 2–4 with Zeng’s electrolyte. *See Ex parte Obiaya*, 227 USPQ 58, 60 (BPAI 1985) (“The fact that appellant has recognized another advantage which would flow naturally from following the suggestion of the

prior art cannot be the basis for patentability when the difference would otherwise be obvious.").

Claim 1 recites “based on the total weight of the electrolyte, a weight percentage of the propyl propionate [PP] is Z; wherein, about 0.01 $\leq(Y/Z)\leq$ about 0.3.” Ex. 1001, 33:40–43.

As discussed above, Petitioner argues that Zeng’s Embodiments 4 and 6 had 20 wt% PP *before* adding LiPF₆ and the remaining additives to the solvent mixture, and if LiPF₆ had zero weight, PP would have theoretical upper limit weight percentages in the total electrolytes of Embodiments 4 and 6 as follows:

Embodiment 4: $88.3\% \times (20 / (25 + 10 + 30 + 5 + 10 + 20)) = 17.66 \text{ wt}\%$

Embodiment 6: $88.5\% \times (20 / (25 + 10 + 30 + 5 + 10 + 20)) = 17.70 \text{ wt}\%$

Pet. 24–25 (citing Ex. 1003 ¶ 87). Petitioner argues that, assuming LiPF₆ has a non-zero weight, and Zeng teaches it was mixed in the base solvent to a concentration of 1.0 mol/L before mixing the remaining additives, the weight percentages Z of PP in the total electrolyte solutions are $Z < 17.66 \text{ wt}\%$ in Embodiment 4 and $Z < 17.70 \text{ wt}\%$ in Embodiment 6. *Id.* at 26 (citing Ex. 1003 ¶ 93). Based on this analysis, Petitioner argues the Y and Z and Y/Z for Zeng’s Embodiments 4 and 6 have the following values:

Embodiment	Y	Z	Y/Z
4	1 wt%	<17.66 wt%	>0.057
6	1 wt%	<17.70wt%	>0.056

Pet. 39. Therefore, Zeng discloses a Y/Z ratio that overlaps the claimed range of “about 0.01 $\leq(Y/Z)\leq$ about 0.3.” *Id.* at 38–39 (citing Ex. 1003 ¶ 128).

Patent Owner’s arguments that Petitioner fails to show that Zeng renders the claimed Z and Y/Z ranges obvious are based almost entirely on the premise that Zeng discloses adding a 1.0 M solution of LiPF₆ in some

unknown solvent to the electrolyte solvent. *See* Prelim. Resp. 10–16. Having determined that Zeng discloses adding solid LiPF_6 to the identified electrolyte solvent, we do not further address those arguments.

Patent Owner argues that Zeng’s Table 1 lists “‘the electrolyte solution *partial* component content’ [such that] Zeng necessarily considers the presence of other electrolyte solution components in its embodiments.” Prelim. Resp. 14. However, we find nothing in Zeng to suggest the electrolyte solution contains any additional, unnamed components. *See generally* Ex. 1006. This argument is unavailing.

Patent Owner argues that propyl propionate is not required to be in Zeng’s electrolyte solution based on Zeng’s disclosure that “ $10\% \leq \text{ethyl propionate (EP)} + \text{propyl propionate (PP)} \leq 50\%$,” and thus could be 0% PP.⁹ Prelim. Resp. 15 (citing Ex. 1006 ¶ 15). We agree that Zeng discloses the range of EP + PP stated, however, Petitioner relies on specific Embodiments 4 and 6, which each have 20 mass percent of PP. *See* Ex. 1006 ¶ 46. This argument is unavailing as well.

According to Patent Owner, the ’131 patent establishes criticality of the claimed Y/Z range, and criticizes Petitioner for failing to address that the “*specific weight percentage ratio ranges*, including Y/Z values [in the claimed ranges] were *unexpectedly found* to provide a firm, protective SEI film on the surface of the cathode that was not easily decomposed.” Prelim. Resp. 16–18 (citing Ex. 2015 ¶ 123; Ex. 1001, 1:55–62, 28:56–64). The ’131 patent states “[t]he present inventors unexpectedly found that by using a

⁹ Dr. Wheeler testifies that if PP is zero, then Y/Z is equal to 0. Ex. 2015 ¶¶ 122. Mathematically, it is not. Any number divided by zero is undefined.

mixture of a dinitrile compound, a trinitrile compound and propyl propionate, a firm protective film which is not easily decomposed on the surface of the cathode at a high potential can be formed.” Ex. 1001, 1:55–60. The ’131 patent does not state that the specific weight percentage ratio ranges unexpectedly were found to provide the benefits. *See generally id.*

Based on the current record, we find Petitioner’s position that Zeng discloses this claim limitation to be supported by evidence.

Claim 1 recites “wherein the trinitrile compound is one selected from the group consisting of . . . 1,3,6-hexanetricarbonitrile.” Ex. 1001, 33:44–46. Petitioner argues that Zeng’s Embodiments 4 and 6 both contain the recited trinitrile 1,3,6-hexanetricarbonitrile (HTCN). Pet. 40 (citing Ex. 1006 ¶¶ 46, 49).

As discussed above, Patent Owner argues that Zeng does not require the presence of a trinitrile. Prelim. Resp. 17. However, the record supports Petitioner’s position that this claimed element is disclosed by Zeng’s Embodiments 4 and 6, which both contain the recited trinitrile 1,3,6-hexanetricarbonitrile. Ex. 1006 ¶¶ 46, 49.

On this preliminary record, we find that Petitioner demonstrates sufficient argument and evidence to show it is more likely than not that claim 1 would have been obvious over Zeng and Sunose.

b) Claim 14

Claim 14 differs from claim 1 in that claim 14 recites “[a]n electrochemical device, comprising: electrodes” rather than “an electrode” as recited in claim 1. Compare Ex. 1001, 35:44–45 (claim 14) with Ex. 1001, 33:18–19 (claim 1). Additionally, claim 14 recites “the first electrode comprises a first current collector and a single-sided coating; the second

electrode comprises a second current collector and a double-sided coating” rather than “a first part of the current collector . . . and a second part of the current collector” having a single- and double-sided coating as recited in claim 1. Compare Ex. 1001, 36:1–4 (claim 14) with Ex. 1001, 33:28–33 (claim 1).

Petitioner accounts for the limitations of independent claim 14 on the basis that claim 14 reads on an electrode with single- and double-sided portions for the same reasons provided for claim 1. Pet. 43. For claim 14’s recited first and second electrodes, Petitioner identifies Zeng’s lithium-ion batteries having two electrodes (a cathode and an anode). *Id.* Patent Owner does not provide arguments for claim 14 separate from the arguments directed to claim 1, which we address above. Prelim. Resp. 7 (referring to “claims 1 and 14”).

On this preliminary record, we find that Petitioner demonstrates sufficient argument and evidence to show it is more likely than not that claim 14 would have been obvious over Zeng and Sunose.

c) Claims 2, 4–7, 12, 15, and 17

Petitioner accounts for the limitations recited in claims 2, 4–7, 12, 15, and 17. Pet. 40–44. Petitioner explains how Zeng and Sunose disclose the recitations of claims 2, 4–7, and 12, which depend from claim 1, and claims 15 and 17, which depend from claim 14. Patent Owner does not assert any additional arguments for the dependent claims. Prelim. Resp. 24.

In sum, based on the evidence in the present record, we are persuaded that Petitioner has shown sufficiently for purposes of this Decision that Zeng and Sunose disclose or suggest all limitations recited in claims 2, 4–7, 12, 15, and 17 as well as independent claims 1 and 14.

2. *Obviousness over Zeng, Sunose, Matsuoka*

Petitioner asserts that claims 1, 2, 4–7, 12, 14, 15, and 17 are obvious over Zeng and Sunose as discussed above, and further in view of Matsuoka under 35 U.S.C. § 103, citing the Declaration of Dr. Lucht for support. Pet. 49–55 (citing Ex. 1003). We have reviewed Petitioner’s arguments and evidence and have found them to be sufficient to meet the threshold of 314(a).

Petitioner argues Matsuoka lists non-nitrile additives with LUMO and HOMO levels appropriate for use in its electrolytes. Pet. 49–50 (citing Ex. 1007 ¶¶ 36, 38–40). According to Petitioner, Matsuoka discloses PP isomers as suitable additives with LUMO and HOMO energies falling in or near the most-preferred ranges. *Id.* (citing Ex. 1007 ¶¶ 38, 40). The preferred amount of non-nitrile additive is 0.1 to 30 wt%, and the more preferred amount is 0.1 to 10 wt%. *Id.* (citing Ex. 1007 ¶ 41). Petitioner argues that Matsuoka’s PP amount, when used in Zeng’s electrolytes, results in a Y/Z ratio overlapping the recited range in element [1.7] and corresponding [14.7]. *Id.*

Petitioner argues that a POSITA would have been motivated, with a reasonable expectation of success, to incorporate Matsuoka’s preferred non-nitrile weight percentages as the weight percentage of the PP (Z) in Zeng’s Examples 4 and 6. Pet. 51. Petitioner contends that Zeng uses “[f]luoroethylene carbonate (FEC), which has good film-forming properties and resistance to oxidation” and “ensures good high-voltage cycling performance of the battery without seriously affecting the high-temperature performance of the battery” (Ex. 1006 ¶ 28), and Matsuoka uses its non-

nitrile additive such as PP to form a stable protective film on the negative electrode, suppressing side reactions that generate gas and rise in internal resistance that can damage the battery and/or hurt cycling performance (Ex. 1007 ¶¶ 11, 22, 36, 42, 57, 104). *Id.* at 51. Consequently, Petitioner argues, a POSITA would have considered Matsuoka in the proposed combination of Zeng and Sunose. *Id.* at 49.

According to Petitioner,

To the extent Zeng's recipe is hypothetically unclear about how much PP to use, that would have prompted the POSITA to consider Matsuoka's teachings about appropriate amounts of PP to include in Zeng's electrolytes. The POSITA would have noted Matsuoka's "off-the-shelf" preferred weight proportion ranges for PP, a non-nitrile additive, to fine-tune the weight percentage Z of PP in Zeng Embodiments 4 and 6.

Pet. 52 (citing Ex. 174). Petitioner argues that Matsuoka teaches increasing the amount of the non-nitrile additive improves electrolyte stability at the cost of low-temperature performance, and vice versa. *Id.* at 53 (citing Ex. 1007 ¶ 41). Per Petitioner, by using the non-nitrile additive in Matsuoka's preferred weight proportion ranges, "all of the cycling performance of the electrolyte solution, high-rate performance under a low temperature environment, and other battery characteristics can be further improved." *Id.* Petitioner argues that the desire for balanced performance would have motivated the POSITA to use Matsuoka's preferred weight proportion ranges as the amount of PP in Zeng's Example 4 and 6 electrolytes. *Id.*

Petitioner contends that a POSITA would have had a reasonable expectation of success in using Matsuoka's preferred non-nitrile weight proportions for PP in Zeng's electrolytes, citing to the overlap in composition of Zeng's electrolytes and those of Matsuoka, which both also

include the same carbonate-based solvents (EC, PC), ester compound (EP), LiPF_6 as the lithium salt, and VC as an additive. Pet. 53. Petitioner also argues that Zeng and Matsuoka both use electrolyte components to improve the SEI film. *Id.* at 55.

Petitioner argues that the combination of Zeng and Matsuoka teaches or suggests the claimed Y/Z ranges, e.g., in claim 1, “a weight percentage of the propyl propionate is Z; wherein about $0.01 \leq (Y/Z) \leq$ about 0.3.” Pet. 54 (citing Ex. 1003 ¶ 178–179); *see also* Ex. 1001, 33:40–43. According to Petitioner, using Matsuoka’s more preferred upper limit for PP in Zeng’s Examples 4 and 6 results in Y/Z range from 0.1 to 10, overlapping the claimed range. *Id.*

As an alternative reason for a motivation to combine Matsuoka with Zeng, Petitioner indicates that Matsuoka highlights PP’s ability to prevent a rise in internal resistance, which the ’131 patent suggests needs improvement. Pet. 55 (citing Ex. 1001, 1:30–62; Ex. 1007 ¶ 36; Ex. 1003 ¶ 180–181). Petitioner contends that a POSITA seeking to keep internal resistance low would have optimized the PP content in Zeng’s Embodiments 4 and 6, “experimenting within Matsuoka’s ranges of 0.1–10 wt% and 0.1–30 wt%.” *Id.*

Patent Owner argues that there is no motivation to modify Zeng’s electrolyte system with Matsuoka. Prelim. Resp. 22. According to Patent Owner, “Zeng already provides the POSITA with the necessary amount of PP to include in a relative mass ratio of the base solvent mixture. Ex. 2015 ¶¶ 160–162.” *Id.* at 24. The purpose of Petitioner’s alternative ground including Matsuoka, however, is counter any assertion that Zeng is ambiguous as to the weight proportion of the solvent components. Pet. 49.

Moreover, Patent Owner's position is inconsistent with its position that the disclosure of Zeng does not provide sufficient detail that would allow the POSITA to determine that Zeng discloses the claimed weight percentages of propyl propionate (Z). Prelim. Resp. 16 ("There is simply not enough information in Zeng to reliably perform the calculations needed."); Ex. 2015 ¶ 119 ("[T]he concentration of propyl propionate in the final electrolyte solution cannot be unambiguously determined from the teachings of Zeng.").

Patent Owner argues Petitioner fails to show that a POSITA would have selected PP from Matsuoka's numerous non-nitrile additives, noting that Matsuoka lists PP isomers (*n*-propyl propionate and isopropyl propionate) in two lists of more than 75 other potential "non-nitrile additive" components. *Id.* at 25–26 (citing Ex. 1007 ¶¶ 38, 40). Patent Owner contends that nearly all of the additives in the LUMO list fall within the most-preferred LUMO ranges and a majority of the additives in the HOMO list fall in or near the most-preferred HOMO ranges. *Id.* Patent Owner argues that neither PP isomer is given special significance in Matsuoka or is tested for actual functionality, pointing out that Table 2 lists 20 additives used in the Examples and Comparative Examples of Matsuoka but PP compound is not included. *Id.* at 26; Ex. 1007 ¶ 108, Table 2.

Patent Owner's argument is unavailing because Petitioner relies on Zeng's disclosure to include PP in the solvent, not Matsuoka, and alternatively relies on Matsuoka in addition to Zeng for an appropriate amount of PP. Pet. 49. That is, Petitioner relies on Matsuoka's direct disclosure of an appropriate weight percentage Z of PP, rather than determining it from Zeng. *Id.* Dr. Lucht testifies that Matsuoka lists *n*-propyl propionate and isopropyl propionate as suitable non-nitrile additives with

LUMO and HOMO energies falling in or near Matsuoka's most-preferred ranges. Ex. 1003 ¶ 167 (citing Ex. 1007 ¶¶ 38, 40). Dr. Lucht testifies that Matsuoka teaches the preferred amount of non-nitrile additive is 0.1 to 30 wt%, and the most preferred amount is 0.1 to 10 wt%, such that Matsuoka's preferred ranges overlap the claimed Z range. *Id.* ¶¶ 168–169 (citing Ex. 1007 ¶ 41), 178–179. Dr. Lucht testifies that any uncertainty in Zeng's instructions would have motivated a POSITA to look to Matsuoka for implementation details regarding appropriate amounts of PP to include in Zeng's electrolytes. *Id.* ¶ 174. In addition, "Matsuoka uses its non-nitrile additive such as PP to form a stable protective film on the negative electrode, suppressing side reactions that generate gas and rise in internal resistance that can damage the battery and/or hurt cycling performance." *Id.* ¶ 172.

Patent Owner contends that "the electrolyte solutions of Zeng and Matsuoka are so fundamentally different that the POSITA would not be motivated to combine or have an expectation of success" in combining Matsuoka with Zeng. Prelim. Resp. 29 (citing Ex. 2015 ¶¶ 178–191). Patent Owner argues that "Matsuoka identifies at least PP, ethyl propionate (EP), and monofluorobenzene (FB) as '*non-nitrile additives*,' however, Zeng considers and accounts for at least PP, EP, and FB as *solvent* components in the initial solvent mass ratio, *not as additives*." *Id.* (emphasis added) (citing Ex. 1007 ¶¶ 38, 40; Ex. 1006 ¶ 37; Ex. 2015 ¶ 179).

A POSITA would not identify the teachings of Matsuoka as applicable to Zeng and would have no reason to expect that the applicability of amounts or ranges of Matsuoka's ***additive*** components to the same components found in Zeng's solution as ***solvent*** components (especially in view of Zeng's solvents being present in a defined solvent mass ratio) would have

predictable results given the inherent unpredictability of the interactions of these components.

Id. In addition, according to Patent Owner, Matsuoka considers acetonitrile (a mononitrile) to be not only essential, but the solitary or main solvent component. *Id.* (citing Ex. 2015 ¶ 180; Ex. 1007 ¶¶ 43, 109, Tables 3–5). Patent Owner points out that Zeng’s Embodiments 4 and 6 do not include any mononitriles as a solvent or an additive, and only adiponitrile (a dinitrile), 1,2-bis(2-hexanetricarbonitrile (a trinitrile) as minor additives. *Id.* at 29–30 (citing Ex. 1006 ¶¶ 45–49). None of Matsuoka’s examples include a trinitrile as an additive, which Patent Owner argues supports that a POSITA would consider the electrolyte systems of Zeng and Matsuoka to be fundamentally different. *Id.* at 30. Patent Owner contends that a POSITA would not have any indication that the preferred non-nitrile additive range described in Matsuoka as advantageous for an acetonitrile solvent-based electrolyte would have any positive effect on other electrolyte solutions which do not contain acetonitrile as a solvent component, such as Zeng. *Id.* (citing Ex. 2015 ¶ 181; Ex. 1007 ¶ 41).

Patent Owner argues that Matsuoka teaches away from Zeng’s mixed solvent electrolyte systems due to Matsuoka showing lower discharge capacity at low temperatures for mixed solvents. Prelim. Resp. 30–31 (citing Ex. 1007, Table 3, Table 9; Ex. 2015 ¶¶ 182–186). Matsuoka also teaches away from Zeng’s use of the single inorganic lithium salt, LiPF_6 , according to Patent Owner. *Id.* at 31. In addition to acetonitrile, Matsuoka requires “an organic lithium salt, wherein an anion of the organic lithium salt has a LUMO [] energy in the range of -2.00 to 4.35 eV, and a HOMO [] energy in the range of -5.35 to -2.90 eV.” *Id.* (quoting Ex. 2015 ¶ 187; citing Ex. 1007 ¶ 14). Patent Owner argues Zeng does not meet the organic lithium salt

requirements or the HOMO requirements of Matsuoka because Zeng's LiPF_6 is an inorganic lithium salt having a LUMO of 4.05 eV and a HOMO of -5.39 eV. *Id.* (citing Ex. 1007 ¶¶ 29, 30, Table 1; Ex. 2015 ¶ 188). According to Patent Owner, Matsuoka teaches away from electrolyte solutions incorporating only an inorganic lithium salt like Zeng, thus, the ground lacks a sufficient motivation to combine Matsuoka. *Id.* at 31–32 (citing Ex. 1007, Tables 1, 3, 6; Ex. 2015 ¶¶ 189–190).

Based on the current record, we do not consider Matsuoka's disclosure to "criticize discredit, or otherwise discourage" investigation into use of mixed solvents such as Zeng. The data in Matsuoka's Table 9 supports Dr. Wheeler's testimony that the acetonitrile-only solvents have better *low temperature* performance than the mixed solvents. Ex. 1007 ¶¶ 109, 177; Ex. 2015 ¶ 184. The same cannot be said of a comparison of performance at 25 °C, however, where the mixed solvent examples demonstrate better performance than the acetonitrile-only solvents. Ex. 1007 ¶ 177. Zeng is drawn to wide-temperature-range homogeneous non-aqueous electrolyte solutions, not low-temperature non-aqueous electrolyte solutions. Ex. 1006 ¶ 1. Zeng discusses problems in electrolyte solutions at both high temperatures and low temperatures. *See id.* ¶¶ 5–7, 8 ("[I]t is indeed necessary to provide an electrolyte solution that can remain homogeneous and stable over a wide temperature range in order to ensure that a lithium-ion battery has good high-voltage cycle performance and can perform at high and low temperatures.").

Similarly, at this stage in the proceeding we do not consider Matsuoka's limited data comparing an organic lithium ion in acetonitrile to LiPF_6 in acetonitrile sufficient to discredit or otherwise discourage the use of

LiPF₆ in mixed solvents for electrolyte solutions. Dr. Wheeler asserts that Matsuoka requires an organic lithium salt with specified LUMO and HOMO energy ranges. Ex. 2015 ¶ 188 (citing Ex. 1007 ¶¶ 29, 30). Matsuoka, however, provides one comparison of an organic lithium ion in acetonitrile to LiPF₆ in acetonitrile, and discloses that the acetonitrile/LiPF₆ electrolyte solution had much lower discharge capacity. *Id.* ¶ 189.

Patent Owner contends that claims 2, 4–7, 12, 15, and 17 are not unpatentable over Zeng, Sunose, and Matsuoka for at least the same reasons discussed above directed to independent claims 1 and 14. Prelim. Resp. 32 (citing Ex. 2015 ¶ 191).

The combination of Matsuoka with Zeng and Sunose is sufficiently supported for purposes of this Decision because a POSITA, seeking enhancements based on Zeng, would recognize from Matsuoka that PP effectively suppresses rise in internal resistance. Ex. 1003 ¶ 167. A POSITA would therefore be able to adjust the PP content in Zeng's Embodiments 4 and 6, experimenting within Matsuoka's preferred ranges of 0.1–10 wt% and 0.1–30 wt% to identify an optimum PP proportion for suppressing rise in internal resistance. *Id.* ¶¶ 168–169.

On this preliminary record, Petitioner meets the threshold showing under 35 U.S.C. § 314(a) for institution of trial with respect to at least claims 1, 2, 4–7, 12, 14, 15, and 17.

3. *Obviousness over Zeng, Sunose, Kim*

Petitioner asserts that claims 1, 2, 4–7, 12, 14, 15, and 17 are obvious over Zeng, Sunose, and Kim under 35 U.S.C. § 103, citing the Declaration of Dr. Lucht for support. Pet. 55–60 (citing Ex. 1003). We have reviewed

Petitioner's arguments and evidence and have found them to be sufficient to meet the threshold of § 314(a).

Petitioner relies on Kim as disclosing a trinitrile and PP in a dinitrile-based electrolyte. Pet. 56. Petitioner argues “Kim’s experiments show electrolytes having both trinitrile and PP had better capacity retention—after storage at 60°C for four weeks, and after 250 cycles—versus similar electrolytes missing either or both components.” Pet. 57 (citing Ex. 1008, Tables 2–4).

According to Petitioner, Kim’s Examples show enhanced performance of electrolytes that incorporate a trinitrile and PP compared to those lacking one or both. Pet. 58. Only Examples 1 and 2 contain both a HTC_N (trinitrile) and PP, Comparative Examples 1–6 lacking trinitrile HTC_N, PP, or both. *Id.* at 57–58 (citing Ex. 1008 ¶¶ 90–91). Petitioner contends this draws attention to electrolytes containing both a trinitrile and PP in different relative amounts, and the Y/Z element of the ’131 patent claims. *Id.* at 58–59 (citing Ex. 1003 ¶ 190). Petitioner argues that the dinitrile and trinitrile contents are identical in Examples 1 and 2, but the PP weight percentage increases from 40% in Example 1 to 60% in Example 2. *Id.* at 59 (citing Ex. 1008 ¶ 90, Table 1). Petitioner contends that Kim shows that adjusting PP while maintaining trinitrile content in Examples 1 and 2 significantly impacts battery performance, causing a POSITA to recognize that fine-tuning trinitrile to PP weight percentage ratios (Y/Z) optimizes battery performance. *Id.* (citing Ex. 1008 ¶¶ 92–103 and Ex. 1003 ¶ 191).

Petitioner argues that both Kim and the ’131 patent highlight adjusting Y/Z to improve electrolyte performance. Pet. 53 (citing Ex. 1003 ¶ 174). According to Petitioner, the difference between the general teachings of the

'131 patent and Kim lies in their focus on the effect of PP: “[t]he ’131 Patent explicitly states that adding PP to dinitrile and trinitrile helps suppress DC internal resistance,” while “Kim shows combining PP with nitriles improves cycling but does not specifically mention DC resistance.” *Id.* at 60 (citing Ex. 1008 ¶¶ 90–104 and Ex. 1003 ¶¶ 193–195). Petitioner asserts that testing DC internal resistance was a routine procedure for evaluating electrolyte performance, and since Kim already teaches that adding PP to electrolytes containing dinitrile and trinitrile improves battery performance, it would have been routine to evaluate performance of Kim’s electrolytes based on internal resistance. *Id.* (citing Ex. 1003 ¶ 195).

Petitioner argues that Kim “would have further motivated a POSITA to consider and adjust the proportions of trinitrile and PP in Zeng’s electrolytes and/or use Matsuoka’s PP amounts in Zeng’s electrolytes.” Pet. 60 (citing Ex. 1003 ¶ 196).

Patent Owner argues that Petitioner purports to cure, with Kim, the deficiencies in Zeng (or Zeng and Matsuoka) in disclosing the claimed ratio of the weight percentage of trinitrile (Y) to the weight percentage of PP (Z), i.e., Y/Z. Prelim. Resp. 32. According to Patent Owner, a POSITA would have interpreted Zeng as teaching that the addition of a trinitrile compound *negatively* impacts the capacity retention rate, such that he or she would not turn to any trinitrile teachings of Kim. *Id.* at 33. Patent Owner contends that “no teaching in Zeng would prompt or otherwise ‘motivate[] [a POSITA] adjusting relative amounts of these two components (i.e., Y/Z) to improve performance,’ because the comparative capacity retention rate data of Zeng’s Embodiments teaches otherwise.” *Id.* (quoting Pet. 55–56) (citing Ex. 2015 ¶ 77).

Patent Owner contends that Petitioner never makes a motivation to combine argument for the combination of Zeng, Sunose, (Matsuoka,) and Kim, and never evaluates a POSITA's reasonable expectation of success—thus failing to make out a *prima facie* case of obviousness to combine Kim with the other references, which is fatal to grounds relying on Kim. Prelim. Resp. 33–34 (citing Pet. 55–60). “Even setting aside this fatal deficiency,” Patent Owner argues that “Kim is replete with internally contradicting data and woefully inadequate experimental procedure details from which a POSITA could not draw any conclusions.” *Id.* at 34.

Patent Owner challenges Petitioner's position that “Examples 1 and 2, ‘show electrolytes having both trinitrile and PP had better capacity retention . . . versus similar electrolytes missing either or both components.’” Prelim. Resp. 34 (citing Pet. 57–58). Patent Owner specifically criticizes Petitioner's analysis of Kim's Examples 1 and 2, and Kim's evaluation methods that purportedly would lead a POSITA to “optimizing the trinitrile (Y)/PP (Z) ratio affects performance.” *Id.* (quoting Pet. 59).

According to Patent Owner, Kim's experimental procedures are not articulated in any meaningful way that allows evaluation or reproduction. Prelim. Resp. 34–35. Patent Owner contends that Kim fails to provide the meanings of “recovery capacity” and “thickness variation,” as well as how those values are calculated from or related to underlying capacity and thickness measurements. *Id.* (citing Ex. 2015 ¶ 196). As a first issue, Patent Owner argues that Kim does not specify how its “capacity” values are measured, when many different tests can be used to measure capacity and cycling. *Id.* at 35 (citing Ex. 2015 ¶¶ 197–199). Kim does not specify how or where its “thickness” values are measured, or how multiple values are

treated, whether the thickness is measured under a particular stack pressure, among other conceivable interpretations of “thickness.” *Id.*

Patent Owner next asserts that Kim’s undiscussed data shows that its capacity results are highly dependent on cell format, e.g., prismatic cells in comparison to pouch cells. Prelim. Resp. 35 (citing Ex. 2015 ¶¶ 199–200; Ex. 1008, Tables 2 and 3). “No description is given as to how the respective prismatic and pouch cells are manufactured or are otherwise distinct from each other, nor are there teachings as to how they should be comparatively evaluated.” *Id.* at 36. According to Patent Owner, a POSITA would infer that there is a comparatively wide band of statistical uncertainty in the measurements made for each example in the two cell formats, making comparisons unreliable. *Id.* (citing Ex. 2015 ¶¶ 199–200).

Patent Owner contends that Kim’s disclosure with respect to linear sweep voltammetry contradicts itself, as Kim states that the thermal aging measurements on pouch cells were made after being “allowed to stand at 60°C. for **3 weeks**,” but Table 3 indicates the same measurements were made after being “allowed to stand at 60°C. for **4 weeks**.” Prelim. Resp. 36–37 (citing Ex. 1008 ¶¶ 99–100 and Table 3). Patent Owner also argues that Kim’s Fig. 2 provides “linear sweep voltammetry” data which purports to show that Examples 1 and 2 are more electrochemically stable electrolytes than Comparative Examples 1 to 6 at all electrode potentials tested, however, “a POSITA cannot determine from the plot the stability/currents for Examples and Comparative Examples at more realistic potentials, i.e. around 4.4V.” *Id.* at 37 (citing Ex. 1008, Fig. 2; Ex. 2015 ¶ 202).

Patent Owner argues that Kim lacks key information for assessing the performance of Kim’s batteries shown in Fig. 7, such as the voltage up to

which the battery is charged or discharged and at what rate the cycling is performed. Prelim. Resp. 37–38. According to Patent Owner, Kim’s summary of cycle life in Table 4 is inconsistent with the data presented in Fig. 7, “leading [a POSITA] away from relying on Kim at all.” *Id.* at 38.

Patent Owner contends that Kim shows significant discrepancies in the data reported in Table 4 and Fig. 7 regarding capacity retention values of Comparative Examples 5 and 6, which reported values should be identical. Prelim. Resp. 38–39 (citing Ex. 1008, Table 4, Fig. 7). According to Patent Owner, the notable unexplained discrepancies between Figure 7 and Table 4’s capacity retention values for the same Comparative Examples would deter a POSITA from relying on or applying Kim. *Id.* at 39 (citing Ex. 2015 ¶ 205). According to Patent Owner, the multiple “evaluation methods” of Kim relied on by Petitioner are not clear or reproducible and are therefore not usable by a POSITA. Prelim. Resp. 39 (citing Pet. 57; Ex. 2015 ¶¶ 195–198).

Patent Owner further argues that Kim’s Examples 1 and 2 do not motivate a POSITA to adjust the relative amounts of PP and a trinitrile as Petitioner claims. Prelim. Resp. 39–40 (citing Ex. 2015 ¶ 206). Even if a POSITA had confidence in Kim’s data, he or she would note that Example 1 is superior to Example 2 in Kim’s data, and therefore would consider Example 1’s composition as superior to Example 2’s composition. *Id.* at 40. Such conclusion would require substitution of a portion of the PP and PC solvent fractions used in Example 2, with a substantial EP solvent fraction used in Example 1, thus teaching away from using an even higher fraction of PP than is used in Example 1. *Id.* Patent Owner asserts that this “would draw

the POSITA's attention, if any, to the ratio of PP to EP (rather than PP to HTCN as asserted by Petitioner.” *Id.*

According to Patent Owner, nothing in Kim indicates a preference for, much less mandates, the presence of PP and other alkyl propionates, such as variations of butyl (C₄) or pentyl (C₅) propionate. Prelim. Resp. 40–41 (citing Ex. 1008 ¶¶ 13–14 (“C3 to C5 alkyl propionate”)). Patent Owner argues that “Kim provides no direct comparison between different C3-C5-alkyl propionates that would motivate selection of PP over another C3-C5-alkyl propionate discussed in Kim, and Petitioner provides no motivation to make such a selection.” *Id.* at 41 (citing Ex. 2015 ¶ 207).

Patent Owner further argues that Kim fails to provide a POSITA with any guidance with respect to a weight percentages ratio of a trinitrile compound to PP based on a total weight of the electrolyte, i.e. Y/Z. Prelim. Resp. 41 (citing Ex. 2015 ¶ 208). Kim discloses solvents in volume percentages, based on the total amount of the organic solvent, which Patent Owner argues means that Kim does not disclose the claimed weight percentage of PP “based on a total weight of the electrolyte.” *Id.* (citing Ex. 1008 ¶ 13, Table 1). According to Patent Owner, Kim fails to provide a POSITA with any guidance as to a ratio based on weight percentages of components, let alone weight percentages of the components based on a total weight of the electrolyte. *Id.* at 41–42. Thus, Patent Owner argues, a POSITA would not be motivated to turn to Kim from Zeng at least because the solvents of Zeng are set forth in a relative mass ratio and Kim only discloses its solvents in volume percentages. *Id.*

Patent Owner asserts that “there is little variation and no experimentation in Kim to suggest to a POSITA that there should be a

preferred or critical range of values for the combination of dinitrile (X) and trinitrile (Y) compounds, and Petitioner and Dr. Lucht fail to provide any motivation to modify Kim or Zeng to arrive at the claimed values or ranges. Prelim. Resp. 42.

To the extent that Patent Owner calls into question Kim's methods of testing, "in considering the disclosure of a reference, it is proper to take into account not only specific teachings of the reference but also the inferences which one skilled in the art would reasonably be expected to draw therefrom." *In re Preda*, 401 F.2d 825, 826 (CCPA 1968). Rejecting a blinkered focus on individual documents, the Supreme Court in *KSR* required an analysis that reads the prior art in context, taking account of "demands known to the design community," "the background knowledge possessed by a person having ordinary skill in the art," and "the inferences and creative steps that a person of ordinary skill in the art would employ." *Randall Mfg. v. Rea*, 733 F.3d 1355, 1362 (Fed. Cir. 2013) (citing *KSR*, 550 U.S. at 418). "This 'expansive and flexible approach,' . . . , is consistent with our own pre-*KSR* decisions acknowledging that the inquiry 'not only permits, but *requires*, consideration of common knowledge and common sense.'" *Id.* (citing *DyStar Textilfarben*, 464 F.3d at 1367).

Concluding, Patent Owner argues that Petitioner does not provide sufficient motivation to combine Kim with Zeng. Prelim. Resp. 42. Patent Owner notes that Kim does not contain any teaching to prevent increases in the internal DC resistance of a battery, which is a main objective of the '131 patent. *Id.* According to Patent Owner, Kim does not contain any teachings to improve electrode plate wettability and interfacial compatibility, which are main objectives of Zeng. *Id.* at 43 (citing Ex. 1006, Abst; Ex. 2015

¶ 211). Kim’s purpose is to increase the thermal stability of a battery through the use of “an electrolyte additive including greater than or equal to about three nitrile groups,” with the optional addition of an additive, which is intended to suppress the generation of gas in the electrodes during storage at high temperatures. *Id.* (citing Ex. 1008 ¶¶ 55–56, 64).

Contrary to Patent Owner’s arguments, Petitioner identifies motivations to combine Kim with Zeng to adjust the relative amounts of trinitrile and PP. *See* Pet. 56, 60. And Petitioner explains how Kim’s disclosure of using PP along with a dinitrile and a trinitrile in both Examples was more successful than the Comparative Examples, none of which employed all three components. *See id.* at 58–59 Ex. 1008 ¶ 90, Table 1.

On this preliminary record, Petitioner meets the threshold showing under 35 U.S.C. § 314(a) for institution of trial with respect to claims 1, 2, 4–7, 12, 14, 15, and 17.

4. *Obviousness over Zeng, Sunose, Matsuoka, Kim*

Petitioner asserts that claims 1, 2, 4–7, 12, 14, 15, and 17 are obvious over Zeng, Sunose, Matsuoka, and Kim under 35 U.S.C. § 103, citing the Declaration of Dr. Lucht for support. Pet. 55 (citing Ex. 1003). We have reviewed Petitioner’s arguments and evidence and have found them to be sufficient to meet the threshold of 314(a) for the reasons discussed above in connection with the combination of Zeng, Sunose, and Kim.

As with the combination of Kim with Zeng and Sunose above, Patent Owner contends that Petitioner does not provide any motivation to combine Kim with Zeng, Matsuoka, and Sunose. Prelim. Resp. 43. At this stage in the proceeding, we find Petitioner sufficiently identifies motivations to combine

Kim with either Zeng or Matsuoka in the combination to adjust the relative amounts of trinitrile and PP. *See* Pet. 56, 60. Petitioner explains how Kim’s disclosure of using PP along with a dinitrile and a trinitrile in both Examples was more successful than the Comparative Examples, none of which employed all three components. *See id.* at 58–59 (citing Ex. 1008 ¶ 90, Table 1).

5. *Obviousness over Zeng, Sunose, and Su*

Petitioner argues claims 3 and 16 are obvious over Zeng, Sunose, and Su under 35 U.S.C. § 103, citing the Declaration of Dr. Lucht for support. Pet. 44–48 (citing Ex. 1003). Claims 3 and 16 depend from independent claims 1 and 14, respectively, and recite “wherein the electrode is an anode, and $1.2 \text{ g/cm}^3 \leq D2 \leq 1.8 \text{ g/cm}^3$.” Ex. 1001, 33:57–58, 36:29–30.

We have reviewed Petitioner’s arguments and evidence and find them to be sufficient to meet the threshold of § 314(a).

Petitioner argues a POSITA would have found it obvious, with a reasonable expectation of success, to implement Su’s Examples 2 and 3 for the negative electrode (anode) of Zeng/Sunose to increase energy density. Pet. 45–46. Petitioner argues that Sunose describes a rolled electrode configuration and focuses primarily on the positive electrode (cathode), but leaves out details on implementing the anode. *Id.* at 46. Thus, Petitioner argues, a POSITA would have looked to Su, which describes a rolled electrode configuration like Sunose, “for such anode implementation details, including appropriate compaction densities for the single- and double-sided coating portions of the current collector.” *Id.* (citing Ex. 1012 ¶¶ 39–40).

In addition, Petitioner argues a POSITA would have found it obvious to try Su's Examples 2 and 3 anode configurations in Zeng/Sunose. Pet. 47 (citing Ex. 1003 ¶¶ 159). Petitioner contends that all three references recognized a market need for high energy density lithium batteries. *Id.* Petitioner argues that Su's disclosure of only seven Example batteries and one comparative Example battery indicates that there was a finite number of identified, predictable solutions, making it obvious for a POSITA to try all Examples. *Id.* (citing Ex. 1012 ¶¶ 50–84). Petitioner asserts that a POSITA would have had a reasonable expectation of success because Sunose and Su both describe wound/rolled electrode configurations and have current collectors with single- and double-coated portions. *Id.* at 48. Petitioner contends that Sunose describes a cathode configuration in detail, and it has a similar single-sided and double-sided configuration to that described by Su. *Id.* In addition, Su's Example batteries were successfully tested over more than 2000 cycles, with good results in capacity and energy density, according to Petitioner. *Id.*

Patent Owner contends that the deficiencies of Zeng and Sunose discussed above apply equally to this asserted ground of unpatentability. Prelim. Resp. 44.

On the record at this stage of the proceeding, having found no fault with Petitioner's position on Zeng's disclosure and having no comment from Patent Owner to counter Petitioner's argument regarding Sunose or Su or their combination with Zeng, we find that Petitioner meets the threshold showing under 35 U.S.C. § 314(a) for institution of trial with respect to claims 3 and 16.

6. *Obviousness over Zeng, Sunose, Matsuoka, Su*

Petitioner argues claims 3 and 16 are obvious over Zeng, Sunose, Matsuoka, and Su under 35 U.S.C. § 103. Pet. 49.

We have reviewed Petitioner's arguments and evidence and find them to be sufficient to meet the threshold of 314(a).

Patent Owner contends that the deficiencies of Zeng and Sunose in combination with Matsuoka discussed above apply equally to this asserted ground of unpatentability. Prelim. Resp. 44.

On the record at this stage of the proceeding, having found no fault with Petitioner's position on Zeng's disclosure and addressing Patent Owner's arguments regarding Matsuoka or their combination with Zeng, we find that Petitioner meets the threshold showing under 35 U.S.C. § 314(a) for institution of trial with respect to claims 3 and 16.

7. *Obviousness over Zeng, Sunose, Su, Kim*

Petitioner argues claims 3 and 16 are obvious over Zeng, Sunose, Su, and Kim under 35 U.S.C. § 103. Pet. 55. We have reviewed Petitioner's arguments and evidence and find them to be sufficient to meet the threshold of § 314(a).

Patent Owner contends that the deficiencies of Zeng and Sunose in combination with Kim discussed above apply equally to this asserted ground of unpatentability. Prelim. Resp. 44.

On the record at this stage of the proceeding, having found no fault with Petitioner's position on Zeng's disclosure and addressing Patent Owner's arguments regarding Kim or their combination with Zeng, we find

that Petitioner meets the threshold showing under 35 U.S.C. § 314(a) for institution of trial with respect to claims 3 and 16.

8. *Obviousness over Zeng, Sunose, Su, Matsuoka, Kim*

Petitioner argues claims 3 and 16 are obvious over Zeng, Sunose, Su, Matsuoka, and Kim under 35 U.S.C. § 103. Pet. 55. We have reviewed Petitioner's arguments and evidence and have found them to be sufficient to meet the threshold of 314(a).

Patent Owner contends that the deficiencies of Zeng and Sunose in combination with Matsuoka and Kim discussed above apply equally to this asserted ground of unpatentability. Prelim. Resp. 44.

On the record at this stage of the proceeding, having found no fault with Petitioner's position on Zeng's disclosure and addressing Patent Owner's arguments regarding Matsuoka and Kim or their combination with Zeng, we find that Petitioner meets the threshold showing under 35 U.S.C. § 314(a) for institution of trial with respect to claims 3 and 16.

9. *Obviousness over Zhou, Sunose*

Petitioner asserts that claims 1, 2, 4–7, 12, 14, 15, and 17 are obvious over Zhou and Sunose under 35 U.S.C. § 103, citing the Declaration of Dr. Lucht for support. Pet. 60–75 (citing Ex. 1003). We have reviewed Petitioner's arguments and evidence and have found them to be sufficient to meet the threshold of 314(a). Below, we address independent claims 1 and 14 and address the dependent claims collectively.

a) Claim 1

Claim 1 recites as a component in an electrochemical device “an electrolyte comprising a dinitrile compound, a trinitrile compound, and propyl propionate [PP]; wherein, based on a total weight of the electrolyte, a weight percentage of the dinitrile compound is X, and a weight percentage of the trinitrile compound is Y; wherein, about $2\text{ wt}\% \leq (X+Y) \leq \text{about } 8\text{ wt}\%$, and about $0.1 \leq (X/Y) \leq \text{about } 6$.” Ex. 1001, 33:19–27.

Petitioner relies on Zhou Example 8 as disclosing an adiponitrile-based (ADN, *dinitrile*) electrolyte containing HTCEN (*trinitrile*) and the linear carboxylic acid ester ethyl acetate (EA). Pet. 60. Petitioner argues that a POSITA would have found it obvious to select Zhou’s Example 8, citing a recognized need, finite number of identified, predictable solutions, and reasonable expectation of success. *Id.* at 64–66. Petitioner contends that “[e]ach of Zhou’s Example electrolytes is a self-contained, working embodiment providing a complete list of compounds, amounts, and preparation instructions.” *Id.* at 64 (citing Ex. 1003 ¶¶ 209–210). According to Petitioner, a POSITA would have been motivated to implement Zhou’s Example 8 with a reasonable expectation of success, as the battery of Example 8 significantly outperformed the Comparative Example batteries on low impedance. *Id.* (citing Ex. 1014 ¶¶ 57, 61), Figs. 1, 4; *id.* at 66.

Petitioner also contends that it would have been obvious to try Zhou Example 8. *Id.* Petitioner asserts that there was a market need for fast-charging technology driven by popularization of smart digital products and electrical vehicles that Zhou addressed with “a combination of solvents and additives that matches the fast charging electrolytes” and “[i]mprov[es] battery kinetics, high temperature performance, and cycle performance[.]”

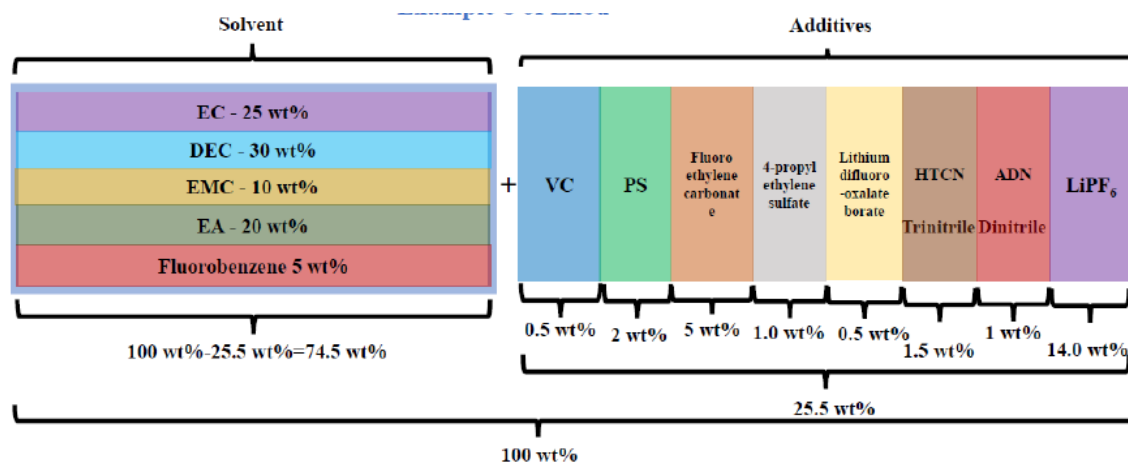
Id. at 65 (citing Ex. 1014 ¶ 5). Petitioner argues that Zhou discloses only eight electrolyte solutions (Examples 1–8), all of which had better performance than the Comparative Examples. *Id.* (citing Ex. 1014 ¶¶ 32–48). Petitioner contends that Example 8 outperformed Examples 3–6 in discharge capacity and outperformed Examples 1, 2, 4, and 6 in internal impedance, making Example 8 a priority to try. *Id.*

Petitioner acknowledges that Example 8 lacks the required PP, but argues that Zhou lists only eight alternative suitable linear carboxylic acid esters, two of which are EA and PP, and replacement of EA with PP in Example 8 would have been obvious. *Id.* at 60–61. Petitioner contends that Example 8 has 16.56 wt% EA, so substituting EA with PP results in PP falling within claim 7’s recited range of 5–50 wt% of the total electrolyte. *Id.*; see also Ex. 1014 ¶ 11.

Petitioner argues that replacement of EA with PP in Zhou’s Example 8 would have been obvious with a reasonable expectation of success given Zhou’s disclosure of a limited number of alternative suitable linear carboxylic acid esters. *Id.* at 60–61. Petitioner contends that the substitution of PP for EA would have been a simple one, replacing one carboxylic acid ester for another having two additional methyl groups, similar properties, and would yield predictable results. *Id.* at 60–61, 67, 69 (citing Ex. 1003 ¶¶ 219–220, 227).

According to Petitioner, “Zhou prefers dinitriles and trinitriles as they ‘improve the high temperature performance of the battery,’” and particularly prefers HTCEN “because it is ‘[an] efficient high temperature additive’ having ‘better compatibility with the negative electrode and . . . protect[ing] the positive electrode.’” Pet. 62 (citing Ex. 1014 ¶ 59.).

Petitioner provides the overall composition of Zhou Example 8 in the following illustration:



Petitioner’s illustration above lists each ingredient and its weight percentage separately for Example 8’s solvent and additives. Pet. 63 (citing Ex. 1014 ¶ 47; Ex. 1003 ¶¶ 204–184). According to Petitioner, Zhou specifies the weight percentage of additives based on “the total mass of the lithium-ion battery electrolyte.” *Id.* at 62 (quoting Ex. 1014 ¶¶ 9, 13–16, 18; Ex. 1003 ¶ 202).

Petitioner contends that the weight percentage of ADN (dinitrile) in the total electrolyte is 1 wt% (the claimed X) in Example 8. Pet. 63. Petitioner contends that HTCN (trinitrile) has a weight ratio of 1.5 wt% (the claimed Y). *Id.* Example 8 is asserted to have a weight ratio for EA (denoted as Z’ and claimed to be interchangeable with PP) in the total electrolyte after mixing the additives with the lithium salt and solvent, of $(1-25.5\%) \times (20\% / (25\% + 30\% + 10\% + 20\% + 5\%)) = 16.56\%$.¹⁰ *Id.* Petitioner reports the

¹⁰ Because the solvent components add up to 90 wt%, rather than 100 wt%, Petitioner’s calculation is incorrect, but it appears that Z’ would be < 20 wt% taking the error into account.

following values for X, Y, and Z': X = 1 wt%, Y = 1.5 wt%, Z' = 16.56 wt%. *Id.* at 64 (citing Ex. 1003 ¶ 207).

Regarding the recited relationships between dinitrile (X) and trinitrile (Y), Petitioner argues that X plus Y is 2.5 wt% and the ratio X/Y is 0.67 in Zhou's Example 8, satisfying the claimed ranges. Pet. 70–71.

Patent Owner alleges that Zhou fails to teach, suggest, disclose, or otherwise render obvious at least the trinitrile to PP ratio required by claim 1. Prelim. Resp. 44.

Patent Owner argues that Petitioner fails to show that a POSITA would have selected or implemented Zhou's Example 8. *Id.* Patent Owner asserts that an objective task of the '131 patent was to provide electrolyte compositions which prevent premature degradation of the electrolyte and thus deterioration of the battery material with reduced battery capacity, especially for electrochemical devices working at voltages above 4.4V, such as 4.45V. *Id.* at 45 (citing Ex. 2015 ¶ 241–242). According to Patent Owner, Zhou is silent with respect to cathode SEI film formation or high-voltage operation as its objective is a fast-charging electrolyte, which emphasizes better wettability, lower viscosity, and lower lithium-ion transmission resistance. *Id.* (citing Ex. 2015 ¶ 244; Ex. 1014 ¶ 3). Patent Owner argues that Zhou is directed to batteries with a lower charging voltage of only 4.35V, which a POSITA would know is substantially different from and much lower than the high working voltages (e.g. 4.45V) of the '131 patent. *Id.* (citing Ex. 2015 ¶ 245 (explaining that a POSITA would know that small voltage differences can lead to substantial (e.g., exponential) differences in rates of reaction)). Patent Owner also argues that a POSITA would have found Zhou's AC impedance testing/focus to be insufficient when faced

with the decomposition and premature degradation problem of the '131 patent because the DC internal resistance of the '131 patent is different from the AC impedance studied in Zhou. *Id.* at 46 (citing Ex. 2015 ¶¶ 246–247). Patent Owner alleges that Zhou has “multiple erroneous references to different or non-existent comparative examples in nearly every Example and Comparative Example,” causing a POSITA not to select or implement the reference. *Id.* (citing Ex. 2015 ¶¶ 248).

Patent Owner challenges Petitioner’s and Dr. Lucht’s position that Example 8 of Zhou outperforms all other example batteries depicted in Zhou’s Fig. 4. Prelim. Resp. 47 (citing Ex. 2015 ¶¶ 249–253; Ex. 1003 ¶¶ 209, 212). Patent Owner details why it believes Dr. Lucht’s interpretations of Fig. 4 are wrong. *Id.* at 47–49 (citing Ex. 2015 ¶¶ 249–253).

Patent Owner notes that Zhou’s Fig. 3 is the only figure that purports to depict battery cycle performance at high temperatures (45 °C), and Zhou indicates that HTCEN is particularly preferred to improve the high temperature performance of the battery. Prelim. Resp. 49. Patent Owner questions Petitioner’s failure to address the fact that the electrolyte solutions of Examples 4 and 8 of Zhou are the only examples that include a trinitrile (HTCEN), yet neither Example 4 nor Example 8 is depicted in Fig. 3. *Id.* at 50. Patent Owner concludes that a POSITA would not be able to draw any conclusions from Zhou regarding the effect of a trinitrile on high temperature performance, and would not have selected or implemented Example 8 over any other Examples. *Id.* (citing Ex. 2015 ¶ 257). Patent Owner thus asserts that a POSITA would not have a reasonable expectation of success in implementing Example 8. *Id.*

Patent Owner argues that there is no unambiguous data that would indicate to or encourage a POSITA to choose any particular embodiment of Zhou over another. Prelim. Resp. 51 (citing Ex. 2015 ¶ 259). Patent Owner identifies the following in support of this argument:

Ex. 1014, FIGS. 1 (Examples 1 and 2 are absent), 2 (Examples 3 and 6–8 are absent), 3 (Examples 3, 4, 7, and 8 are absent and Comparative Example 1 is depicted as having two distinct curves), and 4 (Examples 3, 5, and 7 are absent) ¶¶ [0060]–[0063].

Prelim. Resp. 51.

Further questioning Petitioner’s use of Zhou’s Example 8, Patent Owner notes that the sum of the mass ratio of the solvent components in Example 8 only adds up to 90, while the mass ratios of all other Examples and Comparative Examples add up to 100. Prelim. Resp. 51 (citing Ex. 2015 ¶ 260). Patent Owner criticizes Petitioner’s failure to address the discrepancy. *Id.* at 51–52. Patent Owner further criticizes Dr. Lucht’s assumption that mass ratio directly corresponds to weight percentages of the identified solvent components. *Id.* Patent Owner suggests that “[i]t is unknown if there is an additional, different solvent component present at 10 wt%, if there is an additional 10 wt% of one or more of the identified solvent components,” concluding that a POSITA would have disregarded Example 8. *Id.* at 52.

Because Zhou does not teach or suggest the ratio of the content of the trinitrile compound to the content of PP, argues Patent Owner, Petitioner relies on what is characterized as Dr. Lucht’s erroneous interpretations of Example 8. Prelim. Resp. 51. Patent Owner contends that Dr. Lucht assumes that the mass percentages for various additives (including ADN and HTC�) and for lithium salt are all based on the total mass of the final electrolyte

solution, and uses this assumption in his calculations. *Id.* at 51–52 (citing Ex. 1003 ¶ 203). However, Patent Owner urges, Example 8 is silent as to what the identified mass percentages are relative to and is subject to at least two other interpretations detailed by Patent Owner. *Id.* at 53. Patent Owner argues that “Dr. Lucht’s flawed assumptions otherwise permeate each of his resulting calculations of the alleged weight percentages of dinitrile, trinitrile, and PP, as well as the corresponding claimed weight percentage sums and ratios such that they should be disregarded.” *Id.* at 54 (citing Ex. 2015 ¶ 265).

Patent Owner’s issues regarding multiple alleged errors in Zhou and by Dr. Lucht, are better addressed through the discovery process in which experts for both sides can state and defend their positions.

Patent Owner challenges Petitioner’s assertion that a POSITA would have substituted PP for ethyl acetate (EA) in Zhou’s Example 8. Prelim. Resp. 54–56. Patent Owner argues that Zhou reports “no preference, special significance, or even the slightest indication to select PP” as the linear carboxylic acid ester for the electrolyte solution “since PP is not used in any of the Comparative Examples or Examples or otherwise tested for its functionality.” *Id.* at 54 (citing Ex. 1014 ¶¶ 26–48, 52–55; Ex. 2015 ¶ 267). According to Patent Owner, the chemical interactions and effects of complex combinations of various compounds in electrolyte solutions are extremely complex and unpredictable, not yielding predictable results from substituting PP for EA. *Id.* at 54–55.

In addition, Patent Owner contends that a POSITA would not expect PP to have a low melting point and provide a good channel for ion conductivity because PP is a larger molecule and substitution of it for EA

would increase both the melting point and the boiling point relative to the smaller EA molecule, defeating Zhou's identified purpose of providing a more suitable channel for lithium-ion transmission and reducing the impedance of the battery system. *Id.* at 55 (citing Ex. 2015 ¶¶ 270). Dr. Wheeler testifies that having both a low melting point and a low boiling point correlates to lower viscosity. Ex. 2015 ¶ 270. Dr. Wheeler testifies that PP's boiling point is considerably higher than other solvents used in Examples 1–8, its melting point is also nearly 10 °C higher than that of EA, and its viscosity is 53% higher than that of EA. *Id.* ¶¶ 270–271. Without accounting for such varying parameters, Patent Owner contends Petitioner's assumption that the PP would be substituted at a 1:1 weight percentage ratio "severely undercuts the reliability of Dr. Lucht's opinions." Prelim. Resp. 56 (citing Ex. 2015 ¶ 275).

Patent Owner argues that the chemical reactions in a battery are unpredictable, and a POSITA would understand that all of the components of an electrolyte are important and interact in complex and unexpected ways and substituting one component for another, even if apparently chemically similar, can cause substantial changes to properties of interest. Prelim. Resp. 56 (citing Ex. 2015 ¶ 274).

Considering Zhou's identification of PP as a linear carboxylic acid ester for use in Zhou's electrolyte, Petitioner sufficiently shows for purposes of institution that Zhou discloses this limitation of claim 1.

Patent Owner contends that Zhou is fundamentally different from the '131 patent claims, and "[a] POSITA would not have selected or implemented Zhou because the electrolyte formulation purposes in Zhou are not aligned with the objective task underlying the '131 Patent." Prelim.

Resp. 45. However, our reviewing court holds “[o]ne of ordinary skill in the art need not see the identical problem addressed in a prior art reference to be motivated to apply its teachings.” *Cross Med. Prods., Inc. v. Medtronic Sofamor Danek, Inc.*, 424 F.3d 1293, 1323 (Fed. Cir. 2005); *see also In re Oetiker*, 977 F.2d 1443, 1448 (Fed. Cir. 1992) (Nies, C.J., concurring). “In determining whether the subject matter of a patent claim is obvious, neither the particular motivation nor the avowed purpose of the patentee controls. What matters is the objective reach of the claim.” *KSR*, 550 U.S. at 419.

Thus, we do not find that a POSITA would be dissuaded from considering Zhou for all that it discloses. For purposes of § 103, a reference is prior art for all that it discloses, regardless of whether it is enabled. *Symbol Techs., Inc. v. Opticon, Inc.*, 935 F.2d 1569, 1578 (Fed. Cir. 1991).

Patent Owner argues Zhou teaches away from the combination of a dinitrile compound and a trinitrile compound in its electrolyte solutions and, thus, teaches away from Example 8, because dinitrile contains less nitrile groups for the same volume. Prelim. Resp. 50. Patent Owner contends that a POSITA would not have selected or implemented Example 8, having both a dinitrile and a trinitrile to avoid the negative effect on cycle performance in fast charging of “excessive addition of nitrile.” Prelim. Resp. 50–51 (quoting Ex. 1014 ¶ 59).

Zhou states:

For the improvement of high temperature performance under high voltage of the fast charging system, *among the nitrile compounds containing 2 or 3 nitrile functional groups in the third additive used in the present invention to improve the high temperature performance of the battery, 1,3,6-hexane trinitrile is particularly preferred.* This is related to the poor compatibility of nitrile compounds with the negative electrode.

The high temperature performance is often challenged when using the solvent system of the present invention. An efficient high temperature additive is the best choice. Nitrile compounds containing 2 or 3 nitrile functional groups, such as 1,3,6-hexane trinitrile, contain three nitrile groups, and the density of nitrile groups per unit volume is higher. It has better compatibility with the negative electrode and is easier to protect the positive electrode. The high temperature improvement effect of other dinitrile compounds or mononitrile compounds is relatively poor. This requires more nitrile to compensate. However, *excessive addition of nitrile has a negative effect on the cycle performance*, especially in the case of fast charging, this phenomenon is more obvious, and the cycle performance will drop rapidly.

Ex. 1014 ¶ 59 (emphasis added). We do not read Zhou as explicitly teaching away from implementing Example 8. Rather, Zhou seems to encourage use of HTCN, the trinitrile used in Example 8. Zhou teaches “*excessive addition of nitrile*” *id.* (emphasis added) has a negative effect, but does not “criticize, discredit, or otherwise discourage investigation into” any of the electrolyte solutions of the Examples. *See Meiresonne*, 849 F.3d at 1382.

Based on the current record, we find Petitioner’s position that Zhou discloses this claim limitation to be supported by evidence.

Claim 1 recites “an electrode . . . the electrode comprises a current collector, a single-sided coating and a double-sided coating; a first part of the current collector is provided with the single-sided coating and a second part of the current collector is provided with the double-sided coating.”

Ex. 1001, 33:19, 28–33.

According to Petitioner, Zhou discloses or suggests an electrode comprising a current collector because Zhou discloses electrolytes for lithium-ion batteries, which, by definition, have positive and negative electrodes that each comprise a current collector. Pet. 71 (citing Ex. 1014,

Abstr., ¶¶ 2–6, 20, 47, 57, 61; Ex. 1003 ¶¶ 233–234). Petitioner argues that a POSITA would have looked to Sunose for details to implement its improved electrode, discussed above in connection in the combination of Zeng and Sunose, because Zhou focuses on electrolytes rather than the physical battery configuration and Sunose relates to lithium-ion batteries, including those employing non-aqueous electrolytes. *Id.* at 70–71 (citing Ex. 1010, Abstr. ¶¶ 1–11, Ex. 1014 ¶¶ 1–8).

Patent Owner argues that the deficiencies discussed with respect to the combination of Zeng and Sunose apply equally here. Prelim. Resp. 56–57. Patent Owner argues that a POSITA would not have been motivated to combine Sunose with Zhou because Sunose does not disclose electrolytes or a relationship between an electrolyte having Zhou’s additives and electrode compaction density. *Id.* at 57. Patent Owner argues Sunose attempts to solve a compaction problem on particular roller mill equipment without any bearing on the problem attributed to the electrolyte composition, thus there is no logical connection between Zhou and Sunose. *Id.* (citing Ex. 2015 ¶ 279).

As discussed above in connection with the combination of Sunose with Zeng, “any need or problem known in the field of endeavor at the time of invention and addressed by the patent can provide a reason for combining the elements in the manner claimed.” *KSR*, 550 U.S. at 420. It is not necessary that the benefit afforded by Sunose’s electrode structure be the same as the ’131 patent or sought specifically and explicitly by Zhou.

Based on the current record, we find Petitioner’s position that a POSITA would have had a reason to combine Sunose’s electrode configuration comprising a cathode having single- and double-sided coating

portions on its current collector with Zhou's battery for the benefit disclosed by Sunose to be supported by evidence.

Claim 1 recites "an electrode compaction density of the electrode corresponding to the first part with the single-sided coating is D1, and, an electrode compaction density of the electrode corresponding to the second part with the double-sided coating is D2, wherein, about $0.8 \leq D1/D2 \leq$ about 1.2." Ex. 1001, 33:34–39.

Petitioner argues that Sunose discloses the claimed battery configuration for the same reasons discussed above in connection with the combination of Zeng and Sunose. Pet. 71–72.

Patent Owner argues that the deficiencies discussed with respect to the combination of Zeng and Sunose applies equally here, including that a POSITA would be deterred from Sunose's teaches in view of Sunose's erroneous value which Patent Owner asserts are not physically realizable. Prelim. Resp. 56–57.

Based on the current record, we find Petitioner's position that Zhou as modified by Sunose discloses this claim limitation to be supported by evidence. As stated above in connection with the combination of Zeng and Sunose, to the extent that Sunose's Table 1 may include packing densities that exceed the crystalline density of LCO, it is insufficient to conclude that (1) the packing densities identified for Sunose's Examples 2–4 are not electrode compaction densities and (2) that the ratios (M/N) for Sunose's identified packing densities for Examples 2–4 are incommensurable with the claimed ratio (D2/D1). Patent Owner acknowledges that "some physical origin" underlies Sunose's packing densities and ratios. Prelim. Resp. 21. If some physical origin underlies Sunose's packing densities for Examples 2–4

and these identified packing density values are not challenged as “physically impossible,” then it is not readily apparent that the ratios (M/N) for Sunose’s Examples 2–4 are incommensurable with the claimed ratio (D2/D1) as Patent Owner asserts. In addition, the asserted synergy between the claimed ratio and the electrolyte would be expected to flow from the combination of Sunose’s Examples 2–4 with Zhou’s electrolyte. *See Ex parte Obiaya*, 227 USPQ 58, 60 (BPAI 1985).

Claim 1 recites “based on the total weight of the electrolyte, a weight percentage of the propyl propionate [PP] is Z; wherein, about 0.01 $\leq(Y/Z) \leq$ about 0.3.” Ex. 1001, 33:40–43.

Petitioner argues that for Zhou’s Example 8, Y=1.5 wt% and Z (PP substituted for EA)=16.56 wt%, thus Y/Z= 0.091, falling within the claimed range. Pet. 72 (citing Ex. 1003 ¶¶ 236–237).

Based on the current record, we find Petitioner’s position that Zhou discloses this claim limitation to be supported by evidence.

Claim 1 recites “wherein the trinitrile compound is one selected from the group consisting of . . . 1,3,6-hexanetricarbonitrile.” Ex. 1001, 33:44–46.

Petitioner argues that Zhou’s Example 8 has 1,3,6-hexanetricarbonitrile (HTCN) as recited in claim 1 for the trinitrile compound. Pet. 72 (citing Ex. 1014 ¶ 47; Ex. 1003 ¶ 238).

Based on the current record, we find Petitioner’s position that Zhou discloses this claim limitation to be supported by evidence.

In sum, based on this preliminary record, we find that Petitioner demonstrates sufficient argument and evidence to show it is more likely than not that claim 1 would have been obvious over Zhou and Sunose.

b) Claim 14

Claim 14 differs from claim 1 in that claim 14 recites “[a]n electrochemical device, comprising: electrodes” rather than “an electrode” as recited in claim 1. Compare Ex. 1001, 35:44–45 (claim 14) with Ex. 1001, 33:18–19 (claim 1). Additionally, claim 14 recites “the first electrode comprises a first current collector and a single-sided coating; the second electrode comprises a second current collector and a double-sided coating” rather than “a first part of the current collector . . . and a second part of the current collector” having a single- and double-sided coating as recited in claim 1. Compare Ex. 1001, 36:1–4 (claim 14) with Ex. 1001, 33:28–33 (claim 1).

As with Petitioner’s challenge to claim 14 over Zeng and Sunose, Petitioner accounts for the limitations of independent claim 14 on the basis that claim 14 reads on an electrode with single- and double-sided portions for the same reasons provided for claim 1. Pet. 75. Patent Owner does not provide arguments for claim 14 separate from the arguments directed to claim 1, which we address above. Prelim. Resp. 58 (referring to “claims 1 and 14”).

On this preliminary record, we find that Petitioner demonstrates sufficient argument and evidence to show it is more likely than not that claim 14 would have been obvious over Zhou and Sunose.

c) Claims 2, 4–7, 12, 15, and 17

Petitioner accounts for the limitations recited in claims 2, 4–7, 12, 15, and 17. Pet. 73–75. Petitioner explains how Zhou and Sunose disclose the recitations of claims 2, 4–7, and 12, which depend from claim 1, and claims

15 and 17, which depend from claim 14. *Id.* Patent Owner does not assert any additional arguments for the dependent claims. Prelim. Resp. 58.

In sum, based on the evidence in the present record, we are persuaded that Petitioner has shown sufficiently for purposes of this Decision that Zhou and Sunose disclose or suggest all limitations recited in claims 2, 4–7, 12, 15, and 17 as well as independent claims 1 and 14.

10. Obviousness over Zhou, Sunose, Kim

Petitioner asserts that claims 1, 2, 4–7, 12, 14, 15, and 17 are obvious over Zhou, Sunose, and Kim under 35 U.S.C. § 103, citing the Declaration of Dr. Lucht for support. Pet. 76–77 (citing Ex. 1003). We have reviewed Petitioner’s arguments and evidence and have found them to be sufficient to meet the threshold of 314(a) for the reasons discussed above in connection with the combination of Zhou and Sunose.

As with the combination of Kim with Zeng and Sunose discussed above, Patent Owner contends that Kim fails to provide guidance with respect to a Y/Z ratio because Kim discloses volume percentages rather than weight percentages. Prelim. Resp. 58. Patent Owner contends that a POSITA would be deterred from Kim’s teachings in view of Kim’s internally contradicting data, statistical uncertainty, and inadequate experimental procedure details. *Id.*

As with the combination of Zhou and Sunose, Patent Owner contends that Zhou provides no preference or slightest indication for a POSITA to select PP as a substitution for EA in the absence of PP in Zhou’s Examples. Prelim. Resp. 58–59. As discussed above regarding Zhou, considering Zhou’s identification of PP as a linear carboxylic acid ester for use in Zhou’s

electrolyte, Petitioner sufficiently shows for purposes of institution that Zhou discloses this limitation of claim 1. However, we agree with Patent Owner that Petitioner's citation to Zhou's paragraph 59 fails to support the assertion that Zhou cautions against an excessive amount of PP. Prelim. Resp. 59 (citing Pet. 77; Zhou ¶ 59). Zhou's paragraph 59 refers to an excessive amount of nitrile, not PP. Zhou ¶ 59.

At this stage in the proceeding, we find Petitioner sufficiently identifies a motivation to combine Kim with Zhou to adjust the relative amounts of trinitrile and PP. *See* Pet. 56, 60. Petitioner explains how Kim's disclosure of using PP along with a dinitrile and a trinitrile in both Examples was more successful than the Comparative Examples, none of which employed all three components. *See id.* at 58–59 (citing Ex. 1008 ¶ 90, Table 1). Thus, Petitioner has shown sufficiently for purposes of this Decision that Zhou, Sunose, and Kim disclose or suggest all limitations recited in claims 1, 2, 4–7, 12, 14, 15, and 17.

11. Obviousness over Zhou, Sunose, Su

Petitioner argues claims 3 and 16 are obvious over Zhou, Sunose, and Su under 35 U.S.C. § 103, citing the Declaration of Dr. Lucht for support. Pet. 75–76 (citing Ex. 1003). Claims 3 and 16 depend from independent claims 1 and 14, respectively, and recite “wherein the electrode is an anode, and $1.2 \text{ g/cm}^3 \leq D_2 \leq 1.8 \text{ g/cm}^3$.” Ex. 1001, 33:57–58, 36:29–30. According to Petitioner, Zhou discloses this claim limitation. Pet. 75 (citing Ex. 1003 ¶ 248). Petitioner argues that a POSITA would have configured Zhou's anode according to Su's Examples, citing Zhou's disclosure of market

demand for batteries with high energy density as support for the combination. Pet. 76 (Ex. 1014 ¶¶ 2–5; Ex. 1003 ¶ 249).

Patent Owner argues that Su does not cure the deficiencies of the combination of Zhou and Sunose. Prelim. Resp. 59.

Based on the evidence in the present record, we are persuaded that Petitioner has shown sufficiently for purposes of this Decision that Zhou, Sunose, and Su disclose or suggest all limitations recited in claims 3 and 16.

12. Obviousness over Zhou, Sunose, Su, Kim

Petitioner argues claims 3 and 16 are obvious over Zhou, Sunose, and Su in further view of Kim under 35 U.S.C. § 103. Pet. 76–77. It is not clear from the Petition why this ground is raised. Petitioner’s statement of this ground highlights Kim’s motivation to consider the ratio of trinitrile to PP in Zhou and substituting EA for PP in Zhou’s Example 8. *Id.* at 76. Petitioner argues that Zhou highlights the advantage of trinitrile (HTCN). *Id.* at 76–77 (citing Ex. 1014 ¶ 59). Petitioner argues that Zhou draws attention to PP by substituting EA with PP. *Id.* at 77 (citing Ex. 1014 ¶ 11). We agree with Patent Owner that Petitioner’s assertion that Zhou cautions against an excessive amount of PP is not supported by Zhou’s paragraph 59. Prelim. Resp. 59 (citing Pet. 77; Zhou ¶ 59). Zhou’s paragraph 59 refers to an excessive amount of nitrile, not PP. Zhou ¶ 59.

Patent Owner argues that Su does not cure the deficiencies of the combination of Zhou and Sunose. Prelim. Resp. 59.

Because we determine that Petitioner has shown sufficiently for purposes of this Decision that Zhou, Sunose, and Su disclose or suggest all limitations recited in claims 3 and 16, and because we find evidence to

support Kim's disclosure of using PP along with a dinitrile and a trinitrile in both Examples was more successful than the Comparative Examples (Ex. 1008 ¶ 90, Table 1), we determine Petitioner's arguments to be sufficient to meet the threshold of ¶ 314(a) for this ground.

IV. CONCLUSION

Petitioner has, at this stage, established that it will more likely than not prevail in showing that at least one of the challenged claims is unpatentable. This determination is, however, based on a preliminary record and is not final on any issues of patentability. We will make a final determination on the patentability of the challenged claims, as necessary and applying the preponderance of the evidence standard, based on a fully developed record through trial.

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, pursuant to 35 U.S.C. § 324(a) post grant review of claims 1–7 and 14–17 of the '131 patent is hereby *instituted* on the grounds set forth in the Petition, commencing on the entry date of this Order, and pursuant to 35 U.S.C. § 324(d) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial; and

FURTHER ORDERED that the trial will be conducted in accordance with a separately issued Scheduling Order.

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