

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZHUHAI COSMX BATTERY CO., LTD.,
Petitioner,

v.

NINGDE AMPEREX TECHNOLOGY LIMITED,
Patent Owner.

IPR2025-00432
Patent 11,575,148 B2

Before DONNA M. PRAISS, KEVIN W. CHERRY, and
DEBRA L. DENNETT, *Administrative Patent Judges*.

CHERRY, *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 to institute *inter partes* review of claims 1–19 of U.S. Patent No. 11,575,148 B2 (Ex. 1001, “the ’148 patent”). Paper 2 (“Pet.”). Ningde Amperex Technology Ltd. (“Patent Owner”) filed a Preliminary Response. Paper 7 (“Prelim. Resp.”).

We have authority under 35 U.S.C. § 314 to determine whether to institute an *inter partes* review. 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 “there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” The Supreme Court has held that the Board, in a decision to institute under 35 U.S.C. § 314(b), may not institute review on less than all claims challenged in the petition. *SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1355–56 (2018). Moreover, in accordance with our rules, “[w]hen instituting *inter partes* review, the Board will authorize the review to proceed on all of the challenged claims and on all grounds of unpatentability asserted for each claim.” 37 C.F.R. § 42.108(a) (2020); *see also PGS Geophysical AS v. Iancu*, 891 F.3d 1354, 1360 (Fed. Cir. 2018) (interpreting the statute to require “a simple yes-or-no institution choice respecting a petition, embracing all challenges included in the petition”).

Applying those standards, and upon considering the Petition, the Preliminary Response, and the evidence of record, we determine the information presented a reasonable likelihood that Petitioner would prevail in establishing the unpatentability of at least one of the challenged claims of the ’148 patent. Accordingly, we institute an *inter partes* review.

II. BACKGROUND

A. *Related Matters*

The parties identify the following district-court proceeding between the parties concerning the '148 patent: *Ningde Amperex Technology Limited v. Zhuhai CosMX Battery Co.*, 2:24-cv-00728 (E.D. Tex.).

B. *Real Parties in Interest*

Petitioner identifies its real party in interest as Zhuhai CosMX Battery Co., Ltd. Pet. 77.

Patent Owner identifies Ningde Amperex Technology Ltd. as its real party in interest. Paper 3, 1.

C. *The '148 Patent*

The '148 patent is titled “Porous Film and Lithium-Ion Battery.” Ex. 1001, Code [54]. The '148 patent issued from Application Serial No. 17/061,427, filed Oct. 1, 2020. *Id.* at Code [21], [22]. The '427 application is a continuation of Application Serial No. 16/000,764, filed on June 5, 2018, which is now U.S. Patent No. 10,833,355. *Id.* at Code [63]. The '148 Patent claims priority to China Patent Application No. 201810322931.1 filed April 11, 2018. *Id.* at Code [30].

The '148 patent relates to a porous film, including a binder and inorganic particles, that includes pores that are formed by the binder and that at least include a part of the inorganic particles. *Id.* at Code [57]. The Specification explains that, at the time of the invention, lithium-ion batteries were widely used in portable electronic devices and were applied as the power supply for new energy vehicles, promoting the development of lithium-ion battery technology. *Id.* at 1:22–29. Cycle capacity of the lithium-ion battery was reduced, influencing the lithium-ion battery's service

life, from a gap created between the electrode and the separator during the charging and discharging of the cycle process of the lithium-ion battery. *Id.* at 1:29–33. The Specification contends that there is a need for a technical solution to solve the problem of the gap between the separator and the electrode in order to improve the service life of the lithium-ion battery. *Id.* at 1:33–37. Thus, it is one object of the invention to provide a porous film and a lithium-ion battery, with parameters to reduce the probability of pore blockage of the porous film and enable the porous film to have high ionic activity, allowing the lithium-ion battery to achieve better rate performance and cycle performance. *Id.* at 2:47–56.

The '148 patent achieves its objective using the composition and structure of the pores in its porous film, including “the average wall thickness between the pores is in the range of 20nm to 500nm,” “the porous film has an average pore size of 0.3 μm to 20 μm ,” and different particle size and volume accumulation range combinations. *Id.* at 1:49–52. For example, the '148 patent describes that “the inorganic particles have particle sizes such that particle size having a volume accumulation of 10% (Dv10) is in a range of 0.015 μm to 3 μm , particle size having a volume accumulation of 50% (Dv50) is in a range of 0.2 μm to 5,” and the “particle size having a volume accumulation of 10% (Dv10) is less than particle size having a volume accumulation of 50% (Dv50).” *Id.* at 1:53–57, 2:4–6.

The '148 patent explains that “[p]article size having a volume accumulation of 10% (Dv10) refers to particle sizes which reach 10% of the cumulative volume from the side of small particle size in the granularity distribution on a volume basis.” *Id.* at 1:59–62. The '148 patent further explains that “[p]article size having a volume accumulation of 50% (Dv50)

refers to particle sizes which reach 50% of the cumulative volume from the side of small particle size in the granularity distribution on a volume basis.” *Id.* at 1:62–66. Finally, the ’148 patent describes that “[p]article size having a volume accumulation of 90% (Dv90) refers to particle sizes which reach 90% of the cumulative volume from the side of small particle size in the granularity distribution on a volume basis.” *Id.* at 1:66–2:3.

The porous film has “a pore size distribution coefficient (D) of the pores in the porous film is in a range of 1 to 5” and “a porosity of 20% to 90%, and the porous film has a thickness of 0.2 to 10 μm ,” as well as “a volumeratio of the inorganic particles to the binder [that] is in a range of 0.2 to 3.0.” *Id.* at 2:16–18, 2:36–37. As a result, the porous film described in the ’148 patent “has excellent adhesion, and meanwhile the pore structure of the porous film can still be well maintained after being immersed in the electrolyte,” allowing for the intended reduced probability of pore blockage and the enabled high ionic conductivity of the porous film. *Id.* at 2:47–52.

D. The Challenged Claims

Petitioner challenges claims 1–19 of the ’148 patent, which are all of the claims of the ’148 patent. Pet. 1. Of the challenged claims, claims 1 and 10 are independent, and are reproduced below with Petitioner’s identifiers for the claim limitations, as illustrative of the subject matter recited in the challenged claims.

[1.pre] A porous film, comprising:

[1.1] a binder; and

[1.2] inorganic particles;

[1.3] wherein the porous film comprises pores formed by the binder

[1.4] the pores at least comprises a part of the inorganic particles

- [1.5] wherein the inorganic particles have particle sizes that Dv10 is in a range of 0.015 μm to 3 μm ,
- [1.6] Dv50 is in a range of 0.2 μm to 5 μm , and
- [1.7] Dv90 is in a range of 1 μm to 10 μm ;
- [1.8] Dv10 of the inorganic particles is less than Dv50 of the inorganic particles, and
- [1.9] Dv50 of the inorganic particles is less than Dv90 of the inorganic particles, and
- [1.10] the inorganic particles have particle sizes that the ratio of Dv90 to Dv10 is in a range of 2 to 100.

Ex. 1001, 25:33–46.

- [10.pre] A lithium-ion battery, comprising:
 - [10.1] a positive electrode;
 - [10.2] a negative electrode;
 - [10.3] a separator, arranged between the positive electrode and the negative electrode;
 - [10.4] non-aqueous electrolyte; and
 - [10.5] a porous film, comprising:
 - [10.6] a binder; and
 - [10.7] inorganic particles;
 - [10.8] wherein the porous film comprises pores formed by the binder,
 - [10.9] the pores at least comprises a part of the inorganic particles,
 - [10.10] wherein the inorganic particles have particle sizes that Dv10 is in a range of 0.015 μm to 3 μm ,
 - [10.11] Dv50 is in a range of 0.2 μm to 5 μm ,
 - [10.12] Dv90 is in a range of 1 μm to 10 μm ;
 - [10.13] Dv10 of the inorganic particles is less than Dv50 of the inorganic particles, and

[10.14] Dv50 of the inorganic particles is less than Dv90 of the inorganic particles; and

[10.15] the inorganic particles have particle sizes that the ratio of Dv90 to Dv10 is in a range of 2 to 100.

Ex. 1001, 26:11–30.

E. Evidence

Petitioner submits the following evidence:

Evidence	Exhibit No.
Declaration of Samuel P. Gido, Ph.D.	1003
Murakami, US 2017/0162849 A1 (published June 8, 2017, filed July 31, 2015) (“Murakami”)	1005
Honda, WO 2015/178351 A1 (published Nov. 26, 2015, filed May 18, 2015) (“Honda”)	1007
Tanaka, JP P2017-137432A (published Aug. 10, 2017, filed Feb. 4, 2016) (“Tanaka”)	1009
Beard, US 2012/0228214 A1 (published Sep. 13, 2012, filed Mar. 13, 2012) (“Beard”)	1010
Akiike, US 2016/0013465 A1 (published Jan. 14, 2016, filed Mar. 19, 2014) (“Akiike”)	1011

Patent Owner supports its Preliminary Response with the Declaration of Dean R. Wheeler, Ph.D. Ex. 2015.

F. Asserted Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1, 2, 5–11, 14–19	103 ¹	Murakami
3, 12	103	Murakami, Honda
4, 13	103	Murakami, Tanaka
1, 2, 5–11, 14–19	103	Murakami, Beard

¹ The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended 35 U.S.C. § 103. The ’148 patent claims benefit of an April 11, 2018, filing date, which is after the effective date of the applicable AIA amendments. Ex. 1001, Code [30].

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
3, 12	103	Murakami, Beard, Honda
4, 13	103	Murakami, Beard, Tanaka
1–3, 5–12, 14–19	103	Beard, Akiike
4, 13	103	Beard, Akiike, Tanaka

Pet. 15–16.

III. PATENTABILITY ANALYSIS

Petitioner contends that claims 1–19 of the ’148 patent are unpatentable under 35 U.S.C. § 103 over various combinations of Murakami, Honda, Tanaka, Beard, and Akiike. Pet. 8, 15–16.

A patent claim is unpatentable under 35 U.S.C. § 103 if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time of the effective filing date to a person having ordinary skill in the art to which said subject matter pertains. *See 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) when in evidence, objective evidence of nonobviousness.² *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

“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.

² Patent Owner does not present arguments or evidence of secondary considerations in its Preliminary Response. Therefore, secondary considerations do not constitute part of our analysis herein.

Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (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 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).

We organize our patentability analysis into four sections. First, we address the level of ordinary skill in the art. Second, we address claim construction. Third, we provide an overview of the asserted references. And fourth, taking account of the information presented, we consider whether the Petition satisfies the threshold requirement for instituting an *inter partes* review under 35 U.S.C. § 314(a).

A. Level of Ordinary Skill in the Art

We consider the asserted grounds of unpatentability in view of the understanding of a person of ordinary skill in the art. In assessing the level of ordinary skill in the art, various factors may be considered, including the “type of problems encountered in the art; prior art solutions to those problems; rapidity with which innovations are made; sophistication of the technology; and educational level of active workers in the field.” *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995) (quoting *Custom Accessories, Inc. v. Jeffrey-Allan Indus., Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986)). “[O]ne or more factors may predominate.” *Id.*

Relying on the declaration testimony of Dr. Gido, Petitioner contends that an ordinarily skilled artisan for the ’148 patent “would have had at least a bachelor’s degree or equivalent degree from an accredited institution in chemistry, chemical engineering, materials science, or a similar discipline

covering relevant principles of organic and inorganic chemistry, polymer processing, ceramic materials, and ceramic processing” and “three or more years of experience in electrochemical energy storage devices, lithium-ion battery technology, separators, characterizations and analyses of particle size, film thickness, and/or materials compositions, battery performance characterization, or other applications of polymer chemistry, ceramic chemistry, and ceramic processing.” Pet. 14. Petitioner additionally contends “[m]ore education could substitute for less experience, and *vice versa*.” *Id.* (citing Ex. 1003 ¶ 17).

Patent Owner “adopts the definition proposed by the Petitioner.” Prelim. Resp. 14.

Based on this record, we adopt Petitioner’s articulation of the level of ordinary skill in the art, which is consistent with the ’148 patent and the asserted prior art, and we apply it in our obviousness evaluations below. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art, itself, can reflect appropriate level of ordinary skill in art). We note that our decision would be the same applying either party’s definition of a person of ordinary skill in the art.

B. Claim Construction

Next, we turn to claim construction. In interpreting the claims of the ’148 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) (2020). 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 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 contends that “[n]o claim terms require express construction.” Pet. 14–15. Patent Owner does not at this time address claim construction. See Prelim. Resp. 14–15.

Having considered the record, we determine that no express claim construction is necessary for any claim terms. See *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (holding that only claim terms in controversy need to be construed, and only to the extent necessary to resolve the controversy (citing *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))). We note, however, there may be some claim terms below whose constructions that the parties may wish to address during trial.

C. The Prior Art

Before turning to Petitioner’s asserted grounds of unpatentability, we provide brief summaries of the asserted references.

1. *Murakami* (Ex. 1005)

Murakami is titled “Porous Layer, Separator Formed by Laminating Porous Layer, and Non-Aqueous Electrolyte Secondary Battery Including Porous Layer or Separator.” Ex. 1005, Code [54]. *Murakami* focuses “on a voidage of a porous layer which is laminated onto one surface or each of both surfaces of a porous film.” *Id.* ¶ 13. *Murakami* is based on, “in a case where a degree of variability of the voidage is controlled within a predetermined range, a non-aqueous electrolyte secondary battery” including “a separator that is a laminated body in which the porous layer is laminated

onto one surface or each of both surfaces of the porous film, has an excellent cycle characteristic.” *Id.*

Murakami’s porous layer “contains a filler in which, in terms of average particle diameter obtained based on a volume (i) D10 is 0.005 μm to 0.4 μm , D50 is 0.01 μm to 1.0 μm , and D90 is 0.5 μm to 5.0 μm and (ii) a difference between D10 and D90 is 2 μm or less.” *Id.* ¶ 18. Murakami’s porous layer “is laminated on one surface or each of both surfaces of a porous film containing polyolefin as a main component or laminated on a surface of at least one of a positive electrode and a negative electrode” and “a degree of variability in voidage that is measured in the 32 [divided] sections” of the porous layer “is 16.0% or lower, each of the 32 sections being a rectangular parallelepiped whose longitudinal length is 2.3 μm , transverse length is 2.3 μm , and thickness is identical with that of the porous layer.” *Id.* ¶ 23.

2. *Honda (Ex. 1007)*

Honda is entitled “Non-Aqueous Rechargeable Battery Separator, Manufacturing Method Thereof, and Non-Aqueous Rechargeable Battery.” Ex. 1007, Code [54]. Honda relates “to a non-aqueous rechargeable battery separator, a manufacturing method thereof, and a non-aqueous rechargeable battery.” *Id.* ¶ 1. Honda describes prior art “outer covering[s] of non-aqueous rechargeable batteries,” such as “packs made of aluminum laminated films” that “have been developed as an outer covering material in place of metal cannisters,” are soft and allow for gaps to be “easily formed between the electrodes and the separator by external impact or expansion and contraction of the electrodes due to charging and discharging, and cycle life may decrease.” *Id.* ¶ 3.

Honda provides “a non-aqueous rechargeable battery separator that achieves excellent handling properties and high affinity with an electrolyte solution in a well-balanced manner” as well as “high manufacturing efficiency.” *Id.* ¶ 8. Honda discloses

A non-aqueous rechargeable battery separator, provided with a porous base material containing a thermoplastic resin, and a porous layer provided on one surface or both surfaces of the porous base material and containing a polyvinylidene fluoride resin, the porous layer having a structure in which a large number of cells open in a direction perpendicular to the surface of the porous layer are aligned adjacent to each other in the surface direction of the porous layer and having a contact angle with water of 115° to 140°.

Id. ¶ 9. Honda’s “porous layer is partitioned into cells having a large number of openings by mesh-shaped partitions in the direction perpendicular to the surface of the porous layer,” including a honeycomb structure. *Id.* ¶¶ 36, 38–39.

3. *Tanaka (Ex. 1009)*

Tanaka is titled “Polyolefin Porous Sintered Compact.”

Ex.1009, Code [54]. Tanaka discloses “a polyolefin porous sintered compact.” *Id.* ¶ 1. Tanaka provides “a polyolefin porous sintered compact that can ensure high water absorption performance, has little pressure loss, and has excellent durability.” *Id.* ¶ 9. Tanaka teaches

a polyolefin porous sintered compact containing polyolefin particles composed of a polyolefin, having a thickness of 0.05 to 1 mm, and having a median pore diameter distribution in which, when defining a median pore diameter corresponding to 10% cumulative and 90% cumulative from the large diameter side of the cumulative pore distribution as D10 and D90, respectively, a D10/D90 ratio is 10 or less.

Id. ¶ 15.

4. *Beard (Ex. 1010)*

Beard is entitled “Filled Porous Membrane.” Ex. 1010, Code [54]. Beard relates to “porous membranes” that are used “in electrochemical devices such as batteries and capacitors,” requiring “consistent pore size and good tortuosity.” *Id.* ¶ 2. Beard seeks to provide a porous membrane with “a high concentration of spherical fillers with a polymer binder,” which “may have an affinity for the filler materials and may hold the filler materials together in a porous structure with high tortuosity and consistent pore size.” *Id.* ¶ 3. Beard teaches that, “[w]ithin the pore walls that may be less than 0.02 microns in width, a densely packed filler material may have an average diameter of less than 0.005 microns.” *Id.*

The microporous membrane has “spherical filler” particles densely packed in the pore walls, making the membrane suitable for use as a battery separator. *Id.* ¶¶ 10, 33. The filler consists of inorganic particles such as titanium oxide (*id.* ¶¶ 36, 54), and the polymer binder forms pores because the polymer binder and filler material are suspended in a “liquid pore forming agent,” which is later removed “after solidification begins” (*id.* ¶¶ 57–59).

5. *Akiike (Ex. 1011)*

Akiike is entitled “Slurry for Lithium Ion Secondary Battery Porous Film, Production Method Therefor, Separator for Lithium Ion Secondary Battery, and Lithium Ion Secondary Battery.” Ex. 1011, Code [54]. Akiike relates to “a slurry for a lithium ion secondary battery porous membrane and a production method thereof, as well as a separator for a lithium ion secondary battery and a lithium ion secondary battery using the slurry.” *Id.* ¶ 1. Akiike seeks to provide

a lithium ion secondary battery excellent in both high temperature cycle property and safety by forming a porous membrane using a slurry that includes non-conductive particles, a water-soluble polymer having an acidic group-containing monomer unit, and a particulate polymer, wherein the amount of the water-soluble polymer is set within a predetermined range and a BET specific surface area of the non-conductive particles is set within a predetermined range.

Id. ¶ 7.

The separator includes “an organic separator layer; and a porous membrane obtained by applying onto the organic separator layer the slurry for a lithium ion secondary battery porous membrane.” *Id.* ¶ 16. The slurry “includes non-conductive particles, a water-soluble polymer, and a particulate polymer.” *Id.* ¶ 26. The particulate polymer “function[s] as a binder in the porous membrane.” *Id.* ¶ 67. Akiike discloses D10, D50, and D90 ranges and values based on volume for these inorganic particles. *Id.* ¶¶ 10–13, 31–33 (preferred D10, D50, and D90 ranges), (Tables 1-4).

D. Alleged Ground of Unpatentability Over Murakami

Petitioner contends that claims 1, 2, 5–11, and 14–19 of the ’148 patent are unpatentable under 35 U.S.C. § 103 as obvious over Murakami. Pet. 19–40. Patent Owner argues that Murakami does not teach or suggest limitations [1.3]–[1.10]. Prelim. Resp. 15–34.

1. Claim 1

a) [1.pre] “A porous film, comprising”

To the extent the preamble is limiting, Petitioner argues that Murakami discloses a porous film. See Pet. 20–21 (citing Ex. 1003 ¶¶ 75–81; Ex. 1005 ¶¶ 3, 13–210). At this time, Patent Owner does not dispute that Murakami teaches or suggests this limitation. Accordingly, based on our

review of the current record, we find that Petitioner has shown sufficiently that Murakami teaches this limitation.

b) [1.1] a binder; and

Petitioner contends that Murakami discloses this limitation. See Pet. 21–22 (citing Ex. 1005 ¶¶ 17 (noting “[t]he porous layer of the present invention . . . contains a filler and a binder resin”), 53, 140; Ex. 1003 ¶¶ 82–84). At this time, Patent Owner does not dispute that Murakami teaches or suggests this limitation. Accordingly, based on our review of the current record, we find that Petitioner has shown sufficiently that Murakami teaches this limitation.

c) [1.2] inorganic particles;

Petitioner contends that Murakami discloses this limitation. See Pet. 22–23 (citing Ex. 1005 ¶¶ 17, 18, 59, 61 (noting “[t]he filler is more preferably a filler made of inorganic oxide”), 140; Ex. 1003 ¶¶ 85–87). At this time, Patent Owner does not dispute that Murakami teaches or suggests this limitation. Accordingly, based on our review of the current record, we find that Petitioner has shown sufficiently that Murakami teaches this limitation.

d) [1.3] wherein the porous film comprises pores formed by the binder

Petitioner submits that Murakami discloses this limitation. See Pet. 23–25 (citing Ex. 1003 ¶¶ 88–95; Ex. 1005 ¶¶ 93, 121, 209, 211, claims 10–13, Abstract). Petitioner argues that Murakami’s porous layer comprises pores, and “[t]he porous film comprises pores formed by the binder given pores are found within the binder and porous layer.” *Id.* at 23 (citing Ex. 1002, 22). In particular, Petitioner contends that “‘the filler is bound by the binder resin’ containing the pores within the porous layer.” *Id.*

(citing Ex. 1005 ¶ 70). Petitioner further notes that Murakami’s process for coating the porous layer onto the porous film forms the pores in a comparable way to the process disclosed in the ’148 patent, which will result in a similar structure as that disclosed in the ’148 patent. *Id.* at 23–25 (citing Ex. 1003 ¶ 91–94; Ex. 1005 ¶¶ 16, 23, 52, 58, 71–79, 87–89; Ex. 1017, 9:57–10:2).

Patent Owner asserts that the plain meaning of “pores formed by the binder” requires “the pore geometry to be defined by the boundaries of the binder.” Prelim. Resp. 16. Patent Owner argues, based on this construction, that Murakami fails to teach or suggest this limitation. Prelim. Resp. 16–25. Patent Owner contends that “imaging, such as SEM imaging, is critical for determining pore structure,” and without such imaging, a person of ordinary skill in the art would not have been able to determine pore structure of Murakami. *Id.* at 18–20.

At this stage of the proceeding, we find that no construction is necessary of the term “pores formed by the binder.”³ We find that Petitioner has shown sufficiently that Murakami teaches or suggests “pores formed by the binder.” As Petitioner explains, the pores are found within the binder and porous layer, and “the filler is bound by the binder resin” containing the pores within the porous layer. Pet. 23 (citing Ex. 1002, 22; Ex. 1005 ¶ 70). We further find support for this finding in the fact that Murakami’s process for coating the porous layer onto the porous film forms the pores in a comparable way to the process employed in the ’148 patent. *Id.* (citing Ex. 1003 ¶ 91). Not only does Murakami disclose a similar process to the

³ The parties may wish to address the proper construction of this term during trial.

'148 patent, *see* Pet. 23–24 (citing Ex. 1005 ¶¶ 16, 23, 52, 58, 71–79, 87–89; Ex. 1003 ¶ 92–94), Murakami explains that the binder remaining after Murakami's process forms “a resin layer containing a fibrillar resin or a granular resin” that is the porous layer. Ex. 1005 ¶ 16; *see id.* ¶¶ 23, 58, 71, 87; Ex. 1003 ¶ 92.

As Dr. Gido explains, the '148 patent and Murakami use a widely-known “phase inversion or coagulation process” to “obtain porosity in coating layers containing particles and resin binder.” Ex. 1003 ¶ 93; Ex. 1017, 9:57–10:2. Dr. Gido further opines that Murakami and the challenged patent describe forming a porous layer by coating a solution containing binder, and then causing that binder to phase separate (coagulate) out of solution to form a solid porous structure by the addition another solvent that does not dissolve the binder resin. Ex. 1003 ¶ 94. Thus, we find that regardless of the construction of “pores formed by the binder,” Petitioner has shown sufficiently, at this stage, that Murakami teaches or suggests this limitation.

e) *[1.4] the pores at least comprises a part of the inorganic particles*

While Petitioner acknowledges that Murakami does not expressly disclose this limitation, Petitioner argues that Murakami either inherently discloses or renders obvious this limitation. Pet. 25–30. Petitioner notes that, in Murakami, the amount of filler by weight percent greatly exceeds the amount of binder by weight percent. *See id.* at 26. Thus, Petitioner contends, supported by the testimony of Dr. Gido, that, given the disclosed compositions, a person of ordinary skill in the art would understand that the pores in Murakami's porous layer necessarily include at least some portion

of the inorganic filler or would have found this obvious. *See id.* (citing Ex. 1003 ¶ 97).

Patent Owner argues that “[f]or a pore to comprise a part of the inorganic particles, that means that least some of the inorganic particles must extend into the empty space delineated by the boundary of the binder.” Prelim. Resp. 25 (citing Ex. 2015 ¶ 98). Patent Owner asserts that a person of ordinary skill in the art “would understand that the pore geometry is defined by the binder because the binder is what divides the empty spaces, and at least some of the inorganic particles extend at least partially into those empty spaces (the pores).” *Id.* at 26. Patent Owner contends that “the inorganic particles cannot merely be in the walls that surround the pores,” but rather “at least some inorganic particles must be part of the pores themselves.” *Id.*

We find that Petitioner has shown sufficiently that Murakami teaches or suggests this limitation. *See* Pet. 25–30. As Petitioner explains, many of Murakami’s examples include more inorganic filler by weight than binder, and the natural result of this is that some of Murakami’s pores will comprise part of the inorganic particles. *See* Ex. 1003 ¶¶ 91–94. Patent Owner’s arguments seem to seek to read in extraneous limitations about the structure of the pore wall and the extent to which the inorganic particles must extend into the pores. None of these limitations are supported by the claim language or the Specification, and we decline to read them into the claims on this record.⁴ Thus, we find that Petitioner has shown sufficiently that Murakami teaches or suggests this limitation.

⁴ The parties may address the claim construction of this limitation in their briefing during trial.

- f) [1.5] wherein the inorganic particles have particle sizes that Dv10 is in a range of $0.015\text{ }\mu\text{m}$ to $3\text{ }\mu\text{m}$,
- g) [1.6] Dv50 is in a range of $0.2\text{ }\mu\text{m}$ to $5\text{ }\mu\text{m}$, and
- h) [1.7] Dv90 is in a range of $1\text{ }\mu\text{m}$ to $10\text{ }\mu\text{m}$;

Petitioner submits that Murakami discloses the claimed Dv10, Dv50, and Dv90 ranges. See Pet. 31–32 (citing Ex. 1003 ¶¶ 109–112; Ex. 1005 ¶¶ 18, 140, 161). Specifically, Petitioner notes the Murakami’s general description discloses an overlapping range, and Examples 1 and 2 disclose specific points that fall within the claimed Dv10, Dv50, and Dv90 ranges. *Id.*

Patent Owner argues that claims require a certain particle size distribution of the inorganic particles *in* the porous film, but Murakami only discloses the initial size distributions of inorganic particles *before* they become part of the porous layer. Prelim. Resp. 27–28. Patent Owner asserts that during the manufacturing process used in Murakami, the particle size would dramatically change from the starting distribution. *Id.* at 30–31. Thus, Patent Owner contends that Murakami fails to disclose the claimed particle size distribution.

We find that Petitioner has shown sufficiently that Murakami discloses the claimed particle size distribution. To begin with, we are uncertain whether Patent Owner’s claim construction, which requires that the particle size distribution be measured at the time it is in the film, not before, is correct. We have not located, nor has Patent Owner directed us to, disclosure in the ’148 patent of measuring the particle size distribution *in the film*. Instead, the discussion we have located seems to focus on the particle size distribution of the inorganic particles at the time they are added to the binder. The parties should address this claim construction during the trial.

However, even if Patent Owner's construction is correct, we find that Murakami teaches this limitation. To begin with, we do not agree with Patent Owner that Murakami only teaches the particle size distribution before it is added to the porous film. For example, claim 10 of Murakami claims (as with claim 1 of the '148 patent), a porous film. Ex. 1005, claim 10. Claim 10 of Murakami specifically recites that the porous film contains "a filler" and then recites a specific particle size distribution for the filler—with D[v]10 of 0.005 μm to 0.4 μm , D[v]50 of 0.01 μm to 1.0 μm , and D[v]90 of 0.5 μm to 5.0 μm . *Id.* As Petitioner explains, this range at least partially overlaps with the range disclosed in the '148 patent. See Pet. 31. Thus, Patent Owner is not correct that Murakami does not disclose the particle sizes *in the film*.

Even if Patent Owner is correct that Murakami only discloses the initial particle size distribution, not the particle size distribution in the porous film, we still find that Petitioner has shown sufficiently that Murakami teaches these limitations. Patent Owner's contentions rest on the assertion that Murakami's manufacturing process would dramatically alter the particle size distribution of the final porous film from the initial distribution of particles added to the binder. Prelim. Resp. 29–31. Patent Owner's expert testifies that the particular manufacturing technique disclosed in Murakami (the Sugino Machine Ltd. Star Burst) would change the particle size and distribution. Ex. 2015 ¶¶ 106–107. Patent Owner's expert relies, at least in part, on a graph included in a brochure (Ex. 2029) from the manufacturing purporting to show the effect of "ten passes at a pressure of 98 MPa [(megapascals)]," which Patent Owner's expert submits is 2 MPa less than Murakami discloses. *Id.* ¶ 106 (citing Ex. 2029, 3).

However, Patent Owner's arguments are difficult to reconcile with the express disclosure of Murakami. For example, in paragraphs 61 to 68, Murakami provides a detailed discussion of its filler materials. Murakami explains that the filler can be "wet-ground with the use of a wet grinding device in order to control an average particle diameter" and goes on to provide a detailed discussion about how to control the particle size distribution. *See* Ex. 1005 ¶¶ 61–65. Murakami then explains its preferred particle-size distribution, the results from using this distribution, and the implications of departing from this distribution. *Id.* ¶ 66. In particular, Murakami explains that "in a case where a filler is used whose average particle diameter and particle size distribution are less than the above range, cohesive force between particles in the filler becomes excessively high, and therefore dispersibility tends to be decreased." *Id.* Murakami also discloses multiple dispersion and coating methods. *See id.* ¶ 73. Thus, given the extent of this disclosure and the significance Murakami explains the particle size distribution has on the resulting porous film, it seems, on the current record, unlikely that Murakami would ignore the significant effect that Patent Owner alleges the Sugano Star Burst machine would have on the resulting distribution. At this stage, this tension leads us to give little weight to Dr. Wheeler's testimony.

A further reason we give little weight, at this stage, to Dr. Wheeler's testimony is that we are not persuaded that the distribution change shown in the Star Burst brochure reflects what would occur in the manufacturing process disclosed in Murakami. As Patent Owner acknowledges, the Star Burst brochure describes the results after ten "passes" when Murakami only describes using three. *See* Prelim. Resp. 30 (citing Ex. 1005 ¶ 141; Ex. 2015

¶ 105). Additionally, Patent Owner points to the brochure's graph, purporting to show the change in particle size distribution resulting from the Star Burst machine. *See* Prelim. Resp. 31 (citing Ex. 2029, 3). However, it is unclear how this graph relates to the manufacturing process disclosed in Murakami, i.e., whether it involves the same or similar materials, whether the conditions are similar. For example, the text accompanying the graphs explains that "uniform particle with narrow particle size distribution can be achieved by controlling the injection speed of the raw material." Ex. 2029, 3. Given the dependence on injection speed, it is unclear how this is equivalent to what is disclosed in Murakami. In sum, these uncertainties lead us to give less weight to Dr. Wheeler's testimony versus the express disclosure of Murakami, at this stage of the proceeding.

Thus, we find Petitioner has shown sufficiently that Murakami accounts for this limitation.

i) *[1.8] Dv10 of the inorganic particles is less than Dv50 of the inorganic particles, and*

Petitioner contends that Murakami discloses this limitation. Pet. 32–33 (citing Ex. 1003 ¶¶ 113–115; Ex. 1005 ¶¶ 18, 140, 161). Aside from the arguments considered above regarding limitations [1.5]–[1.7], Patent Owner does not, at this time, dispute that Murakami discloses this limitation. Because we did not find those arguments persuasive, we find, on this record, that Petitioner has shown sufficiently that Murakami teaches this limitation.

j) *[1.9] Dv50 of the inorganic particles is less than Dv90 of the inorganic particles, and*

Petitioner contends that Murakami discloses this limitation. Pet. 33–34 (citing Ex. 1003 ¶¶ 116–118; Ex. 1005 ¶¶ 18, 140, 161). Aside from the arguments considered above regarding limitations [1.5]–[1.7], Patent Owner

does not, at this time, dispute that Murakami discloses this limitation. Because we did not find those arguments persuasive, we find, on this record, that Petitioner has shown sufficiently that Murakami teaches this limitation.

- k) *[1.10] the inorganic particles have particle sizes that the ratio of Dv90 to Dv10 is in a range of 2 to 100.*

Petitioner contends that Murakami teaches or suggests this limitation. Pet. 34 (citing Ex. 1003 ¶¶ 119–121; Ex. 1005 ¶¶ 18, 140, 161). In particular, Petitioner argues that when the ratio of Dv90 and Dv10 values disclosed in Murakami is calculated, the ratio falls within the claimed range. *Id.* In addition to the arguments regarding Dv10 and Dv90 discussed above, Patent Owner also argues that Murakami never expressly discloses the taking ratio of Dv90 to Dv10, but instead discusses taking the difference between Dv90 and Dv10. Prelim. Resp. 32–33. Patent Owner also contends that Petitioner relies on a range that is much larger than what is claimed, and thus, this argument fails to consider the criticality of the claimed ratio range. *Id.* (citing *E.I. du Pont de Nemours & Co. v. Synvina C.V.*, 904 F.3d 996, 1006 (Fed. Cir. 2018)).

We find that Petitioner has shown sufficiently, on this record, that Murakami teaches this limitation. To begin with, we disagree with Patent Owner that Murakami needed to expressly discuss the claimed ratio. Here, the ratio can be easily determined from the express disclosure of Murakami. As for Patent Owner’s arguments regarding criticality, Petitioner has shown examples not only of overlapping ranges, but also points within the range that are disclosed. *See Titanium Metals, Inc. v. Banner*, 778 F.2d 775, 782–83 (Fed. Cir. 1985); Thus, we find this sufficient to account for this limitation.

l) Summary as to Claim 1

We find that Petitioner has shown sufficiently that Murakami accounts for all the limitations of claim 1. Patent Owner does not raise any secondary considerations of nonobviousness at this stage of the proceeding. Thus, we conclude that Petitioner has shown a reasonable likelihood of prevailing in showing that claim 1 would have been obvious over Murakami.

2. Claims 2, 5–11, and 14–19

Patent Owner does not raise any other separate arguments regarding claims 2, 5–11, and 14–19 other than those we have considered above with respect to claim 1. *See* Prelim. Resp. 15–34. We have reviewed Petitioner’s contentions and evidence regarding these claims, and find that Petitioner has shown a reasonable likelihood of prevailing in showing that claims 2, 5–11, and 14–19 are unpatentable as obvious over Murakami.

E. Alleged Ground of Unpatentability Over Murakami and Honda

Petitioner contends that claims 3 and 12 of the ’148 patent are unpatentable under 35 U.S.C. § 103 as obvious over Murakami and Honda. Pet. 41–43.

Patent Owner argues that this ground suffers from the same deficiencies to the disclosures of Murakami as discussed above with respect to obviousness over Murakami considered above. Prelim. Resp. 34–35. On the current record, we do not find Patent Owner’s arguments persuasive, as explained above. We have reviewed Petitioner’s contentions and evidence regarding claims 3 and 12, and determine that Petitioner shows a reasonable likelihood of prevailing with respect to the unpatentability of claims 3 and 12 as obvious over Murakami and Honda.

F. Alleged Ground of Unpatentability Over Murakami and Tanaka

Petitioner contends that claims 4 and 13 of the '148 patent are unpatentable under 35 U.S.C. § 103 as obvious over Murakami and Tanaka. Pet. 43–48.

Patent Owner argues that this ground suffers from the same deficiencies to the disclosures of Murakami as discussed above with respect to obviousness over Murakami. Prelim. Resp. 35. On the current record, we do not find Patent Owner's arguments persuasive, as explained above. We have reviewed Petitioner's contentions regarding claims 4 and 13, and determine that Petitioner shows a reasonable likelihood of prevailing in showing claims 4 and 13 would have been obvious over Murakami and Tanaka.

G. Alleged Grounds of Unpatentability Over Murakami and Beard, Murakami and Beard and Honda, and Murakami and Beard and Tanaka

Petitioner contends that claims 1, 2, 5–11, and 14–19 of the '148 patent are unpatentable under 35 U.S.C. § 103 as obvious over Murakami and Beard; that claims 3 and 12 of the '148 patent are unpatentable under 35 U.S.C. § 103 as obvious over Murakami, Beard, and Honda; and that claims 4 and 13 of the '148 patent are unpatentable under 35 U.S.C. § 103 as obvious over Murakami, Beard, and Tanaka. Pet. 48–56.

In this combination, Petitioner relies on Murakami for most of the limitations of claims 1 and 10, but submits that, to the extent Murakami does not disclose limitations [1.3] and [10.8]'s requirement that “the porous film comprises pores formed by the binder,” and limitations [1.4] and [10.9]'s requirement that “the pores at least comprises a part of the inorganic particles,” that Beard teaches those limitations. Pet. 48. Patent Owner argues that neither Beard nor Murakami discloses limitations [1.4] and

[10.9], and that a person of ordinary skill would not have been motivated to combine Murakami and Beard. Prelim. Resp. 35–36. Patent Owner further argues that Beard does not address its arguments regarding Murakami with respect to claim limitations [1.5]–[1.9] (and the corresponding limitations in claims 10 (limitations [10.10]–[10.14])). *Id.* at 36. We addressed Patent Owner arguments regarding Murakami above, and focus our discussion on limitations [1.3] (and [10.8]), [1.4] (and [10.9]), and the motivation to combine.

1. [1.3]/[10.8] wherein the porous film comprises pores formed by the binder

In particular, with respect to limitations [1.3] and [10.8], Petitioner provides the following annotated version of Beard’s Figure 1.

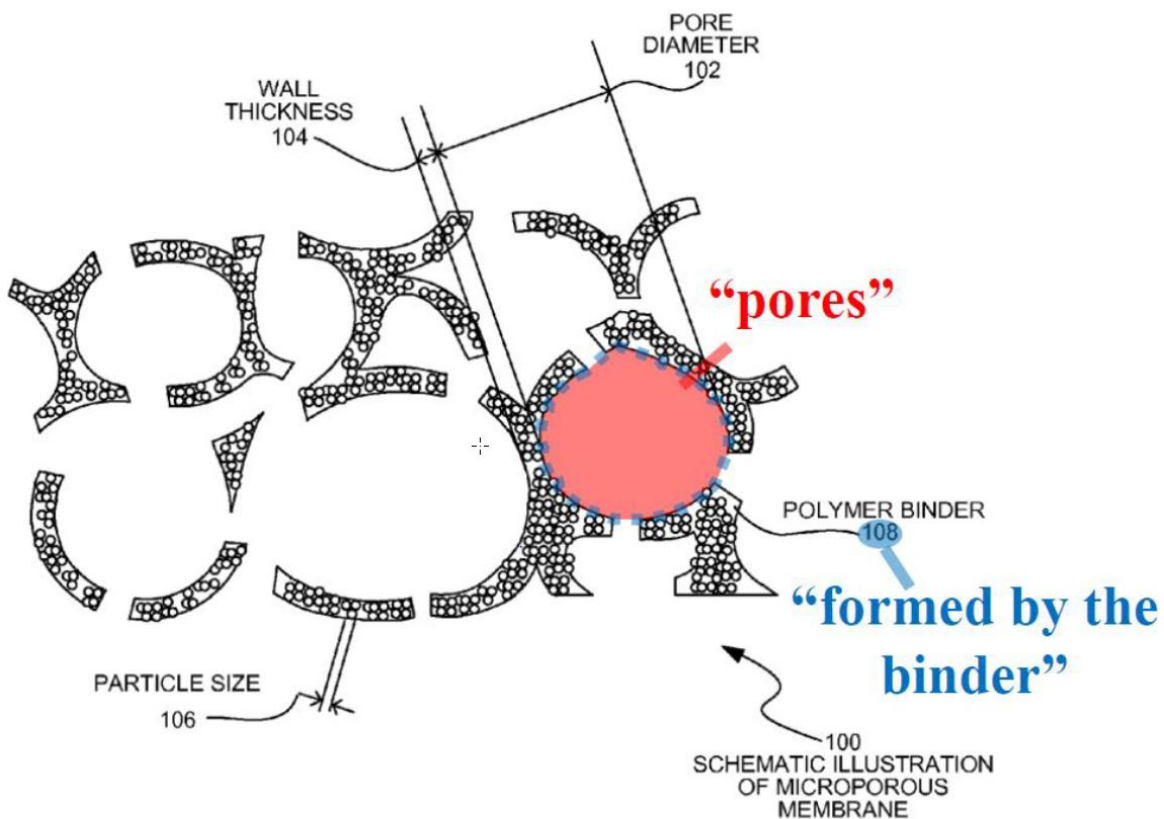


FIG. 1

An annotated version of Beard’s Figure 1 showing the pore structure of the porous film of Beard with the pores and that they are “formed by the binder” highlighted. Ex. 1003 ¶ 167.

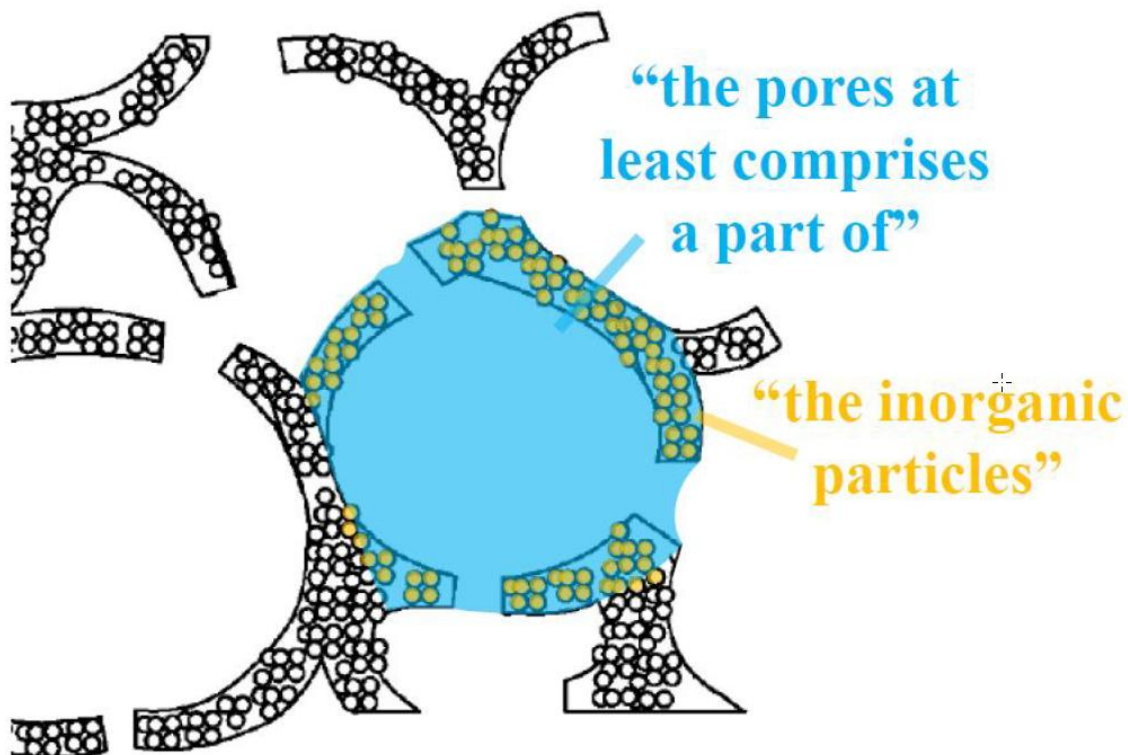
Petitioner contends that Beard also expressly teaches “pores formed by the binder,” explaining that “the manufacturing process melts or dissolves the polymer, mixes the polymer with a pore-forming agent and filler material, and then solidifies it.” Pet. 51 (citing Ex. 1010 ¶¶ 57–60). Petitioner submits that “[t]he pore-forming agent is removed ‘after solidification begins,’ leaving behind the porous layer—i.e., pores created by the binder.” *Id.* (citing Ex. 1010 ¶ 59). Petitioner contends that “[t]he pore-forming agent induces coagulation of the binder polymer or phase separation of the polymer binder upon cooling.” *Id.* (citing Ex. 1010 ¶¶ 57–59).

Petitioner notes that “[a]ccording to Beard, two main factors—the amount of pore forming agent and degree of thermodynamic energy required to wet the polymer—control how the pores in the porous layer are formed by the binder.” *Id.* (citing Ex. 1010 ¶¶ 66–69; Ex. 1003 ¶ 168). Petitioner contends that Beard uses a process using a solvent coagulation process like that described in the ’148 patent, Murakami, and Honda. *Id.* (citing Ex. 1003 ¶¶ 169–172; Ex. 1001, 6:16–32; Ex. 1010 ¶¶ 57–59).

At this stage of the proceeding, Patent Owner does not dispute that Beard discloses this limitation. We address Patent Owner’s arguments about the effect of the combination on this limitation below. *See* Prelim. Resp. 48–50. We have reviewed Petitioner’s contentions and evidence, and find that Petitioner has shown sufficiently that Beard teaches or suggests limitations [1.3] and [10.8]. *See* Pet. 49–52.

2. [1.4]/[10.9] the pores at least comprises a part of the inorganic particles

With respect to limitations [1.4] and [10.9], Petitioner argues that Beard discloses these limitations two ways. First, Petitioner provides the following annotated version of Beard's Figure 1 highlighting the inorganic particles and illustrating that Beard's pore walls comprise a part of the inorganic filler.



Beard, FIG. 1*

Petitioner's annotated version of Beard's Figure 1 showing the inorganic parties in yellow and pore in light blue illustrating its contention that Beard's pore "comprises a part of the inorganic particles. Pet. 52.

Petitioner asserts that this annotated version of Figure 1 shows that "the 'fillers are very tightly packed into the pore walls of [the] microporous membrane.'" *Id.* at 53 (citing Ex. 1010 ¶¶ 3, 10, 12). Petitioner argues that

“[t]his occurs because “smaller fibrous particles may be captured inside the polymer binder 108[.]” *Id.* (citing Ex. 1010 ¶ 25). Thus, Petitioner submits that Beard’s pore walls comprise smaller filler particles. *Id.*

Second, Petitioner argues that Beard’s pore voids comprise at least some filler material. *Id.* (citing Ex. 1003 ¶ 176). Petitioner notes that “[t]he ’148 Patent provides no information about what it means for pores to at least comprise a part of the inorganic particles—beyond repeating the broad claim language.” *Id.* (citing Ex. 1001, Abstract, 1:45–50). Petitioner submits that “the claim language does not require the inorganic particles to be inside the pore voids themselves.” Petitioner asserts that “Figure 1 of Beard shows at least some inorganic filler particles protruding beyond the pore wall and into the void itself.” *Id.* Petitioner provides a version of Beard’s Figure 1, annotated by Petitioner and reproduced below, where Petitioner purports to identify inorganic filler particles shown to be extending into Beard’s pores.

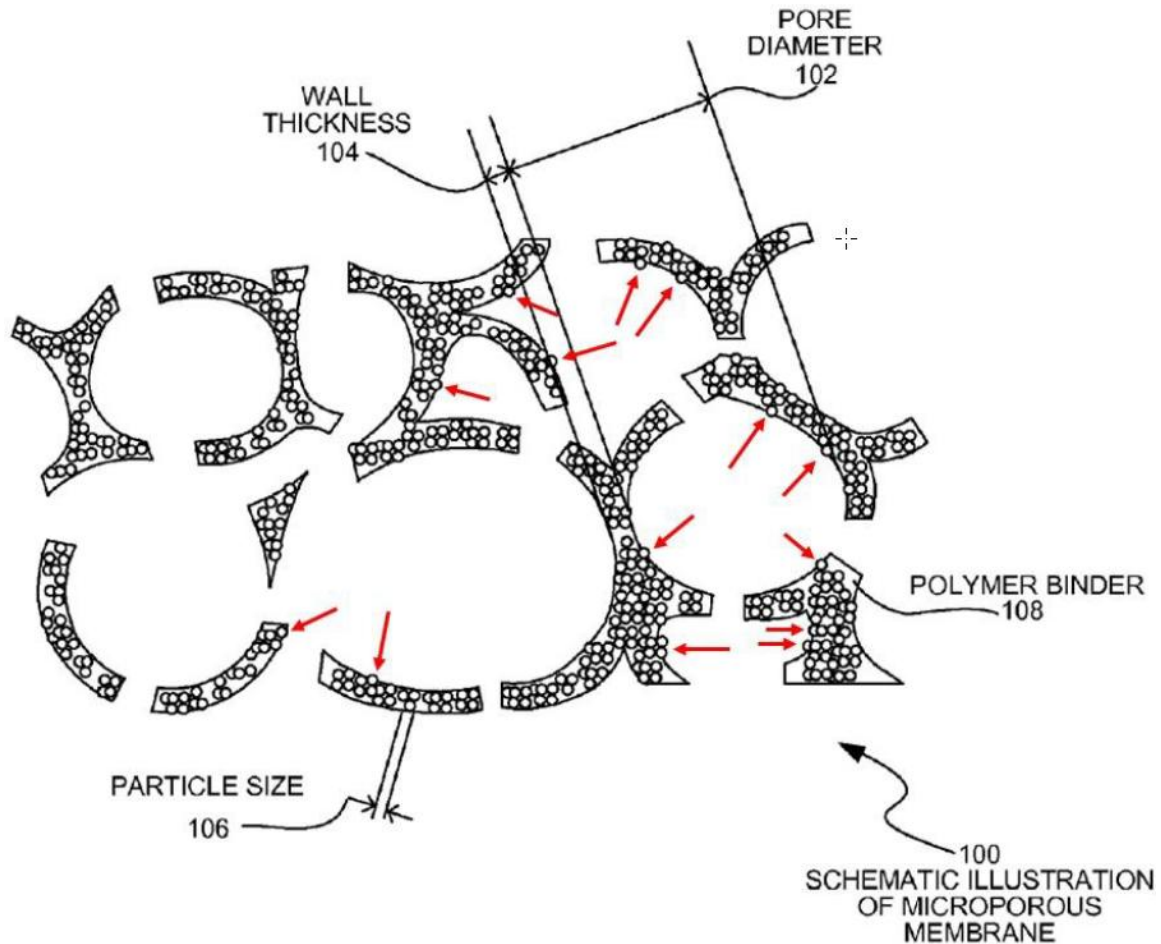


FIG. 1

Beard's Figure 1, annotated with arrows by Petitioner that point to inorganic filler particles that Petitioner alleges extend into Beard's pores. *Id.* at 54.

Petitioner notes that Beard also explains that "larger fibrous particles, greater than 1 micron may extend through, across or between the pores creating a porous fibrous network independent of the fillers deployed within the polymer membrane walls that surround the larger fibrous particles." *Id.* (citing Ex. 1010 ¶ 25). Thus, Petitioner asserts that Beard's pore voids contain at least a part of larger inorganic filler particles. *Id.* (citing Ex. 1003 ¶ 176).

Patent Owner argues that Petitioner has failed to show that Beard discloses limitations [1.4] and [10.9]. Prelim. Resp. 36–41. As with Murakami, Patent Owner contends that “pores . . . comprise a part of the inorganic particles” requires “at least some of the inorganic particles to extend into the pores.” *Id.* at 37. Thus, Patent Owner asserts that Petitioner’s first theory for how Beard accounts for this limitation fails. *Id.* at 37–38. As for the second theory, Patent Owner argues Petitioner cannot rely on Figure 1 because it is an inaccurate handwritten conceptual drawing that contradicts the disclosure of Beard. *Id.* at 38–41. Finally, Patent Owner contends that Petitioner also cites to an alternative embodiment in Beard where “larger fibrous particles, greater than 1 micron may extend through, across or between the pores creating a porous fibrous network independent of fillers deployed within the polymer membrane walls that surround the larger fibrous particles.” *Id.* at 41 (citing Ex. 1010 ¶ 25). Patent Owner asserts that this embodiment would contradict Petitioner’s motivation to combine and would result in a film where the pores would not be “formed by the binder” as required by the claims. *Id.* at 42.

On the current record, we find that Petitioner has shown sufficiently that Beard accounts for this limitation. We find that Petitioner has shown, even under Patent Owner’s interpretation of this limitation, that Beard accounts for this limitation in its disclosure in Figure 1 of particles that extend into the pores. Pet. 53–54. Patent Owner’s reliance on *Hockerson-Halberstadt, Inc. v. Avia Group Int’l*, 222 F.3d 951, 956 (Fed. Cir. 2000), is misplaced. See Prelim. Resp. 38. In *Hockerson-Halberstadt*, the Federal Circuit rejected a broader claim construction that “hinge[d] on an inference drawn from certain figures about the quantitative relationship between the

respective widths of the groove and fins” because it was contrary to well-established precedent that “patent drawings do not define precise proportions of the elements and may not be relied on to show particular sizes if the specification is completely silent on the issue.” *See id.* at 956. However, that does “not mean that things patent drawings show clearly are to be disregarded.” *In re Mraz*, 455 F.2d 1069, 1072 (CCPA 1972). Instead, “[d]escription for the purposes of anticipation can be by drawings alone as well as by words.” *Id.* (citation omitted). Indeed, patent drawings are useful for all they reasonably convey to one skilled in the art. *See In re Aslanian*, 590 F.2d 911, 914 (CCPA 1979).

Here, Petitioner is not attempting to ascribe a particular size to certain particles or a precise dimension to how much the particle extends into the pore. Rather, Petitioner relies on Figure 1 to teach that at least some of the inorganic filler particles may be on the surface of the pores and may extend into the pores themselves—a qualitative relationship that does not require precise sizing or actual dimensions, as was required in the case of the figure in *Hockerson-Halberstadt*.

Patent Owner’s arguments that Petitioner’s contentions regarding the disclosure of Figure 1 of Beard are inconsistent with the written description of Beard, are also not persuasive. *See* Prelim. Resp. 39–41. Patent Owner, relying on its expert, Dr. Wheeler, argues that the SEM image reproduced in Beard in Figure 2 “shows no regular incorporation of filler particles into the pores such that the pores comprise a part of the inorganic particles.” *Id.* at 39 (citing Ex. 2015 ¶¶ 127–129). However, the SEM images Beard discloses are not relied upon by Petitioner and only purport to show an embodiment of the invention. *See* Ex. 1010 ¶ 25. Moreover, Figure 2’s

disclosure does not negate Figure 1's teachings. *See In re Applied Materials, Inc.*, 692 F.3d 1289, 1298 (Fed. Cir. 2012) ("A reference must be considered for everything that it teaches, not simply the described invention or a preferred embodiment.").

Patent Owner also contends that "a POSITA would understand that Beard teaches trapping the inorganic particles within the pore walls, rather than having them extend into the pores themselves." Prelim. Resp. 40. In particular, Patent Owner argues that "when describing Figure 1, Beard states that '[t]he particles in the example of embodiment 100 may be captured inside the polymer binder 108, as opposed to having the particles loosely positioned within the pores.'" Prelim. Resp. 40 (citing Ex. 1010 ¶ 26, Abstract; Ex. 2015 ¶ 129). Patent Owner also submits that Beard states that the "TiO₂ particles are on the order of or smaller than the cell wall thickness 208," and that "[g]ood results may be achieved when the solid particles are contained exclusively or largely within the pore walls." *Id.* (citing Ex. 1010 ¶¶ 37, 86; Ex. 2015 ¶ 129). We disagree with Patent Owner that these statements in Beard are inconsistent with Petitioner's interpretation of Figure 1. We see nothing in the statement that the particles are not "loosely positioned within the pores" that precludes particles at the surface of the pore that extend into the empty space of the pore. Similarly, the statement that "good results may be achieved when the solid particles are contained exclusively or largely within the pore walls," does not preclude Petitioner's interpretation because particles that protrude into the pore can still be "largely within the pore walls" as illustrated in Figure 1. Thus, we find that Petitioner has shown sufficiently that Beard discloses limitations [1.4] and [10.9].

3. *Motivation to Combine*

Petitioner asserts that “[a] POSITA would have been motivated, with a reasonable expectation of success, to implement, in Murakami’s porous layer, Beard’s porous membrane structure with inorganic particles densely packed in the pore walls.” Pet. 54–55 (citing Ex. 1003 ¶¶ 178–181). Petitioner notes that “Beard explains that ‘[g]ood results may be achieved when the solid particles are contained exclusively or largely within the pore walls and when an open, continuous pore structure is provided throughout the film.’” *Id.* at 55 (citing Ex. 1010 ¶ 86).

Petitioner argues that “[s]pecifically, ‘incorporating high levels of desirable filler additives . . . may have the following properties: high levels of porosity, uniform pore distribution, well defined and controlled pore geometry, and high film strength, including good bond between filler particles and polymers.’” *Id.* (citing Ex. 1010 ¶ 65). Petitioner asserts that “Beard notes that its ‘highly filled membrane,’ when used as a battery separator, helps prevent the porous structure from melting and collapsing, resulting in a ‘catastrophic release of energy’ in a short circuit.” *Id.* (citing Ex. 1010 ¶ 33). Petitioner argues that a “POSITA would have wanted the ‘good results’ achieved by Beard,” so this “would have motivated implementing Beard’s pore structure, densely packed with particles, in Murakami’s separator to improve porosity, pore distribution, and pore geometry while maintaining mechanical strength to prevent separator collapse and short circuits.” *Id.* (citing Ex. 1003 ¶ 179).

Petitioner contends that a “POSITA would have had a reasonable expectation of success combining Murakami and Beard,” because both use similar manufacturing processes. *Id.* at 55–56.

Patent Owner raises a number of arguments why Petitioner has failed to show a motivation to combine the references. Prelim. Resp. 43–48. First, Patent Owner argues that Beard and Murakami have incompatible particle size and particle size distributions. *Id.* at 43–44 (citing Ex. 2015 ¶¶ 136–140; Ex. 1010 ¶ 37, 64, 86; Ex. 1005 ¶ 18). Second, Patent Owner asserts that Beard and Murakami use materially different amounts of binder. *Id.* at 44–45 (citing Ex. 2015 ¶¶ 141–142; Ex. 1005 ¶ 70; Ex. 1010 ¶ 29; Ex. 1003 ¶ 103). Third, Patent Owner argues that Beard and Murakami have “incompatible binding and dispersing properties.” *Id.* In particular, Patent Owner contends that “Murakami uses a high-pressure dispersion technique in making its porous layer,” but “Beard simply states that its porous membranes are manufactured using ‘a two-liquid casting process.’” *Id.* at 46 (citing Ex. 1010 ¶¶ 34, 54). Patent Owner argues that “Petitioner does not explain which technique to use, and a POSITA would not be able to use both.” *Id.* (citing Ex. 2015 ¶ 143). Moreover, Patent Owner argues Murakami teaches not to disperse the filler in the resin, but Beard teaches the opposite. *Id.* (citing Ex. 1005 ¶ 70; Ex. 1010 ¶ 86). Patent Owner also notes that Murakami teaches driving off the solvent with heat, but Beard is unclear how the solvent should be removed. *Id.* Fourth, Patent Owner argues that Beard’s SEM image in Figure 2 shows a porous structure that is highly inconsistent, but Murakami teaches that the porous structure should minimize variability. *Id.* at 47. Finally, Patent Owner contends that a POSTIA would not have a reasonable expectation of success in making the combination because of all these differences. *Id.* at 47–48.

At this stage of the proceeding, although Patent Owner raises some interesting arguments that should be developed further, we find that

Petitioner has shown sufficiently that there would be a motivation to combine Murakami and Beard with a reasonable expectation of success. As Petitioner explains, Beard teaches particular benefits of its porous structure that a person of ordinary skill in the art would be motivated to combine with the teachings of Murakami. *See* Pet. 54–56.

At this stage, Patent Owner’s counterarguments do not undermine this showing. To begin with, we note that Patent Owner appears to mischaracterize the combination as incorporating Beard’s cell structure into Murakami, when it is merely to incorporate Beard’s technique of closely packing inorganic particles in the cell walls into Murakami. Thus, at this stage and on the current record, Patent Owner’s arguments about alleged incompatibilities between Beard’s and Murakami’s particle size distributions, amounts of binder, and binding and dispersion processes are not persuasive. As for the contentions regarding Figure 2, we note that Petitioner does not rely on Figure 2, which appears to include the incorporation of fibers. Thus, it is unclear why the pore structure of Figure 2 would be relevant to the combination that Petitioner proposes.

Finally, we find that Petitioner has shown sufficiently, on this record, that Petitioner has shown a reasonable expectation of success. As Petitioner and its expert explain, Beard and Murakami teach similar manufacturing techniques (which are also similar to the ’148 patent), and Beard and Murakami provide ample detail on how to implement their techniques. *See* Ex. 1003 ¶¶ 167–172; Ex. 1010 ¶¶ 57–60; Ex. 1005 ¶¶ 71–72. We find this level of detail adequate, at this stage, to show that a person of ordinary skill would have a reasonable expectation of success in making the combination.

See Pfizer Inc. v. Apotex, Inc., 480 F.3d 1348, 1365 (Fed. Cir. 2007) (noting that “the expectation of success need only be reasonable, not absolute”).

Patent Owner also argues that, even if there is a reasonable expectation of success from the combination, the combination would not disclose “pores formed by the binder” because Murakami does not use enough binder for the pores to be “formed by the binder.” Prelim. Resp. 48–50. However, on this record, we do not find that argument persuasive for at least the reasons given above with respect to Murakami alone, i.e., that under the processes described in Murakami the pores are formed from the binder. *See supra* § III.D.1.d.

4. Summary as to the Murakami and Beard Based Grounds

We have reviewed Petitioner’s contentions that claims 1, 2, 5–11, and 14–19 of the ’148 patent are unpatentable under 35 U.S.C. § 103 as obvious over Murakami and Beard; that claims 3 and 12 of the ’148 patent are unpatentable under 35 U.S.C. § 103 as obvious over Murakami, Beard, and Honda; and that claims 4 and 13 of the ’148 patent are unpatentable under 35 U.S.C. § 103 as obvious over Murakami, Beard, and Tanaka. Pet. 48–56. At this stage of the proceeding, we find them, after considering Patent Owner’s arguments addressed above, sufficient to show a reasonable likelihood of prevailing.

H. Alleged Ground of Unpatentability Over Beard and Akiike

Petitioner contends that claims 1–3, 5–12, and 14–19 of the ’148 patent are unpatentable under 35 U.S.C. § 103 as obvious over Beard and Akiike. Pet. 56–73. Petitioner relies on Beard for limitations [1.pre]–[1.4] (and similar limitations in claim 10). *See* Pet. 56–60. Petitioner submits that Beard discloses “a porous film,” Pet. 56–57 (citing Ex. 1010 ¶¶ 1, 9, 10, 12,

51–53, 65; Ex. 1003 ¶¶ 182; a “binder,” *id.* at 57–58 (citing Ex. 1010 Abstract, ¶¶ 3, 25, 26, 33, 54, 57; Ex. 1003 ¶ 184; and “inorganic particles,” *id.* at 58–60 (citing Ex. 1010 ¶¶ 3, 10–13, 36, 37, 49, 50, 54; Ex. 1003 ¶¶ 186–188)). We have discussed in detail Petitioner’s contentions regarding Beard’s disclosure of limitations [1.3] and [1.4] above. *See supra* §§ III.G.1, III.G.2. Petitioner acknowledges that Beard does not disclose limitations [1.5]–[1.10], but contends that Akiike discloses these limitations. Pet. 60–62 (citing Ex. 1011 ¶¶ 10, 31–33, 36–38, 48, 49, 194, Tables 1–5). Petitioner argues that a person of ordinary skill in the art would have been motivated to combine Beard and Akiike with a reasonable expectation of success. Pet. 62–65.

Patent Owner argues that Beard does not teach or suggest limitations [1.4] and [10.9], and that a person of ordinary skill in the art would not have been motivated to make the combination with a reasonable expectation of success. Prelim. Resp. 51–59. Patent Owner does not dispute that Beard teaches limitations [1.pre]–[1.2]. *See id.* Based on the current record, we find that Petitioner has shown sufficiently that Beard teaches those limitations. We have addressed Patent Owner’s arguments regarding Beard’s disclosure of limitations [1.3]/[10.8] and [1.4]/[10.9]. *See supra* §§ III.G.1, III.G.2. We also find that Petitioner has shown sufficiently that Akiike accounts for limitations [1.5]–[1.10], so we focus on Patent Owner’s arguments regarding motivation to combine.

1. Motivation to Combine

a) Petitioner’s Contentions

Petitioner submits that “Beard explains that its membrane contains ‘a highly packed spherical filler material ... bound with a polymer’ in the pore walls.” *Id.* at 62 (citing Ex. 1010 ¶ 10). Petitioner notes that “Beard also

mentions that ‘the filler particle size may be on the order of 0.001 microns or more,’ but does not provide size distributions of the filler particles.” *Id.* (citing Ex. 1010 ¶ 11). Petitioner contends that “[l]acking these details, a POSITA would have looked to a similar separator porous membrane reference like Akiike for guidance on the appropriate size distributions for Beard’s filler particles.” *Id.* (citing Ex. 1003 ¶¶ 200–201). Petitioner provides reasoning for each portion of the particle size distribution claimed in claim 1. *Id.* at 63–65.

With respect to the Dv10 portion, Petitioner submits that Akiike discloses that D10 (Dv10) of its non-conductive particles (inorganic particles) is “preferably 0.2 μm or more and more preferably 0.3 μm or more, and preferably 0.4 μm or less.” Pet. 63 (citing Ex. 1011 ¶ 31). Petitioner notes that Akiike explains that “[k]eeping D10 (Dv10) values above this floor reduces the number of inorganic particles with ‘extremely small sizes,’ improving ‘battery properties such as high temperature cycle property.” *Id.* (citing Ex. 1011 ¶ 31). Petitioner argues that “[r]educing the number of extremely small particles also reduces ‘resistance against the passage of ions through the porous membrane’ and decreases overall surface area of the membrane and limiting water absorption and resulting corrosion.” *Id.* (citing Ex. 1011 ¶ 34). Petitioner asserts that “[k]eeping D10 (Dv10) values under 0.4 μm , on the other hand, reduces the number of extremely large inorganic particles, improving mechanical strength and heat resistance of the porous membrane.” *Id.* at 63–64 (citing Ex. 1011 ¶¶ 31–34). Thus, Petitioner contends that “a POSITA would have been motivated to use inorganic particles such that Dv10 is in a range of 0.015 μm to 3 μm , as claimed.” *Id.* at 64 (citing Ex. 1003 ¶ 202).

With respect to the Dv50 portion, Petitioner argues that “Akiike discloses that D50 (Dv50) of its non-conductive particles (inorganic particles) is ‘preferably 0.5 μm or more and more preferably 0.7 μm or more, and preferably 0.9 μm or less.’” *Id.* (citing Ex. 1011 ¶ 32). Petitioner submits that “[k]eeping D50 (Dv50) values above a floor of 0.5 μm and preferably above 0.7 μm also reduces the number of inorganic particles with ‘extremely small sizes,’ improving ‘battery properties such as high temperature cycle property.’” *Id.* (citing Ex. 1011 ¶ 32). Petitioner argues that “[o]n the other hand, keeping D50 (Dv50) values below a ceiling of 0.9 μm reduces the number of extremely large inorganic particles, improving mechanical strength and heat resistance of the porous membrane.” *Id.* (citing Ex. 1011 ¶ 32). Petitioner concludes that, therefore, “a POSITA would have been motivated to use inorganic particles such that Dv50 is in a range of 0.2 μm to 5 μm , as claimed.” *Id.* (citing Ex. 1003 ¶ 203).

With respect to the Dv90 portion, Petitioner argues that “Akiike discloses that D90 (Dv90) of its non-conductive particles (inorganic particles) is ‘preferably 1.0 μm or more and more preferably 1.2 μm or more, and preferably 3.0 μm or less, more preferably 2.0 μm or less, and further preferably 1.5 μm or less.’” *Id.* (citing Ex. 1011 ¶ 33). Petitioner asserts that “Akiike explains that keeping D90 of the inorganic particles within these bounds reduces the number of extremely large and extremely small inorganic particles, improving temperature cycling, mechanical strength, and heat resistance of the porous membrane.” *Id.* at 65 (citing Ex. 1011 ¶ 33). Petitioner argues that “Akiike also teaches that reducing the number of extremely large inorganic particles allows dense packing of the inorganic particles in the porous membrane, providing ‘excellent mechanical strength,

heat resistance, and electrical insulation” *Id.* (citing Ex. 1011 ¶ 35). Thus, Petitioner contends that “a POSITA would have been motivated to use inorganic particles such that Dv90 is in a range of 1 μm to 10 μm , as claimed.” *Id.* (citing Ex. 1003 ¶ 204).

Petitioner also asserts that a “POSITA would have had a reasonable expectation of success in using Akiike’s particle size distributions in Beard’s porous membrane.” *Id.* (citing Ex. 1003 ¶ 205). Petitioner notes that both Beard and Akiike use a polymer binder for their separators.” *Id.* (citing Ex. 1010 ¶ 25; Ex. 1011 ¶ 67). Petitioner argues that “Beard teaches that its ‘polymer binder ... ha[s] an affinity for the filler materials and may hold the filler materials together in a porous structure with high tortuosity and consistent pore size,’ and identifies TiO_2 as an example filler material. *Id.* (citing Ex. 1011, Abstract, ¶ 23). Petitioner submits that “Akiike also identifies TiO_2 (titania) a suitable inorganic filler, so a POSITA would expect Beard’s binder to have an affinity for Akiike’s inorganic particles, resulting in a separator that performs as the references describe.” *Id.* (citing Ex. 1011 ¶ 39; Ex. 1003 ¶ 205).

b) Patent Owner’s Arguments

Patent Owner argues that Beard does not lack implementation details, so a person of ordinary skill would not look to Akiike for additional details. Prelim. Resp. 52–53. Moreover, Patent Owner asserts that Beard teaches that very small particle sizes are key to its pore structure, and that Akiike’s larger particle sizes would not work with Beard’s disclosure. *Id.* at 53–54 (citing Ex. 1010 Abstract, ¶ 37, 64, 86; Ex. 2015 ¶ 164). Patent Owner also argues that there are differences in the amount of binder used in the two references that are not explained by Petitioner. *Id.* at 54–55. Patent Owner further asserts that Beard and Akiike have incompatible bonding and

dispersing properties. *Id.* at 55–56. Patent Owner also contends that Petitioner has not shown a reasonable expectation of success. *Id.* at 57. Finally, Patent Owner argues that, even if combined, the references would fail to meet the limitation that the pores are “formed by the binder.” *Id.* at 57–58.

c) Analysis

We find that Petitioner has shown sufficiently that there is a motivation to combine Beard and Akiike with a reasonable expectation of success. We find that Petitioner has shown sufficiently that a person of ordinary skill in the art would have looked to Akiike for teachings regarding particle size and particle size distributions because of the benefits it teaches that these distributions have on improving battery properties such as high temperature cycle property, reducing resistance to the passage of ions, limiting water absorption and resulting corrosion, mechanical strength, and heat resistance of the porous film. Pet. 63–64 (citing Ex. 1011 ¶¶ 32–35). Patent Owner’s arguments to the contrary do not negate this showing. First, we disagree that Beard has sufficient implementation details (Prelim. Resp. 52–53), especially given the teachings of Akiike on the importance of controlling the particle size distribution overall (Ex. 1011 ¶¶ 32–35). Second, we disagree with Patent Owner’s contention that Beard teaches that very small particle sizes are “key” to its pore structure. Prelim. Resp. 53–54. The examples cited by Patent Owner either use the word “may” or deal with a particular embodiment of Beard. *See, e.g.*, Ex. 1010 ¶¶ 64 (“extremely small particles *may* be blended”), 37 (describing for Figure 2 of Beard), Abstract (“a densely packed filler material *may* have an average diameter less than 0.005 microns”). Third, we disagree that the differences in the amount of binder used in Akiike and Beard or how they are dispersed would

dissuade a person of ordinary skill from the combination. Akiike explains the benefits of its particle size distribution and those benefits appear to be independent of the amount of binder that Akiike proposes to use. *See* Ex. 1010 ¶¶ 27–37. Thus, on this record, we do not agree that the differences in the amount of binder used or how the particles are dispersed would undermine the motivation to combine the references.

Fourth, Patent Owner argues that Petitioner has failed to show a reasonable expectation of success. Prelim. Resp. 57 (citing Ex. 2015 ¶¶ 172–174). On this record, we find that Petitioner has shown a reasonable expectation of success. As Petitioner explains, both Beard and Akiike use polymer binder and titania particles as inorganic filler. Pet. 65. On the current record, we find that Petitioner has sufficiently demonstrated—supported by Akiike, Beard, the other references of record, and supported by the testimony of Dr. Guido—it was well within the level of skill in the art to fabricate porous layers given the disclosure of Beard. *See* Ex. 1003 ¶ 205.

Finally, Patent Owner argues that, even if the combination were successful, that the resulting porous layer would not have “pores formed by the binder” because “the inorganic particles would be too big to be contained within the binder and thus would form the porous network rather than the binder forming the pores.” Prelim. Resp. 58 (citing Ex. 2015 ¶ 164). On the current record, we disagree with Patent Owner’s assertion. In the combination proposed, Petitioner argues that the person of ordinary skill would retain the pore structure of Beard, but use the particle size distribution of Akiike. “A person of ordinary skill in the art is also a person of ordinary creativity, not an automaton.” *KSR*, 550 U.S. at 421. “[I]n many cases a person of ordinary skill will be able to fit the teachings of multiple patents

together like pieces of a puzzle.” *Id.* at 420. On the current record, assuming Patent Owner’s construction of “pores formed by the binder” is correct,⁵ we find that Petitioner has shown sufficiently that a person of ordinary skill in the art would be able to adjust the composition of Beard to retain its general pore structure while using the particle size distribution of Akiike. *See* Ex. 1003 ¶ 205.

2. Summary as to Claim 1

We find that Petitioner has shown sufficiently that the combination of Beard and Akiike accounts for all the limitations of claim 1, and that a person of ordinary skill in the art would have been motivated to combine Beard and Akiike in the manner presented with a reasonable likelihood of success. Patent Owner does not raise any secondary considerations of nonobviousness at this stage of the proceeding. Thus, we conclude that Petitioner has shown a reasonable likelihood of prevailing in showing that claim 1 would have been obvious over the combination of Beard and Akiike.

3. Claims 2, 3, 5–12, and 14–19

Patent Owner does not raise any other separate arguments regarding claims 2, 3, 5–12, and 14–19 other than those we have considered above with respect to claim 1. *See* Prelim. Resp. 51–58.

On the current record, we do not find Patent Owner’s arguments persuasive, as explained above. We have reviewed Petitioner’s contentions regarding claims 2, 3, 5–12, and 14–19 (Pet. 67–73), and determine that Petitioner shows a reasonable likelihood of prevailing with respect to the obviousness of claims 2, 3, 5–12, and 14–19 over Beard and Akiike.

⁵ The parties are encouraged to address the construction of this term during the trial.

I. Alleged Ground of Unpatentability Over Beard, Akiike, and Tanaka

Petitioner contends that claims 4 and 13 of the '148 patent are unpatentable under 35 U.S.C. § 103 as obvious over Beard, Akiike, and Tanaka. Pet. 73–75.

Patent Owner argues that this ground suffers from the same deficiencies to the disclosures of Beard and Akiike as discussed above. Prelim. Resp. 59. On the current record, we do not find Patent Owner's arguments persuasive, as explained above. We have reviewed Petitioner's contentions regarding claim 4 and 13 (Pet. 73–75), and determine that Petitioner shows a reasonable likelihood of prevailing with respect to the obviousness of claims 4 and 13 over Beard, Akiike, and Tanaka.

IV. CONCLUSION

After considering the arguments presented in the Petition, the Preliminary Response, and the evidence of record, we determine that Petitioner has demonstrated at least a reasonable likelihood of success in proving that at least one claim of the '148 patent is unpatentable. Thus, we institute an *inter partes* review of all challenged claims (i.e., claims 1–19) on all the grounds raised in the Petition.

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that, pursuant to 35 U.S.C. § 314(a), an *inter partes* review of claims 1–19 of the '148 patent is hereby ordered on all grounds of unpatentability set forth in the Petition; and

FURTHER ORDERED that pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial commencing on the entry date of this decision.

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