

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LG ENERGY SOLUTION, LTD.,
SAMSUNG ELECTRONICS CO., LTD. AND
SAMSUNG ELECTRONICS AMERICA, INC.,
Petitioner,

v.

MOLECULAR REBAR DESIGN, LLC,
Patent Owner.

Case: IPR2024-01006¹

U.S. Patent No. 8,808,909

**PETITIONER SAMSUNG ELECTRONICS CO., LTD. AND SAMSUNG
ELECTRONICS AMERICA, INC.'S NOTICE OF APPEAL**

¹ Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. were joined as parties to IPR2024-01006 via a Motion for Joinder in IPR2025-00356.

Pursuant to 35 U.S.C. §§ 141(c), 142, and 319, 37 C.F.R. § 90.2(a), notice is hereby given that Petitioner Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (collectively, “Samsung”) appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision, entered December 15, 2025 (Paper 37) (“Final Written Decision”), and the Decision Denying Petitioner’s Request for Rehearing, entered May 13, 2026 (Paper 47) (“Rehearing Decision”), in Case No. IPR2024-01006 by the Patent Trial and Appeal Board (“the Board”), and from all underlying orders, decisions, rulings, and opinions related thereto and included therein that are adverse to Samsung. This appeal is timely under 35 U.S.C. § 142, 37 C.F.R. § 90.3, Federal Rule of Appellate Procedure 15(a)(1), and Federal Circuit Rule 15(a)(1).

For the limited purpose of providing the Director with the information required by 37 C.F.R. § 90.2(a)(3)(ii) and Federal Rule of Appellate Procedure 15(a)(2)(C), the issues on appeal may include, but are not limited to:

1. The Board’s decision that claims 1-8 of the ’909 patent were not shown to be unpatentable as obvious under 35 U.S.C. § 103 in view of:
 - a. Ohata and Kavan for claims 1, 2, 5-8;
 - b. Lee and Wepasnick for claims 1, 2, 5-8;
 - c. Lee, Wepasnick, and Zhamu for claims 3 and 4;

2. All of the Board's subsidiary findings supporting its determination that claims 1-8 of the '909 patent were not shown to be unpatentable under 35 U.S.C. § 103; the Board's failure to consider evidence of record properly; the Board's legal errors in undertaking the obviousness analysis; the Board's findings that conflict with the evidence of record and are not supported by substantial evidence; and
3. All other issues decided adversely to Petitioner in any orders, decisions, rulings, or opinions underlying or supporting the Final Written Decision and Rehearing Decision.

Samsung further reserves the right to challenge any finding or determination supporting or relating to the issues above and reserves the right to address any issues that may arise on appeal or that Patent Owner may raise on appeal.

Pursuant to 35 U.S.C. § 142 and 37 C.F.R. § 90.2(a)(1), this notice is being filed with the Director of the U.S. Patent and Trademark Office, and a copy is also being filed with the Board. In addition, pursuant to Federal Circuit Rule 15(a)(1) and 37 C.F.R. § 90.2(a)(2), Samsung also is electronically filing this

notice with the Clerk of the U.S. Court of Appeals for the Federal Circuit, and paying the fee set forth in Federal Circuit Rule 52.

Dated: June 25, 2026

Respectfully submitted,

/Andrew R. Sommer/

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*Counsel for Petitioner Samsung Electronics
Corporation, Ltd. and Samsung Electronics
America, Inc.*

CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4) and 42.205(b), the undersigned certifies that on June 25, 2026, a complete and entire copy of this Petitioner's Notice of Appeal was provided via email to the Patent Owner by serving the correspondence address of record as follows:

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Pursuant to 37 C.F.R. §§ 90.2(a)(1), I hereby certify that in addition to being filed electronically through the Board's P-TACTS System, this Petitioner's Notice of Appeal is being provided to the Director of the USPTO on June 25, 2026, by electronically filing to the email address as follows:

Director of the United States Patent and Trademark Office

c/o Office of the General Counsel

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I hereby certify that on June 25, 2026, a true and correct a copy of the foregoing Petitioner's Notice of Appeal, along with a copy of the Final Written

Decision and Rehearing Decision, were filed electronically with the Clerk's Office of the United States Court of Appeals for the Federal Circuit, at the following address:

United States Court of Appeals for the Federal Circuit
717 Madison Place, N.W., Suite 401
Washington, DC 20005

/Andrew R. Sommer/

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Reg. No. 53,932

Exhibit A

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LG ENERGY SOLUTION, LTD.,
SAMSUNG ELECTRONICS CO., LTD. and
SAMSUNG ELECTRONICS AMERICA, INC.
Petitioner,

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MOLECULAR REBAR DESIGN, LLC,
Patent Owner.

IPR2024-01006¹
Patent 8,808,909 B2

Before GRACE KARAFFA OBERMANN, KRISTINA M. KALAN,
and AVELYN ROSS, *Administrative Patent Judges*.

OBERMANN, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining No Challenged Claims Unpatentable
35 U.S.C. § 318(a)

¹ Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (“the Samsung Petitioners”) were joined as parties via a Motion for Joinder in IPR2025-00356 (“IPR356”). We designate this Decision as confidential because we cite information from a paper that the Samsung Petitioners identified as confidential in IPR356. *See infra* n.2 (citing IPR356, Paper 4).

I. INTRODUCTION

A. Background and Summary

Petitioner² filed a Petition for an *inter partes* review (Paper 2 (“Pet.”)) challenging claims 1–8 of U.S. Patent No. 8,808,909 B2 (Ex. 1001 (“the ’909 patent”)). Patent Owner³ filed a Preliminary Response. Paper 5. After receiving authorization from the Board (Ex. 3001), Petitioner filed a Reply to the Preliminary Response (Paper 6) and Patent Owner filed a Sur-reply (Paper 7). Taking account of those papers, we instituted an *inter partes* review. Paper 8 (“Inst. Dec.”).

Thereafter, in timely sequence, Patent Owner filed a Response (Paper 16, “Resp.”), Petitioner filed a Reply (Paper 21, “Reply”), and Patent Owner filed a Sur-reply (Paper 30, “Sur-reply”). In addition, pursuant to an unopposed request for authorization (Ex. 3002), Petitioner filed observations on cross-examination (Paper 32).

B. Related Matters

The parties identify these lawsuits as related matters: *Molecular Rebar Design, LLC v. LG Energy Solution, Ltd.*, 2-24-cv-00107 (E.D. Tex.) (“district court litigation”) and *Molecular Rebar Design, LLC v. Samsung Electronics Co., Ltd.*, 2-24-cv-00108 (E.D. Tex.). Pet. 84; Paper 13 at 1–2.

² The real parties-in-interest include LG Energy Solution, Ltd. (Pet. 84) and the Samsung Petitioners (IPR356, Paper 4 at 82). With “caveats and reservations,” the Samsung Petitioners further identify [REDACTED]. *Id.*

³ The real party-in-interest is Molecular Rebar Design, LLC, which has granted Black Diamond Structures, LLC an exclusive license to the ’909 patent in certain enumerated “applications and uses related to electrical energy storage.” Paper 4 at 2.

Patent Owner further identifies *Molecular Rebar Design, LLC v. LG Chem, Ltd.*, 1-22-cv-01130 (D. Del.) (dismissed). Paper 13 at 2.

Patent Owner also identifies as related matters these administrative proceedings, which involve the Samsung Petitioners: IPR2025–00355, IPR2025–00356, IPR2025–00357, IPR2025–00358, and IPR2025–00359. Paper 13 at 2. Patent Owner further identifies as related matters these administrative proceedings, which LG Energy Solution, Ltd.: IPR2024–01005, IPR2024–01011, IPR2024–01012, and IPR2024-01013. *Id.*

C. The '909 Patent (Ex. 1001)

The '909 patent, titled “Lithium Ion Batteries Using Discrete Carbon Nanotubes, Methods for Production Thereof and Products Obtained Therefrom,” issued August 19, 2014, and is directed to “[c]ompositions, and methods of obtaining them, useful for lithium ion batteries comprising discrete oxidized carbon nanotubes having attached to their surface lithium ion active materials in the form of nanometer sized crystals or layers.” Ex. 1001, codes (45), (54), (57).

The specification informs that commercial lithium-ion rechargeable batteries using cobalt, nickel or manganese oxides for the cathode material “are known for their poor electrical conductivity and poor electrochemical stability which results in poor cycling (charge/discharge) ability.” Ex. 1001, 1:27–32. Olivine structures, such as LiFePO_4 or LiMnPO_4 , operate at higher charge and discharge rates, “but are still limited by low electrical conductivity and the kinetics of Li-ion diffusion.” Ex. 1001, 1:32–36.

The specification also identifies prior attempts to overcome these deficiencies, including the use of nano-sized crystals of lithium salts and carbon nanotubes for improved charge/discharge rates. Ex. 1001, 1:37–43.

The carbon nanotubes of the prior art, however, were not considered to be discrete, i.e., “individually uniformly dispersed tubes,” because carbon nanotubes conventionally made via gas phase reaction “result in a tangled bundle of tubes.” Ex. 1001, 1:42–47. According to the specification, in those conventional nanotubes, “lithium nanocrystals are not ionically or covalently attached to the surface of the discrete carbon nanotubes to provide for intimate electron transfer and enhanced mechanical strength of the active material.” Ex. 1001, 1:47–50.

The '909 patent discloses a composition that includes “discrete carbon nanotubes having attached to their surface lithium ion active materials in the form of nanometer sized crystals or layers.” Ex. 1001, 2:32–35. This attachment may be achieved ionically or chemically. Ex. 1001, 3:28–31. “Examples of ion active materials are lithium iron phosphate, lithium manganese phosphate, lithium cobalt oxide, silica, manganese dioxide, cadmium, titanium dioxide and carbon.” Ex. 1001, 4:30–33.

D. Illustrative Claims

Of the challenged claims, claim 1 is the sole independent claim, and is reproduced below.

Claim 1:

[1pre] A composition useful for lithium ion batteries comprising:

[1a] discrete carbon nanotubes

[1b] having crystals or layers of lithium ion active material attached to their surface,

[1c] wherein the discrete carbon nanotubes have an aspect ratio of 10 to 500 and

[1d] oxidation levels from 1% to 15% by weight of the carbon nanotube.

Ex. 1001, 7:2–8 (labels added to correspond with Petitioner’s designation of claim limitations (Pet. vii)).

E. Asserted Unpatentability Challenges

Petitioner asserts that claims 1–8 would have been unpatentable based on the following challenges:

Claims Challenged	35 U.S.C. §⁴	References/Basis
1, 2, 5–8	103(a)	Ohata ⁵ , Kavan ⁶
1, 2, 5–8	103(a)	Lee, ⁷ Wepasnick ⁸
3, 4	103(a)	Lee, Wepasnick, Zhamu ⁹

Pet. 1–2. Petitioner relies on declarations provided by Dr. Yu Zhu. Ex. 1003 (supporting Petition); Ex. 1058 (supporting Reply). Patent Owner relies on a declaration from Dr. Deborah D.L. Chung. Ex. 2006 (supporting Response).

⁴ The relevant sections of the Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, took effect on March 16, 2013. Because the ’909 patent claims priority to a provisional application filed on June 23, 2011, prior to the effective date of the applicable AIA amendments, we apply the pre-AIA version of § 103 for purposes of this Decision.

⁵ US 2004/0160156 A1, published Aug. 19, 2004 (Ex. 1004).

⁶ Ladislav Kavan, et al., *Multi-walled carbon nanotubes functionalized by carboxylic groups: Activation of TiO₂ (anatase) and phosphate olivines (LiMnPO₄; LiFePO₄) for electrochemical Li-storage*, J. OF POWER SOURCES, Vol. 195, 5360–5369 (2010) (Ex. 1005).

⁷ US 2010/0136431 A1, published June 3, 2010 (Ex. 1006).

⁸ Kevin Wepasnick, et al., *Surface and structural characterization of multi-walled carbon nanotubes following different oxidative treatments*, CARBON, Vol. 49, 24–36, 2011 (Ex. 1010).

⁹ US 2012/0064409 A1, published Mar. 15, 2012 (Ex. 1008).

II. ANALYSIS

A. Legal Standard

Each challenge is based on an assertion of obviousness under Section 103(a). Pet. 1–2 (claim chart). A patent claim is unpatentable on that basis 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 the invention was made to a person having ordinary skill in the art to which said subject matter pertains.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007).

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. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). Those facts guide our resolution of the disputed issues.

B. Level of Ordinary Skill in the Art

The level of ordinary skill in the art is a factual determination that provides a primary guarantee of objectivity in an obviousness analysis. *Al-Site Corp. v. VSI Int’l Inc.*, 174 F.3d 1308, 1324 (Fed. Cir. 1999) (citing *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966); *Ryko Mfg. Co. v. Nu-Star, Inc.*, 950 F.2d 714, 718 (Fed. Cir. 1991)).

In determining the level of skill in the art, we consider the type of problems encountered in the art, the prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the educational level of active workers in the field. *Custom*

Accessories, Inc. v. Jeffrey-Allan Indus. Inc., 807 F.2d 955, 962 (Fed. Cir. 1986); *Orthopedic Equip. Co. v. U.S.*, 702 F.2d 1005, 1011 (Fed. Cir. 1983).

Petitioner asserts that a person of ordinary skill in the art “would have had at least a Master’s degree in materials science, chemistry, chemical engineering, a field relevant to polymer science and engineering, or the equivalent, and at least three years of experience in nanomaterials, electrochemistry, batteries, or polymer related activities” and that “[a]dditional work experience can compensate for less formal education, and vice versa.” Pet. 4 (citing Ex. 1003 ¶ 11).

“Patent Owner applies Petitioner’s definition of” the level of ordinary skill in the art “for purposes of this proceeding.” Resp. 8. We adopt Petitioner’s unopposed definition because, on this record, it appears consistent with the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (holding that the prior art itself can reflect the appropriate level of ordinary skill in the art).

C. Claim Construction

In an *inter partes* review, we construe claim terms according to the standard set forth in *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–17 (Fed. Cir. 2005) (en banc). 37 C.F.R. § 42.100(b). Under *Phillips*, claim terms are afforded “their ordinary and customary meaning.” *Phillips*, 415 F.3d at 1312.

“[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention.” *Id.* at 1313. “Importantly, the person of ordinary skill in the art is deemed to read the claim term not only in the

context of the particular claim in which the disputed term appears, but in the context of the entire patent, including the specification.” *Id.*

Petitioner argues that “no formal claim constructions are necessary.” Pet. 4–5. Patent Owner similarly contends that “no construction is required.” Resp. 17. Upon review of the record, we agree that no claim terms require express construction for purposes of this Decision. *See Realtime Data, LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’”) (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)).

As explained in our analysis of the challenges below, however, the parties raise a dispute about the scope of the term “discrete carbon nanotubes,” which appears in claim [1a] and is expressly defined in the specification as “carbon nanotubes capable of being separated to give individual tubes.” Ex. 1001, 3:47–49. We address that dispute in our analysis only to the extent necessary to resolve the challenges.

D. Overview of Asserted Prior Art

a) Ohata (Ex. 1004)

Ohata discloses that an electrode for a secondary lithium-ion battery “is typically produced by mixing an electrode active material with a conductive material and a binder to form a paste, which is then applied onto a current collector.” Ex. 1004 ¶ 2.

Ohata explains that the conductive material “is used to secure the conductivity of an electrode,” but if the amount of conductive material is large, the battery capacity will be decreased. Ex. 1004 ¶ 2. Ohata further explains that a masterbatch process had been proposed in the art, wherein a

conductive material is uniformly dispersed in a binder in the production of a positive electrode. Ex. 1004 ¶ 2.

In this method, the “primary particles of carbon black or powdered graphite are linked into a chain to form a conductive path.” Ex. 1004 ¶ 3. Such a conductive path, however, is likely to be damaged by shearing force applied to the conductive material during the masterbatch process. Ex. 1004 ¶ 3. “For this reason,” according to Ohata, “the use of the masterbatch process to uniformly disperse the conductive material in a binder does not yield an electrode superior in conductivity.” Ex. 1004 ¶ 3.

To overcome these difficulties, Ohata discloses a method of producing an electrode for a battery comprising the steps of:

(a) producing a masterbatch comprising at least carbon nanotubes and a resin; (b) blending an electrode material mixture containing at least the masterbatch and an electrode active material with a dispersion medium to prepare an electrode material mixture paste; (c) applying the electrode material mixture paste onto an electrode substrate and then drying and rolling the electrode material mixture paste coated on the electrode substrate to obtain an electrode plate; and (d) cutting the electrode plate to obtain an electrode with a predetermined shape.

Ex. 1004 ¶ 5.

With regard to forming a masterbatch, Ohata states that carbon nanotubes are tangled and twisted before they are blended with a resin, but are unraveled and straightened after blending. Ex. 1004 ¶ 16. Ohata provides a depiction of this effect on the nanotubes in Figure 1, reproduced below.

FIG. 1

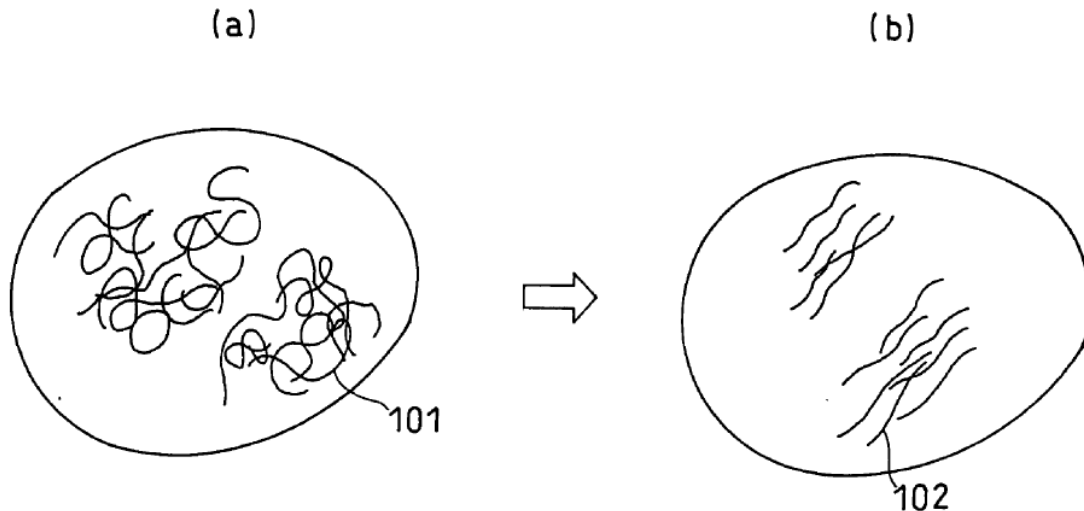


Figure 1(a) is a schematic diagram showing carbon nanotubes tangled and twisted with one another before being blended with a resin, and Figure 1(b) is a schematic diagram showing the carbon nanotubes unraveled and straightened after they have been blended with the resin. Ex. 1004 ¶¶ 12–13.

Ohata explains that “[t]he unraveled and straightened carbon nanotubes 102 are expected to form an excellent conductive path in an electrode even if the amount thereof is small.” Ex. 1004 ¶ 16. Ohata further explains that resin with the unraveled and straightened carbon nanotubes “serves to increase the mechanical strength of an electrode plate,” providing the plate with “great strength against bending and therefore electrode damage is unlikely to occur during production of an electrode group.” Ex. 1004 ¶ 17.

Ohata discloses that the carbon nanotubes preferably have an average length of 1 to 100 μm . Ex. 1004 ¶ 19. According to Ohata, when the carbon nanotubes are too short, “excellent conductive paths may not be formed in

some electrodes,” and when the length of carbon nanotubes is large, “the dispersibility of the carbon nanotubes in the resin may be slightly low.”

Ex. 1004 ¶ 19.

Ohata also explains that the carbon nanotubes preferably have an aspect ratio of not less than 100 because when the aspect ratio is too small, excellent conductive paths may not be formed in some electrodes. Ex. 1004 ¶ 20. “Conversely, when the aspect ratio is too large, the carbon nanotubes are unlikely to be straightened sufficiently even after a resin is blended thereto. Accordingly, the aspect ratio is preferably no greater than 1000.” Ex. 1004 ¶ 20. Additionally, Ohata states that “[t]he proper amount of the carbon nanotubes contained in the masterbatch is 5 to 20 parts by weight per 100 parts by weight of the resin.” Ex. 1004 ¶ 21.

Ohata states that the positive and negative electrode active materials to be used “varies depending on the battery type.” Ex. 1004 ¶¶ 26–27. For example, LiCoO_2 , LiNiO_2 or LiMn_2O_4 may be used as the positive electrode active material. Ex. 1004 ¶ 26. The negative electrode active material may be a graphite material, or other carbonaceous materials such as hard carbon. Ex. 1004 ¶ 27.

b) Kavan (Ex. 1005)

Kavan is a study regarding multi-walled carbon nanotubes functionalized by carboxylic groups. Ex. 1005, 1. Kavan states that “[m]ulti-walled carbon nanotubes functionalized by carboxylic groups, exhibit better affinity towards TiO_2 . . . as compared to that of pristine nanotubes.” Ex. 1005, 1. Kavan explains that “[t]he electrochemical lithium storage in carbon nanotube/ TiO_2 composites” has been studied, “reflecting the fact that TiO_2 (especially anatase),” $\text{TiO}_2(\text{B})$, and rutile “belong to the top interesting

host structures for lithium insertion,” and “studies confirmed in unison that the electrochemical activity of the composite TiO_2 /nanotubes is improved compared to that of the parent pure TiO_2 .” Ex. 1005, 1.

Kavan also states that phosphate olivine materials are promising cathode materials due to their “high safety, low cost and environmental tolerability,” but “their poor electrical conductivity is a crucial issue to be addressed either by doping or by surface coating with elemental carbon.” Ex. 1005, 1 (internal citations omitted). Kavan notes that the use of carbon nanotubes to improve conductivity was disclosed in the art, but the improvement in capacity and charging rate was “quite modest.” Ex. 1005, 1–2. Kavan further notes that surface oxidation of carbon nanotubes by nitric acid (HNO_3) to produce carboxyls “was sometimes mentioned to improve the anchoring of TiO_2 or LiMPO_4 [wherein $\text{M} = \text{Fe}, \text{Mn}$].” Ex. 1005, 2 (internal citations omitted).

Kavan describes experiments in which multi-walled carbon nanotubes were prepared and oxidized in a mixture of HNO_3 . Ex. 1005, 2. The nanotubes were dispersed in water and a powder including TiO_2 (P90) and LiMnPO_4 or LiFePO_4 was added to the solution to create a suspension, which was subsequently dried. Ex. 1005, 2. Kavan reported that film electrodes produced in this way included nanotubes “covered with individual nanocrystals of P90 in a homogeneous nanocomposite.” Ex. 1005, 3. Kavan explains “that oxidative functionalization through HNO_3 is crucial for proper anchoring of nanotubes towards TiO_2 ” and that examination of the electrode material’s surface showed “that industrial powder (P90) is a good source of nanocrystals which spontaneously self-assemble on the nanotube surface.” Ex. 1005, 4.

c) Lee (Ex. 1006)

Lee describes an anode active material for an anode of a lithium battery. Ex. 1006, code (57). Lee explains that “research is currently being conducted into a binder that can enhance the integrity of a[n] anode active material” in order to address the problem of poor cycle lifetime characteristics. Ex. 1006 ¶ 8. To achieve improved cycle lifetime characteristics, Lee discloses an embodiment of an anode active material that comprises “secondary particles that include agglomerated primary nanoparticles, wherein the primary nanoparticles include a non-carbonaceous material that is bound to hollow carbon nanofibers.” Ex. 1006 ¶ 14. One embodiment of Lee’s anode active material is shown in Figure 1, reproduced below.

FIG. 1

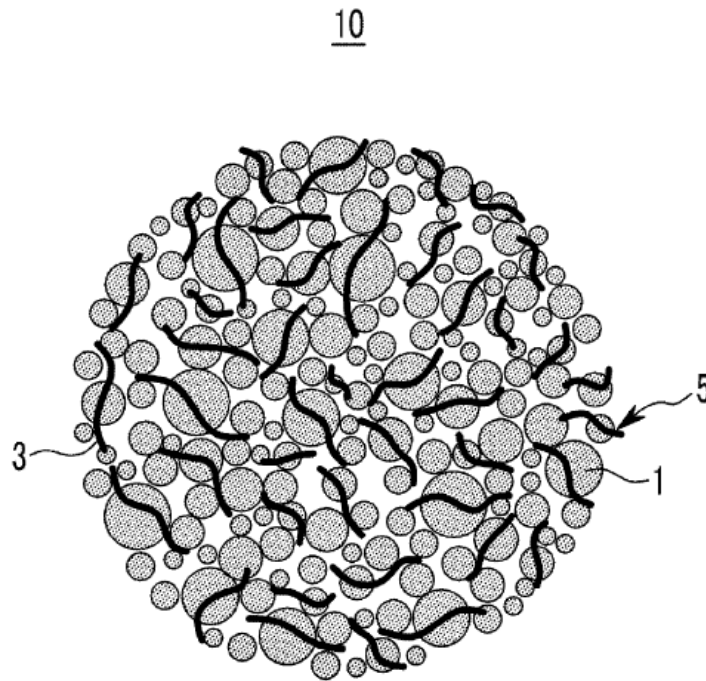


Figure 1 of Lee shows a schematic view of the structure of anode active material 10 that includes primary nanoparticles 5, comprised of non-

carbonaceous material 1 and hollow carbon nanofibers 3, which are bound to the non-carbonaceous material by Van der Waals forces. Ex. 1006 ¶ 40. Lee states that “the non-carbonaceous material 1 is bound to the hollow carbon nanofibers 3 to form a composite compound,” and the carbon nanofibers may be carbon nanotubes having an aspect ratio of about 10 to about 10,000. Ex. 1006 ¶¶ 43, 46–47. Lee states that “a mixing ratio of the non-carbonaceous material 1 to the hollow carbon nanofibers 3 may be in a range of about 2:1 to about 50:1, by weight.” Ex. 1006 ¶ 48.

Lee explains that “[t]he non-carbonaceous material may be a silicon-based material, such as silicon (Si), a silicon oxide (SiO_x , where $0 \leq x \leq 2$), Si-Y, or a mixture thereof. Herein, Y may be As, Sb, Bi, Cu, Ni, Mg, In, Zn, Ag, Al, or a combination thereof.” Ex. 1006 ¶ 41. An anode formed from an active material layer including anode active material 10 and a polymeric binder having an electron donor group may additionally include a conductive agent, such as a carbonaceous material. Ex. 1006 ¶¶ 49, 57.

d) Wepasnick (Ex. 1010)

Wepasnick is a study in which “[s]ix commonly used wet chemical oxidants (HNO_3 , KMnO_4 , $\text{H}_2\text{SO}_4/\text{HNO}_3$, $(\text{NH}_4)_2\text{S}_2\text{O}_8$, H_2O_2 , and O_3) were evaluated in terms of their effects on the surface chemistry and structure of MWCNTs [multi-walled carbon nanotubes] using a combination of analytical techniques.” Ex. 1010, Abstract. Specifically, Wepasnick was concerned with studying the “extent of surface oxidation” and quantifying “the concentration of carboxyl, carbonyl, and hydroxyl groups at the surface.” Ex. 1010, Abstract.

Wepasnick explains that “oxidative treatments are also used to help remove amorphous carbon and metallic impurities from as-produced CNTs.”

Ex. 1010, 2. Wepasnick further explains that “[t]he easiest and most reliable way to control the extent of MWCNT oxidation was to vary the oxidant concentration, specifically the w/w% HNO₃ (from 0-70%).” Ex. 1010, 7.

e) Zhamu (Ex. 1008)

Zhamu discloses “[a] nano graphene-enhanced particulate for use as a lithium-ion battery anode active material, wherein the particulate is formed of a single sheet of graphene or a plurality of graphene sheets and a plurality of fine anode active material particles with a size smaller than 10 μm.”

Ex. 1008, code (57).

E. Obviousness Challenge Based on Ohata and Kavan

Petitioner contends that claims 1, 2, and 5–8 of the ’909 patent would have been unpatentable as obvious over Ohata in view Kavan. Pet. 5–38. The challenge is based on Petitioner’s proposed “Ohata-Kavan combination composition.” Pet. 7. We refer to this as the proposed Ohata-Kavan composition.

When describing the allegedly obvious modifications that would have led an ordinarily skilled artisan to the proposed Ohata-Kavan composition, Petitioner explains that it uses Ohata “as a starting point,” relying on Ohata’s “electrode material mixture containing [a] masterbatch and an electrode active material.” Pet. 7 (quoting Ex. 1004 ¶ 23). In Petitioner’s view, “[t]he masterbatch contains nanotubes dispersed in a resin where the aspect ratio of the nanotubes and the ratio of nanotubes to electrode active material are as taught by Ohata.” *Id.*

It is worth emphasizing here that Petitioner affirmatively argues that the nanotubes in the proposed Ohata-Kavan composition are “dispersed in a

resin” using the ratio of materials “taught by Ohata” (*id.*), because that admission, as we discuss below, undercuts this challenge.

Petitioner argues that the nanotubes used to prepare Ohata’s masterbatch would have been first “functionalized, e.g., ‘by carboxylic groups,’ as taught by Kavan, such that ‘[t]he amount of atomic oxygen present’ on the nanotube surface is ‘7%.’” Pet. 7 (quoting Ex. 1005, Abstract, 2, 4). Following the teachings of Ohata, Petitioner contends, the oxidized nanotubes then would have been “unraveled and straightened by blending them with a resin” as taught by Ohata to form a masterbatch. *Id.* at 7–8 (quoting Ex. 1004 ¶ 16). Significant to our analysis, and the failure of this ground, Ohata teaches the use of a relatively small proportion of nanotubes (e.g., 5–20 parts by weight) that are mixed with a much larger proportion of resin (e.g., 100 parts by weight) to form this masterbatch composition. Ex. 1004 ¶ 6.

According to Petitioner, this modified masterbatch composition of Ohata next would have been mixed with an electrode active material, which varies depending on the type of battery being produced, then blended with a dispersion medium (namely, N-methyl-2-pyrrolidone (“NMP”)) to form an “electrode material mixture paste” as described in Ohata. Pet. 8. Specifically, Petitioner contends, the “electrode material mixture paste” would have been further modified in view of Kavan to include, for example, a negative electrode material such as TiO_2 or a positive electrode active material such as phosphate olivine (LiMPO_4) to achieve the Ohata-Kavan composition that is the focus of the challenge. *Id.*

Petitioner proposes that a person of ordinary skill in the art would have been led to combine the teachings of Ohata and Kavan to form the

proposed Ohata-Kavan composition, and would have had a reasonable expectation of success in achieving the claimed invention. Pet. 8–16. Patent Owner opposes on several bases, which we assess below. Resp. 18–68.

a) Claim 1

Claim [1a]: “Discrete Carbon Nanotubes”

Claim [1a] specifies a composition comprising “discrete carbon nanotubes.” Ex. 1001, 7:4. Petitioner argues that Ohata prepares a masterbatch composition that includes carbon nanotubes blended with a resin, which results in the carbon nanotubes becoming “unraveled and straightened” and dispersed within the resin. Pet. 19–20 (quoting Ex. 1004 ¶¶ 16, 17 (emphasis omitted)). Here again, that admission — that discrete nanotubes are dispersed within the resin in the proposed Ohata-Kavan composition — represents a dispositive deficiency in the challenge.

Petitioner refers to Figure 1(b) of Ohata, which, we agree, depicts at least a subset of carbon nanotubes as untangled, isolated, and dispersed – as well as embedded or fully coated – within Ohata’s resin material. *Id.* at 18–19. Petitioner argues that, “to the extent discrete is interpreted as referring to nanotubes that are generally individually distinct,” a person of ordinary skill in the art would have understood “that at least some of these ‘unraveled and straightened carbon nanotubes’ are discrete because they are generally ‘dispersed’ as individual nanotubes in the resin, as described and illustrated by Ohata.” *Id.* at 20 (emphasis omitted) (citing Ex. 1004 ¶ 17, Fig. 1(b); Ex. 1003 ¶ 80).

The preamble of claim 1 includes the open-ended term “comprising,” indicating an open-ended claim scope that is broad enough to embrace a composition that contains both discrete carbon nanotubes and other carbon

nanotubes. Ex. 1001, 7:1–3. It seems reasonable, Petitioner suggests, that Ohata’s Figure 1(b) would have suggested a composition comprising at least five individual carbon nanotubes dispersed in the resin, given that five nanotubes are depicted as dispersed individually in the resin — making no contact with any other nanotubes. Ex. 1004, Fig. 1(b) (reproduced *supra* 10).

Patent Owner, for its part, advances counterarguments and evidence supporting that Ohata’s Figure 1(b) would not have alerted an ordinarily skilled artisan that Ohata’s masterbatch composition, in fact, includes “discrete carbon nanotubes” within the scope of claim [1a]. Resp. 51–59 (and evidence cited therein). For example, Patent Owner posits that Ohata’s Figure 1(b) merely is a “cartoon” illustration that does not capture “a real-world representation of actual masterbatch results” attainable by Ohata’s process. *Id.* at 53. Further, according to Patent Owner, this challenge fails because Petitioner does not demonstrate that any discrete carbon nanotubes present in Ohata’s masterbatch composition “would remain discrete after ***being further mixed*** with the active material to create the electrode material paste mixture,” which is the proposed Ohata-Kavan composition. *Id.* at 53–54 (Patent Owner’s emphasis).¹⁰

For reasons that follow, we need not resolve whether the proposed Ohata-Kavan composition includes “discrete carbon nanotubes” because the dispute is not material to the outcome of this challenge.

¹⁰ The challenge, as articulated in the Petition, uses Ohata “as a starting point” and, in particular, relies on Ohata’s “electrode material mixture containing [a] masterbatch and an electrode active material.” Pet. 7 (quoting Ex. 1004 ¶ 23).

*Claim [1b]: “Crystals or Layers of Lithium
Ion Active Material Attached to their Surface”*

We need not resolve the parties’ dispute, set forth above, about whether the proposed Ohata-Kavan composition would include “discrete carbon nanotubes” as specified in claim [1a], because even if we accept Petitioner’s view that it does, this challenge fails for lack of credible evidence that the applied references suggest the additional limitation of claim [1b].

Claim [1b] specifies that the discrete carbon nanotubes must have “crystals or layers of lithium ion active material attached to their surface.” Ex. 1001, 7:4–5. In Petitioner’s view, Ohata’s carbon nanotubes would have been oxidized according to the process of Kavan, then added to the resin of Ohata’s masterbatch binder, wherein they unravel and straighten (becoming “discrete”), and at which point the surfaces of the oxidized nanotubes become available for attachment (and, in fact, become attached) to an added electrode active material (TiO_2 or LiMPO_4), in satisfaction of the requirements of claim [1b]. Pet. 7–8.

That view is false. In contrast to both Kavan and the ’909 patent, the ‘masterbatch’ process of Ohata” involves embedding (that is, fully coating) carbon nanotubes in a resin (namely, polyvinylidene fluoride (“PVDF”)), which, critically for our purposes, prevents the nanotube surfaces from being exposed and available for attachment to the electrode active material. Ex. 2006 ¶ 98.

Patent Owner advances compelling evidence on that particular point, most notably the intrinsic disclosure of Ohata, which persuades us that a person of ordinary skill in the art “would understand that when a small proportion of nanotubes (e.g., 5–20 parts by weight) are mixed with a large

proportion of fluorocarbon resin (e.g., 100 parts by weight) as taught by Ohata,” then “the nanotubes become embedded within, and are fully coated by, the fluorocarbon resin.” Ex. 2006 ¶ 105 (citing Ex. 1004 ¶ 6; Ex. 1014, 3; Ex. 2009, 2; Ex. 2024, 65:21–66:9). We emphasize again, because it strongly supports Patent Owner’s position on this point, that Petitioner affirmatively argues that the nanotubes in the proposed Ohata-Kavan composition are “dispersed in a resin” using the ratio of materials “taught by Ohata.” Pet. 7.

Herein lies the problem for Petitioner: In the proposed Ohata-Kavan composition, the electrode active material (TiO_2 or LiMPO_4) would **not** attach to the surfaces of the nanotubes because those surfaces are not available for such attachment. To the contrary, those surfaces would be **unavailable** for such attachment, precisely because they are fully coated (that is, embedded) in PVDF resin, which prevents exposure of the surfaces to the active material. Resp. 18–44.¹¹ This is clear from Figure 1(b) in Ohata, which Petitioner advances in support of this challenge. That figure (reproduced *supra* 10) plainly depicts discrete carbon nanotubes embedded in PVDF resin.

¹¹ For the sake of brevity, we cite to Patent Owner’s information, adopt Patent Owner’s assessment of the evidence as our own, and determine that the information fully supports this factual finding. In addition, we specifically call out the persuasiveness of Patent Owner’s witness, Dr. Chung, who directs us to “[n]umerous objective references” that “prove this point.” Ex. 2006 ¶ 105; *see id.* ¶¶ 106–117 (Dr. Chung, identifying and explaining those additional references). Dr. Chung cogently explains, with exceptional clarity, why the carbon nanotubes surfaces, embedded within PVDF resin in the proposed Ohata-Kavan composition, are **unavailable** for attachment to the electrode active material (namely, TiO_2 or LiMPO_4) as required by claim [1b]. Ex. 2006 ¶¶ 99–126.

The proposed Ohata-Kavan composition conducts electricity by a mechanism materially different from the mechanism at play in Kavan and the '909 patent.¹² Ohata teaches “a large volume of polymer” (namely, PVDF resin) “with a small amount of” carbon nanotubes, which leads to formation of an electrically conductive “interconnected network of” carbon nanotubes. Sur-reply 29, 30; *see id.* at 19–27 (explaining this mechanism, including the phenomena of electron tunnelling and percolation threshold).

Kavan and the '909 patent, in contrast, achieve electrical conductivity by a materially different mechanism, which depends on physical contact between the oxidized surfaces of nanotubes and an electrode active material (in other words, the physical attachment required by claim [1b]) — a difference that undermines Petitioner’s stated rationale for why an ordinarily skilled artisan would have been led to combine Ohata and Kavan in the manner claimed with a reasonable expectation of success. Sur-reply 27; *see id.* at 19–27 (explaining differences between these mechanisms). Given that difference, we find impermissible hindsight reconstruction in this challenge.

The point of Ohata’s masterbatch process is to embed carbon nanotubes in a resin to form a binder. Resp. 20–27. “[T]he first step in all embodiments of Ohata is to prepare the ‘masterbatch,’ which is ‘5 to 20 parts by weight’ of carbon nanotubes ‘per 100 parts by weight of the resin.’” Resp. 24; Ex. 2006 ¶ 85 (Dr. Chung’s declaration testimony, citing Ex. 1004 ¶¶ 5, 6 (Ohata)). In other words, the resin “makes up the overwhelming

¹² Here again, we emphasize, this challenge uses Ohata “as a starting point,” relying on Ohata’s “electrode material mixture containing [a] masterbatch and an electrode active material.” Pet. 7 (quoting Ex. 1004 ¶ 23).

majority of the masterbatch binder.” Resp. 24; Ex. 2006 ¶ 85; *see* Ex. 1004, Fig. 1(b) (reproduced *supra* 10).

On this record, in the Ohata-Kavan composition, the allegedly discrete carbon nanotubes are embedded (and fully coated) by resin. Petitioner’s attempt to refute that fact in the Reply is unavailing and inconsistent with the Petition. *Compare* Resp. 18–44, *with* Reply 5–10; *but see* Pet. 20 (acknowledging that, in the proposed Ohata-Kavan composition, the carbon nanotubes would be present as “individual nanotubes in the resin”).

If the nanotubes in the proposed Ohata-Kavan composition are truly “discrete” and dispersed from one another in the resin, as argued by Petitioner in the Petition, and the composition is formed of 80% PVDF resin (at minimum) (Ex. 1004 ¶ 6), it follows that those discrete carbon nanotubes would be fully coated in the resin. Ex. 2006 ¶ 105 (citing Ex. 1004 ¶ 6). During the final hearing, Petitioner’s counsel effectively admitted that this ground fails if the discrete carbon nanotubes in the proposed Ohata-Kavan composition are fully coated in resin. Tr. 32:13–23.

In the Reply, Petitioner posits that the carbon nanotubes ***must not be*** fully coated, because in order to achieve electrical conductivity, there ***must*** be direct physical contact between the nanotube surfaces and the active material. Reply 5–6. That is false. Patent Owner explains, and we agree, that Ohata (as compared to the materially different process of Kavan or the ’909 patent) relies on a different mechanism to achieve electrical conductivity, whereby such ***physical*** contact is not required for there to be ***electrical*** contact: Petitioner’s arguments to the contrary fail to account adequately, if at all, for the phenomena of electron tunneling and percolation threshold that

undergird Ohata's mechanism, and drive the functionality of Ohata's composition. *See* Sur-reply 14–27 (and evidence cited therein).

To be clear, Ohata reflects “the conventional wisdom at the time,” which “was to achieve a network of interconnected” carbon nanotubes (e.g., “a ‘continuous’ network) between active material particles.” Resp. 13. The '909 patent, by contrast, describes a composition that achieves electrical conductivity differently, by employing discrete carbon nanotubes to which “the active material crystals are attached (e.g., ionically or covalently bonded) to the surface of the” carbon nanotubes “via oxidation.” *Id.* at 13–14 (citing Ex. 1001, 1:46–59).

Patent Owner's witness, Dr. Chung, directs us to compelling objective proof, including scanning electron microscopy images (*see* Ex. 2006 ¶¶ 63, 99–124 (and evidence cited therein)), supporting that the PVDF resin in Ohata's composition exerts a “consuming effect” on carbon nanotubes, creating a polymer layer “that ‘prevents direct contact of particle surfaces’” even when the PVDF resin layer is “as thin as a single layer of molecules” (*id.* ¶¶ 125–126). We credit Dr. Chung's well-reasoned and well-supported testimony, including her view that an ordinarily skilled artisan would have recognized that it would have been “scientifically impossible for the active material to attach to the surface of” the carbon nanotubes, in the proposed Ohata-Kavan composition, precisely because the nanotubes are embedded, or fully coated, in PVDF resin. *Id.* ¶¶ 126, 127; Resp. 18–44.

Petitioner nevertheless proposes, in the Reply, that the addition of Ohata's dispersion medium (namely, NMP) to the masterbatch composition would have dissolved the PVDF resin sufficiently to expose the surfaces of the nanotubes, in a manner that necessarily results in attachment between the

nanotube surfaces and the active material (TiO_2 or LiMPO_4) as required by claim [1b]. Reply 7–8. Petitioner falls short of establishing that this would, in fact, happen in the proposed Ohata-Kavan composition, not least because Ohata plainly achieves electrical conductivity by an entirely different mechanism that does not involve such attachment. *See* Sur-reply 14–19 (explaining the principles of operation behind Ohata’s electrically conductive composition).

In any event, we determine that Petitioner comes forward with inadequate objective proof that the dispersion medium (NMP) would act to remove the resin (PVDF) from the oxidized surfaces of the carbon nanotubes so completely that those surfaces would become available for attachment to the electrode active material. Reply 7–10. Petitioner essentially asks us to make two unsupported assumptions: first, that because PVDF is soluble in NMP, the NMP added to the proposed Ohata-Kavan composition necessarily would have removed PVDF resin sufficiently to expose the oxidized surfaces of the carbon nanotubes for further reaction; and, second, that those oxidized surfaces, once exposed, necessarily would have become attached, via an ionic or covalent bond, to the electrode active material. *Id.* We find the evidentiary basis for either assumption deficient.

To the contrary, as Patent Owner explains, “NMP ‘dissolution’” ***does not equate*** with removal of PVDF from the oxidized surfaces of the carbon nanotubes. Sur-reply 19–20. We agree with Patent Owner that “Ohata describes NMP as a ‘dispersion medium’” that “easily” disperses the PVDF as domains that act as globules of conductive glue in Ohata’s masterbatch.” *Id.*; Ex. 1004 ¶ 46; Ex. 2006 ¶¶ 118–126. That dispersion function is not shown on this record to be equivalent to, or result in, removal of PVDF from

the nanotube surfaces in the proposed Ohata-Kavan composition, in a manner that *necessarily* results in the attachment of “crystals or layers of lithium ion active material” to those surfaces as specified in claim[1b].

Ex. 1001, 7:4–5.

Petitioner’s arguments, in that regard, amount to an unproven inherency theory of obviousness. *Par Pharm., Inc. v. TWI Pharms., Inc.*, 773 F.3d 1186 (Fed. Cir. 2014) (discussing a number of cases, the Federal Circuit explains that, in order to rely on inherency in an obviousness analysis, “the limitation at issue necessarily must be present, or the natural result of the combination of elements explicitly disclosed by the prior art”). Chemistry is an unpredictable art, which counsels against accepting Petitioner’s inadequately-supported view that an ordinarily skilled artisan would have understood that the addition of NMP as a dispersion medium in the proposed Ohata-Kavan composition inherently would remove PVDF from the oxidized surfaces of the nanotubes, free up those surfaces for ionic or covalent bonding to an electrode active material, and establish (with a reasonable expectation of success) electrical conductivity by a mechanism completely different from the one that is Ohata’s concern and focus.

We find persuasive Patent Owner’s counterview, which is supported by solid objective proof, that PVDF would, in fact, “coat onto” the surfaces due to the “strong interaction between PVDF and” oxidized carbon nanotubes. Sur-reply 20–21 (quoting Ex. 2009, 2) (citing additional persuasive evidence). Even if, as Petitioner argues, this interaction may be relatively “weak” compared to a different dispersion medium, that argument falls short of demonstrating that NMP would, in fact, necessarily remove PVDF from the oxidized nanotube surfaces in the proposed Ohata-Kavan

composition, much less result in the attachment required by claim [1b].

Id. at 21.

In a nutshell, Patent Owner advances evidence that PVDF would bond to the oxidized carbon nanotube surfaces in the proposed Ohata-Kavan composition, and Petitioner raises insufficiently persuasive evidence that the addition of NMP as a dispersion medium would break that bond. Resp. 34; Ex. 2006 ¶ 115; Ex. 2009, 2. Where the burden of proof on this point falls on Petitioner, we find in favor of Patent Owner.

Based on the full trial record, therefore, we determine that Petitioner fails to establish that the dispersion medium at hand (namely, NMP) would remove the “molecular layer” of resin-coating (that is, the PVDF) from the oxidized nanotube surfaces in the proposed Ohata-Kavan composition, such that those surfaces would be made available for attachment to the electrode active material (TiO₂ or LiMPO₄). Resp. 44; Sur-reply 21; Ex. 2006 ¶ 126.

Conclusion on Claim 1

For the above reasons, Petitioner does not demonstrate by a preponderance of the evidence that claim 1 would have been obvious in view of the combined teachings of Ohata and Kavan. Because our assessment of the claim [1a] and [1b] limitations are dispositive, we need not address the sufficiency of Petitioner’s challenge as to the limitations of claim [1c] or [1d].

b) Claims 2 and 5–8

Claims 2 and 5–8 depend, directly or indirectly, from claim 1. Ex. 1001, 7:9–31. These claims inherit the claim [1b] limitation that requires “crystals or layers of lithium ion active material attached to” the surfaces of discrete carbon nanotubes. Ex. 1001, 7:4–5. Our reasoning above, provided

in the context of claim [1b], applies with equal force to claims 2 and 5–8. Accordingly, we determine that Petitioner fails to demonstrate that any of these dependent claims would have been obvious in view of the combined teachings of Ohata and Kavan.

c) Conclusion on the Ohata-Kavan Combination

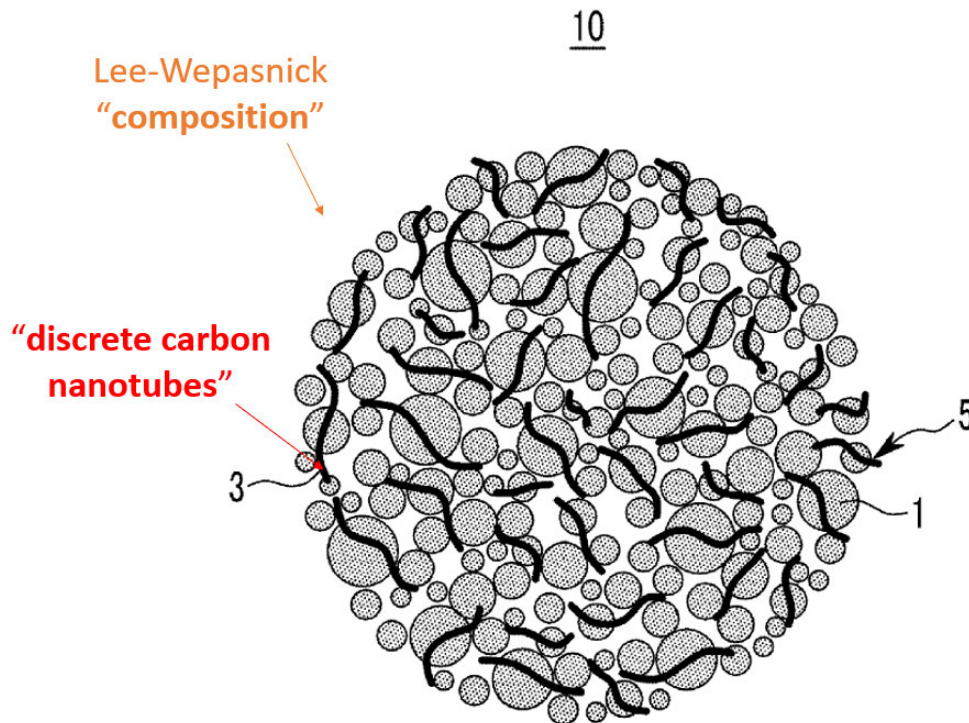
Petitioner does not establish that any of the challenged claims are obvious in view of the combined teachings of Ohata and Kavan.

F. Remaining Obviousness Challenges

Petitioner asserts two additional obviousness challenges. First, Petitioner argues that claims 1, 2, and 5–8 are unpatentable as obvious in view of the combined teachings of Lee and Wepasnick; second, Petitioner argues that claims 3 and 4 are unpatentable as obvious in view of the combined teachings of Lee, Wepasnick, and Zhamu. Pet. 38–82. Our assessment of the first challenge (as directed against claim 1, from which the other claims depend) is dispositive of all the remaining challenges.

Claim [1a] specifies a composition “comprising discrete carbon nanotubes.” Ex. 1001, 7:2–4. Petitioner contends that Lee’s “anode active material” renders obvious the composition of claim 1, and that Lee’s “anode active material” includes carbon nanotubes. Pet. 52 (citing Ex. 1006 ¶ 40). Petitioner alternatively argues that Lee’s “anode active material composition” renders obvious the composition of claim 1, and that “[t]his combination anode active material composition includes ‘the anode active material’ discussed *supra*, ‘a binder, and a solvent.’” Pet. 50 (citing Ex. 1006 ¶ 16). According to Petitioner, the combination “anode active material composition” can be coated onto a current collector, and Lee shows “the structure of the active material layer” in Figure 3. Pet. 50.

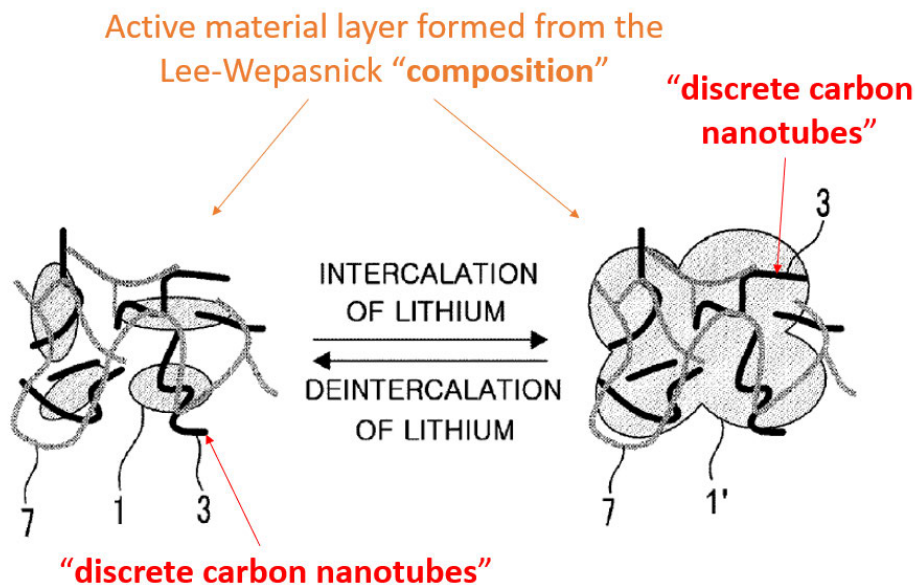
With regard to the discrete nanotube limitation of claim [1a], Petitioner first argues that, “[a]s illustrated in Lee’s FIG. 1, the carbon nanotubes in the combination anode active material (the **composition**) are **discrete**, e.g., to the extent that discrete in this context is interpreted as referring to nanotubes present in the anode active material as generally individually distinct (e.g., non-agglomerated) nanotubes.” Pet. 53. Petitioner provides an annotated version of Figure 1 of Lee, reproduced below, to support its argument.



Pet. 54; Ex. 1006, Fig. 1. Figure 1 of Lee shows “a schematic view of the structure of an anode active material” 10 comprising primary nanoparticles 5 that include non-carbonaceous material 1 and hollow carbon nanofibers 3. Ex. 1006 ¶¶ 23, 40. Petitioner’s annotated version includes a label identifying carbon nanofibers 3 as “discrete carbon nanotubes.” Pet. 53.

Petitioner submits that a person of ordinary skill in the art would have understood that the nanotubes in the proposed composition are discrete “because, at least in some instances, oxidation of nanotubes can help promote non-agglomeration of the nanotubes.” *Id.* at 54.

Petitioner additionally argues, in the alternative, that Lee’s “anode active material composition” includes nanotubes because it contains the “anode active material,” which itself contains nanotubes. *Id.* at 55. Petitioner likewise contends that the nanotubes in the “anode active material composition” are discrete for the same reasons the nanotubes in the “anode active material” are discrete. *Id.* at 55–56. Petitioner further relies on an annotated version of Lee Figure 3, reproduced below, to support its argument.



Pet. 56; Ex. 1006, Fig. 3. Lee’s Figure 3 shows the structure of active material layer 14 including carbon nanofibers 3, Li composite 1', non-carbonaceous material 1, and binder 7. Ex. 1006 ¶¶ 49–50. Petitioner’s

annotated version includes labels identifying carbon nanofibers 3 as “discrete carbon nanotubes.” Pet. 56.

In Petitioner’s view, “the nanotubes in the combination anode active material composition are discrete based on Lee’s teaching that ‘[t]he electron donor group’ of the polymer binder in the anode active material composition ‘aids the dispersal of the hollow carbon nanofibers.’” *Id.* at 56 (quoting Ex. 1006 ¶ 53) (emphasis omitted).

In our Institution Decision, we set forth our concerns about Petitioner’s conclusions derived from Lee. Inst. Dec. 33–34. Specifically, Lee discloses that its “anode active material includes secondary particles formed of agglomerated primary nanoparticles,” and that the “primary nanoparticles include a non-carbonaceous material bound with hollow carbon nanofibers.” Ex. 1006, code (57), ¶ 14.

Petitioner acknowledges these disclosures in Lee, but fails to sufficiently address them in the Petition. *See* Pet. 42, 48, 52. For example, in the Petition, Petitioner does not attempt to reconcile Lee’s teachings, regarding the agglomeration of particles, with its assertion that Figures 1 and 3 in Lee show discrete, non-agglomerated carbon nanotubes. *Id.* We decline to draw the same conclusion Petitioner does about Figures 1 and 3, as demonstrating the presence of discrete carbon nanotubes, particularly in view of Lee’s disclosures regarding agglomeration. Petitioner, in that regard, directs us to paragraphs 162 and 167 of Dr. Zhu’s Declaration to support the assertions in the Petition, but those paragraphs simply restate the conclusory arguments provided in the Petition, offering no sufficient supporting technical reasoning or objective proof for those arguments. Pet. 53–54, 56.

Patent Owner calls out the Petition’s deficiency, in that regard, by arguing that, on its face, the Petition lacks reasoning adequate to demonstrate “how Lee can teach ‘discrete’” carbon nanotubes “given the repeated teachings of ‘agglomeration.’” Resp. 71. In Patent Owner’s view, this represents a “fatal” defect in the challenges based on Lee, because “[a]rguments in a petition must be made with particularity, not opacity.” *Id.* (quoting *Microsoft Corp. v. FG SRC, LLC*, 860 Fed. Appx. 708, 713 (Fed. Cir. 2021)). We agree with Patent Owner and, on that basis, find that the grounds based on Lee, as asserted in the Petition, fall short of establishing adequately the unpatentability of any challenged claim.

Furthermore, we agree with Patent Owner that, under the unique circumstances presented on this record, “it is impermissible for Petitioner to use its reply in an attempt to supplement” the “Petition to provide a sufficient explanation” about why Lee allegedly discloses discrete carbon nanotubes, particularly where, in our Institution Decision, we found that the challenges based on Lee, as articulated in the Petition, are deficient for lack of such an explanation. *Id.* at 72. It would be unfair to allow Petitioner, guided by our Institution Decision, to use the Reply as a vehicle for curing challenges that are deficiently asserted in the Petition.

Patent Owner comes forward with abundant evidence and argument that explains, in compelling detail, why our initial determination in the Institution Decision is correct—namely, that the information presented in the Petition is inadequate to make out the challenges based on Lee. *See id.* at 69–82 (and evidence cited therein). Here again, we reject any suggestion that this material in the Response represents an invitation for Petitioner to

undertake a belated attempt to backfill its Petition with new information advanced for the first time in its Reply. *See* Reply 20–28.

In our Institution Decision, moreover, we expressed similar concerns about Petitioner’s argument that the oxidation of nanotubes can help promote non-agglomeration of the nanotubes in the context of Lee. Inst. Dec. 34 (citing Pet. 54). We agreed with Patent Owner that “Petitioner’s speculation about Lee somehow having ‘discrete’ carbon nanotubes [is] directly contrary to the teachings throughout Lee of ‘agglomerated’ nanoparticles.” *Id.* (quoting Prelim. Resp. 30). Moreover, we considered particularly relevant Lee’s teachings about agglomerated nanoparticles, given Petitioner’s qualification that oxidation “can” help promote non-agglomeration “in some instances.” *Id.* (quoting Pet. 54).

We found “similarly problematic” Petitioner’s arguments, as presented in the Petition, regarding dispersal of nanofibers. *Id.* We could not discern, from the information provided in the Petition, how a composition with agglomerated nanoparticles, and including a polymer binder, would provide discrete nanotubes. *Id.* Petitioner, in the Petition, simply cited to paragraph 168 of the Zhu Declaration, but that paragraph offers no more than the inadequate information presented in the Petition. *Id.* (citing Pet. 56–57).

Petitioner attempts to cure the above-identified deficiencies in the Petition by submitting additional evidence with the Reply, including supplemental declaration testimony of Dr. Zhu. Reply 20–22 (citing Dr. Zhu’s Reply Declaration (Ex. 1056)). That endeavor, coming too late for Patent Owner to counter effectively with new evidence in the Sur-reply, is ineffective to cure the deficiencies in the Petition. We find the Petition fails

to identify “with particularity . . . the grounds on which the challenged to each claim is based, and the evidence that supports the grounds for the challenge to each claim.” 35 U.S.C. § 312(a)(3).

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). “Unlike district court litigation—where parties have greater freedom to revise and develop their arguments over time and in response to newly discovered material—the expedited nature of IPRs bring with it an obligation for petitioners to make their case in their petition to institute.” *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016). Although “the introduction of new evidence in the course of the trial is to be expected in *inter partes* review trial proceedings,” *Genzyme Therapeutic Prods. LP v. Biomarin Pharm. Inc.*, 825 F.3d 1360, 1366 (Fed. Cir. 2016), the shifting of arguments is not, *Wasica Fin. GmbH v. Cont’l Auto. Sys., Inc.*, 853 F.3d 1272, 1286 (Fed. Cir. 2017).

Petitioner, having “failed to carry its burden” to show sufficiently in the Petition how or why the Lee-Wepasnick combination supports the unpatentability of any challenged claim, “now seeks to shift blame to” Patent Owner and the Board for “fundamentally ‘misunderstanding’ Lee.” Sur-reply 32 (quoting Reply 21, n.2). The arguments raised by Petitioner in the Reply do not expand on evidence advanced in the Petition, but improperly seek to cure a deficiency in the Petition; namely, the lack of persuasive explanation as to how or why Lee discloses discrete carbon nanotubes. *Compare* Pet. 38–57 (nowhere addressing persuasively how or why Lee discloses “discrete carbon nanotubes” as specified in claim [1a]),

with Reply 20–28 (raising new arguments and evidence in a belated attempt to cure that deficiency in the Petition).

In the alternative, for reasons well-stated by Patent Owner, the information presented by Petitioner in the Reply, regarding the grounds based on Lee, falls short of curing effectively the deficiencies in the Petition. Sur-reply 32–39. We adopt as our own Patent Owner’s analysis in that regard. *Id.*

By way of example, in the Reply, Petitioner argues that Patent Owner “does not contest that the nanotubes in the primary nanoparticles are discrete.” Reply 22. To the contrary, Patent Owner plainly argues that an ordinarily skilled artisan “considering Lee as a whole would understand each thick squiggly-line in Figure 1 to represent intertwined” carbon nanotubes. Sur-reply 32 (citing Resp. 75 n.6). Each of the other arguments presented in the Reply is persuasively countered in the Sur-reply. *Compare* Reply 20–28, *with* Sur-reply 32–39.

Against that backdrop, we determine that Petitioner has not established by a preponderance of the evidence that claim 1, or any other challenged claim, all of which depend from claim 1, would have been obvious based on the grounds that assert Lee.

III. CONCLUSION

Petitioner does not establish by a preponderance of the evidence that any of claims 1–8 of the ’909 patent is unpatentable. Therefore, we do not find any challenged claim unpatentable.

We summarize our decision in the following chart.

Claims	35 U.S.C. §	References	Claims Shown Unpatentable	Claims Not Shown Unpatentable
1, 2, 5–8	103	Ohata, Kavan		1, 2, 5–8
1, 2, 5–8	103	Lee, Wepasnick		1, 2, 5–8
3, 4	103	Lee, Wepasnick, Zhamu		3, 4
Overall Outcome				1–8

IV. ORDER

It is

ORDERED that Petitioner has not proven by a preponderance of the evidence that any of claims 1–8 of the '909 patent is unpatentable;

FURTHER ORDERED that *within one week of this Decision*, the Samsung Petitioners shall submit to the Board, via email to Trials@uspto.gov, a version of this Decision to be filed in the public record, with proposed any redactions (*see supra* n.1); and

FURTHER ORDERED that, because this is a Final Written Decision, any party to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

IPR2024-01006
Patent 8,808,909 B2

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Exhibit B

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

LG ENERGY SOLUTION, LTD.,
SAMSUNG ELECTRONICS CO., LTD., and
SAMSUNG ELECTRONICS AMERICA, INC.,
Petitioner,

v.

MOLECULAR REBAR DESIGN, LLC,
Patent Owner.

IPR2024-01006
Patent 8,808,909 B2

Before GRACE KARAFFA OBERMANN, KRISTINA M. KALAN, and
AVELYN M. ROSS, *Administrative Patent Judges*.

OBERMANN, *Administrative Patent Judge*.

DECISION
Denying Petitioner's Request for Rehearing
37 C.F.R. § 42.71(d)

I. INTRODUCTION

Petitioner filed a Request for Rehearing (Paper 41, “Reh. Req.”) of our Final Written Decision (Paper 37, “Dec.”) in which we determined that Petitioner did not demonstrate that claims 1–8 of U.S. Patent No. 8,808,909 B2 (Ex. 1001, “the ’909 patent”) are unpatentable. With our authorization, Patent Owner filed a Response to the Request (Paper 44, “Reh. Resp.”), and Petitioner filed a Reply to Patent Owner’s Response to the Request (Paper 45, “Reh. Reply.”). We *deny* the Request for the following reasons.

II. STANDARD OF REVIEW

The standard applicable to the Request is provided in Rule 42.71(d), which states in pertinent part:

The burden of showing a decision should be modified lies with the party challenging the decision. The request must specifically identify all matters the party believes the Board misapprehended or overlooked, and the place where each matter was previously addressed in a motion, an opposition, a reply, or a sur-reply.

37 C.F.R. § 42.71(d). A request for rehearing is not an opportunity to present new arguments or evidence or merely to disagree with the panel’s assessment of the arguments or weighing of the evidence.

III. ANALYSIS

In Petitioner’s view, the Board erred in its analysis of the Ohata-Kavan combination by “wrongly conclud[ing] that Ohata achieves electrical conductivity ‘by a materially different mechanism’—namely through the phenomenon of ‘electron tunneling’ and ‘percolation threshold’—despite an acknowledged lack of ‘physical contact between the oxidized surfaces of

nanotubes and an electrode active material.” Reh. Req. 1 (citing Dec. 21–24). Petitioner argues that “[t]he record evidence makes clear that a battery electrode, such as those found in Ohata, operates through physical contact that is made between the conductive additive (e.g., carbon nanotubes) and the ion active materials.” *Id.* at 3.

In addition, Petitioner contends the Board erred by misapprehending Lee’s disclosure “in concluding that the Lee-Wepasnick combination lacks discrete nanotubes,” and by “overlook[ing] subsequent briefing from Petitioner clarifying Lee’s disclosure.” Reh. Req. 2; *see* Reh. Reply 7. In particular, Petitioner argues, “the Petition explains why the nanotubes themselves remain discrete despite the agglomeration of the nanoparticles to which they belong,” and the “Reply clarifies Lee’s structure—agglomerated nanoparticles that nevertheless contain discrete nanotubes.” Reh. Req. 13.

Patent Owner disputes each of Petitioner’s contentions. As to the Ohata-Kavan combination, Patent Owner asserts that the Board correctly determined that the carbon nanotubes in Ohata’s masterbatch binder remain fully coated with resin (PVDF), even after it is blended with a dispersion medium (NMP), such that the carbon nanotubes do not make physical contact with electrode active material. *See* Reh. Resp. 2–5. Patent Owner also asserts that the Board correctly determined that the binder is electrically conductive such that physical contact does not need to occur in Ohata. *See id.* at 5–9. With respect to the Lee-Wepasnick combination, Patent Owner asserts that the Board fully addressed all arguments presented by Petitioner, and that Petitioner fails to identify anything in the Final Written Decision

that misapprehends or overlooks any material issue regarding Lee's agglomerated nanoparticles. *See id.* at 13.

Based on the information presented by the parties, we are not persuaded that we misapprehended or overlooked any matters in the Final Written Decision. Accordingly, we decline to modify the Final Written Decision for the reasons explained by Patent Owner, which we adopt as our own. *See* Reh. Resp. 1–10. We provide the following discussion for emphasis only.

A. The Ohata-Kavan Combination

In the Final Written Decision, we observed that the claimed feature in which the “discrete carbon nanotubes” have “crystals or layers of lithium ion active material attached to their surface” (claim limitation [1b]) was critical to our determination that no claims are unpatentable under the Ohata-Kavan ground. *See* Dec. 19.

In particular, we were not persuaded by Petitioner's arguments or evidence that Ohata's carbon nanotubes, after being “added to the resin of Ohata's masterbatch binder,” would “become available for attachment (and, in fact, become attached) to an added electrode active material.” *Id.* (citing Pet. 7–8). Instead, we determined that “the ‘masterbatch’ process of Ohata[] involves embedding (that is, fully coating) carbon nanotubes in a resin . . . which, critically for our purposes, prevents the nanotube surfaces from being exposed and available for attachment to the electrode active material.” *Id.* (citing Ex. 2006 ¶ 98).

That determination is supported by the preponderance of the evidence, which strongly favors Patent Owner's position that the surfaces of the

Ohata-Kavan nanotubes are unavailable for attachment. *See, e.g.*, Dec. 20 n.11 (citing Ex. 2006 ¶¶ 99–126) (“Dr. Chung cogently explains, with exceptional clarity, why the carbon nanotube[] surfaces, embedded within PVDF resin in the proposed Ohata-Kavan composition, are **unavailable** for attachment to the electrode active material . . .”).

Nothing in Petitioner’s Request is persuasive to show that the preponderance of the evidence does **not** support that crucial factual finding. The position Petitioner presents in the Rehearing—namely, that there must, in fact, be physical contact between the nanotubes and active material in order for Ohata to function as intended (*see* Reh. Req. 3)—was fully considered in view of the totality of the evidence of record (*see* Dec. 22 (“Petitioner posits that . . . there **must** be direct physical contact between the nanotube surfaces and the active material. Reply Br. 5–6.^[1] That is false.”)).

In particular, we were unpersuaded in the Final Written Decision by Petitioner’s assertion that Ohata’s blending of a dispersion medium (NMP) into a mixture of the masterbatch binder and electrode active material necessarily dissolves the resin sufficiently so as to make the nanotubes available for attachment. *See* Dec. 23–26. Although Petitioner argues we overlooked this aspect of Ohata’s process (*see* Reh. Req. 4, 10–12; Reh. Reply 4–5), all the evidence of record on this point was fully considered (*see* Dec. 26 (“Patent Owner advances evidence that PVDF would bond to the oxidized carbon nanotube surfaces in the proposed Ohata-Kavan composition, and Petitioner raises insufficiently persuasive evidence that the addition of NMP as a dispersion medium would break that bond.”)).

¹ The citation is to Petitioner’s Reply to the Preliminary Response (Paper 6).

Significantly, there is no genuine dispute that in the Ohata-Kavan combination, the nanotubes are immersed in relatively substantial amounts of resin (namely, nanotubes mixed with “80% PVDF resin (at minimum).” Dec. 22 (citing Ex. 1004 ¶ 6). In light of that significant circumstance, the hurdle was relatively high for Petitioner to discharge its burden of proving that the nanotubes are not coated with resin and, therefore, are available for attachment to the electrode active material in the proposed combination. *See id.* (citing Tr. 32:13–23) (“Petitioner’s counsel effectively admitted that this ground fails if the discrete carbon nanotubes in the proposed Ohata-Kavan composition are fully coated in resin.”).

To be clear, the burden of proving that the nanotubes are not coated with resin fell squarely on Petitioner during the trial, but Petitioner’s evidence on point was sparse and was overwhelmed by Patent Owner’s countervailing proof. *See* Dec. 20–26 (detailed weighing of the evidence on point). Rehearing is not an opportunity to express disagreement with our weighing of the evidence.

Petitioner also presents a review of the evidence that allegedly contradicts the theories of electron tunneling and percolation threshold, arguing that the Board reversibly erred by accepting “the notion that Ohata somehow works in a materially different manner without physical contact between the nanotube surface and the active materials.” Reh. Req. 9–10; *see id.* at 5–9; Reh. Reply 1–4. But Petitioner acknowledges that we considered and rejected this position. *See* Reh. Req. 8 (noting “the Board stated that ‘Petitioner’s arguments ... fail to account adequately ... for the phenomena of electron tunneling and percolation threshold that undergird Ohata’s

mechanism’”) (citing Dec. 21–24). Again, rehearing is not an opportunity to disagree with the panel’s assessment of the arguments or weighing of the evidence.

In Petitioner’s further view, Patent Owner’s argument that Ohata achieves electrical conductivity without physical contact between carbon nanotubes and active material as “an eleventh-hour, attorney-driven pivot—raised for the first time in Patent Owner’s Sur-Reply.” Reh. Req. 2. But Petitioner raised the issue of whether physical contact is required in Ohata in the Reply (*see, e.g.*, Pet. Reply 6 (asserting that “without contact between the conductive additive (*e.g.*, nanotubes) and the active material, the electrode material would be inoperable in a battery”)), and, thus, Patent Owner properly responded by presenting evidence and argument to the contrary, by showing that electrical conductivity does not require physical contact (*see, e.g.*, PO Sur-reply 14 (“**Physical** contact is not required for there to be electrical contact due to the scientific principles of ‘electron tunneling’ and ‘the percolation threshold.’”))).

We disagree with Petitioner that, in weighing the evidence on this point, the Board in the Final Written Decision “erroneously required Petitioner to essentially prove that Ohata’s masterbatch process ‘necessarily results in attachment between the nanotube surfaces and the active material.’” Reh. Req. 2 (citing Dec. 23–24). This was the position Petitioner adopted (Pet. Reply 7 (asserting that “an electrode material without contact between nanotubes and active material would be non-functional, while Ohata’s material has good electrochemical performance”); Dec. 25 (“Petitioner’s arguments, in that regard, amount to an unproven inherency

theory of obviousness.”)), and, thus, Petitioner bore the burden of proving its position, which it failed to bear.

Patent Owner’s extensive and detailed counterarguments as to Petitioner’s identification of alleged reversible errors in the Board’s treatment of the Ohata-Kavan combination are persuasive, and we adopt Patent Owner’s reasoning as our own. Reh. Resp. 1–9.

B. Treatment of Lee’s Disclosure

In the Final Written Decision, the Board explained the shortcomings of the Petition, which similarly were identified in the Institution Decision, with respect to Petitioner’s assertion that Lee teaches “discrete, non-agglomerated carbon nanotubes.” Dec. 30; *see id.* at 24–27. We further explained that “[i]t would be unfair to allow Petitioner, guided by our Institution Decision, to use the Reply as a vehicle for curing challenges that are deficiently asserted in the Petition.” *Id.* at 31.

In any event, alternatively, we considered Petitioner’s arguments about Lee’s disclosure in the Reply, in view of all the evidence of record, and found them lacking. *See id.* at 34. Petitioner’s arguments in the Request merely disagree with our conclusions, and fall short of identifying any matters that we misapprehended or overlooked in our analysis of the record evidence on point. Reh. Req. 2–3, 12–15. Here again, Patent Owner’s counterarguments are persuasive, and we adopt Patent Owner’s reasoning as our own. *See* Reh. Resp. 9–10.

IV. CONCLUSION

For the above reasons, Petitioner has not carried its burden of demonstrating that the Board misapprehended or overlooked any matters in

IPR2024-01006
Patent 8,808,909 B2

rendering the Final Written Decision. *See* 37 C.F.R. § 42.71(d). Because Petitioner's challenge does not meet the standard set forth for a successful request for rehearing, Petitioner's Request is *denied*.

V. ORDER

It is

ORDERED that Petitioner's Request is *denied*.

IPR2024-01006
Patent 8,808,909 B2

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