

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: IPR2024-01011¹

U.S. Patent No. 8,968,924

**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 IPR2024-01011 via a Motion for Joinder in IPR2025-00357.

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 38) (“Final Written Decision”), and the Decision Denying Petitioner’s Request for Rehearing, entered May 13, 2026 (Paper 47) (“Rehearing Decision”), in Case No. IPR2024-01011 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 1-5 of the ’924 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, 4, 5;
 - b. Cheng and Gan for claims 1, 4, 5;
 - c. Cheng, Gan, and Zhao for claims 2, 3;

2. All of the Board's subsidiary findings supporting its determination that claims 1-5 of the '924 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/

Andrew R. Sommer
Reg. No. 53,932

*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/

Andrew R. Sommer
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,

v.

MOLECULAR REBAR DESIGN, LLC,
Patent Owner.

IPR2024-01011¹
Patent 8,968,924 B2

Before GRACE KARAFFA OBERMANN, KRISTINA M. KALAN,
and AVELYN M. 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 IPR2025-00357 (“IPR357”). We designate this Decision as confidential because we cite information from a paper that the Samsung Petitioners identified as confidential in IPR357. *See infra* n.2 (citing IPR357, Paper 3).

IV. INTRODUCTION

A. Background and Summary

Petitioner² filed a Petition for an *inter partes* review (Paper 2 (“Pet.”)) challenging claims 1–5 of U.S. Patent No. 8,968,924 B2 (Ex. 1001 (“the ’924 patent”)). Patent Owner³ filed a Preliminary Response. Paper 6. After receiving authorization from the Board (Ex. 3001), Petitioner filed a Reply to the Preliminary Response (Paper 7) and Patent Owner filed a Sur-reply (Paper 8). Taking account of those papers, we instituted an *inter partes* review. Paper 9 (“Inst. Dec.”).

Thereafter, in timely sequence, Patent Owner filed a Response (Paper 17, “Resp.”), Petitioner filed a Reply (Paper 22, “Reply”), and Patent Owner filed a Sur-reply (Paper 31, “Sur-reply”). In addition, pursuant to an unopposed request for authorization (Ex. 3002), Petitioner filed observations on cross-examination (Paper 33).

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. 72–73; Paper 14 at 1–

² The real parties-in-interest include LG Energy Solution, Ltd. (Pet. 72) and the Samsung Petitioners (IPR357, Paper 3 at 72). 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.

2. Patent Owner further identifies *Molecular Rebar Design, LLC v. LG Chem, Ltd.*, 1-22-cv-01130 (D. Del.) (dismissed). Paper 14 at 2.

Patent Owner also identifies as related matters these administrative proceedings, which involve the Samsung Petitioners: IPR2025–00355, IPR2025–00356, IPR2025–00358, and IPR2025–00359. Paper 14 at 2.

Patent Owner further identifies as related matters these administrative proceedings, which LG Energy Solution, Ltd.: IPR2024–01005, IPR2024–01006, IPR2024-01011, IPR2024-01012, and IPR2024–01013. *Id.*

C. The '924 Patent (Ex. 1001)

The '924 patent, titled “Lithium Ion Batteries Using Discrete Carbon Nanotubes, Methods for Production Thereof and Products Obtained Therefrom,” issued March 3, 2015, 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, 1:32–37. 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, 1:37–41.

The specification also identifies prior attempts to overcome these deficiencies, including the use of nano-sized crystals of lithium salts and carbon nanotubes, which improved charge/discharge rates. Ex. 1001, 1:42–

47. 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, 1:47–52. 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, 1:52–55.

The '924 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, 2:37–40. This attachment may be achieved ionically or chemically. Ex. 1001, 3:33–36. The discrete carbon nanotubes preferably have oxidation levels from 1 to 15 weight percent of the carbon nanotube. Ex. 1001, 2:47–50. “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, 4:34–37.

D. Illustrative Claims

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

Claim 1:

[1pre] A composition used in lithium ion batteries comprising:

[1a] discrete carbon nanotubes

[1b] having 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,

[1b (continued)] and wherein the ion active material comprise a lithium metal salt and an element selected from the group consisting of: iron, manganese, cobalt, copper, nickel, vanadium, titanium, and mixtures thereof.

Ex. 1001, 7:7–15 (labels added to correspond with Petitioner’s designation of claim limitations (Pet. vii)).

E. Asserted Unpatentability Challenges

Petitioner asserts that claims 1–5 are unpatentable based on the following challenges:

Claims Challenged	35 U.S.C. § ⁴	References/Basis
1, 4, 5	103(a)	Ohata ⁵ , Kavan ⁶
1, 4, 5	103(a)	Cheng, ⁷ Gan ⁸
2, 3	103(a)	Cheng, Gan, Zhao ⁹

Pet. 1. Petitioner relies on declarations provided by Dr. Yu Zhu. Ex. 1003

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 parties agree that the ’924 patent has an effective filing date of at least June 21, 2012, which is prior to the effective date of the applicable AIA amendments, we apply the pre-AIA version of § 103.

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 CN 101714627 A, published May 26, 2010 (Ex. 1006 (original language); Ex. 1007 (certified English translation)).

⁸ US 2012/0058255 A1, published Mar. 8, 2012 (Ex. 1021).

⁹ CN 102136576 A, published July 27, 2011 (Ex. 1017 (original language); Ex. 1018 (certified English translation)).

(supporting Petition); Ex. 1058 (supporting Reply). Patent Owner relies on a declaration from Dr. Deborah D.L. Chung. Ex. 2006 (supporting Response).

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. 8 (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. 9. 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]. 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

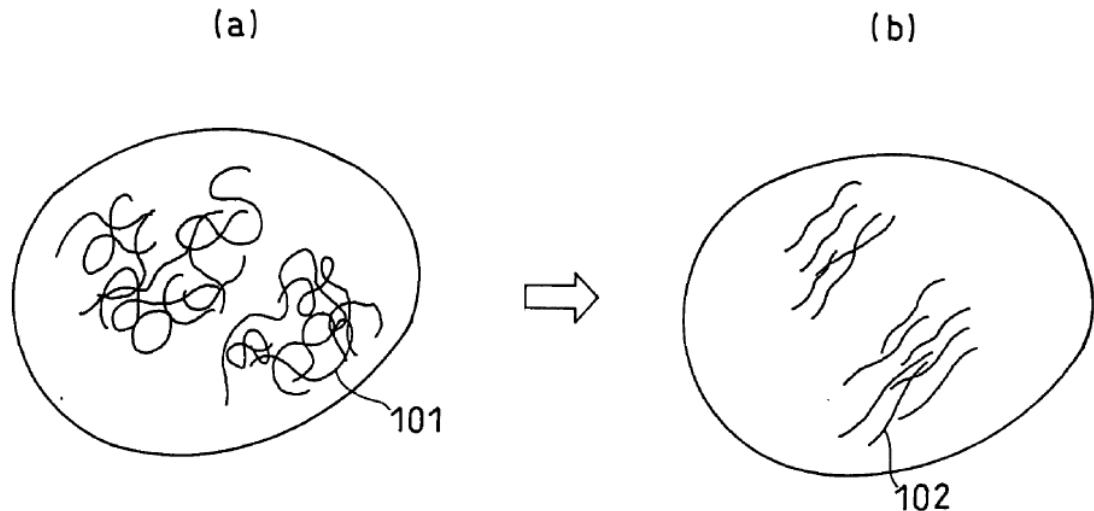


Figure 1(a) is a schematic diagram showing carbon nanotubes tangled and twisted with one another before being blended with a resin, and Figure 1(b) is a schematic diagram showing the carbon nanotubes unraveled and straightened after they have been blended with the resin. Ex. 1004 ¶¶ 12–13.

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) Cheng (Ex. 1007)

Cheng is directed to lithium ion battery materials and, in particular, “a carbon nanotube/lithium iron phosphate composite cathode material.”
Ex. 1007, code (57). Cheng describes a method of preparing its battery material that includes ultrasonically dispersing carbon nanotubes, acetylene black, and a dispersing agent in water or an organic solvent; adding a lithium source, an iron source, and a phosphate salt; adding an organic carbon source; ball milling and drying; and calcining the mixture to obtain a composite cathode material. Ex. 1007, code (57).

According to Cheng, the “carbon nanotubes are uniformly dispersed in a bulk phase and on surfaces of lithium iron phosphate.” *Id.* Cheng states:

Uniform dispersion of carbon nanotubes in the bulk phase and on surfaces of lithium iron phosphate is achieved by means of an in situ solid phase reaction process, thereby solving the problem in the prior art in which carbon nanotubes are distributed only on the surface of the electrode material and cannot form a continuously connected three-dimensional electrically conductive network structure both in the interior and on the surface of the material, and also solving the problem in which the properties of carbon nanotubes cannot be fully utilized because the carbon nanotubes cannot be fully dispersed.

Ex. 1007 ¶ 10.

Cheng further states that the carbon nanotubes have a “tube diameter of 10 to 200 nm and the length of 5 to 20 μm ” and “the carbon nanotubes account for 0.5-15% by weight.” Ex. 1007 ¶¶ 21, 23. According to Cheng, “[c]ompared with carbon nanotubes having a smaller tube diameter and a

greater length, the carbon nanotubes are less entangled with each other and are more easily dispersed.” Ex. 1007 ¶ 21.

d) Gan (Ex. 1021)

Gan is directed “to composites of carbon nanotubes and conductive polymer materials, . . . articles made from such composites, and methods of making such composites and articles.” Ex. 1021 ¶ 2. Gan describes the functionalization of carbon nanotubes (“CNTs”) and explains that such functionalization “[i]mproves the solubility and dispersibility of the CNTs in water and conductive polymer materials into which the CNTs are to be mixed,” “[r]educes contact resistance between CNTs incorporated into the conductive polymer material by drawing the CNTs closer together,” and “[p]rovides a conductive bridge between CNTs to reduce the electrical contact resistance therebetween.” Ex. 1021 ¶¶ 18–21.

Gan describes embodiments in which “suitable functionalization with carboxyl or hydroxyl groups ranged from about 2.5 to about 10 wt%.” Ex. 1021 ¶ 24.

e) Zhao (Ex. 1018)

Zhao discloses “a conductive agent for a lithium-iron-phosphate battery.” Ex. 1018, code (57). Zhao states that the conductive agent “consists of a carbon nanotube/carbon black composite material, graphene, and a binder, and the weight ratio of the components is: carbon nanotube/carbon black composite material : graphene : binder = 1 : (0.001 to 0.1) : (0.01 to 1).” *Id.* According to Zhao, the conductive agent has high electron conductivity and uniform heat conductivity and “effectively utilizes respective advantages of fibrous carbon nanotubes, spherical carbon black, and sheet-like graphene, and cause[s] the same to achieve a synergistic

effect, thereby significantly improving electrochemical performance of the battery.” Ex. 1018 ¶¶ 4, 12. In addition, Zhao states:

graphene has a greater electron transport rate and better heat dissipation performance than carbon nanotubes, so that further addition of graphene to the carbon nanotube/carbon black composite material can not only reduce the internal resistance of the carbon nanotube/carbon black composite material, but also improve heat dissipation performance of a unit cell.

Ex. 1018 ¶ 11.

E. Obviousness Challenge Based on Ohata and Kavan

Petitioner contends that claims 1, 4, and 5 of the '924 patent would have been unpatentable as obvious over Ohata in view Kavan. Pet. 9–35. The challenge is based on Petitioner’s proposed “Ohata-Kavan combination composition.” Pet. 11. 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. 11 (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. 12 (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.* (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. 12. Specifically, Petitioner contends, the "electrode material mixture paste" would have been further modified in view of Kavan to include, for example, 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.* at 12–13.

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. 13–18. Patent Owner opposes on several bases, which we assess below. Resp. 18–59.

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. 22 (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 21. 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 22 (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, 7:7–8. 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. 52–59 (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 55 (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.

Claim [1b]: “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

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. 11 (quoting Ex. 1004 ¶ 23).

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 “ion active material attached to their surface.” Ex. 1001, 7:8–9. 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 in satisfaction of the requirements of claim [1b]. Pet. 12–13.

That view is false. In contrast to both Kavan and the ’924 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. 11.

Herein lies the problem for Petitioner: In the proposed Ohata-Kavan composition, the electrode active material 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. 18–45.¹¹ 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.

The proposed Ohata-Kavan composition conducts electricity by a mechanism materially different from the mechanism at play in Kavan and the ’924 patent.¹² Ohata teaches “a large volume of polymer” (namely,

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, TiO₂ or LiMPO₄) as required by claim [1b]. Ex. 2006 ¶¶ 99–126.

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. 11 (quoting Ex. 1004 ¶ 23).

PVDF resin) “with a small amount of” carbon nanotubes, which leads to formation of an electrically conductive “interconnected network of” carbon nanotubes. Sur-reply 30; *see id.* at 15–27 (explaining this mechanism, including the phenomena of electron tunnelling and percolation threshold).

Kavan and the ’924 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 17–28 (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. 20–28. “[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 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. 22

(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 ’924 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 15–27 (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. 14. The ’924 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.* (citing Ex. 1001, 1:52–64).

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. 18–45.

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 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 15–21 (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 22–28. 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.* at 22; 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 “lithium ion active material” to those surfaces as specified in claim[1b]. Ex. 1001, 7:8.

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 24 (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 24–25.

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. 34–35; 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. Resp. 45; Sur-reply 22; 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 4 and 5

Claims 4 and 5 depend directly from claim 1. Ex. 1001, 7:21–26. These claims inherit the claim [1b] limitation that requires “lithium ion active material attached to” the surfaces of discrete carbon nanotubes. Ex. 1001, 7:8–9. Our reasoning above, provided in the context of claim [1b], applies with equal force to claims 4 and 5. 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. Challenges that Assert Cheng

Two challenges remain, and both assert Cheng. Pet. 1 (grounds chart). First, Petitioner argues that claims 1, 4, and 5 would have been obvious over Cheng and Gan; and, second, Petitioner argues that claims 2 and 3 would have been obvious over Cheng, Gan, and Zhao. *Id.* 33–70.

In the analysis that follows, we focus on whether Petitioner shows that Cheng’s carbon nanotube/lithium iron phosphate composite material, when modified by Gan as proposed in the Petition, would have met claim [1d], which requires a composition in which the carbon nanotubes have “oxidation levels from 1% to 15% by weight of the carbon nanotube.” Ex. 1001, 7:10–12; Pet. 36–64.¹³ We determine that Petitioner does not make out that showing, in reasoning that applies with equal force to both remaining challenges and all challenged claims.

a) Proposed Modified Composition of Cheng-Gan

Cheng prepares a carbon nanotube/lithium iron phosphate composite cathode material by combining (in a first process step) carbon nanotubes, carbon acetylene black, and a dispersing agent “‘in water or an organic solvent’ based on ultrasonic dispersion,” then (in a second process step) mixing the resulting dispersion “with ‘a lithium source, an iron source and a phosphate salt,” followed by “further mixing and processing steps.” Pet. 37 (citing Ex. 1007, Abstract, ¶¶ 12–20, 40, 41, 44, 48, 49, 63, 64, 72, 76, 77, claim 2, claim 8; Ex. 1003 ¶ 101 (Dr. Zhu’s declaration testimony)). Critical

¹³ Our assessment of claim [1d] is dispositive. We need not resolve the parties’ further dispute about whether the proposed Cheng-Gan composition would have included “discrete carbon nanotubes” as specified in claim [1b]. *Compare* Pet. 51–55; Reply 25–26, *with* Resp. 70–84; Sur-reply 31–33.

to our analysis, the Petition is silent on the details of the “further mixing and processing steps” that follow Cheng’s first and second process steps. *Id.*

Gan describes “the functionalization of carbon nanotubes with carboxyl and/or hydroxyl groups.” Pet. 39; Ex. 1021 ¶¶ 18–24. In Petitioner’s view, an ordinarily skilled artisan, by “applying” Cheng’s process steps to an ultrasonic dispersion of carbon nanotubes functionalized according to Gan, would have obtained a “carbon nanotube lithium iron phosphate composite cathode material” (Ex. 1007 ¶ 19) that meets every limitation of claim 1, including the oxidation levels for the carbon nanotubes set forth in claim [1d]. Pet. 37, 42 (making plain that the challenge is based on using Gan’s functionalized nanotubes as a starting material in Cheng’s process, by making a first-step ultrasonic dispersion, then subjecting that dispersion to Cheng’s “further mixing and process steps” to obtain the “composite cathode material” reported in Cheng (Ex. 1007 ¶ 19)).

Petitioner’s showing with respect to claim [1d] is deficient for several reasons, which we address in turn below.

b) Impermissible Hindsight Reconstruction

The Petition glosses over the “further mixing and processing steps” that follow Cheng’s first and second process steps. Pet. 37. As Patent Owner correctly points out, however, those additional steps culminate in a “carbon thermal reduction” (Resp. 62) which, ultimately, forms the “composite cathode material” (Ex. 1007 ¶ 19) that is the focus of this challenge.

Although declining to discuss in any detail the “further mixing and processing steps” involved in Cheng’s method (Pet. 37), Petitioner makes crystal clear in the Petition that the Cheng-Gan composition, upon which the challenge rests, is a “carbon nanotube/lithium iron phosphate composite

cathode material” (Ex. 2007 ¶ 19) produced by those steps. *See* Pet. 36–70 (Petitioner’s arguments on point).

When addressing the reasons why an ordinarily skilled artisan would have been led to select Gan’s functionalized carbon nanotubes as a starting material in Cheng’s first-step ultrasonic dispersion (Ex. 2007 ¶ 13), Petitioner emphasizes that Gan teaches how to functionalize “carbon nanotubes with carboxyl and/or hydroxyl groups” to a degree controlled “to achieve one or more of” three desirable objections, while simultaneously minimizing unwanted effects on “desirable intrinsic properties of the” carbon nanotubes (Pet. 38–40 (quoting Ex. 1021 ¶¶ 18–24, claims 4, 7)). From among the multiple objectives that enter this calculus, Petitioner singles out a disclosure in Gan in which carbon nanotubes are functionalized to levels “from about 2.5 to about 10wt%” — a range encompassed by claim [1d]. *Id.* at 40.

In Petitioner’s view, one would have selected carbon nanotubes characterized by that level of oxidation as a starting material in Cheng’s first step to achieve “an objective of ‘improv[ing] the solubility and dispersibility of’ carbon nanotubes ‘in water and conductive polymer materials.’” *Id.* (alteration in original) (quoting Ex. 1021 ¶ 19). But Petitioner does not attempt to explain why those carbon nanotubes, after undergoing further chemical processing to form Cheng’s final product, would retain the same levels of oxidation. *Id.* at 36–70.

To be clear, Petitioner selects functionalized carbon nanotubes as a starting material, based on a level of oxidation that meets claim [1d], without addressing whether or why those carbon nanotubes would retain the same level of oxidation after enduring Cheng’s subsequent calcining step, which is

necessary to obtain “the carbon nanotube lithium metal salt composite cathode material.” Ex. 1007 ¶ 19. In this unpredictable chemical art, we detect the taint of impermissible hindsight reconstruction in that selection. Petitioner alludes to Cheng’s “further mixing and processing steps” (Pet. 37) then, in conclusory fashion, assumes the carbon nanotubes in the final composition would have the same level of oxidation as the starting material. *Id.* at 41–42; *but see* Ex. 1007 ¶¶ 12–19 (explaining sequence of Cheng’s process, which includes “ultrasonically dispersing” carbon nanotubes in a first step (Ex. 1007 ¶ 13) then “calcining” those nanotubes to obtain the “composite cathode material” (*id.* at ¶ 19)).

Even if we set aside our concerns about impermissible hindsight reconstruction, this challenge is deficient for another reason; namely, Patent Owner’s evidence casts significant doubt on whether Gan’s functionalized carbon nanotubes would have emerged from Cheng’s calcining step without removal of the functional groups. *See* Resp. 62–66. First, we provide an overview of Cheng’s “calcining” process step. Ex. 1007 ¶ 19. Second, we address the impact of Petitioner’s failure to address, in the Petition, Cheng’s calcining step. Third, we discuss Petitioner’s untimely and unpersuasive efforts to account for that impact in the Reply.

c) Overview of Cheng’s Calcining Step

Although not discussed in the Petition, Cheng’s “further mixing and processing steps” (Pet. 37) culminate in “a carbon thermal reduction that ***calcines the [carbon nanotubes] at 600°C to 850°C for 4 to 48 hours.***” Resp. 62 (Patent Owner’s emphasis). This “is a mandatory step in all embodiments of Cheng” precisely because this step is necessary to form the

modified “carbon nanotube lithium iron phosphate composite cathode material” that forms the basis for the challenge. *Id.*; Ex. 1007 ¶ 19)

Importantly, Cheng’s calcining step “is necessary to both convert the carbon source into carbon and form the lithium ion phosphate.” Resp. 62 (citing Ex. 2006 ¶¶ 168–170 (citing Ex. 2034, 1; Ex. 2038, 1)); Ex. 2026, 38:18–39:5). The necessity of the calcining step is supported by the intrinsic disclosures within the four corners of Cheng. Ex. 1007 ¶¶ 12–20; *see especially*, Ex. 1007 ¶¶ 15, 18, 19 (Cheng adds “a lithium source, an iron source and a phosphate salt” as well as “an organic carbon source” to the mixture prior to the calcining step from which the “carbon nanotube lithium iron phosphate composite cathode material” is obtained).

The impact of Cheng’s calcination step on the sufficiency of Petitioner’s challenge was neither presented in the Petition nor argued by either party during the pre-institution stage of this proceeding. In our Institution Decision, therefore, we determined that Petitioner had demonstrated a reasonable likelihood of prevailing on this challenge in an analysis that did not account for the impact of Cheng’s calcining step on the weight percentage of oxidized carbon nanotubes that, ultimately, end up in the modified Cheng-Gan composition. Inst. Dec. 30. We take account of that calcining step below.

d) Inadequacy of Petition Evidence as to Calcining Step

The sufficiency of this challenge rests on the persuasiveness of Petitioner’s evidence that Cheng’s process steps, when applied to a starting material that includes Gan’s functionalized carbon nanotubes, necessarily would have resulted (after subsequent “mixing and processing steps” (Pet. 37)) in a “carbon nanotube lithium ion phosphate composite cathode

material” that includes carbon nanotubes having oxidation levels that meet the range specified in claim [1d]. Ex. 1007 ¶¶ 13–19; *see* Pet. 37, 42 (making clear that the challenge, as articulated in the Petition, rests on whether the subject matter of claim 1 would have been obvious in view of the composite cathode material ultimately obtained by using Gan’s functionalized carbon nanotubes as a starting material in Cheng’s process).

Petitioner, in the Petition, refers to “further mixing and processing steps” endured by the carbon nanotube dispersion, without further discussion or assessment. Pet. 37. Patent Owner, however, comes forward with compelling evidence in the Response that Cheng’s calcining step would remove most, if not all, of the oxidized functional groups from the carbon nanotubes. Resp. 62–66 (and evidence cited therein).

Given the unpredictable nature of chemical reactions, we determine that the Petition is deficient for failure to discuss the impact of Cheng’s calcining process step on the oxidation levels of the carbon nanotubes that end up in the final Chen-Gan composition. *See* Pet. 36–70 (nowhere addressing Cheng’s calcining step, when arguing that a composite cathode material prepared according to Cheng’s process from Gan’s functionalized carbon nanotubes would meet the oxidation range of claim [1d]).

e) Inadequate Counterarguments Raised in the Reply

Petitioner addresses, for the first time in the Reply, the impact of Cheng’s calcining step on the oxidation levels of the carbon nanotubes in the proposed modified composite material of Cheng-Gan. Reply 17–22. We agree with Patent Owner that Petitioner fails to meet its burden of proving that Gan’s functionalized carbon nanotubes — *after* undergoing the calcining step described in Cheng (Ex. 1007 ¶ 19) — *necessarily* would

retain their starting oxidation levels and that, thereby, Petitioner does not prove that the Cheng-Gan composition would have met claim [1d]. Sur-reply 33–37. Instead, Petitioner (1) suggests that Patent Owner bears the burden of proving that *all* of Gan’s oxidized functional groups would have been removed by Cheng’s calcining step; and (2) argues that Cheng’s calcining step could, under some conditions, result in minimal loss of oxidized functional groups. Reply 17–22.

Petitioner bears the ultimate burden of proving that Gan’s functionalized carbon nanotubes *would* retain, *after* the calcining step, oxidation levels that fall within the range specified in claim [1d]. We agree with Patent Owner that Petitioner does not come forward with persuasive evidence that the oxidized functional groups on the carbon nanotubes would satisfy claim [1d] after enduring Cheng’s calcining step. Sur-reply 34–35 (Patent Owner’s persuasive counterarguments on point). To the contrary, Petitioner focuses on presenting evidence that, under some circumstances, “loss of oxidized functional groups can be minimal.” Reply 18. That is inadequate to carry Petitioner’s burden of proof.

f) First Untimely New Theory Set Forth in Petitioner’s Reply

Petitioner comes forward with a new theory of unpatentability in the Reply. Reply 18–20. In essence, Petitioner argues that applying Cheng’s process steps to Gan’s functionalized carbon nanotubes would naturally result in a composite cathode material in which the carbon nanotubes retain oxidation levels that satisfy the range specified in claim [1d]. Reply 18–20; *see* Ex. 1007 ¶ 19 (setting forth the calcining conditions). This is an untimely new theory improperly raised in the first instance in the Reply, and we reject this new theory on that basis.

Alternatively, this new theory is supported insufficiently to carry Petitioner's burden of proof on this issue. Petitioner does not explain how or why its newly-asserted evidence proves that, under the particular conditions of Cheng's calcining step, the "natural result" would be a composite cathode material that includes nanotubes having oxidation levels that meet claim [1d]. *Par Pharm., Inc.*, 773 F.3d at 1195; *see* Reply 18–20 (Petitioner's inadequate evidence); *see also* Sur-reply 34–35 (including footnote 5) (Patent Owner's persuasive countering evidence).

To the extent that Petitioner now makes an inherency argument, we acknowledge that it may be proper to use inherency in an obviousness challenge to account for a claim limitation not expressly disclosed by the prior art. *Par Pharm., Inc.*, 773 F.3d at 1194–1195. But the application of inherency in an obviousness analysis is confined to situations where the limitation at issue is the "natural result" of the combination of prior art elements, which Petitioner does not demonstrate here. *Id.* at 1195.

All that remains, in support of this challenge, is the conclusory cross-examination testimony of Petitioner's witness, Dr. Zhu, who does not support his opinions adequately with persuasive objective evidence. *See* Reply 18–22 (and citations therein to Dr. Zhu's opinions). We agree with Patent Owner that Dr. Zhu opines, in practical effect, that under the calcining conditions set forth in Cheng, the "functional groups are mysteriously protected from high-heat removal in the presence of" the lithium iron salt, "something none of his cited evidence corroborates." Sur-reply 36–37. We agree that Dr. Zhu "does not provide any technical detail, explanation, or statements supporting *why*" he concludes "that the feature in question was required or would have been obvious based on the prior art

disclosure.” *Xerox Corp. v. Bytemark, Inc.*, IPR2022-00624, Paper 9 at 12 (Aug. 24, 2022) (designated precedential Feb. 10, 2023). Dr. Zhu’s bare opinions on point are insufficient to carry this challenge. *Id.*

g) Second Untimely New Theory Set Forth in Petitioner’s Reply

In the Reply, Petitioner attempts to cure the deficiency in the challenge, as presented in the Petition, by raising a second untimely and unpersuasive new theory of unpatentability. Reply 22–23. In that regard, Petitioner argues, for the first time in the Reply, that an ordinarily skilled artisan, through “optimization” and “routine experimentation,” would have arrived at modified conditions for Cheng’s calcining step, which would have led to a composite cathode material having carbon nanotubes characterized by a level of oxidation that would have met the oxidation range of claim [1d]. *Id.*

We agree with Patent Owner that this Reply argument represents an “improper new” theory of unpatentability that is “designed to retroactively address Petitioner’s failure to account for the effects of Cheng’s calcining conditions” in the Petition. Sur-reply 34. This theory, based on modifying Cheng’s calcining process step, is not mentioned, much less described adequately, in the Petition. *See* Pet. 36–70. We reject this new theory as untimely.

Alternatively, even if we consider this new theory on its merits, Petitioner’s new arguments are insufficiently supported by persuasive objective evidence. We are not persuaded by Petitioner’s evidence that an ordinarily skilled artisan would have known how to modify Cheng’s calcining conditions to predictably obtain a composite cathode material in which the functionalized carbon nanotubes retain oxidation levels that fall

within the range specified in claim [1d]. Reply 22–25. Tellingly, Petitioner does not identify the reaction conditions of the proposed modified calcining step that would, in fact, achieve such a result. *Id.* Instead, Petitioner states in conclusory fashion that one would have “adjusted calcination conditions (e.g., temperature, duration) based on the materials and synthesis objectives,” without further detail. *Id.* at 23 (citing Dr. Zhu’s conclusory testimony on point (Ex. 2026, 40:4–42:14; 44:24–47:7), which similarly does not describe a modified calcining step of Cheng that would have led to the claimed invention)).

Petitioner further asserts, on that point, that Patent Owner concedes that an ordinarily skilled artisan “would have had a reasonable expectation of success of achieving oxidation above” either the “claimed level or Gan’s level” when taking into consideration “the effects of calcination.” Reply 24–25 (citing Resp. 68–69). That assertion is insufficient to carry Petitioner’s burden of proof, not least because Petitioner mischaracterizes Patent Owner’s argument. Far from conceding the point, Patent Owner emphasizes: “There is no evidence that there was an expectation that Cheng-Gan would have worked for its intended purpose when accounting for the calcination step—a key step Petitioner failed to consider” in the Petition. Resp. 68; *see id.* at 69 (observing that applying Cheng’s “calcining” step to Gan’s functionalized carbon nanotubes would decrease their oxidation levels).

Furthermore, the calcining step “is a mandatory step in all embodiments of Cheng to (1) convert the carbon source into carbon and (2) ***form the lithium iron phosphate.***” Resp. 62 (Board’s emphasis); Ex. 1007 ¶ 19; Ex. 2006 ¶¶ 168–170 (citing Ex. 2038, 1; Ex. 2034, 1); Ex. 2026, 38:18–39:5. Petitioner fails to oppose adequately, if at all, Patent

Owner’s well-supported proposition that the calcining step is necessary to form the lithium iron phosphate. *See* Reply 22–23. Petitioner’s new theory of unpatentability focuses on claim [1d] without taking account adequately of claim [1b], which requires calcining conditions sufficient to produce the “lithium iron phosphate.” Ex. 1007 ¶ 19.

Even if we were to find that Petitioner identifies, in the Reply, some modified calcining conditions that would have been sufficient to protect the functional groups on the carbon nanotubes, this challenge would fail because Petitioner comes forward with no persuasive evidence that the conditions of that modified step would have been sufficient to form the lithium iron phosphate. Reply 22–23; *see* Resp. 60, 63, 66 (further explaining this point); *see also id.* at 64 (directing us to persuasive evidence that the oxidized functional groups of Gan’s carbon nanotubes “would also adversely interfere with the formation of the lithium iron phosphate” in Cheng’s process).

h) Conclusion on Cheng-Gan Combination

Our reasoning above applies with equal force to both challenges and all challenged claims. Petitioner does not establish that any claim would have been obvious based on the proposed Cheng-Gan combination.

III. CONCLUSION

Petitioner does not establish by a preponderance of the evidence that any of claims 1–5 of the ’924 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, 4, 5	103	Ohata, Kavan		1, 4, 5
1, 4, 5	103	Cheng, Gan		1, 4, 5
2, 3	103	Cheng, Gan, Zhao		2, 3
Overall Outcome				1–5

IV. ORDER

It is

ORDERED that Petitioner has not proven by a preponderance of the evidence that any of claims 1–5 of the '924 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.

IPR2024-01011
Patent 8,968,924 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.

IPR2024-01011¹
Patent 8,968,924 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)

¹ Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. were joined as parties via a Motion for Joinder in IPR2025-00357.

I. INTRODUCTION

Petitioner filed a Request for Rehearing (Paper 42, “Request” or “Reh. Req.”) of our Final Written Decision (Paper 38, “Decision” or “Dec.”) in which we determined that Petitioner did not demonstrate that claims 1–5 of U.S. Patent No. 8,968,924 B2 (Ex. 1001, “the ’924 patent”) are unpatentable. With our authorization, Patent Owner filed a Response to the Request (Paper 45, “Reh. Resp.”), and Petitioner filed a Reply to Patent Owner’s Response to the Request (Paper 46, “Reh. Reply.”). We *deny* the Request for the following reasons.

II. STANDARD OF REVIEW

The standard applicable to a request for rehearing of a Board decision 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. 21–23). 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 the Cheng-Gan combination, specifically, by “assum[ing] that the **starting** material for the Cheng-Gan combination includes nanotubes having an oxidation level based on Gan.” Reh. Req. 2. Moreover, Petitioner contends “the Board compounded its error by overlooking Petitioner’s responsive evidence (*see, e.g.*, Pet. Reply, 18-22) demonstrating that the Cheng-Gan nanotubes would retain their oxidative functionalities.” *Id.* at 3.

Patent Owner disputes each of Petitioner’s contentions. As to the Ohata-Kavan combination, Patent Owner asserts that the Board properly 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. 1–4. Patent Owner also asserts that the Board properly determined that the binder is electrically conductive such that physical contact does not need to occur in Ohata. *See id.* at 4–8. With respect to the Cheng-Gan combination, Patent Owner asserts that Petitioner presents a new theory in the Request that “was never raised in

the Petition/Reply,” and, in any case, Petitioner’s “new theory fails.” Reh. Resp. 9–10.

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 “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. 12–13). Instead, we determined “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.^[2] 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.”)).

² 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, that 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. 10; *see id.* at 6–10; 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. 21–23). 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 16 (“**Physical** contact is not required for there to be electrical contact. Petitioner’s theory disregards 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). 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”); Dec. 24 (“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. 1–8.

B. The Cheng-Gan Combination

In the Final Written Decision, the Board explained the shortcomings of Petitioner’s challenge involving the Cheng-Gan combination, which is “based on using Gan’s functionalized nanotubes as a starting material in Cheng’s process, by making a first-step ultrasonic dispersion, then subjecting that dispersion to Cheng’s ‘further mixing and process steps’ to obtain the ‘composite cathode material’ reported in Cheng.” Dec. 28 (citing Pet. 37, 42; Ex. 1007 ¶ 19). As explained, we were not persuaded that Gan’s nanotubes selected by Petitioner, which are “functionalized to levels ‘from about 2.5 to about 10wt%’—a range encompassed by claim [1d],” “would retain the same level of oxidation after enduring Cheng’s subsequent calcining step.” *Id.* at 29 (citing Pet. 36–70).

In particular, and in addition to concerns about impermissible hindsight reconstruction, we determined that “Patent Owner’s evidence casts significant doubt on whether Gan’s functionalized carbon nanotubes would have emerged from Cheng’s calcining step without removal of the functional groups.” *Id.* at 30 (citing PO Resp. 62–66); *see id.* at 32 (“[W]e determine that the Petition is deficient for failure to discuss the impact of Cheng’s

calcining process on the oxidation levels of the carbon nanotubes that end up in the final Chen-Gan composition.”).

We disagree with Petitioner that we misapprehended the Cheng-Gan combination presented in the Petition as using Gan’s functionalized nanotubes as starting material for Cheng’s process. As pointed out by Patent Owner, the challenge, as articulated in the Petition, proposes either functionalizing carbon nanotubes or obtaining functionalized carbon nanotubes from commercial sources, as described by Gan, and “*applying such functionalized [CNTs] in* preparing the composite described in Cheng.” Reh. Resp. 8 (citing Pet. 41–42, 50).

Petitioner belatedly argues “that the specific oxidation level taught by Gan applies to the final composition of the Cheng-Gan combination (not the starting material), which would be achieved using starting material having any suitable oxidation level,” because this was not presented in the Petition and changes the thrust of the challenge. Reh. Req. 3. As explained above, a request for rehearing is not an opportunity to present new arguments. Accordingly, we decline to consider this new argument.

Alternatively, even when we consider this new argument, we find the challenge is deficient for the three reasons cogently explained by Patent Owner. First, Patent Owner alleges that Petitioner “never advanced arguments or evidence as to the starting ox-level needed”; second, “Gan *expressly teaches away* from oxidizing above 10% because it damages the CNTs”; and third, “the Board rejected similar unsubstantiated/conclusory obviousness arguments ‘[g]iven the unpredictable nature of chemical reactions.’” Reh. Resp. 10.

Further, to the extent Petitioner asserts that the theory set forth in the Request does not require a higher starting oxidation level of carbon nanotubes in order to result in Gan’s described oxidation range of 2.5–10%, despite being subjected to Cheng’s calcining process (*see, e.g.,* Reh. Req. 14–15 (“Petitioner’s Reply presented evidence, supported by expert testimony, demonstrating that oxidized carbon nanotubes retain their functional groups following calcination in an inert atmosphere”)); *see also* Reh. Reply 7), that assertion falls short of establishing that we misapprehended or overlooked anything on this issue in the Final Written Decision.

Specifically, this theory does not overcome Patent Owner’s compelling evidence, raised in the trial-phase Response, establishing “that the calcining step of Cheng-Gan would bring the oxidation levels” of the nanotubes “below the claimed range;” evidence that was credited in the Final Written Decision, and evidence that Petitioner’s failed to counter in the Reply. Reh. Resp. 9 (citing Paper 17, 62–66). As Patent Owner persuasively points out, this theory fails “*to account for the calcining step*” and, importantly, lacks evidentiary support sufficient to outweigh Patent Owner’s compelling evidence that an ordinarily skilled artisan would have needed “to start with significantly higher oxidation levels so that the final ox-levels would fall within the 2.5–10% range *after calcination.*” Reh. Resp. 10 (Patent Owner emphasis).

In sum, Patent Owner’s counterarguments are persuasive, and we adopt Patent Owner’s reasoning as our own. *See* Reh. Resp. 8–10.

IV. CONCLUSION

For the above reasons, Petitioner has not carried its burden of demonstrating that the Board misapprehended or overlooked any matters in 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 request for rehearing, Petitioner's Request is *denied*.

V. ORDER

It is

ORDERED that Petitioner's Request is *denied*.

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