

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: IPR2024-01013¹

U.S. Patent No. 10,153,483

**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 IPR2024-01013 via a Motion for Joinder in IPR2025-00359.

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 46) (“Rehearing Decision”), in Case No. IPR2024-01013 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 1-4 and 7-18 of the ’483 patent were not shown to be unpatentable as obvious under 35 U.S.C. § 103 in view of:
 - a. Ohata, Kavan, and Gong for claims 1-4, 7-18;
 - b. Ohata, Kavan, and Liu for claims 1-4, 7-18;
 - c. Ohata, Kavan, and Ichinose for claims 1-4, 7-18;

2. All of the Board's subsidiary findings supporting its determination that claims 1-4 and 7-18 of the '483 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:

Stephen D. Zinda Reg. No. 67,272

James H. Hall Reg. No. 66,317

CABELLO HALL ZINDA PLLC

801 Travis, Suite 1610

Houston, TX 77002

Email: stephen@chzfirm.com

james@chzfirm.com

paralegal@chzfirm.com

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

efileSO@uspto.gov

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.

IPR2024-01013¹
Patent 10,153,483 B2

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

ROSS, *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 IPR2025-00359 (“IPR359”). We designate this Decision as confidential because we cite information from a paper that the Samsung Petitioners identified as confidential in IPR359. *See infra* n.2 (citing IPR359, Paper 4).

I. INTRODUCTION

A. Background and Summary

Petitioner² filed a Petition for an *inter partes* review (Paper 2 (“Pet.”)) challenging claims 1–4 and 7–18 of U.S. Patent No. 10,153,483 B2 (Ex. 1001 (“the ’483 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, Patent Owner filed a Response (Paper 16, “PO Resp.”), Petitioner filed a Reply (Paper 21, “Pet. 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”), *Molecular Rebar Design, LLC v. Samsung Electronics Co., Ltd.*, 2-24-cv-00108 (E.D. Tex.), and *Molecular Rebar*

² The real parties-in-interest include LG Energy Solution, Ltd. (Pet. 70) and the Samsung Petitioners (IPR359, Paper 1 at 69). With “caveats and reservations,” the Samsung Petitioners further identify [REDACTED].

³ The real party-in-interest is Molecular Rebar Design, LLC, which has granted Black Diamond Structures, LLC an exclusive license to the ’483 patent in certain enumerated “applications and uses related to electrical energy storage.” Paper 13 at 1. *Id.*

IPR2024-01013
Patent 10,153,483 B2

Design, LLC v. LG Chem, Ltd., 1-22-cv-01130 (D. Del.) (dismissed).
Pet. 70; Paper 4, 2; 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, involving LG Energy Solution, Ltd. as the petitioner: IPR2024–01005, IPR2024–01006, IPR2024–01011, IPR2024–01012 and IPR2024–01013. *Id.*

C. The '483 Patent (Ex. 1001)

The '483 patent, titled “Lithium Ion Batteries Using Discrete Carbon Nanotubes, Methods for Production Thereof and Products Obtained Therefrom,” issued on December 11, 2018. Ex. 1001, codes (45), (54). The '483 patent explains that lithium-ion rechargeable batteries that use “cobalt, nickel or manganese oxides for their cathode materials are known for their poor electrical conductivity and poor electrochemical stability which results in poor cycling (charge/discharge) ability.” Ex. 1001, 1:26–31. The '483 further explains that olivine structures, such as LiFePO_4 and LiMnPO_4 , operate at higher charge and discharge rates, “but are still limited by low electrical conductivity and the kinetics of Li-ion diffusion.” *Id.* at 1:31–35.

The '483 patent notes that improvement in the charge/discharge rates of batteries have been achieved using nano-sized crystals of lithium salts and carbon nanotubes. Ex. 1001, 1:36–40. Although these materials have improved the charge/discharge rates of batteries, the '483 patent notes that the carbon nanotubes of the prior art were not considered to be discrete, i.e., individually and uniformly dispersed tubes, and the “lithium nanocrystals

[were] 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.” *Id.* at 1:39–50.

The ’483 patent discloses a composition useful for lithium ion batteries 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, 2:35–38. The attachment of the crystals to the carbon nanotubes may be by ionic or chemical means. *Id.* at 3:33–37. The discrete carbon nanotubes preferably have an aspect ratio of 10 to 500 and oxidation levels from 1 to 15 weight percent of the carbon nanotube. *Id.* at 2:46–49.

D. Illustrative Claims

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

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

[1a] discrete, non-agglomerated, and exfoliated carbon nanotubes having a surface, and

[1b] mixtures of ion active materials comprising migratable ions said materials comprising crystals or layers of lithium ion active material,

[1c] wherein a ratio of lithium ion to other total ions in the ion active materials is at least 2:1 to 25:1, and

[1d] wherein the discrete carbon nanotubes have crystals or layers of lithium ion active material ionically attached to their surface and

[1e] wherein the discrete carbon nanotubes comprise oxidized species selected from the group consisting of carboxylic, ketone, or hydroxyl functionalities, and

[1f] wherein the discrete carbon nanotubes have an aspect ratio of 10 to 500 and oxidation levels from 1% to 15% by weight of the carbon nanotube.

Ex. 1001, 7:5–19.⁴

1. Asserted Unpatentability Challenges

Petitioner asserts that claims 1–4, and 7–18 are unpatentable based on the following challenges:

Claims Challenged	35 U.S.C. § ⁵	Reference(s)/Basis
1–4, 7–18	103	Ohata, ⁶ Kavan, ⁷ Gong ⁸
1–4, 7–18	103	Ohata, Kavan, Liu ⁹
1–4, 7–18	103	Ohata, Kavan, Ichinose ¹⁰

Pet. 1. Petitioner relies on declarations provided by Dr. Yu Zhu. Ex. 1003 (supporting Petition); Ex. 1058 (supporting Petitioner Reply). Patent Owner

⁴ The claim limitation identifiers have been added to correspond with Petitioner’s designation of claim limitations. Pet. vii.

⁵ The relevant sections of the Leahy-Smith America Invents Act (“AIA”), Pub. L. No. 112–29, took effect on March 16, 2013. Because the ’483 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.

⁶ US 2004/0160156 A1, published Aug. 19, 2004 (Ex. 1004).

⁷ 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).

⁸ CN 101364643 A, published February 11, 2009 (Ex. 1006 (Chinese language document); Ex. 1007 (certified English translation) (“Gong”).

⁹ CN 102456881, published May 16, 2012 (Ex. 1008, Chinese language document); Ex. 1009 (certified translation) (“Liu”).

¹⁰ US 2006/0269842 A1, published November 30, 2006 (Ex. 1034, “Ichinose”).

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 (claim chart). A patent claim is unpatentable as obvious 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.¹¹ *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

¹¹ Neither party presents evidence as to objective indicia of nonobviousness.

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. 7 (citing Ex. 1003 ¶¶ 11–12).

“Patent Owner applies Petitioner’s proposed definition of” the level of ordinary skill in the art “for purposes of this proceeding.” PO Resp. 7. On this record, we adopt Petitioner’s unopposed definition because 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 the claim term “‘a ratio of lithium ion[s] to other total ions in the ion active materials’ should be interpreted as ***a ratio of lithium ions to other migratable ions in the ion active materials.***” Pet. 8–9. Patent Owner contends that “[b]ecause Petitioner fails to demonstrate unpatentability pursuant to its own application of the claim language, no construction is required.” PO Resp. 16. Upon review of the record, and because the outcome of this Decision does not rely on the construction of the “ratio of lithium ion to other total ions in the ion active materials,” we agree that no claim terms require express construction for purposes of this Decision. Inst. Dec. 7–8; *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, the parties also raise a dispute about the scope of the term “discrete carbon nanotubes,” which appears in claim [1a] and is defined in the ’483 patent as “carbon nanotubes capable of being separated to give individual tubes.” Ex. 1001, 3:53–55. 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

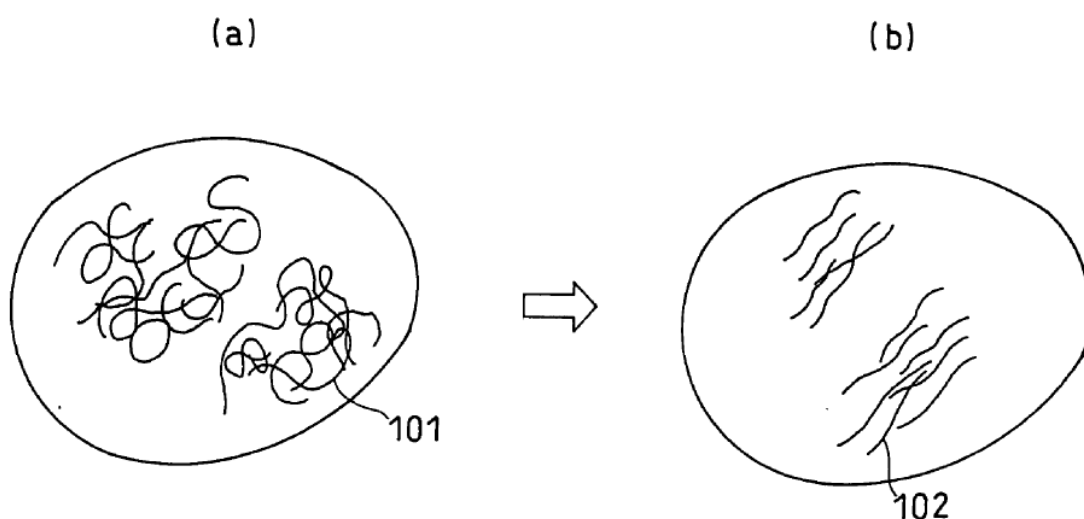


Figure 1(a) is a schematic diagram showing carbon nanotubes tangled and twisted with one another before being blended with a resin, and Figure 1(b) is a schematic diagram showing the carbon nanotubes unraveled and straightened after they have been blended with the resin. Ex. 1004 ¶¶ 12–13.

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 the production of an electrode group.”
Ex. 1004 ¶ 17.

Ohata explains 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 not 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) Gong (Ex. 1007)

Gong discloses a boron-containing lithium iron phosphate/carbon composite material, characterized by having a chemical formula of: $\text{Li}_{1-x}\text{M}_x\text{Fe}_{1-y}\text{N}_y\text{P}_{1-z}\text{Si}_z\text{O}_4 \cdot \xi \text{B}_2\text{O}_3/\text{C}$ or $\text{Li}_{1-x}\text{M}_x\text{Fe}_{1-y}\text{N}_y\text{P}_{1-z}\text{Si}_z\text{O}_4 \cdot \zeta \text{LiBO}_2/\text{C}$, wherein the metal element M doped at a lithium site in a bulk phase is at least one of Mg, Ca, Zn, Al, Cr, V, Ti, Zr and Nb, and $0 \leq x \leq 0.1$ and $0 \leq y \leq 1$. Ex. 1007, claim 1.

d) Liu (Ex. 1009)

Liu discloses that transition metal phosphates having an olivine structure are mainly used as positive active materials for secondary lithium batteries, “and have advantages such as low prices and rich reserves of raw materials, no environmental pollution, good chemical stability, very good safety performance, high lithium storage capacity, good cycle performance, high voltage, etc.” Ex. 1009, 3. “The most studied at present is lithium iron phosphate (LiFePO_4), which is considered an ideal candidate for future power supply applications.” *Id.* To overcome some known problems with phosphate olivines, however, Liu discloses the use of carbon nanotubes and a doping element, with the chemical composition of the positive electrode active material being “ $\text{Li}_x\text{A}_a\text{M}_m\text{B}_b\text{PO}_z\text{N}_n$,” where “doping element A is selected from at least one of Na, Mg, Ti, V, Cr, Cu, Mn, Co, Ni, Zn, Ga, In, Ge, W, Hg, Au, Ag, Nb, and Zr.” *Id.* at 6.

e) Inchinose (Ex. 1034)

Inchinose discloses a non-aqueous electrolyte secondary battery “in which an electrode assembly can keep a sufficient amount of non-aqueous electrolyte even when the change in the electrode assembly size is restrained.” Ex. 1034 ¶ 1. The non-aqueous electrolyte battery comprises “an electrode assembly, a non-aqueous electrolyte, and a substantially rectangular battery case for housing the electrode assembly and the non-aqueous electrolyte.” Ex. 1034 ¶ 9. Inchinose explains that the electrolyte may be made from a “lithium salt such as LiPF_6 .” Ex. 1034 ¶ 43.

E. Obviousness Challenges Based on the combination of Ohata and Kavan with either of Gong or Liu or Ichinose

Petitioner contends claims 1–4 and 7–8 of the ’483 patent are unpatentable as obvious over Ohata in view Kavan with either of Gong or Liu. Pet. 1, 10–61. Petitioner further contends that claims 1, 2, and 7–18 are unpatentable as obvious over Ohata and Kavan in combination with Ichinose. Pet. 1, 61–68. Petitioner refers to an “Ohata-Kavan combination composition.” Pet. 18. We likewise refer to this as the proposed Ohata-Kavan composition.

When describing the modifications that allegedly would have led to the proposed Ohata-Kavan composition, Petitioner explains that it uses Ohata “as a starting point,” relying on Ohata’s “electrode material mixture containing the masterbatch and an electrode active material.” Pet. 18 (quoting Ex. 1004 ¶ 23). In Petitioner’s view, the masterbatch contains carbon nanotubes dispersed in a resin, where “[t]he ratio of carbon nanotubes to electrode material is also consistent with Ohata’s teachings.” Pet. 18.

It is worth emphasizing again 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. 18), because that admission, as will become clear, undercuts this challenge.

Petitioner argues that the nanotubes used to prepare the masterbatch are 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. 18–19 (citing Ex. 1005, Abstract, 2, 4; Ex. 1003 ¶ 40). Following the teachings of Ohata, Petitioner contends, the oxidized nanotubes are then “unraveled and straightened by blending them with a resin” to form Ohata’s masterbatch. Pet. 19 (quoting Ex. 1004 ¶ 16). Significant to our analysis, 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). Ex. 1004 ¶ 21; *see* Ex. 1003 ¶ 41.

According to Petitioner, this masterbatch is mixed with an electrode active material, which can vary depending on the type of battery being produced, and then blended with a dispersion medium (namely, N-methyl-2-pyrrolidone (“NMP”)) to form an “electrode material mixture paste” as described in Ohata. Pet. 19. Petitioner contends that a negative electrode material mixture paste can incorporate TiO_2 (as a negative electrode active material) and a positive electrode material mixture paste can incorporate phosphate olivine (LiMPO_4) (as a positive electrode active material) as taught by Kavan. Pet. 19–20.

Petitioner submits 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. 21–29.

Patent Owner opposes. PO Resp. 17–72. Our analysis in large part centers on that dispute.

a) Claim 1

Claim [1a]: “Discrete, Non-agglomerated, and Exfoliated Carbon Nanotubes”

Claim 1 [1a] specifies a composition comprising “discrete, non-agglomerated, and exfoliated carbon nanotubes.” Ex. 1001, 7:6–7. 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. 32–33 (citing Ex. 1004, Abstr., ¶¶ 5–6, 9–10, 15–22, 30; Ex. 1003 ¶ 80). Petitioner’s admission that Ohata’s masterbatch results in the nanotubes becoming dispersed within the resin represents a dispositive deficiency in the challenge.

Petitioner refers to Figure 1(b) of Ohata, which, we agree, shows untangled, isolated carbon nanotubes that are dispersed—as well as embedded or fully coated—within Ohata’s resin material. Pet. 33. Petitioner argues that, “to the extent **discrete** is interpreted as referring to nanotubes that are generally uniformly dispersed or 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 uniformly ‘dispersed’ as individual, distinct nanotubes (separated into individual tubes) in the resin, as described and illustrated by Ohata.” Pet. 35 (emphasis omitted) (citing Ex. 1004 ¶ 17, Fig. 1(b); Ex. 1003 ¶ 82).

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, 7:5–6. Thus, it is reasonable, as Petitioner suggests, that Ohata’s Figure 1(b) would have suggested to an ordinarily skilled artisan “that the nanotubes in the combination composition are **discrete/non-agglomerated/exfoliated**” because Figure 1(b) depicts at least five individual carbon nanotubes are dispersed in the resin, i.e., separated into individual tubes that are not in contact with any other nanotubes. Pet. 36, Ex. 1004, Fig. 1(b).

Patent Owner, for its part, counterarguments that Ohata’s Figure 1[b] would not have alerted an ordinarily skilled artisan that Ohata’s masterbatch, in fact, includes “discrete carbon nanotubes” within the meaning of claim [1a]. PO Resp. 18–19, 52–60. For example, Patent Owner posits that Ohata’s Figure 1(b) is a mere “cartoon” illustration that does not capture “a real-world representation of actual masterbatch results” attainable by Ohata’s process. PO Resp. 53–54. Further, according to Patent Owner, Petitioner stops short of demonstrating 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 mixture paste*,” which is the proposed Ohata-Kavan composition. PO Resp. 55.

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 [1d]: “the Discrete Carbon Nanotubes have Crystals or Layers of Lithium Ion Active Material Ionically Attached to their Surface”

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

Claim [1d] specifies that the discrete carbon nanotubes must have “crystals or layers of lithium ion active material ionically attached to their surface.” Ex. 1001, 7:12–13. 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”), at which point the surfaces of the oxidized nanotubes become available for attachment (and, in fact, become attached) to an electrode active material (TiO_2 or LiMPO_4) in satisfaction of the requirements of claim [1b]. Pet. 42–44.

That view is false. “In contrast to both Kavan and the ’483 patent, the ‘masterbatch’ process of Ohata” involves embedding (that is, fully coating) carbon nanotubes in a resin (namely, polyvinylidene fluoride (“PVDF”)), which, significantly, prevents the nanotube surfaces from being exposed and available for attachment to the electrode active material. Ex. 2006 ¶ 98; *see id.* ¶¶ 99–127.

Patent Owner advances compelling evidence, on that particular point, well-supported by 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 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.” Pet. 18.

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. To the contrary, the nanotube 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. PO Resp. 61–62.¹²

The proposed Ohata-Kavan composition conducts electricity by a mechanism that materially differs from the mechanism at play in Kavan and

¹² Instead of repeating and agreeing with the information presented by Patent Owner in this part of the Response, for the sake of brevity, we cite to the 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 Petitioner’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). Further, Dr. Chung cogently explains, with exceptional clarity, why the carbon nanotubes surfaces, which are embedded in 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 [1d]. Ex. 2006 ¶¶ 99–126.

the '483 patent.¹³ 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 31; *see id.* at 15–21 (explaining this mechanism, including the phenomenon of electron tunnelling and the percolation threshold).

Kavan and the '483 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 [1d])—a material difference that significantly undercuts Petitioner’s 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 28; *see id.* at 15–21 (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. PO 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.*” PO Resp. 23 (citing Ex. 1004 ¶¶ 5–6); Ex. 2006 ¶ 85 (Dr. Chung’s declaration testimony, citing Ex. 1004 ¶¶ 5–6). In other words, the resin

¹³ Importantly, this challenge specifically uses Ohata “as a starting point,” relying on Ohata’s “electrode material mixture containing [a] masterbatch and an electrode active material.” Pet. 18 (quoting Ex. 1004 ¶ 23).

“makes up the overwhelming majority of the masterbatch binder.” PO Resp. 23; Ex. 2006 ¶ 85.

On this record, in the Ohata-Kavan composition, the allegedly discrete carbon nanotubes are embedded (and fully coated) by resin. *Id.* Petitioner’s attempt to refute that fact is unavailing and internally inconsistent. *Compare* PO Resp. 17–44, *with* Pet. Reply 5–13; *but see* Pet. 35–36 (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/or dispersed from one another in the resin, as argued by Petitioner (dispersed from one another), and the composition is formed of 80% PVDF resin (at minimum), 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. 32:13–21.

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. Pet. 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 ’483 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 principles of electron tunneling and the percolation threshold that undergird Ohata’s mechanism, and drive the

functionality of Ohata's composition. *See* Sur-reply 15–28 (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.” PO Resp. 12, 56–57. The '483 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.” PO Resp. 12–13 (citing Ex. 1001, 1:46–58).

Patent Owner's witness, Dr. Chung, directs us to compelling objective proof, including scanning electron microscopy images (*see* Ex. 2006 ¶¶ 63, 99–125 (and evidence cited therein)), which strongly supports 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, in the proposed Ohata-Kavan composition, it would have been “scientifically impossible for the active material to attach to the surface of” the carbon nanotubes, precisely because they are embedded, or fully coated, in PVDF resin. Ex. 2006 ¶¶ 126–127; PO Resp. 17–44.

Petitioner nevertheless proposes, in the Reply, that the addition of the dispersion medium (namely, NMP) to Ohata's masterbatch binder would have dissolved the PVDF resin sufficiently to expose the surfaces of the

nanotubes, in a manner that facilitates, and necessarily achieves, attachment between the nanotube surfaces and the active material (TiO_2 or LiMPO_4) as required by claim [1d]. Pet. Reply 8–9. 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. *See* Sur-reply 15–21 (explaining the principles of operation behind Ohata’s electrically conductive composition).

In any event, Petitioner comes forward with insufficient objective proof that the dispersion medium (NMP) would act to remove the resin (PVDF) from the surface of the carbon nanotubes so completely that those surfaces would become available for attachment to the electrode active material. Sur-reply 22–25 (and evidence cited therein). On that point, Petitioner essentially asks us to assume (1) that because PVD is soluble in NMP, the NMP added to the proposed Ohata-Kavan composition necessarily would have removed PVDF resin sufficiently to expose, for further reaction, the oxidized surfaces of the nanotubes and (2) that those oxidized surfaces, once exposed, necessarily would have become attached via ionic or covalent bond, to the electrode active material. Pet. 42–44; Pet. Reply 8–9, 21–22; PO Resp. 61; Sur-reply 22–23, 31. We find no sufficient evidentiary basis for such an assumption.

To the contrary, as Patent Owner explains, “NMP ‘dissolution’” ***does not equate*** with removal of PVDF from the surfaces of the carbon nanotubes. Sur-reply 22–23. 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. Sur-reply 22; PO Resp. 39–43; Ex. 1004 ¶ 46; Ex. 2006 ¶¶ 118–126. That

dispersion function is not shown on this record to be equivalent to, or result in, removing PVDF from oxidized carbon nanotube surfaces, in a masterbatch binder composition, in a manner that *necessarily* results in the attachment of “crystals or layers of lithium ion active material” to the carbon nanotube surfaces. Ex. 1001, 7:12–13 (claim [1d]).

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 the ordinarily skilled artisan would have understood that the addition of NMP 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 or focus.

We find persuasive Patent Owner’s position, supported by solid objective proof, that PVDF would, in fact, “coat onto” the nanotube surfaces in Ohata’s composition due to the “strong interaction between PVDF and” oxidized carbon nanotubes. Sur-reply 24 (emphasis omitted) (quoting Ex. 2009, 2) (and citations to additional persuasive evidence); PO Resp. 29–43; Ex. 2006 ¶¶ 114–127. Even if, as Petitioner argues, this interaction may be relatively “weak” when compared to a different dispersion medium, that argument falls short of demonstrating that NMP would remove PVDF from

the oxidized nanotube surfaces in the proposed Ohata-Kavan composition, much less result in the attachment required by claim [1d]. Sur-reply 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. Sur-reply 22–28; PO Resp. 34, 37; Ex. 2006 ¶¶ 114–127; 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, 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 (TiO_2 or LiMPO_4). PO Resp. 29–43, 61; Sur-reply 24–25; Ex. 2006 ¶¶ 114–127.

Conclusion on Claim 1

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

b) Remaining Claims (Claims 2–4 and 7–18)

Claims 2–4 depend directly or indirectly from claim 1. Ex. 1001, 7:20–32. Independent claims 7, 8, and 9 each require the “discrete carbon nanotubes [to] have crystals or layers of lithium ion active materials

ionically attached to their surface,” similar to claim limitation 1[d]. Ex. 1001, 7:37–52, 8:14–28; Pet. viii–ix. Remaining claims 10–18 depend directly or indirectly from either of claims 7 or 9. Ex. 1001, 7:20–32, 8:29–55. Thus, claims 2–4 and 7–18 each inherit the claim limitation that requires “crystals or layers of lithium ion active material attached to” the surfaces of discrete carbon nanotubes. Ex. 1001, 7:4–5. Petitioner’s reliance on the remaining references—i.e., Gan, Liu, or Ichinose—does not remedy the deficiencies identified above with respect to claim [1d]. *See generally* Pet. Accordingly, our reasoning above applies with equal force to the remaining independent and dependent claims.

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.

III. CONCLUSION

Petitioner does not establish by a preponderance of the evidence that any of claims 1–4 and 7–18 of the ’483 patent would have been 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, 7–18	103	Ohata, Kavan, Gong		1–4, 7–18
1–4, 7–18	103	Ohata, Kavan, Liu		1–4, 7–18
1–4, 7–18	103	Ohata, Kavan, Ichinose		1–4, 7–18
Overall Outcome				1–4, 7–18

IV. ORDER

It is

ORDERED that Petitioner has not proved by a preponderance of the evidence that any of claims 1–4 and 7–18 of the '483 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.

IPR2024-01013
Patent 10,153,483 B2

FOR PETITIONER:

W. Karl Renner
Timothy Riffe
Hyun Jin In
Gretchen DeVries
FISH & RICHARDSON P.C.
axf-ptab@fr.com
riffe@fr.com
in@fr.com
devries@fr.com

FOR PATENT OWNER:

Stephen D. Zinda
James H. Hall
CABELLO HALL ZINDA, PLLC
stephen@chzfirm.com
james@chzfirm.com
paralegal@chzfirm.com

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.

IPR2024-01013¹
Patent 10,153,483 B2

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

ROSS, *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 IPR2025-00359.

I. INTRODUCTION

Petitioner filed a Request for Rehearing (Paper 41, “Req. Reh’g”) of our Final Written Decision (Paper 37, “Final Dec.”) in which we determined that Petitioner did not demonstrate that claims 1–4 and 7–18 of U.S. Patent No. 10,153,483 B2 (Ex. 1001, “the ’483 patent”) are unpatentable. With our authorization, Patent Owner filed a Response to the Request (Paper 44, “Reh’g Resp.”), and Petitioner filed a Reply to Patent Owner’s Response to the Request (Paper 45, “Reh’g Reply.”). We *deny* the Request for the following reasons.

II. STANDARD OF REVIEW

The standard applicable to the Request for Rehearing 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.’” Req. Reh’g 1 (citing Final Dec. 20–23). 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.

Patent Owner disputes 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’g 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 5–10.

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’g Resp. 1–10. We provide the following discussion for emphasis only.

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 ionically attached to their surface” (claim limitation [1d])

was critical to our determination that no claims are unpatentable under the Ohata-Kavan ground. *See* Final Dec. 18.

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. 42–44). Instead, we determined that “the ‘masterbatch’ process of Ohata[] involves embedding (that is, fully coating) carbon nanotubes in a resin . . . which, significantly, prevents the nanotube surfaces from being exposed and available for attachment to the electrode active material.” *Id.* (citing Ex. 2006 ¶¶ 98, 99–127).

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.*, Final Dec. 19 n.12 (citing Ex. 2006 ¶¶ 99–126) (“Dr. Chung cogently explains, with exceptional clarity, why the carbon nanotubes surfaces, which are embedded in PVDF resin in the proposed Ohata-Kavan composition, are **unavailable** for attachment to the electrode active material . . .”).

Nothing in Petitioner’s Request for Rehearing persuasively shows that the preponderance of the evidence does **not** support that crucial factual finding. The position Petitioner presents in the Request for 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* Req. Reh’g 3, 4)—was fully considered in view of the totality of the evidence of record (*see* Final Dec. 21 (“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* Final Dec. 22–25. Although Petitioner argues we overlooked this aspect of Ohata’s process (*see* Req. Reh’g 4, 10–11; Reh’g Reply 4–5), all the evidence of record on this point was fully considered (*see* Final Dec. 25 (“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.”)).

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).” Final Dec. 21 (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.”)).

² The citation is to Petitioner’s Reply to the Preliminary Response (Paper 6).

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* Final Dec. 18–25 (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.” Req. Reh’g 8; *see also id.* at 5–8; Reh’g Reply 1–4. But Petitioner acknowledges that we considered and rejected this position. *See* Req. Reh’g 7 (noting “the Board stated that ‘Petitioner’s arguments . . . fail to account adequately . . . for the principles of electron tunneling and percolation threshold that undergird Ohata’s mechanism’”) (citing Final Dec. 20–23). Again, rehearing is not an opportunity to reweigh the evidence and, moreover, our weighing of evidence is correct.

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.” Req. Reh’g 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 15–16 (“**Physical** contact is not required for there to be electrical contact—*i.e.*, such that electrons can travel across a non-conductive resin layer. Petitioner’s theory improperly 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.’” Req. Reh’g 2 (citing Final Dec. 22–23). This was the position Petitioner adopted (Pet. Reply 7 (asserting that “an electrode material without contact between nanotubes and active material simply would be non-functional”); Final 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’g Resp. 1–10.

IV. CONCLUSION

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

IPR2024-01013

Patent 10,153,483 B2

rendering the 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*.

IPR2024-01013
Patent 10,153,483 B2

PETITIONER:

W. Karl Renner
Timothy Riffe
Hyun Jin In
Gretchen DeVries
FISH & RICHARDSON P.C.
axf-ptab@fr.com
riffe@fr.com
in@fr.com
devries@fr.com

PETITIONER IPR2025-00359 (joined)

Andrew Sommer
Heath Briggs
Julie Bookbinder
Trenton Ward
Kathryn Albanese
GREENBERG TRAURIG, LLP
sommera@gtlaw.com
briggsh@gtlaw.com
bookbinderj@gtlaw.com
trenton.ward@gtlaw.com
albanesek@gtlaw.com

PATENT OWNER:

Stephen Zinda
James Hall
CABELLO HALL ZINDA, PLLC
stephen@chzfir.com
james@chzfir.com