

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 8,968,924

PATENT OWNER'S RESPONSE TO REQUEST FOR REHEARING²

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

² This filing was authorized by the Board. Paper 44.

TABLE OF CONTENTS

I.	OHATA-KAVAN.....	1
A.	The Board Did Not Misapply the Law.....	1
B.	NMP Would Not Remove the CNT’s PVDF-Coating.....	1
C.	The “Physical Contact” Theory Was Contrived	4
II.	CHENG-GAN.....	8

I. OHATA-KAVAN

Ohata-Kavan's unique process embeds its CNT-network in PVDF to create a *conductive* binder ("masterbatch") that prevents the claimed "attachment." POR, 20-45; FWD, 19-26. "Compelling objective proof" and Dr. Chung's "well-reasoned and well-supported testimony" established this. FWD, 19, 20 n.11, 23. Unable to counter this, LG's Reply advanced the *new* contrived theory that "physical contact" is required between CNTs/active material. Reply, 5-10. PO's Sur-Reply ("SR") disproved this too, showing Ohata-Kavan's binder achieves conductivity with active material via the percolation threshold and electron tunneling. SR, 15-21; FWD, 20-22. This was not an "eleventh-hour, attorney-driven pivot" but an *evidence-driven* response to LG's new theory. Recognizing this, LG resorts to mischaracterizations.

A. The Board Did Not Misapply the Law

LG argues it was erroneously required to prove Ohata-Kavan "necessarily achieves" the claimed "attachment," alleging only motivation to combine and reasonable expectation of success needed to be shown. Rehearing Request ("RR"), 2. This misstates the law. Ohata-Kavan must also satisfy *all* claim limitations. "[T]he obviousness inquiry centers on whether 'the claimed invention *as a whole*' would have been obvious," not *part* of the invention. *Rambus Inc. v. Rea*, 731 F.3d 1248, 1257 (Fed. Cir. 2013). Thus, LG's failure to show "attachment" was fatal. FWD, 20.

B. NMP Would Not Remove the CNT's PVDF-Coating

PO proved that Ohata-Kavan's goal is to create a conductive glue-like binder ("masterbatch") by embedding its network of CNTs within the PVDF and then dispersing the binder as globules with a "dispersion medium" (NMP). POR, 20-28. PO further proved that mixing at the proportions of Ohata-Kavan would fully coat the CNTs with PVDF, which more strongly bonds to oxidized CNTs. *Id.*, 28-36. Objective proof describes and depicts this coating. *Id.* (citing MRD-2006 to 2018; MRD-2028; LGES-1014). PO also proved that Ohata-Kavan's NMP-step would not remove the molecular layer of coating, but instead disperses the binder as globules to act as "glue." *Id.*, 36-45; SR, 22-28 (disproving LG's NMP theory). Objective evidence showed this, including Dr. Chung and numerous SEMs **visually** depicting such coatings. POR, 36-45 (citing MRD-2006; MRD-2014 to 2018; MRD-2020; MRD-2024). Notably, LG **never addressed** MRD-2020. FWD, 23 (citing Dr. Chung's discussion of MRD-2020 (MRD-2006 ¶¶125-126)). Dr. Chung's testimony that it is "scientifically impossible" for the claimed attachment to occur was thus properly credited. *Id.* Given this overwhelming proof, LG attempts to mislead.

First, LG contends the Board misunderstood it to argue that Ohata-Kavan's CNTs become available for attachment "during the earlier masterbatch step" (before NMP is added). RR, 4. But LG ignores **pages of analysis rejecting LG's NMP theory**. FWD, 23-26. LG also argues the Board misrelied on Ohata's FIG. 1 as evidence the CNTs are "plainly" embedded in PVDF. RR, 5. Yet, Ohata itself **states**

the depicted CNTs are blended in “resin” (LGES-1004 ¶¶[0013], [0016]), objective references show that they would “plainly” be embedded in the resin (POR, 30-35), and LG admits Fig. 1(b) shows CNTs “and a resin.” Pet., 20-21. Thus, LG’s discussion of “circles” in Figure 1 is a ruse to persuade the Board it erred.

Second, PO showed that Ohata-Kavan’s masterbatch process *always* fully coats the CNTs (POR, 30-45), not merely in “*certain circumstances*.” (RR, 10).

Third, Ohata’s statement that “the masterbatch was easily dissolved in [NMP]” does not mean it is “*fully* dissolved.” RR, 4, 11. PO demonstrated with evidence, credited by the Board, that Ohata describes NMP as a “*dispersion medium*” and that the statement refers to dissolving PVDF-domains *to disperse them as globules*. SR, 22 (citing POR, 36-44; MRD-2006 ¶¶118-126); FWD, 24-25.

Fourth, LG cites Dr. Zhu’s testimony about Ohata seeking an “excellent conductive path” and that the “path could not occur if the CNTs” are embedded in “*nonconductive* PVDF binder” and unable to contact “*active material*.” RR, 10. But Ohata-Kavan’s binder *is conductive*, and Ohata never suggests the “excellent conductive path” relates to physical contact with *active material*. Ohata teaches “unraveling” CNTs to improve the “conductive path” in the *binder*, not physically contact active material. POR, 20-25 (citing MRD-2006 ¶¶74-87), 30-31 (citing MRD-2010). This renders the *binder* conductive. *Id.* 21-23; SR, 16-18.

Fifth, LG contends that PVDF is “fully dissolvable in NMP,” Ohata’s PVDF

concentration was “within the known range for full PVDF dissolution,” and “solvent capable of dissolving [] PVDF ... *can* ... remove it from the CNT surface.” RR, 10-11. However, these assertions rely on Ohata and other references that merely teach that PVDF is *soluble* by NMP—not that NMP “fully” dissolves PVDF at the Ohata-Kavan proportions. SR, 22-25 (explaining Dr. Zhu’s evidence does not support his opinions); FWD, 23-26. Dr. Zhu himself acknowledges PVDF remains “inside the mixture” after mixing with NMP. MRD-2024, 41:5-25. LG cites to Zhu’s declaration ¶¶14-20, but it was improperly incorporated-by-reference and unsubstantiated. SR, 22-25. Objective proof demonstrates that CNTs remain coated with a molecular layer of PVDF *after NMP mixing*. *Id.*, 22-28; POR, 36-45. LG also fails to explain how binder can serve its binding function if PVDF is *fully* dissolved. SR, 23-24.

C. The “Physical Contact” Theory Was Contrived

LG declares that the FWD turns on a “technical impossibility.” RR, 1. PO disproved this contrived theory with evidence and testimony proving the “masterbatch” is rendered electrically conductive due to the presence of CNTs via the percolation threshold and electron tunneling. SR, 16-18. The Board appropriately rejected LG’s theory and so LG again resorts to mischaracterizations. FWD, 20-23.

First, PO never argued that “gaps” between *the CNTs and active material* was “contrary to Ohata’s express goal.” RR, 6. PO was referring to gaps in the *electrically conductive network of CNTs*. Ohata’s goal is to create a *conductive*

binder with a well-dispersed *electrically conductive CNT network*. POR, 56 (citing MRD-2006 ¶153); FWD, 20-21. Ohata “wants the CNTs to be interconnected” (RR, 6) to make its *binder* conductive; this is why “physical contact” with the active material is unnecessary. SR, 17-18.

Second, contrary to LG’s assertion (RR, 6-7), PO did not rely on Liu-009 as evidence that conductivity is achieved without physical contact. SR, 26-27. PO also disproved LG’s argument that Liu-009 itself “makes clear” that its conductivity improvements come from *physical* “contact” between the active material and carbon black. *Id.*, 27-28. PO further demonstrated that Liu-009 actually undermines LG’s “physical contact” theory. *Id.* Moreover, Liu-009 “uses *significantly smaller* ratios of PVDF:conductive-filler” than Ohata-Kavan, so even if it did rely on physical contact, this does not evidence that the same occurs in Ohata-Kavan. *Id.*

Third, LG’s reliance on Dr. Chung’s testimony (LGES-1054, 17:1-18:16) is highly misleading. RR, 7. She was asked about a hypothetical *without conductive binder* (pure polymer)—not Ohata-Kavan’s *electrically conductive binder* (PVDF-CNT). LGES-1054, 10:2-18:16. She consistently testified that Ohata-Kavan’s CNT-PVDF binder would be conductive and there is no physical contact due to the PVDF coating. SR, 17-19 (citing LGES-1055, 114:19-115:20, 122:24-123:9; LGES-1054, 37:6-20, 38:9-40:20). Evidence proves the binder exhibits “metal-like behavior.” *Id.*

Fourth, Dr. Zhu’s testimony that physical contact is required (LGES-1056 ¶

10), and LG’s arguments based on MRD-2017 and other exhibits, improperly conflates “electrical” contact and conductivity with *physical* contact. SR, 19-20, 25-26; FWD, 22-23. Additionally, ***none*** of those references rely on the high PVDF:conductive-agent ratios of Ohata-Kavan. Recognizing this, LG argues that because Kavan and the ’483 Patent achieve electrical conductivity through “physical contact between the ... nanotubes and ... active material,” Ohata-Kavan must work the same way. RR, 8 (quoting FWD, 21). However, Kavan and the ’483 Patent are fundamentally different than Ohata—they mix ***“naked”*** CNTs with active material to attach CNTs to the active material surface, whereas Ohata ***first*** embeds CNTs in PVDF to make its binder conductive, which ***eliminates the need for physical contact between CNTs/active material and prevents such contact***. POR, 27-28.

Fifth, LG argues that “tunneling” has “no practical relevance” and is a product of “attorney argument.” RR, 8. Yet both experts testified that electrical conductivity occurs across small gaps. MRD-2043, 14:8-16; LGES-1055, 114:19-115:20, 122:24-123:9. Objective references prove that electron tunneling occurs between CNTs embedded in PVDF—like Ohata’s PVDF-CNT masterbatch. SR, 16-17 (discussing MRD-2010, 12; MRD-2012, 5). Dr. Zhu’s unsubstantiated and unexplained statements (MRD-2044, 12:23-14:3) on redirect that ***“I don’t think”*** tunneling plays a role or is “important” cannot rebut this objective evidence.

Sixth, LG misrepresents that Dr. Chung testified that conductivity via

tunneling would be “lousy” and “far from reality.” RR, 8. She **actually** testified that conductivity is “lousy” at **greater distances ($10\geq\text{angstroms}$)** but that the smaller the gap “**the better ... the electrical contact quality.**” LGES-1055, 125:14-126:4. Also, the “far from reality” quote was not about conductivity, but the magnification capability of microscopy. *Id.*, 126:5-18. Indeed, she testified that conductivity occurs across sufficiently small gaps between CNTs. SR, 16 (citing LGES-1055, 114:19-115:20, 122:24-123:9). Tunneling is clearly applicable. FWD, 22-23.

Seventh, LG asserts that “no record evidence supports a conclusion that a POSITA would have applied the theory of ‘percolation’” (RR, 9), despite **numerous objective references** showing the percolation threshold is reached “by very small amounts of CNT in PVDF” (<3-5% CNT) at which point the binder exhibits “metal-like behavior.” SR, 17-18 (discussing MRD-2018; MRD-2014; MRD-2011; MRD-2012; MRD-2019). LG not only ignores this, but **both experts** acknowledge the percolation threshold—Dr. Chung testified that Ohata-Kavan’s binder provides conductivity via this principle. LGES-1054, 38:9-25, 37:6-20, 39:2-40:20.

Eighth, LG’s cursory assertion that the percolation threshold is inapplicable is **pure attorney argument**. RR, 9-10. First, even Dr. Zhu did not support this. MRD-2044, 8:15-9:18. Second, LG ignores that CNTs embedded in the masterbatch would be **interconnected**. POR, 55-58 (citing MRD-2006 ¶¶151-55 (explaining disentangling CNTs is like spreading apart a spider web)). The parties agree Ohata

seeks an improved “network of *interconnected* [CNTs]” (FWD, 22) not that the CNTs are physically isolated from one another. Even if *some* CNTs were, LG cannot dispute the vast majority remain interconnected. Third, tunneling provides conductivity across small gaps, including in CNT-PVDF mixtures. SR, 16-17. The Board thus correctly determined that LG failed to carry its burden. FWD, 21-26.

II. CHENG-GAN

Despite the Board already rejecting two improper attempts by LG to raise new theories due to its failure to account for Cheng-Gan’s *high-temperature calcining* (FWD, 33-37), LG now brazenly attempts to do so a third time via its RR.

The Petition plainly asserted that Cheng-Gan’s CNTs *start* oxidized at levels of 2.5-10 wt% (as in Gan) and *then* are subjected to Cheng’s process:

[T]he [CNTs] in Cheng’s carbon nanotube/lithium iron phosphate composite would have [CNTs] that are ... oxidized with carboxyl or hydroxyl groups at “*about 2.5 to 10 wt%*” *based on Gan’s disclosure*.

[T]he [claimed composition] is rendered obvious by [1] functionalizing the [CNTs] of Cheng using well known methods, *as described in Gan*, or [2] obtaining the functionalized [CNTs] from commercial sources, *as described in Gan*, and *applying such functionalized [CNTs]* in preparing the composite described in Cheng.

Pet., 41-42, 50. Functionalizing “as described in Gan” *starts* with oxidizing CNTs to 2.5-10% before any other step. LGES-1021 ¶¶[0030]-[0031]. And obtaining ox-

CNTs “from *commercial sources*” means the CNTs *start* oxidized at 2.5-10%.

PO then proved that the calcining step of Cheng-Gan would bring the oxidation levels (“ox-levels”) of the CNTs below the claimed range. POR, 62-66. ***Tellingly, LG’s Reply never argued that PO mischaracterized its invalidity theory.*** Reply, 17-25. LG (1) argued that the calcining would not result in the ox-level dropping from 2.5-10% to under 1% and (2) offered new theories to belatedly account for the calcining step. *Id.* PO disproved this (Sur-Reply, 33-37), and the Board thoroughly rejected LG’s positions and new theories. FW, 28-37.

Because LG failed to account for the calcining, LG now advances a new theory where Cheng-Gan does not *start* with ox-levels “as taught by Gan” but where LG simply “assumes” some undisclosed starting ox-level and *magically* ends up with ox-levels of 2.5-10 wt% after calcining. RR, 13. This theory was never raised in the Petition/Reply; it was first raised *at oral argument*. *Id.* (citing Paper 37, 45:3-11). If there was truly a “critical misapprehension,” ***LG indisputably would have raised that in its Reply.*** LG misleads the Board when it argues—based on a single, out-of-context quote—that “the Petition explains that ‘the carbon nanotubes in Cheng’s carbon nanotube/lithium iron phosphate composite’ (*i.e.*, the *final composition*) ‘would have carbon nanotubes that are ... oxidized ... at ‘about 2.5 to 10 wt%’ based on Gan’s disclosure.” *Id.* But the reason LG asserted the CNTs in the “final composition” would have this ox-level is because LG *falsely assumed* the ox-

levels at the beginning/end of Cheng-Gang's process would be the same *because LG failed to account for the calcining step*. Indeed, LG argued Cheng-Gan discloses the same "steps of Example 2 [of the '924 Patent] *in sequential order*," which *starts* with ox-levels of 8%, just like Cheng-Gan *starts* at 2.5-10%. Pet., 53-54.

Even if considered, the new theory fails, because the CNTs would have to start with *significantly higher* oxidization levels so that the final ox-levels would fall within the 2.5-10% range *after calcination*. First, LG 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. POR, 66-67 (citing LGES-1021 ¶0024); Pet., 45. Third, the Board rejected similar unsubstantiated/conclusory obviousness arguments "[g]iven the unpredictable nature of chemical reactions." FWD, 32-37. LG provides no information to prove its new theory and "do[es] not assume any specific oxidation for the starting material" (RR, 13), meaning "optimization"/"experimentation" would be required. The Board rejected similar unsupported theories. FWD, 35-37.

LG's argument that the Board overlooked and failed to credit "robust evidence" (RR, 14-15) is an impermissibly vague request for the Board to reassess whether Cheng-Gan's calcination would remove essentially all oxidation from the CNTs. PO comprehensively addressed this, and the Board credited its "countering evidence" over LG's. POR, 62-66; Sur-Reply, 33-36. Nothing was "overlooked."

PO Response to Rehearing Request

Case IPR2024-01011
U.S. Patent No. 8,968,924

Dated: February 5, 2026

Respectfully,

/Stephen Zinda/

Stephen Zinda (Reg. #67,272)
Counsel for PO

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e)(4), the undersigned certifies that on August 25, 2025, the foregoing document was served via electronic mail on the following attorneys of record at the indicated e-mail address, which Petitioner has consented to electronic service for:

Andrew Sommer (Reg. No. 53,932)
Heath J. Briggs (Reg. No. 54,919)
Julie P. Bookbinder (Reg. No. 56,940)
Trenton A. Ward (Reg. No. 59,157)
Kathryn E. Albanese (Reg. No. 78,153)
Samsung-MRD-IPRs@gtlaw.com
GREENBERG TRAURIG, LLP

W. Karl Renner (Reg. No. 41,265)
IPR18768-0210IP5@fr.com
Timothy Riffe (Reg. No. 43,881)
Hyun Jin In (Reg. No. 70,014)
Gretchen A. DeVries (Reg. No. 72,505)
PTABInbound@fr.com
FISH & RICHARDSON P.C.

/Stephen D. Zinda/
Stephen D. Zinda