

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.,

Petitioners

v.

MOLECULAR REBAR DESIGN, LLC,
Patent Owner

Case IPR2024-01013¹

U.S. Patent 10,153,483

PATENT OWNER'S RESPONSE TO REQUEST FOR REHEARING²

¹ Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. were joined as petitioners in this proceeding based on a petition and motion for joinder filed in IPR2025-00359, which was granted.

² This filing was authorized by the Board. Paper 43.

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LG failed to account for the unique masterbatch process of Ohata-Kavan, which embeds its CNT-network in PVDF to create a *conductive* binder (“masterbatch”) that prevents the claimed “attachment.” POR, 20-44; FWD, 18-25. This was established by “compelling objective proof,” including “numerous objective references” and Dr. Chung’s “well-reasoned and well-supported testimony” explained with “exceptional clarity.” FWD, 18, 19 n.12, 22; POR, 27-44. Unable to counter this proof, LG’s Reply advanced the *new* contrived theory that CNTs cannot be coated because “physical contact” is required between CNTs/active material. Reply, 5-7. PO’s Sur-Reply (“SR”) disproved this too with *objective* proof, showing Ohata-Kavan’s binder achieves conductivity with active material via the percolation threshold and electron tunneling—not physical CNT-contact. SR, 15-21; FWD, 19-22. This was not an “untimely” “eleventh-hour, attorney-driven pivot” but a response to LG’s new theory. And the Board did not overlook or misapprehend anything by crediting PO’s evidence-driven positions over LG’s unsubstantiated new theory. Recognizing this, LG resorts to misstating the law, out-of-context quotes, mischaracterizing prior arguments, and ignoring critical evidence.

I. THE BOARD DID NOT MISAPPLY THE LAW

LG argues that the Board erroneously required it to prove that Ohata-Kavan “necessarily achieves” the claimed “attachment,” alleging it only needs to show motivation to combine and reasonable expectation of success. Rehearing Request

(“RR”), 2. This misstates the law. Even if there were motivation and a reasonable expectation of success, Ohata-Kavan must 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, 19.

II. NMP WOULD NOT REMOVE THE CNTS’ 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” (i.e., NMP). POR, 20-27. PO further proved that mixing at the proportions of Ohata-Kavan would fully embed and coat the CNTs with PVDF and that PVDF more strongly bonds to oxidized CNTs. *Id.*, 29-36. This was supported by objective proof describing and depicting this coating. *Id.* (citing MRD-2006 to 2018; MRD-2028; LGES-1014). PO also proved that Ohata-Kavan’s next step—blending the masterbatch with a “dispersion medium” (NMP) and active material—would not remove the molecular layer of PVDF coating, but instead disperses the binder as globules throughout the composition to act as “glue.” *Id.*, 36-44; SR, 22-28 (disproving LG’s “full dissolution” NMP theory). This was shown by objective evidence, including Dr. Chung and numerous SEMs *visually* depicting such coatings. POR, 36-44 (citing MRD-2006; MRD-2014 to 2018; MRD-2020; MRD-2024). Notably, LG *never*

addressed MRD-2020. FWD, 22 (citing Dr. Chung’s discussion of MRD-2020 (MRD-2006 ¶¶125-126), which describes the “**PVDF consuming** effect of carbon nanoparticles” and how a “**PVDF polymer layer**” “**prevents direct contact of particle surfaces.**”). Thus, the Board properly credited Dr. Chung’s testimony that it is “scientifically impossible” for the claimed attachment to occur. *Id.*

Given this overwhelming proof, LG resorts to misleading arguments. First, LG contends the Board misunderstood it to argue that Ohata-Kavan’s CNTs become available for attachment “during the earlier masterbatch step,” when LG argued this occurred “during the blending step” (when NMP is added). RR, 4. However, LG ignores *pages of detailed analysis clearly rejecting LG’s argument* that NMP “expose[s] the surfaces of the” CNTs during blending. FWD, 22-25.

Second, LG mischaracterizes PO as only alleging that “CNTs can be fully encapsulated in *certain circumstances*” (RR, 9), even though PO showed that Ohata-Kavan’s masterbatch process *always* fully coats the CNTs. POR, 27-44.

Third, LG mischaracterizes Ohata’s statement that “the masterbatch was easily dissolved in [NMP]” as meaning the PVDF is *fully* dissolved. RR, 4, 9. PO demonstrated with evidence, properly credited by the Board, that Ohata repeatedly describes NMP as a “*dispersion* medium” and that the statement refers to dissolving conductive PVDF-domains *to disperse them as globules*. SR, 22 (citing POR, 37-43; MRD-2006 ¶¶118-126); FWD, 23-24.

Fourth, LG cites Dr. Zhu’s testimony that “Ohata aims to use nanotubes to ‘form an excellent conductive path in an electrode’” and that such a “path could not occur if the CNTs” are embedded in a “*nonconductive* PVDF binder” and not “able to contact the *active material particles*.” RR, 9. First, Ohata-Kavan’s binder *is conductive*. Second, Ohata never suggests that the “excellent conductive path” has anything to do with physical contact with *active material*. Ohata teaches “unraveling” its CNTs to improve the “conductive path” in the *binder*, not to physically contact active material. POR, 20-22 (citing MRD-2006 ¶¶74-84), 30-31 (citing MRD-2010, 11-12). This renders the binder conductive, eliminating the need for any physical contact and allowing the binder to provide electrical conductivity (via its embedded CNTs) between active material. *Id.* 20-23; SR, 15-18.

Fifth, LG contends that PVDF is “fully dissolvable in NMP at concentrations greater than or equal to 10% by weight,” Ohata’s PVDF concentration was “well within the known range for full PVDF dissolution,” and “[a] POSITA would recognize that a solvent capable of dissolving [] PVDF ... *can* ... remove it from the CNT surface.” RR, 9-10. However, these assertions by LG and Dr. Zhu are unsubstantiated and 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 (“nothing in [Dr. Zhu’s] cited evidence actually supports that assertion.”); FWD, 23-25. Dr. Zhu himself acknowledges that PVDF remains “inside

the mixture” even 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 shown to be unsubstantiated. SR, 23-25. Contrary to LG’s assertion that PO “offers no evidence,” objective proof demonstrated that CNTs remain coated with a molecular layer of PVDF *even after mixing with NMP*. POR, 36-44; SR, 22-28. LG also never explained how Ohata-Kavan’s masterbatch can serve its function of holding the constituent parts of the electrode together if its PVDF is *fully* dissolved. SR, 24. LG’s arguments and evidence were fully considered and properly rejected. FWD, 22-24.

Sixth, because LG cannot overcome the “compelling objective evidence” discussed above, LG resorts to its meritless “physical contact” theory. *Infra* III.

III. THE “PHYSICAL CONTACT” THEORY WAS CONTRIVED

LG declares that the FWD turns on a “technical impossibility” and that it is “common sense” that “physical contact” between the CNTs/active material is required. RR, 1, 3-4, 6, 8. PO disproved this contrived theory with objective evidence and testimony proving Ohata-Kavan’s “masterbatch” binder is rendered electrically conductive “due to the presence of billions of CNTs” via the percolation threshold and electron tunneling. SR, 17-18. The Board appropriately rejected LG’s theory. FWD, 19-22. LG’s attempt to undo this is premised on mischaracterizations.

First, LG misleadingly quotes PO’s statement about “gaps.” RR, 1. PO never argued that “gaps” between *the CNTs and active material* was “contrary to Ohata’s

express goal.” RR, 1. PO was referring to gaps in the *electrically conductive network of CNTs*. Ohata’s goal is to create a *conductive* binder comprising a well-dispersed *electrically conductive CNT network*, which involves “unraveling” the CNTs to disperse the CNT-network apart like unraveling a “wound spiderweb.” POR, 10 (showing “highly entangled” raw CNTs), 57 (citing MRD-2006 ¶153); FWD, 22. Ohata “wants the CNTs to be interconnected to form a continuous network” to render its *binder* conductive. RR, 5. It is because the *binder itself becomes conductive* that “physical contact” between CNTs/active material is not needed. SR, 16-18.

Second, contrary to LG’s assertion (RR, 5-6), PO did not rely on Liu-009 as evidence that conductivity is achieved without physical contact. SR, 27. PO 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 undermines LG’s “physical contact” theory, because it teaches that: (1) the improved conductivity of its “conductive glue” masterbatch is driven by the percolation threshold; and (2) its carbon black is covered in “PVDF coatings.” *Id.* Also, Liu-009 “uses *significantly smaller* ratios of PVDF-to-conductive filler than Ohata-Kavan,” so even if there was physical contact, that does not evidence 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, 5. She was questioned about a hypothetical *without*

conductive binder (i.e., pure polymer)—not Ohata-Kavan’s *electrically conductive binder* (i.e., PVDF-CNTs). LGES-1054, 10:2-18:16. She consistently testified that the Ohata-Kavan’s *CNT-PVDF binder* would be conductive and that there is no physical contact due to the PVDF coating. SR, 18-19 (citing LGES-1055, 114:19-115:20, 122:24-123:9; LGES-1054, 37:6-20, 38:9-40:20). Evidence proves the binder would exhibit “metal-like behavior” due to the embedded CNTs. *Id.*, 17-18.

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 (e.g., “electrical bridges”) with *physical* contact. SR, 18-21; FWD, 21. Additionally, *none* of those references rely on the uniquely 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 an electrode active material,” Ohata-Kavan must work the same way. RR, 6-7 (quoting FWD, 20). However, as the Board recognized, 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, 26-27.

Fifth, LG argues that “electron tunneling” has “no practical relevance to

lithium-battery electrodes” and is a product of “attorney argument.” RR, 7. 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. And objective references prove that electron tunneling occurs between CNTs embedded in PVDF—just like the Ohata-Kavan PVDF-CNT masterbatch. SR, 16-17 (discussing MRD-2010, 12 (explaining that electrons “can *easily* travel from one tube to another tube without any obstacle (*through tunneling*)” when “the CNTs are touching each other *or very close*”); MRD-2012, 5). Dr. Zhu’s testimony (MRD-2044, 12:23-14:3) was redirect testimony from a *different* deposition taken *a day after* MRD-2043, and his vague, unsubstantiated and unexplained statements that “*I don’t think* tunneling effect actually play any part in the role of these microscopic devices” and “*I don’t think* the tunneling effect is important” cannot rebut the objective evidence or Dr. Chung.

Sixth, LG misrepresents Dr. Chung as testifying that conductivity via electron tunneling would be “lousy” and “far from reality.” RR, 7. However, she *actually* testified that the conductivity is “lousy” at *greater distances (10 $\geq$ angstroms)* but that the smaller the gap “*the better ... the electrical contact quality.*” LGES-1055, 125:14-126:4. Additionally, the “far from reality” quote was not about electrical conductivity, but the magnification capability of microscopy. *Id.*, 126:5-18. Indeed, she unequivocally testified that electrical conductivity occurs across sufficiently small gaps between CNTs. SR, 16 (citing LGES-1055, 114:19-115:20, 122:24-

123:9). Nothing substantiates the assertion that electron tunneling does not occur, and the Board correctly determined LG failed to account for it. FWD, 21-22.

Seventh, LG falsely asserts that “no record evidence supports a conclusion that a POSITA would have applied the theory of ‘percolation’” (RR, 8), despite *numerous objective references* showing that the percolation threshold is reached “by very small amounts of CNT in PVDF” (<3-5% CNT, *i.e.*, even less than Ohata’s *minimum* 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 ignores this evidence*. Both experts acknowledged the percolation threshold, and Dr. Chung testified that Ohata-Kavan’s binder provides electrical conductivity via this principle. LGES-1054, 38:9-25, 37:6-20, 39:2-40:20. Indeed, Liu-009 teaches a “*conductive* glue” created by mixing PVDF/carbon black, similar to how Ohata-Kavan creates “*conductive* glue” but with CNTs/PVDF. POR, 21-22, 33-34.

Eighth, LG’s single-paragraph assertion that the percolation threshold is inapplicable is unsubstantiated. RR, 8. First, even Dr. Zhu did not support this—he instead acknowledged this principle and its operation. MRD-2044, 8:15-9:18. Second, LG ignores that the CNTs embedded within Ohata-Kavan’s masterbatch would be *interconnected*. POR, 55-57 (citing MRD-2006 ¶¶151-53 (explaining disentangling CNTs is similar to spreading apart a heavily wound spider web)). Both parties agree—and the Board correctly concluded—that Ohata seeks an improved

“network of ***interconnected*** [CNTs],” not that the CNTs are physically isolated from one another in the electrode composition. *Id.*; FWD, 22. Even if *some* CNTs would become fully separated, LG cannot plausibly dispute that the vast majority of CNTs remain interconnected after detangling, rendering the binder conductive. Third, electron tunneling would provide conductivity across small gaps between separated CNTs. SR, 16-17. Fourth, LG’s “physical contact” theory is contradicted by its claim 8 argument, which asserts that a POSITA was motivated to space Ohata-Kavan’s CNTs apart “by at least 1 micrometer” (i.e., no physical contact). Pet., 56-57. But if Ohata-Kavan’s goal is to improve conductivity via interconnected CNTs (as the parties agree) and “physical contact” is required (as LG now alleges), LG cannot explain why a POSITA would have sought to *separate* CNTs. LG clearly offered this theory ***understanding that conductivity occurs between fully separated CNTs***.

The Board thoroughly explained why LG failed to show that NMP “would remove the ‘molecular layer’ of resin-coating ... from the oxidized nanotube surfaces” or that physical contact is required for conductivity between CNTs/active material. FWD, 21-25. To conclude otherwise would require making numerous unsubstantiated “assumptions.” *Id.*, 23. Not only did LG fail to carry its burden, PO presented “compelling objective evidence” disproving LG’s positions and showing Ohata-Kavan relies on conductive ***binder*** to provide conductivity to active material, not CNTs attached to the surface of active material like the ’483 Patent or Kavan.

PO Response to Request for Rehearing

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February 5, 2026

Respectfully,

/Stephen Zinda/

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CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §§ 42.6(e)(4), the undersigned certifies that on February 5, 2026, 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:

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