

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
Patent 8,968,924

PETITIONER'S REQUEST FOR REHEARING

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.

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I. Introduction

Pursuant to 37 C.F.R. § 42.71(d), Petitioner respectfully requests rehearing of the December 15, 2025 Final Written Decision (“FWD”) (Paper 38) finding that Petitioner failed to prove that claims 1-5 of U.S. Patent No. 8,968,924 (“the ’924 patent”) are unpatentable. For at least the reasons below, in the FWD, the Board overlooked and/or misapprehended several issues, and the merits of the grounds raised in the Petition show by a preponderance of the evidence that the challenged claims are unpatentable.

First, the Board’s decision turns on a technical impossibility. Specifically, the Board wrongly concludes 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.” FWD, 21-23. This finding is not merely unsupported—it is directly contradicted by the record evidence including statements from both expert witnesses. And Patent Owner does not suggest otherwise; rather, it recognized in its Patent Owner Response (“POR”) that “*gaps in the conductive network* [are] *contrary to Ohata’s express goal* of creating an ‘electrode *superior in conductivity*’ and conventional wisdom at the time.” POR at 56 (citing to Chung Dec., ¶152).²

² All emphasis added unless otherwise noted.

Yet in crediting an eleventh-hour, attorney-driven pivot—raised for the first time in Patent Owner’s Sur-Reply—over the prior art’s actual disclosures and the evidentiary record, the Board embraced a conclusion that the record evidence directly refutes and for which no evidence exists to substantiate that a POSITA would accept.

Furthermore, stemming from this misunderstanding of how Ohata works, the Board erroneously required Petitioner to essentially prove that Ohata’s masterbatch process “necessarily results in attachment between the nanotube surfaces and the active material.” FWD, 23. Under the proper standard for obviousness, however, the relevant question is whether a POSITA would have been motivated to make the modification and would have had a reasonable expectation of success—not absolute predictability or inevitability. *See In re O’Farrell*, 853 F.2d 894, 903 (Fed. Cir. 1988) (“[A]bsolute predictability of success” is not the criterion for obviousness; “all that is required is a reasonable expectation of success.”).

Second, the Board misapprehended the nature of the Cheng-Gan combination, and overlooked statements in the Petition explaining the combination and subsequent briefing providing clarification. Specifically, the Board erroneously assumed that the **starting** material for the Cheng-Gan combination includes nanotubes having an oxidation level based on Gan. *See* FWD, 29. This assumption simply cannot be reconciled by the explicit explanation in the Petition and

subsequent briefing that the specific oxidation level taught by Gan applies to the final composition of the Cheng-Gan combination (not the starting material), which would be achieved using starting material having any suitable oxidation level. *See* Pet., 41-42, 63-64; Oral Hearing Transcript, 44-45. Moreover, even assuming, *arguendo*, that the starting oxidation level is based on Gan (it is not), the Board compounded its error by overlooking Petitioner’s responsive evidence (*see, e.g.*, Pet. Reply, 18-22) demonstrating that the Cheng-Gan nanotubes would retain their oxidative functionalities, instead crediting unsupported attorney argument from Patent Owner’s Sur-reply—argument that is directly refuted by the very reference it cites. FWD, 32-35.

II. Argument

A. The Board’s Finding Misapprehended or Overlooked Evidence Concerning How Ohata-Kavan Actually Works

The 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. Evidence from both Petitioner and Patent Owner support this common sense notion. While the FWD points to alleged evidence in support of this finding, none is relevant to Ohata or the Ohata-Kavan combination. The Board, however, found that Ohata conducts electricity by a “mechanism materially different” from physical contact, *i.e.*, electron tunneling and percolation threshold. FWD, 20-21. While the FWD points to alleged

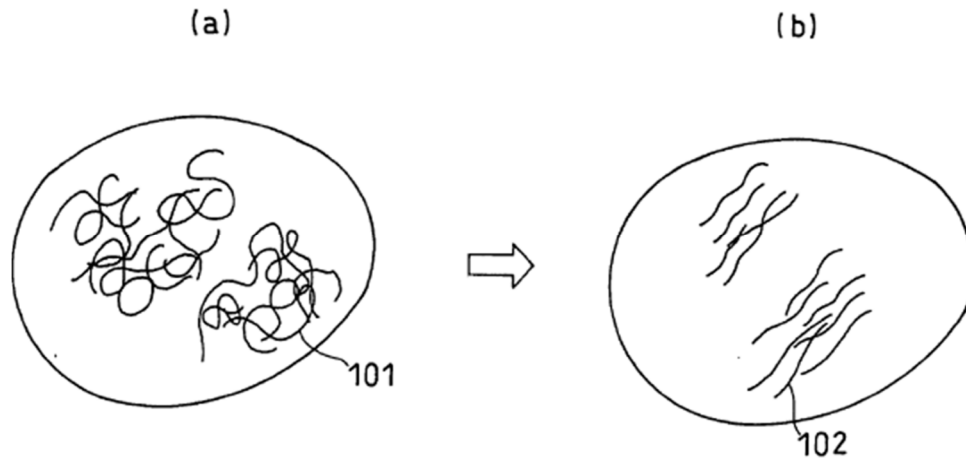
evidence in support of this finding, none is found in Ohata or relevant to the Ohata-Kavan combination.

1. Brief Review of Ohata

As an initial matter, it may be helpful to review briefly the process by which the electrode is formed in Ohata-Kavan. In Ohata, an intermediate “masterbatch” is first produced “by blending at least carbon nanotubes with a resin.” Pet., 10. Here, the resin can be a binder material such as PVDF, and as Petitioner explained for Ohata-Kavan, the added carbon nanotubes can be oxidized as per Kavan. *Id.*, 9-13; LGES-1004, [0022]. Subsequently, “an electrode material mixture containing the masterbatch and an electrode active material” is blended with a solvent such as NMP to form an “electrode material mixture paste,” which is later dried/rolled/cut to form the final electrode material. *Id.*, [0025].

Critically, Ohata teaches that, during this later blending step, “[t]he masterbatch was easily dissolved in [NMP].” LGES-1004, [0032]; Pet. Reply, 7. As Petitioner explained, the CNT surfaces become available for attachment to the active material during this **blending step**—“by way of the dissolution of the masterbatch resin by NMP,” Pet. Reply, 7-8, 16—not, as the FWD suggests, during the **earlier masterbatch production step** “at which point the surfaces of the oxidized nanotubes become available for attachment,” FWD, 19. The Board overlooked this critical distinction.

Moreover, contrary to the FWD's finding, Figure 1(b) of Ohata **does not** “**plainly** depict[] discrete carbon nanotubes embedded in PVDF resin” and thus “**unavailable** for such attachment.” FWD, 20. To the extent the FWD is relying on the circular viewing region of Ohata's Figure 1(b), shown below right, as somehow depicting a fully resin-encapsulated structure, Ohata's Figure 1(a), shown below left, precludes such inference by showing, with the same viewing circle, the state of the nanotubes “before they are blended with a resin”:



LGES-1004 (Ohata), FIG. 1, [0012].

In these figures (depicting the same nanotubes before and after they are blended with a resin), the only difference shown is the “unraveled and straightened” state of the nanotubes. In other words, Figure 1(b) shows no additional structure absent from Figure 1(a), strongly undermining the Board's conclusion that Figure 1(b) “**plainly** depict[] discrete carbon nanotubes embedded in PVDF resin.” FWD, 20.

2. *Ohata Requires Physical Contact Between Its CNT and Active Materials*

The record evidence leaves no room for debate over the fact that battery electrodes like those found in Ohata operate through physical contact between the conductive additive (*e.g.*, carbon nanotubes) and the active materials (*e.g.*, LiCoO₂, TiO₂, or LiMPO₄).

As noted above, Patent Owner acknowledged—before its last-minute, evidence-free pivot at the Sur-Reply stage—that Ohata (consistent with conventional wisdom) teaches against any gaps in the electrode structure. Specifically, in advancing its position that Ohata’s CNTs were not “discrete” because they were “attached” to each other, Patent Owner argued that Ohata’s electrode requires physical contact among the CNTs: “Nothing suggests that Ohata was seeking to achieve discrete CNTs as part of its electrode material mixture paste, *as this would create gaps in the conductive network contrary to Ohata’s express goal of creating an ‘electrode superior in conductivity’ and conventional wisdom at the time.*” POR at 56; *see also* POR at 58 (Ohata “*wants* the CNTs to be interconnected to form a continuous network to improve conductivity”). That is, Ohata achieves superior conductivity in its electrode through physical contact between its nanotubes and active materials. *See* Pet. Reply, 5-7.

In another instance, to “provide[] an example of the type of conductive glue-like ‘masterbatch’ process that Ohata describes,” Patent Owner pointed to Liu-009

(MRD-2008), which like Ohata uses an electrode mixture having carbon that is dispersed in PVDF. POR, 22. But Liu-009 never mentions or even remotely suggests that conductivity is somehow achieved within the electrode structure (*i.e.*, between the conductive additives and the active materials) without any physical contact. Pet. Reply, 10; LGES-1056, ¶¶27-29. Rather, as Dr. Zhu explained, Liu-009 itself “makes clear that conductivity improvements come not from embedding or insulating the conductive additive (carbon black), but from *preserving carbon black’s contact with the active material and maintaining conductive pathways.*” *Id.*, ¶28. Indeed, Liu-009 attributes its excellent electrical performance to “the improved *interface electronic conductivity* between the active material particles and the ... conductive additives,” emphasizing the importance of “closer contact with the active material particles.” *Id.*, ¶29; MRD-2008, 10:21-21, 11:13-17, 12:43-48.

Patent Owner’s expert, Dr. Chung, likewise confirmed this need to achieve *physical contact* between the conductive additive (including carbon nanotubes) and the active particle, explaining that “the conductive additive *needs to be in physical contact with the active material* so that the charges can come out or go in of this active material particle.” LGES-1054, 17:1-18:16; Pet. Reply, 6.

Petitioner’s expert, Dr. Zhu, also repeatedly confirmed this common sense notion that “without contact between the conductive additive (e.g., nanotubes) and the active material, the electrode material would be inoperable in a battery.” LGES-

1056, ¶10; Pet. Reply, 6.

The experts' consistent opinion on this point is corroborated by other record evidence. For example, Nicolas-429 (MRD-2017), cited by Patent Owner, explains that CNTs in electrode materials “provide for the delivery of the electrons to the active material particles” and “form electrical bridges between the active material particles” by maintaining “contacts” despite volume expansion. Pet. Reply, 6, 9-10; LGES-1056, ¶¶10, 25 (citing MRD-2017, [0094]); *see also id.*, ¶¶10, 26 (citing MRD-2018, [0092]). Similarly, Kavan (LGES-1005), like the '924 patent, predictably achieves electrical conductivity through “*physical contact between the oxidized surfaces of nanotubes and an electrode active material*” as the Board itself acknowledged. FWD, 21.

In rejecting this evidence, the Board stated that “Petitioner’s arguments ... fail to account adequately ... for the phenomena of electron tunneling and percolation threshold that undergird Ohata’s mechanism.” FWD 21–23 (citing Sur-Reply). This conclusion is not only based on untimely attorney arguments, but also fundamentally misguided. Regarding “tunneling,” Dr. Zhu explained that tunneling is confined to atomic-scale distances and therefore has no practical relevance to lithium-battery electrodes of the type disclosed in Ohata. MRD-2044, 12:23–14:3; Petitioner’s Observations, 1. The isolated, out-of-context deposition testimony of Patent Owner’s expert about the theoretical possibility of conduction between two

nanotubes that are literally an atom's length apart from each other is not substantial evidence that Ohata's mechanism relies on electron tunneling. *See* Sur-Reply, 17. It is at best Dr. Chung clarifying that such phenomenon does not inform real word application. Indeed, during that same testimony, Dr. Chung acknowledged that any such conductivity would be "lousy" and that a practical discussion of the phenomenon is "far from reality." PO Sur-Reply, 17; LGES-1055, 114:19-115:20, 122:24-126:18. Thus, the relied-upon testimony simply offers no evidence that a POSITA would consider tunneling in the context of Ohata, nor that they would consider tunneling in view of Ohata's stated goal of "providing improved electrical conductivity between active material particles." POR, 55 (citing LGES-1004, [0004], [0018]-[0020]).

Similarly, no record evidence supports a conclusion that a POSITA would have applied the theory of "percolation" to achieve conduction with "no contact" between nanotube surfaces and active particles in the Ohata structure. As Patent Owner's own evidence makes clear, percolation refers to the formation of a continuous conductive path through CNT-CNT *contact points*—*i.e.*, electrons traveling easily "*when touching*." POR 12–13 (citing MRD-2010 at 12). In other words, the percolation concept Patent Owner invokes reinforces, rather than undermines, the central point reflected throughout the record: the relevant conduction mechanisms between the nanotubes and active materials in Ohata-

Kavan's electrodes depend on contact, not on speculative non-contact theories.

Accordingly, for at least these reasons, the notion that Ohata somehow works in a materially different manner without physical contact between the nanotube surface and the active materials defies common sense and is contradicted by Ohata itself as well as the testimonies of both experts and Patent Owner's own cited prior art.

3. *Ohata-Kavan's Nanotubes Do Not Remain Fully Coated*

In the FWD, the Board accepted the misguided premise that Ohata can function without contact between its nanotubes and active materials and consequently concluded that NMP in the Ohata-Kavan process would not have "removed PVDF resin *sufficiently* to expose the oxidized surfaces for further reaction." FWD 23. The Board's analysis gives undue weight to Patent Owner's "evidence" that CNTs can be fully encapsulated by PVDF in *certain circumstances*. Petitioner does not dispute, however, that CNTs can be encapsulated in PVDF—anything can be encapsulated. The relevant question is whether that scenario is consistent with Ohata's disclosed objective and process.

As Dr. Zhu explained, "Ohata aims to use nanotubes to 'form an excellent conductive path in an electrode,'" and he clarified that such a path could not occur if the CNTs remained "'fully embedded' within a nonconductive PVDF binder and thus not able to contact the active material particles." LGES-1056, ¶12. And the

record shows that Ohata's process is designed to enable contact: PVDF in the masterbatch is highly soluble in NMP, and "PVDF is fully dissolvable in NMP at concentrations greater than or equal to 10% by weight." LGES-1056, ¶14 (citing LGES-1062, 2); *see also* LGES-1004, [0032] ("The masterbatch was *easily dissolved* in [NMP].").

Indeed, Ohata's PVDF concentration, which Patent Owner contends is unconventionally high, is well within the known range for full PVDF dissolution since Ohata's "positive electrode material mixture paste was prepared by mixing **3.3 parts by weight of the masterbatch** [containing PVDF], 100 parts by weight of LiCoO₂ active material, and **45 parts by weight of [NMP]**." LGES-1056, ¶14 (citing LGES-1004, [0032], [0040], [0044], [0046]). But instead of crediting this objective evidence of sufficient PVDF dissolution—evidence fully aligned with Ohata's stated objectives—the FWD credits attorney argument from the Sur-Reply that Ohata's statement that NMP "easily dissolve[s]" PVDF should be reinterpreted to mean merely "'easily' dispers[ing]" the PVDF. FWD 24 (citing Sur-Reply 22–28).

As Dr. Zhu explained, "[a] POSITA would recognize that a solvent capable of dissolving [] PVDF—such as NMP—can substantially (most, if not all) remove it from the CNT surface in solution, enabling direct interaction between the CNT and the active material particles." LGES-1056, ¶23. Patent Owner offers no evidence overcoming the straightforward, record-supported conclusion that

dissolving Ohata's masterbatch in NMP (which Ohata expressly describes as "easily" dissolving the masterbatch) would remove enough PVDF to expose the CNT surface and permit the physical attachment/contact required for Ohata's electrode to function as intended. Pet. Reply 7–10; LGES-1056, ¶¶9–23; *see also* Petition 14-15; *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007) ("A person of ordinary skill is also a person of ordinary creativity, not an automaton.").

In sum, the record establishes that Ohata's electrodes achieve physical contact between the CNTs and the active material to function as disclosed. A POSITA would also recognize that, during Ohata's NMP-blending step, sufficient PVDF is dissolved to expose enough CNT surface area to permit the required attachment to the active material. *See* Pet. Reply, 5-10; LGES-1056, ¶¶8-30. Moreover, as detailed throughout these proceedings, the Ohata-Kavan combination renders obvious the attachment of electrode active materials to the oxidized CNT surfaces via, e.g., covalent bond. *See, e.g.*, LGES-1003, ¶76.

4. *Ohata-Kavan's Nanotubes Are Discrete*

As further detailed throughout these proceedings, the oxidized nanotubes in Ohata-Kavan are "discrete," as supported by Ohata's desire to reap the benefits of "unraveled and straightened" nanotubes (*see, e.g.*, LGES-1003, ¶¶20, 69-72) as well as numerous references that speak to the compatibility of oxidized nanotubes and Ohata's process. *See id.*, ¶¶48-50; *see also* Pet. Reply, 1-5; LGES-1056, ¶¶5-7, 31-

33.

B. The Board Erroneously Applied Gan's Oxidation Level to the Starting Material and Overlooked Rebuttal Evidence

The Board's finding of "impermissible hindsight" reveals a fundamental misapprehension of the structure of the Cheng-Gan combination. *See* FWD, 28-30. Specifically, the Board incorrectly assumes that it was Petitioner's position that "one would have selected carbon nanotubes characterized by that [claimed] level of oxidation as a starting material in Cheng's first step," "without addressing whether or why those carbon nanotubes would retain the same level of oxidation after enduring Cheng's subsequent calcining step." *Id.*, 29. But the Board's assumption flips the Petition's reasoning on its head because the Petition does not require that the carbon nanotubes used as the "***starting material***" in the Cheng-Gan combination have the specific oxidation level of Gan's nanotubes. FWD, 29 (emphasis added). Instead, 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 functionalized or oxidized with carboxyl or hydroxyl groups at 'about 2.5 to 10 wt%' based on Gan's disclosure." Petition, 41; *see id.*, 63. During the Oral Hearing, Petitioner further clarified that the oxidation level is an end goal of the final composite, not a required feature of the starting nanotubes. *See* Oral Hearing Transcript, 44-45.

To justify its (incorrect) assumption that Gan's oxidation levels characterize

the starting material, rather than the final product, the Board cites to merely one of the many motivations for the combination provided in the Petition. *See* FWD, 29; Petition, 42-48, 61-64. In doing so, though, the Board overlooks that the combination is motivated by justifications that ***do not*** assume any specific oxidation level for the starting material. For instance, the Petition explains that oxidized nanotubes having oxidation levels of 9.1% were known to “enhance electrical conductivity of conductive network in the [final] electrode composite,” reinforcing that the relevant oxidation level pertains to the end product, not the starting material. Pet., 63-64.

Accordingly, the Board’s conclusion of hindsight is rooted in a critical misapprehension of the nature of the Cheng-Gan ground that overlooks Petition statements as well as subsequent explanation indicating that the final composite material—not the starting nanotubes—***exhibit an oxidation level of about 2.5-10 wt%***. *See* Petition, 41-42, 63.

The Board’s subsequent treatment of “whether Gan’s functionalized carbon nanotubes would have emerged from Cheng’s calcining step without removal of the functional groups” is similarly flawed in its assumption that the starting nanotubes are oxidized to the levels taught by Gan. *See* FWD, 30. The Board’s additional assertion that Petitioner presented “untimely and unpersuasive efforts to account for that impact [of the calcination] in the Reply” overlooks Petitioner’s robust evidence,

accompanied by expert testimony, properly advanced directly in response to issues raised by Patent Owner. *Id.* Specifically, the Petitioner's Reply presented evidence, supported by expert testimony, demonstrating that oxidized carbon nanotubes retain their functional groups following calcination in an inert atmosphere (just as do the nanotubes in the process described the '924 Patent). *See* Pet. Reply, 18-20; LGES-1001, Examples 2, 4; LGES-1042, 7, FIG. 6(e). Yet the Board fails to credit this evidence, instead citing to the "countering evidence"—uncorroborated by expert testimony—in Patent Owner's Sur-reply. FWD, 34 (citing Sur-reply 35, n. 5). The Board's adoption of Patent Owner's speculative theories over Petitioner's expert-endorsed evidence, without careful review of the details of that evidence, is a striking demonstration of improperly overlooking evidence in this proceeding.

III. Conclusion

For the foregoing reasons, Petitioner respectfully requests that the Board grant Petitioner's request for rehearing of the Final Written Decision.

Respectfully submitted,

Dated January 14, 2026

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CERTIFICATE OF SERVICE

Pursuant to 37 CFR §§ 42.6(e)(4) and 42.205(b), the undersigned certifies that on January 14, 2026, a complete and entire copy of this Petitioner's Request for Rehearing was provided by email to the Patent Owner by serving the correspondence email address of record as follows:

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