

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZHUHAI COSMX BATTERY CO., LTD.,
Petitioner

v.

NINGDE AMPEREX TECHNOLOGY LTD.,
Patent Owner

IPR2025-00385
Patent 10,964,927

PATENT OWNER'S PRELIMINARY RESPONSE

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Paper 10 at 17 (PTAB Mar. 14, 2025) 25, 57, 58

TABLE OF EXHIBITS

Exhibit Number	Description
2001	Second Amended Complaint, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG, ECF No. 23 (E.D. Tex. Jan. 28, 2025)
2002	Scheduling Order, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG, ECF No. 27 (E.D. Tex. Feb. 6, 2025)
2003	CosMX Invalidity Contentions Cover Pleading, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:24-cv-00728-JRG (E.D. Tex. Jan. 7, 2025)
2004	Summons to attend oral proceedings in German Case No. 3 Ni 12/23 (EP) (“Germany Order 1”)
2005	Summons to attend oral proceedings in German Case No. 3 Ni 12/24 (EP) (“Germany Order 2”)
2006	Docket Navigator Statistics for Judge Rodney Gilstrap (accessed May 5, 2025)
2007	Docket, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:22-cv-00232 (E.D. Tex.)
2008	Joint Motion for Entry of Protective Order, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , No. 2:24-cv-00728-JRG, ECF No. 30 (E.D. Tex. Feb. 11, 2025)
2009	Amended Final Judgment, <i>Ningde Amperex Tech. Ltd. v. Zhuhai CosMX Battery Co.</i> , Case No. 2:22-cv-00232, ECF No. 427 (E.D. Tex.)

Exhibit Number	Description
2010	Article, <i>Lithium battery manufacturer ATL won injunction against its Chinese rival COSMX in German Court</i> , China IP Today (April 6, 2024)
2011	Reserved
2012	Reserved
2013	Reserved
2014	Reserved
2015	Declaration of Dean R. Wheeler, Ph.D.
2016	<i>Curriculum Vitae</i> of Dean R. Wheeler, Ph.D.
2017	Reserved
2018	Reserved
2019	Reserved
2020	Reserved
2021	Reserved
2022	Reserved
2023	Reserved
2024	Reserved
2025	<i>2016 Batteries Conference GRC</i> , https://www.grc.org/batteries-conference/2016/ (accessed on May 12, 2025)
2026	<i>Hubs – Department of Energy</i> , https://www.energy.gov/hubs (accessed on May 12, 2025)
2027	<i>DOE Energy Innovation Hubs</i> , https://science.osti.gov/bes/Research/DOE-Energy-Innovation-Hubs (accessed on May 12, 2025)
2028	Sergiy Kalnaus, Yanli Wang, John A. Turner, <i>Mechanical behavior and failure mechanisms of Li-ion battery separators</i> , 348, 255-263, J. Power Sources (2017)
2029	Jan Diekmann, Stefan Doose, Svenja Weber, Swantje Münch, Wolfgang Haselrieder, and Arno Kwade, <i>Development of a new procedure for nail penetration of lithium-ion cells to obtain meaningful and reproducible results</i> , 167(9) J. Electrochem. Soc. (2020)

Exhibit Number	Description
2030	Callister and Rethwisch, Materials Science and Engineering: An Introduction, 9 th ed., Wiley, 2014
2031	Jay R. Lund and Joseph P. Byrne, <i>Leonardo Da Vinci's Tensile Strength Tests: Implications for the Discovery of Engineering Mechanics</i> , 00, 1-8, Civil. Eng. and Env. Syst. (2000)

I. INTRODUCTION

Ningde Amperex Technology Ltd. (“ATL” or “Patent Owner”) respectfully submits this Preliminary Response (“POPR”) to the Petition (“Petition”) filed by Zhuhai CosMX Battery Co., Ltd. (“Petitioner” or “CosMX”). Paper 2 (“Pet.”). The Petition seeks *inter partes* review (“IPR”) of claims 1-10 (the “Challenged Claims”) of U.S. Patent No. 10,964,927 (the “’927 Patent,” Ex. 1001).

The Petition asserts four grounds that pertain to Independent Claim 1: Nishikawa (anticipation), Nishikawa (obviousness), Chen and Nishikawa, and Chen and Zhang. None of this prior art, on its own or in combination with other references, discloses or renders obvious the Challenged Claims. For example, Petitioner has not identified any reference that discloses the claimed “absolute plastic deformation” and, instead, urges this Board to overlook express claim language and a detailed formula that is included in the claims themselves. Petitioner further relies on unsupported assumptions and estimates based on conceptual stress-strain curves for metals, which differ substantially from the polymer material at issue here. Petitioner also relies on unsupported assumptions related to stress-strain curves without addressing the underlying factors that directly impact such curves. Altogether, the Petition is deficient, and the cited references do not render the claims unpatentable.

First, the Petition fails on its face because none of the prior art discloses the explicit claim limitation of absolute plastic deformation rate. All the claims require

that “absolute plastic deformation rate is calculated according to an equation $(\underline{L2}-L0)/L0 \times 100\%$, where $L0$ refers to a length of the porous substrate before stretching and $\underline{L2}$ refers to a length of the porous substrate after the porous substrate is stretched to breakage and docked along the fracture caused by the breakage and flattened.” *See e.g.*, Ex. 1001, Claim 1. Petitioner does not assert that any of the prior art actually and explicitly discloses “absolute plastic deformation rate,” and instead relies solely on extensive expert testimony of “estimates” of what theoretically could happen in an attempt to fill in the gaps in its art. *See, e.g.*, Pet. at 25-26 (relying on expert testimony to conclude that absolute plastic deformation rate “*can be estimated* from data disclosed in Nishikawa, specifically the strain at break (elongation) and the plastic strain.”)¹; *see also id.* at 27 (claiming that “[t]he total elongation of a material ($L1 - L0$) in combination with its tensile strength and Young’s modulus (a proxy for $L1 - L2$ as those lengths are defined in the ’927 patent) are inputs from which a POSA *could derive* the claimed absolute plastic deformation rate ($(L2 - L0)/L0 \times 100\%$).”); Ex. 1003 ¶ 120 (admitting “[o]nce again, *Nishikawa does not provide numeric values for the percentage of elastic or plastic deformation*, but it does provide elongation, tensile strength, and Young’s modulus. EX1004 ¶¶ 53, 54, Table 1. From these values, a relative plastic deformation rate (as

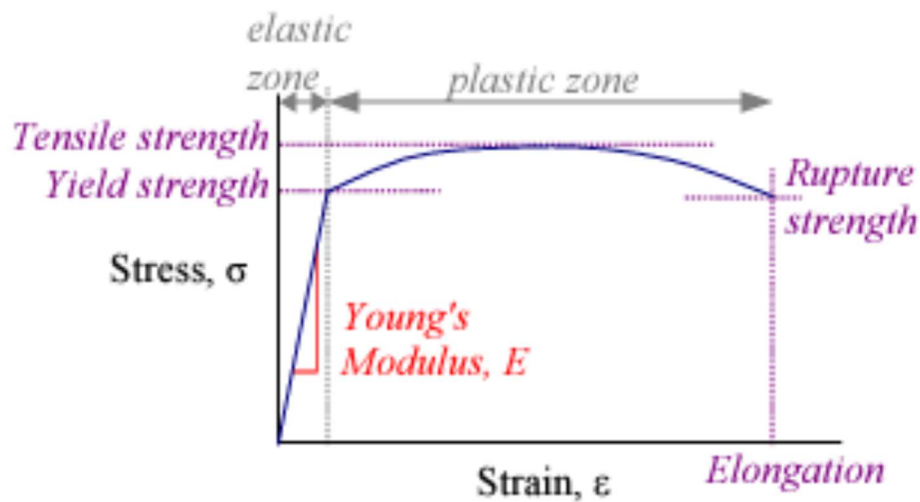
¹ All emphasis in this filing is added unless otherwise indicated.

that term is defined in the '927 patent) *can be estimated*, as shown above for claim 1.”).

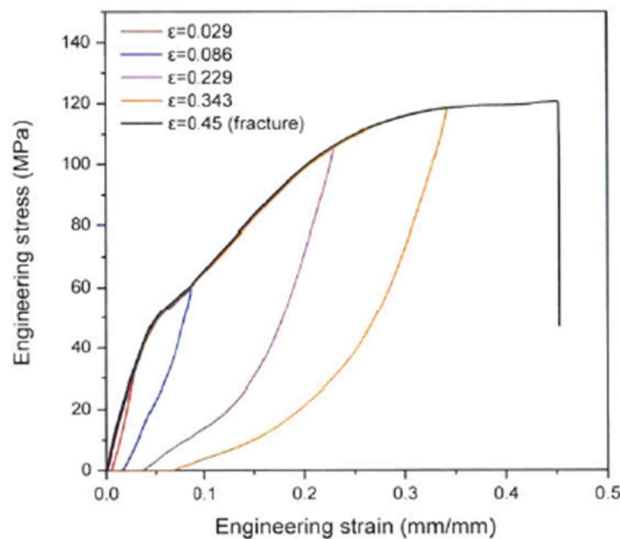
With all its attempts at gap-filling and unsupported estimations, Petitioner effectively redefines “absolute plastic deformation rate” as not requiring the explicitly claimed formula, which includes L2, ignoring the express language of the claims. Pet. at 22 (“These terms [including absolute plastic deformation rate] should be construed as extending to the physical properties they denote, even though those properties may also be expressed *by other equations*.”).

Recognizing the shortcomings of the prior art, in Grounds 1 and 2A, the Petitioner also erroneously argues that the claimed absolute plastic deformation rate is “inherent” to separators having the polymers disclosed in Nishikawa or otherwise obvious based on Nishikawa. Pet. 32-34, 41-44. But to make this argument, Petitioner again must rely on its expert’s attempts to “fill in the gaps,” citing just a few paragraphs of conclusory expert testimony. *See, e.g.*, Pet. at 32 (citing Ex. 1003 ¶¶ 112-113 (arguing that “[a] thermoplastic resin with a high elongation at break will *necessarily* exhibit a large degree of plastic deformation, because the elongation for these materials come from the plasticity and not elasticity.”) (emphasis in original)); Pet. at 41 (citing Ex. 1003 ¶¶ 136-40). This statement is incorrect because elongation in the different stages comes from both elasticity and plasticity, as detailed further below.

Second, the grounds in the Petition fail because Petitioner's expert makes multiple incorrect assumptions and estimates. The foundation for Petitioner's arguments about why the prior art allegedly suggests the claimed absolute plastic deformation rate is its erroneous position that in the stress-strain curve of polymer materials, deformation before the yield point is *all* elastic deformation, and deformation after the yield point is *all* plastic deformation. Pet. at 30-32; *see also* Ex. 1003 ¶ 62:



But even Petitioner's own cited prior art undercuts its theory illustrated by the figure above and proves that Petitioner's assumption is false: there is both plastic *and* elastic deformation after the yield point of the stress-strain curve of polymer materials. *See, e.g.*, Ex. 1007 at 95, Figs. 4-12 (showing stress strain curves of a polypropylene separator that illustrate significant elastic deformation after the yield point):



As such, Petitioner's own documents undercut the premise on which its expert testimony is based.

Third, the Petition fails because it relies on assumptions about stress-strain behavior without accounting for differing parameters that affect that behavior—parameters such as tensile rate (speed of stretching), chuck-to-chuck distance, and sample size. Indeed, the Petition never addresses the fact that those three underlying parameters vary widely between the references and the '927 Patent. For example, the Petition does nothing to address the fact that the prior art discloses stretching at different rates (i.e. 100 mm/min (Nishikawa) and 6 mm/min (Chen)). *See* Ex. 1004 ¶¶ [0133]-[0135]; Ex. 1005 at 14906. These rates are quite different from the 50mm/min that a POSITA would have understood to be at issue and disclosed in the '927 Patent. *See* Ex. 1001 at 10:31-33. The Petition likewise does not address that Nishikawa's chuck-to-chuck distance is 50 mm and Chen's is 30 mm, whereas the

'927 Patent's is 40 mm. *See* Ex. 1004 ¶¶ [0133]-[0135]; Ex. 1005 at 14906; Ex. 1001 at 10:28-31. Nor does the Petition acknowledge that the sample dimension in Nishikawa is 100 mm by 10 mm, whereas it is 50 mm by 10 mm in Chen and 100 mm by 20 mm in the '927 Patent. *See* Ex. 1004 ¶¶ [0133]-[0135]; Ex. 1005 at 14906; Ex. 1001 at 10:26-28. As Dr. Wheeler has demonstrated in his declaration, a POSITA would have known that these different parameters would affect the deformation properties of the porous substrate. Ex. 2015 ¶¶ 112-19. Worse still, even Petitioner's own cited art confirms that some of these three parameters impact the deformation properties of the porous substrate. Ex. 1007 at Fig. 3-2(a) (showing fracture strain values obtained by a tensile test that are different for different sample widths of a polypropylene separator); *see also id.* at Fig. 4-2 (showing stress-strain curves of a separator that indicate clear differences under different tensile rates). A POSITA would not have been able to fairly compare the deformation properties of the various prior art references to the claimed properties in the '927 Patent based on Petitioner's unsupported assumptions about stress-strain behavior, let alone combine references with these widely varying underlying parameters.

For at least these reasons, the Board should deny institution.

II. BACKGROUND²

A. Technology Overview

Lithium-ion batteries are commonly used in portable electronic devices like laptops and cellphones, as well as in electric vehicles. Ex. 2015 ¶ 41. Lithium-ion batteries have an anode, a cathode, an electrolyte, and a separator. *Id.* ¶ 42. When charging the battery, lithium ions move through the electrolyte from the cathode to the anode and are stored at the anode. *Id.* When discharging the battery (i.e. when the battery is being used), lithium ions move back through the electrolyte to the cathode. *Id.* It is the movement of lithium ions from the anode to the cathode that releases energy that powers whatever device is connected to the battery. *Id.*

The separator is a membrane located between the cathode and the anode that prevents direct contact between electrodes, while still allowing lithium ions to pass through between electrodes. *Id.* ¶ 43. It is important to prevent direct contact between electrodes because contact between the cathode and anode can cause a short circuit, and a short circuit could result in a fire or explosion. *Id.* Given the safety function of the separator, a separator must be strong enough to withstand outside forces that could puncture the separator and lead to contact between electrodes. *Id.*

² Patent Owner's expert provided a technology overview and a summary of the '148 Patent. Ex. 2015, § IV.A-B, ¶¶ 41-56.

At the same time, the separator must permit effective ion flow between the electrodes (i.e. high ionic conductivity), and the separator must not react to the electrolyte solution in a way that negatively impacts ionic conductivity. *Id.* ¶ 44.

These various design considerations for separators require a delicate balance related to the composition of the separator and its components, in addition to the separator's physical properties. *Id.* ¶ 45. This balance is something experts in the field have been working on for decades. *Id.*

There are many ways to make a separator. One design involves the use of a porous substrate, on its own, as the separator. *Id.* ¶ 46. Common examples of porous substrates are polypropylene and polyethylene. *Id.* Another design involves the use of a porous substrate with another porous layer added to that substrate, either on one or both sides. *Id.* ¶ 47. The porous layer may comprise many types of materials, such as different types of resins, organic particles, and/or inorganic particles. *Id.*

There are also various ways to test the safety efficacy of a lithium-ion battery. One such way is to subject a lithium-ion battery to a nail penetration test. *Id.* ¶ 48. A nail penetration test is designed to test the worst-case scenario, where there is a conductive metal nail inserted through the different layers of a battery to intentionally create conditions for a "hard-short" (i.e. an electrical connection between the two electrodes) to occur. *Id.* If the battery heats up or swells but does not explode, than that battery has passed the test. *Id.* But if thermal runaway results,

there will be an explosion and the battery will have failed the test. *Id.* A nail penetration test of a lithium-ion battery is different from testing puncture resistance of a separator. A nail penetration test tests the entire battery after some or all of the layers have been punctured, whereas a puncture resistance test is a test of only the separator to measure how much force the separator can withstand without being punctured.

One problem with prior art separators in the prior art is that they did not do a great job of preventing safety issues related to the explosion of batteries caused by external forces. *Id.* ¶ 49.

B. The '927 Patent

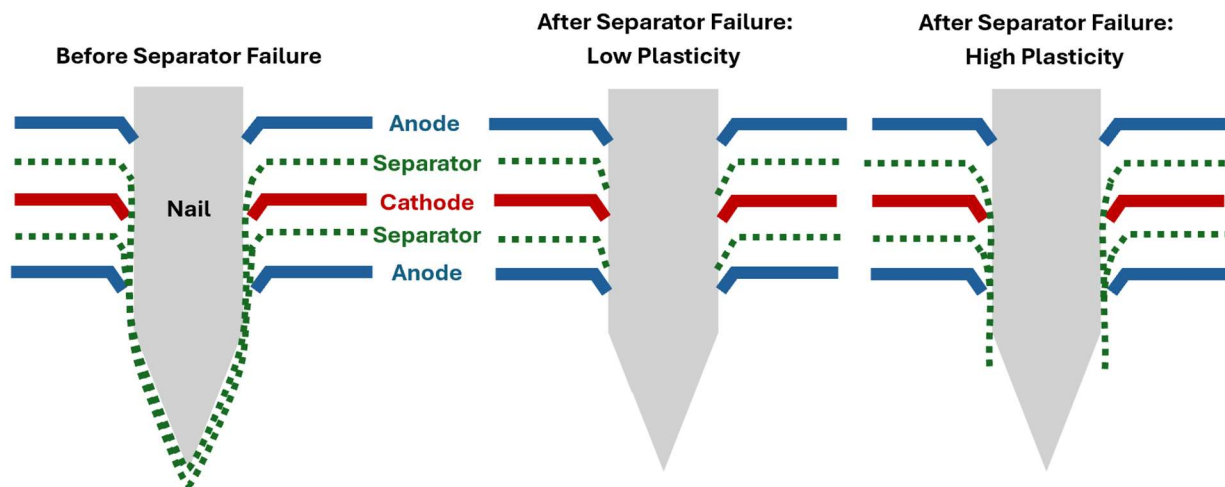
The '927 Patent solves the safety problems of prior art separators by proposing a separator with a porous substrate having certain characteristics or properties. Ex. 1001 at 1:37-44. The patent describes and claims a porous substrate with a “high plastic deformation rate, such that when pierced by a hard object such as a steel nail, the separator around the steel nail will extend together with the steel nail, and eventually create a wrapping effect around the steel nail, thereby reducing the probability of an internal short circuit and effectively preventing fire caused by large-area short circuit inside an electrochemical device (for example, a lithium ion battery).” *Id.* The '927 Patent's disclosure of absolute plastic deformation rate representing the separator extending together with the steel nail and creating a

wrapping effect is different from the puncture resistance discussed in the prior art. Ex. 2015 ¶ 50.

The '927 Patent describes a type of test called a tensile test, where a porous substrate is subjected to stretching to determine its physical properties, such as plastic deformation rate. Ex. 2015 ¶ 51. The patent explains that “[t]he porous substrate is subjected to both elastic deformation and plastic deformation during the tensile test.” *Id.* at 4:22-23. It also states “[p]lastic deformation is a permanent deformation that does not bounce back.” *Id.* at 4:27-28. As Dr. Wheeler explains in his declaration, plastic deformation is different than elastic deformation, which is a temporary deformation from which a material will bounce back to its original state when no longer subjected to stretching. Ex. 2015 ¶ 51.

The '927 Patent states that “[i]n the nail penetration test of a lithium ion battery, the greater the amount of plastic deformation of the porous substrate is, the greater the extent that the separator extends with the nail and produces permanent deformation will be, and the better the wrapping effect around the nail will be, thereby maintaining the effect of the separator in isolating the cathode and the anode, and reducing the probability of failure of lithium ion batteries.” *Id.* at 4:28-35. On the other hand, “if the amount of elastic deformation is relatively large, even if the separator is extended during the piercing process, the separator will be greatly retracted after puncture, thereby weakening the effect of the separator in isolating

the cathode and the anode.” *Id.* at 4:36-40. For example, the below conceptual diagrams (which are not to scale) show the difference between separator failures with a separator with low plasticity and a separator with high plasticity. Ex. 2015 ¶ 52. In both cases, just before separator failure, the separator is extended, providing a protective sheath around the nail (ideally preventing a short circuit). *Id.* After separator failure, a separator with low plasticity (and high elasticity) will retract significantly, leaving the nail exposed to a short circuit. *Id.* A separator with high plasticity (and low elasticity) will remain more elongated even after failure and will not retract as significantly, leaving more of the elongated separator still serving as a protective sheath around the nail. *Id.*



In the various tensile tests conducted in the '927 Patent, “[t]he length before stretching is recorded as L0; the porous substrate of a certain length and width is

stretched to break at a certain rate, and the maximum length reached by the stretching is recorded as L1; and then the broken porous substrates are docked along the fracture and flattened to test the length L2 in a natural state.” *Id.* at 4:15-21. The ’927 Patent defines the following terms: “elastic deformation=L1-L2,” “plastic deformation=L2-L0,” and “the total amount of deformation=the amount of elastic deformation + the amount of plastic deformation.” *Id.* at 4:23-27.

The patent further defines absolute plastic deformation rate and relative plastic deformation rate: “[t]he absolute plastic deformation rate ϵ_1 and the relative plastic deformation rate ϵ_2 of the porous substrate are calculated by the following equation[s]:

$$\epsilon_1=(L_2-L_0)/L_0 \times 100\%$$

$$\epsilon_2=(L_2-L_0)/(L_1-L_0) \times 100\%.”$$

Id. at 4:48-54.

The ’927 Patent describes various embodiments, including examples where “the porous substrate has an absolute plastic deformation rate in a first direction (e.g. a longitudinal direction) ranging from about 40% to about 1800%.” *Id.* at 4:55-58. The inventors of the ’927 Patent discovered that a “porous substrate having the above properties exhibits a high plastic deformation rate, and also exhibits a high plastic deformation rate when a porous layer is provided on the surface of the porous substrate.” *Id.* at 5:14-17. In addition, using these tensile tests and nail penetration

tests, the inventors of the '927 Patent discovered that the properties of the **porous substrate** are what dictate the nail penetration test passing rate (and thus the safety effectiveness of the separator), **not** the porous layer. *Id.* at 22:65-23:5 (finding “different types of porous layers have no significant influence on the nail penetration test passing rate.”).

III. LEGAL STANDARDS

The Petition must both “clearly point out the differences between the claimed invention and [the prior art]” and “explain why a person of ordinary skill in the art would have found the claimed subject matter obvious in spite of those differences.” *Synopsys, Inc. v. Mentor Graphics Corp.*, IPR2012-00041, Paper 16, 14 (P.T.A.B. Feb. 22, 2013). Petitioner must recite where the challenged limitation is found in the reference(s) and explain why a POSITA would have modified the primary reference with the recited limitation from the secondary reference(s). *Microsoft Corp. v. Secure Web Conf. Corp.*, IPR2014-00745, Paper 12, 11-13 (P.T.A.B. Sept. 29, 2014).

In addition, the Board institutes based on what the Petition *actually presents* and not what it could have reasonably contained. *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1381 (Fed. Cir. 2016). The Board cannot “deviate from the grounds in the petition and raise its own” theories of invalidity. *Sirona Dental Sys. GmbH v. Institut Straumann AG*, 892 F.3d 1349, 1356 (Fed. Cir. 2018).

IV. LEVEL OF ORDINARY SKILL IN THE ART

Each of the arguments below should be considered from the standpoint of a person of ordinary skill in the art (“POSITA”) in the field of the ’927 Patent. For purposes of this POPR, ATL adopts the definition proposed by Petitioner. Pet., 5. ATL reserves all rights to challenge Petitioner’s definition and/or further address the level of ordinary skill in the art if this proceeding is instituted.

V. CLAIM CONSTRUCTION

Petitioner contends that “all claim terms should receive their plain and ordinary meaning in the context of the Specification, with the exception of terms that are expressly defined by equations.” Pet., 22. For the equation terms (“absolute plastic deformation rate” and “relative plastic deformation rate”), Petitioner argues “[t]hese terms should be construed as extending to the physical properties they denote, even though those properties may also be expressed by other equations.” *Id.* In this way, Petitioner’s proposed constructions of “absolute plastic deformation rate” and “relative plastic deformation rate” impermissibly read out the express claim language, which requires specific equations for these terms. *See, e.g.*, Ex. 1001 at Claim 1 (“wherein the absolute plastic deformation rate is calculated according to an equation $(L2-L0)/L0 \times 100\%$, where L0 refers to a length of the porous substrate before stretching and L2 refers to a length of the porous substrate after the porous substrate is stretched to breakage and docked along the fracture caused by the

breakage and flattened”); *see also Stylwan IP Holding, LLC v. Stress Eng’g Servs.*, 2025 U.S. App. LEXIS 12733, at *12 (Fed. Cir. May 27, 2025) (non-precedential) (“Thus, even assuming the claimed inventions could operate using other formulas, the district court did not err by limiting the claims to the identifier equations in its construction.”). Indeed, even Petitioner acknowledges that these terms “are expressly defined by equations.” Pet., 22. Construing these terms in a way that ignores their express definitions is contrary to traditional claim construction principles and should not be permitted. *See, e.g., Hoffer v. Microsoft Corp.*, 405 F.3d 1326, 1329 (Fed. Cir. 2005) (“When a whereby or wherein clause states a condition that is material to patentability, it cannot be ignored in order to change the substance of the invention.”); *see also Allergan Sales, LLC v. Sandoz, Inc.*, 935 F.3d 1370, 1380 (Fed. Cir. 2019) (Concurrence, Prost, J.) (“In sum, no part of the specification justifies reading out the express language of the ‘wherein’ clauses defining the claimed invention.”).

Regardless, the Challenged Claims are not anticipated or obvious under any reasonable construction of these terms, nor under Petitioner’s proposed construction. ATL reserves the right to address construction if this proceeding is instituted.

VI. THE BOARD SHOULD NOT INSTITUTE *INTER PARTES* REVIEW

A. Ground 1: Nishikawa Does Not Anticipate Claims 1-10

Petitioner contends that Nishikawa anticipates Claims 1-10 of the '927 Patent. Pet., 23-40. However, Nishikawa fails to teach, suggest, disclose, or otherwise render obvious at least element 1.4, which is a required element for all the Challenged Claims.

1. Nishikawa Is Directed to a Different Problem and Different Solution than the '927 Patent

As an initial matter, and as explained below in Section VI.2, Nishikawa does not disclose, expressly or inherently, element 1.4: a porous substrate having “an absolute plastic deformation rate in the first direction ranging from about 40% to about 1800%, and wherein the absolute plastic deformation rate is calculated according to an equation $(\underline{L2}-L0)/L0 \times 100\%$, where $L0$ refers to a length of the porous substrate before stretching and $\underline{L2}$ refers to a length of the porous substrate after the porous substrate is stretched to breakage and docked along the fracture caused by the breakage and flattened.” Ex. 1001, Claim 1. The fact that absolute plastic deformation rate is not disclosed in Nishikawa is not surprising when one considers that Nishikawa is directed to an entirely different problem and solution than the '927 Patent. Whereas the '927 Patent is directed to increasing battery safety by adjusting properties of a porous substrate, Nishikawa is directed to solving the problem of a gap formed between the electrode and the separator by adjusting

properties of a different part of the separator: the porous layer. Ex. 2015 ¶¶ 66-67. The gap problem is not related to battery safety but rather to battery life. *Id.* ¶ 66. Thus, the disclosures in Nishikawa are unrelated to both the problem and claimed solution in the '927 Patent.

2. Nishikawa Does Not Disclose, Expressly or Inherently, the Claimed Absolute Plastic Deformation Rate

Petitioner has failed to show that Nishikawa discloses element 1.4 at least because: (1) Nishikawa does not disclose the claimed “absolute plastic deformation rate” equation or even all values that would be needed to satisfy the claimed equation, (2) Petitioner’s calculations based on other values in Nishikawa and other equations are based on incorrect assumptions and estimates, (3) Petitioner improperly ignores different parameters that affect stress-strain behavior, and (4) Nishikawa does not inherently disclose the claimed absolute plastic deformation rate.

a. Nishikawa Does Not Disclose or Suggest “Absolute Plastic Deformation Rate” as Defined in the Claims

All claims of the '927 Patent require the porous substrate to have “an absolute plastic deformation rate in the first direction ranging from about 40% to about 1800%, and wherein the absolute plastic deformation rate is calculated according to an equation $(\underline{L2}-L0)/L0 \times 100\%$, where $L0$ refers to a length of the porous substrate before stretching and $\underline{L2}$ refers to a length of the porous substrate after the porous

substrate is stretched to breakage and docked along the fracture caused by the breakage and flattened.” Ex. 1001, Claim 1. There is no dispute that Nishikawa does not report L2, “a length of the porous substrate after the porous substrate is stretched to breakage and docked along the fracture caused by the breakage and flattened.” Ex. 2015 ¶ 70. Indeed, nothing in Nishikawa suggests docking the sample after breakage, let alone measuring the length of the docked sample. *Id.* Moreover, Petitioner’s expert admits that Nishikawa does not directly disclose absolute plastic deformation rate, $(L2-L0)/L0 \times 100\%$. *See* Ex. 1003 ¶ 97 (“[I]t [Nishikawa] does not directly provide a value for plastic deformation rates of its porous substrates.”); *id.* ¶ 120 (“Once again, Nishikawa does not provide numeric values for the percentage of elastic or plastic deformation . . .”). For this reason alone, the Petition must fail. *See, e.g., Western Digital Techs., Inc. v. Good Kaisha IP Bridge 1*, IPR2024-01449, Paper 10 at 17 (PTAB Mar. 14, 2025) (rejecting Petitioner’s argument because “Petitioner does not tie the premise of its obviousness theory regarding barrier height ***to the specific equation that the claim requires*** be used to obtain the barrier height.”).

In an attempt to justify its admitted shortcoming of an actual disclosure in Nishikawa, the Petition relies on a theory that Nishikawa discloses one way of expressing plastic deformation. Pet., 29-30. To support its theory, Petitioner first cites to *Teva* to support the proposition that “[b]y specifying how the values used in

the equation were obtained (stretching to break, docking, and measuring), the claim merely clarifies what absolute plastic deformation represents.” Pet., 26 (citing *Teva Pharmaceuticals USA Inc. v. Sandoz Inc.*, 789 F.3d 1335 (Fed. Cir. 2015)); *see also* 29-30. But *Teva* is unrelated to the claims at issue because *Teva* related to the indefiniteness of the term “molecular weight” and how “molecular weight” should be measured. *Teva*, 789 F.3d at 1344-45. Finding the claim term indefinite, which is not at issue here, the court held that neither the claim nor the specification indicate what measurements to use when evaluating “molecular weight.” *Id.* Here, the claims themselves make express what measurement to use and the specification concurs exactly. Ex. 1001 at Claim 1 (“wherein the absolute plastic deformation rate is calculated according to an equation $(L2-L0)/L0 \times 100\%$, where L0 refers to a length of the porous substrate before stretching and L2 refers to a length of the porous substrate after the porous substrate is stretched to breakage and docked along the fracture caused by the breakage and flattened”); *see also, e.g., id.* at 4:48-54; 10:26-43. Regardless, *Teva* does not stand for the proposition that an express equation in the claims can be reduced to an abstraction of what it “represents,” as argued by Petitioner. The Federal Circuit has in fact said the opposite, holding that wherein clauses that are material to patentability, like the one at issue here, “cannot be ignored in order to change the substance of the invention.” *Hoffer*, 405 F.3d at 1329.

Next, Petitioner relies on an uncertified translation³ of a prosecution history of a related Chinese case. Putting aside the different forum, law, and claims, Petitioner argues that “PO represented that it was well known in the art how to achieve the plastic deformation rates recited in the claims.” Pet., 20. But Petitioner misstates the commentary by the Applicant and mischaracterizes the then-pending claims. As such, Petitioner’s assertions are incorrect and no such admission was made. Even if any admission were made and to the extent such an admission were applicable, Applicant’s statements at EX1008, 0024 responded to a rejection of a claim that was very different from the claims at issue here. The rejected Chinese claim recited (as translated):

1. A separator, comprising: a porous substrate; and a porous layer; wherein the porous layer is disposed on a surface of the porous substrate and comprises inorganic particles and a binder; and the porous substrate has an absolute plastic deformation rate in a first direction ranging from about 40% to about 1800%.

³ Petitioner identified this exhibit (Ex. 1008) in its Exhibit List as a “Certified Translation,” but provides no affidavit attesting to the accuracy of the translation compliant with 37 C.F.R. § 42.63(b). The Board would therefore be justified in rejecting all argument regarding this exhibit.

See Ex. 1008, 0022. As part of the same response that Petitioner identified, Applicant amended Claim 1 to include: “and wherein the absolute plastic deformation rate is calculated according to an equation $(L2-L0)/L0 \times 100\%$, where $L0$ refers to a length of the porous substrate before stretching and $L2$ refers to a length of the porous substrate after the porous substrate is stretched to breakage and docked along the fracture caused by the breakage and flattened.” *Id.* Thus, in combination with the amendment and Applicant’s clarification that the specification provided details regarding the preparation process, etc., Applicant overcame the “lack of support” rejection. Ex. 1008 at 22-24, 41. No further rejections based on “lack of support” issued.

Neither the case law nor the prosecution history absolve Petitioner of the requirement to demonstrate that Nishikawa anticipates the claims by meeting all claim limitations. Petitioner does not meet its burden.

b. The Petition Relies on a Fatal Arithmetic Error and Incorrect Assumptions and Estimates

Even if the claims did not explicitly require $L2$ and $(L2-L0)/L0 \times 100\%$, and even if a POSITA could “approximate” the claimed absolute plastic deformation rate using “other equations,” as Petitioner suggests (Pet. at 22, 30), the Petition fails to disclose or approximate the claimed absolute plastic deformation rate because it

relies on a fatal arithmetic error as well as incorrect assumptions and estimates that are fatal to its arguments.

(i) Petitioner Ignores How Nishikawa Expressly Calculates “Elongation”

At the outset, Petitioner misinterprets Nishikawa. Petitioner relies on Nishikawa’s “elongation” value (Pet. 26-27), but Petitioner and its expert do so in error as they ignore Nishikawa’s actual definition of “elongation” and use a different value altogether. Petitioner’s expert, Dr. Pecht, opines that “elongation . . . reflects $L1 - L0$, as those lengths are defined in the ’927 Patent.” Ex. 1003 ¶ 96. That is, Dr. Pecht assumes that Nishikawa’s “elongation” measured the *difference* $L1 - L0$. But this is not how Nishikawa defines elongation. Instead, Nishikawa defines elongation as the *quotient* of $L1/L0$, not the difference. Ex. 1004 ¶ [0134] (“The chuck-to-chuck distance at break was divided by the initial chuck-to-chuck distance of 50 mm, and

the quotient was taken as elongation.”).⁴ That neither the Petition nor Dr. Pecht acknowledge this express definition of “elongation,” and that they argue for a different definition of elongation, is evidence that the Petition’s analysis is untethered to Nishikawa itself and is unreliable.

Worse still, and as demonstrated below, elongation is a building block to the equations used by Petitioner for its otherwise still improper assumptions and estimates. The inaccurate representation of Nishikawa’s “elongation” as a *difference* between L1 and L0 (instead of the *quotient* it expressly measures) infects the rest of Petitioner’s analysis. Ex. 2015 ¶ 74. As such, Petitioner’s analysis should be disregarded.

⁴ As Dr. Wheeler explains in his declaration, what Nishikawa may have meant to say is that elongation could be calculated as $(L1 - L0)/L0$. Ex. 2015 ¶¶ 75-80. Otherwise, if Nishikawa’s calculated elongation were truly $L1/L0$, a POSITA would expect all the elongation values in Table 1 to be larger than 100%, but they are not. *Id.* Regardless, even if Nishikawa did mean to say $(L1 - L0)/L0$, this is still different from what Dr. Pecht opines elongation is $(L1-L0)$, without being divided by $L0$. Moreover, this inconsistency in Nishikawa between how elongation is defined in Paragraph 134 versus how it is reported in Table 1 only serves as further evidence that Nishikawa itself is not a reliable reference.

(ii) Petitioner's Estimation Calculations Do Not Accurately Reproduce Absolute Plastic Deformation Rate

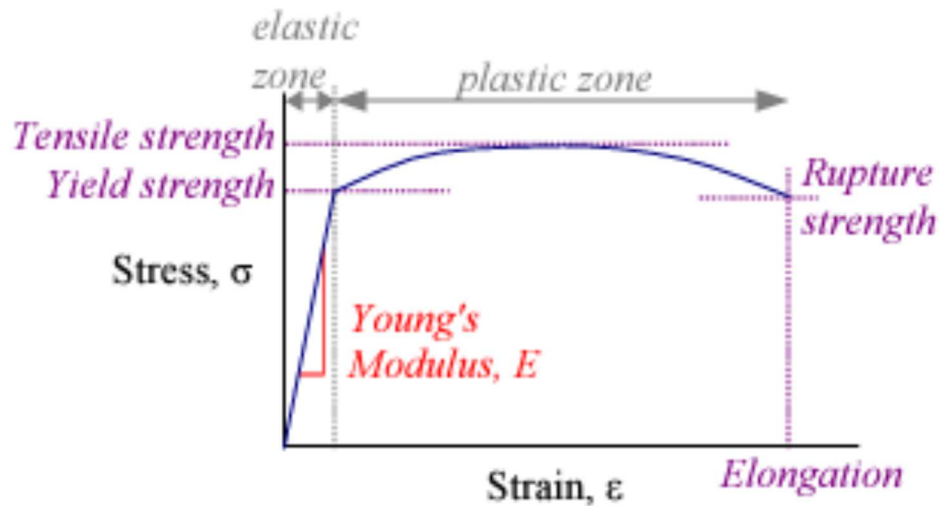
More than that, however, the Petition presents multiple flawed equations that do not accurately reflect absolute plastic deformation rate. The Petition argues that absolute plastic deformation rate is simply “plastic strain” and can be estimated in one of two ways. Pet. at 16, 25-32. The first is by using this equation:

$$\text{Plastic strain} \approx \text{elongation \%} - ((\text{tensile strength/Young's modulus}) * 100\%)^5$$

This calculation requires at least the following first assumption: (tensile strength/Young's modulus)*100% is equal to the amount of elastic strain. Ex. 2015 ¶ 83. This assumption is **critical** to Petitioner's calculation of absolute plastic deformation rate. Pet. at 32 (“Elastic strain for Example 1 MD can be approximated as follows: elastic strain = 0.222 GPa (breaking strength) / 2.4 GPa (Young's modulus) * 100% = 9.25%. EX1003, ¶107. The elongation at break is 82%. Thus, the APD is approximated as follows: APD = 82% (strain at break) - 9.25% (elastic strain) = 72.75%. *Id.*”); Ex. 2015 ¶ 83. However, this first assumption is incorrect. Ex. 2015 ¶ 83.

⁵ This is referred to herein as the “first estimation calculation.” See Ex. 2015 ¶ 82 for a more detailed explanation of how Petitioner arrived at this formula.

Petitioner arrives at this first assumption based on the below conceptual drawing.⁶



Pet. at 10.

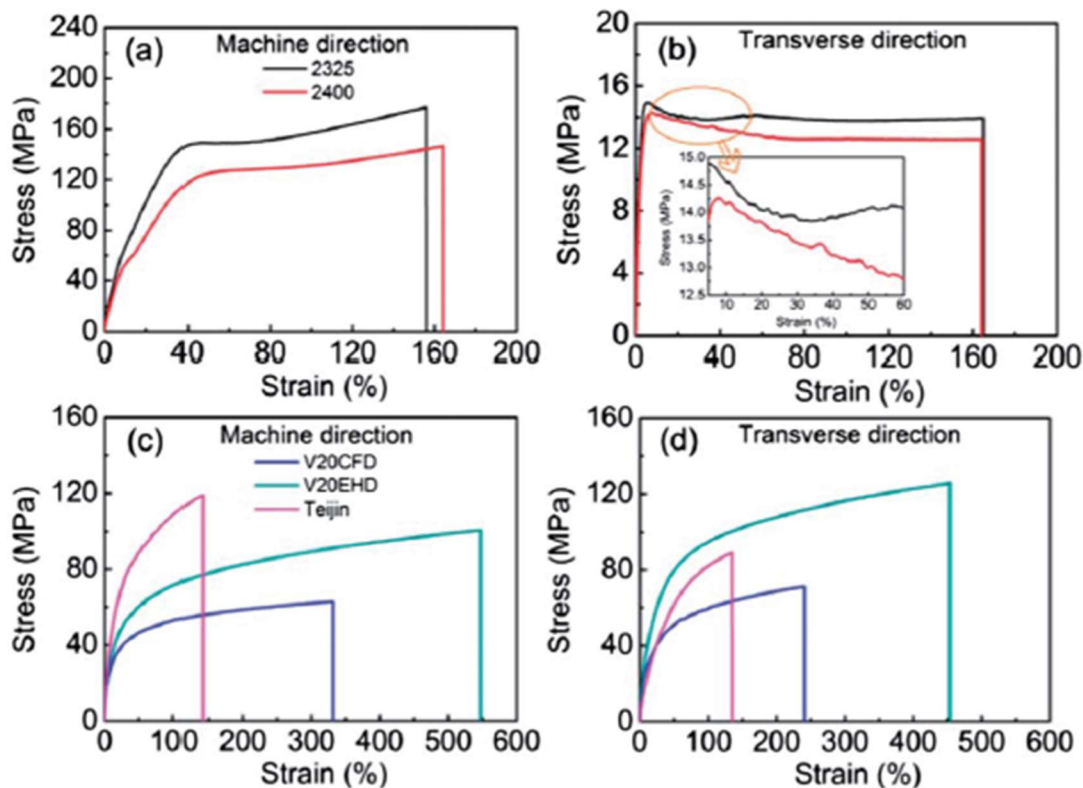
⁶ See Ex. 2015 ¶ 85. In Petitioner's conceptual drawing, the x-axis represents strain on the material and the y-axis represents stress put on the material. Ex. 2015 ¶ 86. A POSITA would have understood this conceptual drawing to show a distinct point at which the curve changes abruptly from a diagonal straight line to a curved line. *Id.* That point is called the yield strength. *Id.* In this drawing, the section before the yield strength is the elastic zone and the section after the yield strength (up until breakage at rupture strength) is the plastic zone. *Id.* The Young's modulus is the (constant) slope of the diagonal line in the elastic zone. *Id.*

But reliance on a conceptual drawing not found in the cited reference is misguided and cannot form the basis of unpatentability. As Dr. Wheeler explains in his declaration, Petitioner's drawing is an academic and idealized approximation of stress-strain behavior for a *metal* material.⁷ Ex. 2015 ¶ 85. A POSITA would have understood that porous substrates and separators, especially those using polymeric constituents, depart in multiple key ways from the idealized behavior in this simplified stress-strain plot. Ex. 2015 ¶ 87. A POSITA would have thus understood that Petitioner's conceptual stress-strain curve is not representative of real-world polymeric materials, like the ones in Nishikawa (or the other references relied on by Petitioner). Ex. 2015 ¶ 87. For example, a POSITA would have understood that for a polymer-based separator material, the stress-strain curve would not have an unambiguous straight-line elastic region with a constant slope. Ex. 2015 ¶ 88. Because of this, even if the conceptual drawing were usable, Young's modulus is not "easily calculated" because a POSITA would need to arbitrarily decide which

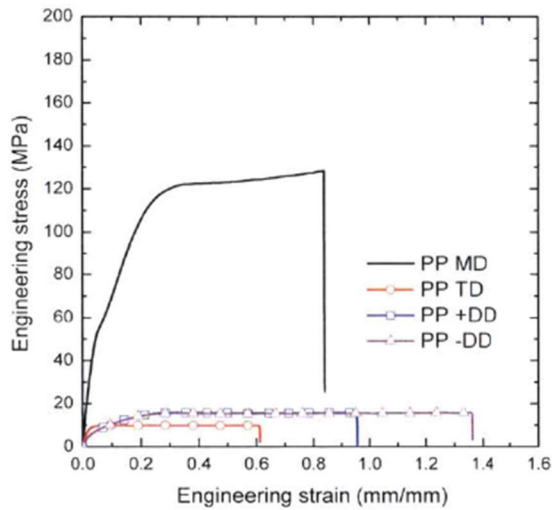
⁷ A conceptual drawing like the one provided by Petitioner is typically provided to students learning materials science to help them learn beginning principles that apply to a few common metal alloys. Ex. 2015 ¶ 85. However, students must later learn that most real materials depart from this idealized behavior. *See id.*

values to use to estimate a Young's modulus along the full stress-strain curve. *Id.* (quoting Ex. 1003 ¶ 57).

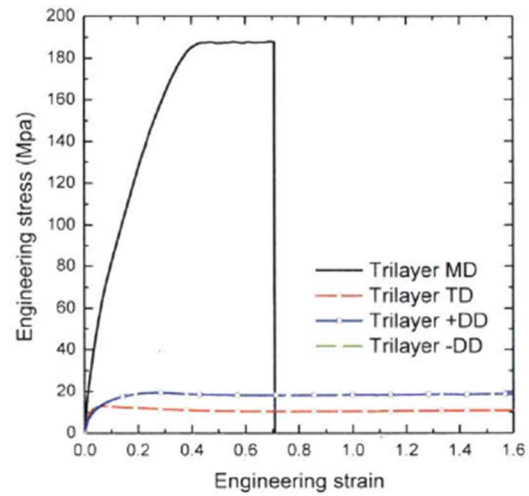
Moreover, Petitioner's own references corroborate Dr. Wheeler's opinion and show that the idealized or conceptual stress-strain plot relied on by Petitioner does not reflect the real-world behavior of polymers, and that in fact, polymers have much more complex stress-strain behavior. Ex. 2015 ¶ 89. The stress-strain plots from Chen and the Zhang Thesis, reproduced below, are clear examples of polymeric stress strain curves.



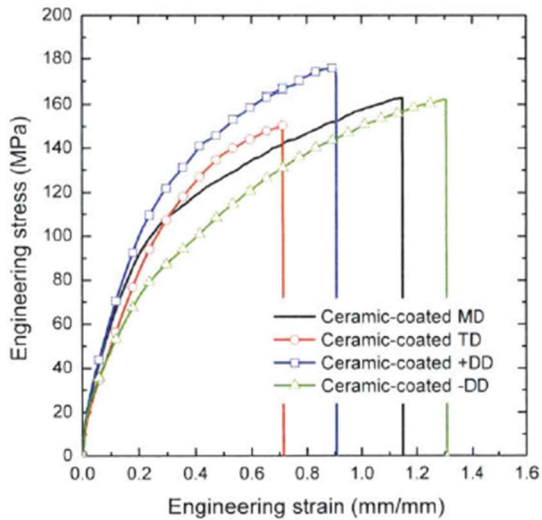
Ex. 1005 at Fig. 3



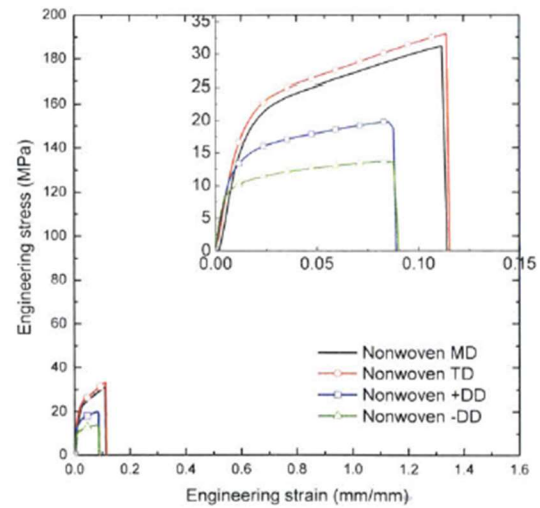
(b)



(c)



(d)



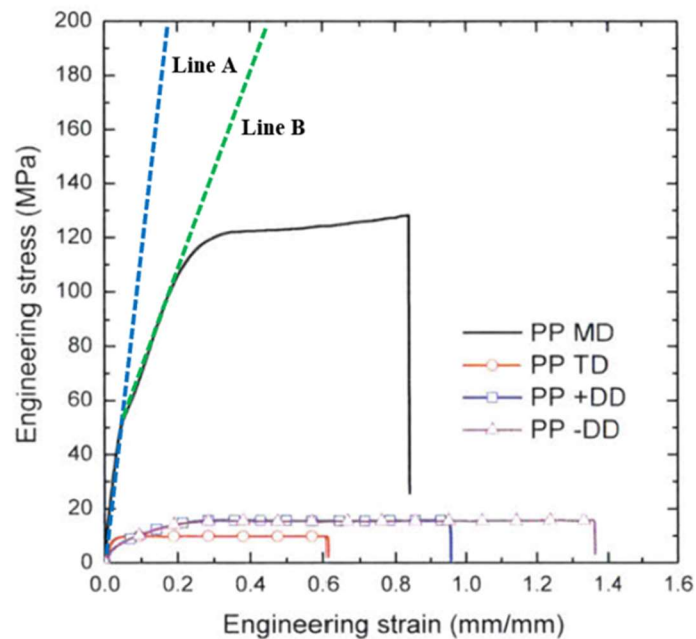
(e)

Ex. 1007 at 68, Fig. 3-1; *see also id.* at 95, Fig. 4-12

As evident in these examples, there is not a clear point where elastic strain ends and plastic strain begins for polymeric materials. Ex. 2015 ¶ 90. Rather, these plots confirm that there is elastic strain interwoven with the plastic strain in a complicated

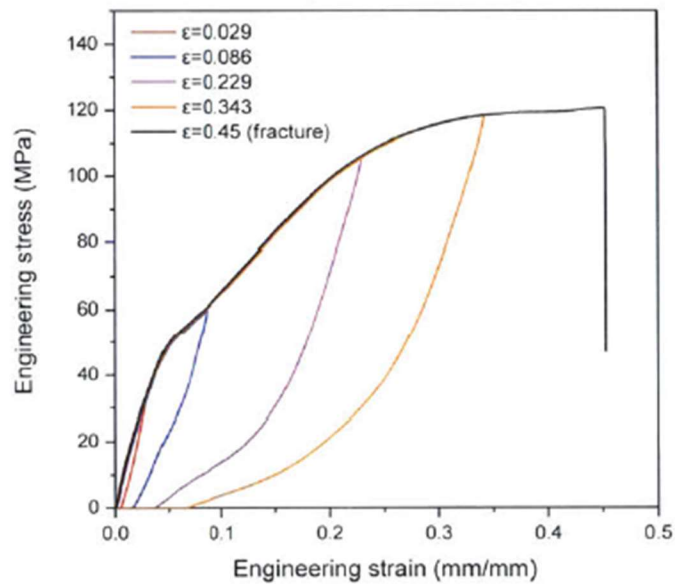
way and show that there is significant elastic strain even after the yield point. *Id.* ¶¶ 90, 94. A POSITA would not and cannot assume that there is a yield strength at which everything before that point is elastic strain and everything after that point is plastic strain. *Id.* ¶ 91. As such, Petitioner's reliance on the conceptual drawing for a *metal* stress-strain curve is inappropriate.

Even if a POSITA could pick two points based on the stress-strain plot and take the slope of the line between those points to arrive at Young's modulus, the resulting Young's modulus value would vary significantly depending on the points chosen. *Id.* ¶ 93. This pitfall can be seen below, which shows that it is not clear in a polymeric material which "diagonal" line (A or B) represents elastic strain. *Id.* Depending on the points one chooses to anchor the line, the calculated slope (and therefore, Petitioner's calculated (estimated) Young's modulus) will be very different. *Id.* ¶¶ 93-94.



Annotated Ex. 1007 Fig. 3-1(b) taken from Ex. 2015 ¶ 93

Yet another problem with Petitioner's first estimation calculation is that it assumes that the Young's modulus is constant across all possible stress values. Ex. 2015 ¶ 95. This is also an incorrect assumption. One of Petitioner's own cited references, the Zhang Thesis, shows that Young's modulus does not remain constant across all stress values. *Id.* ¶ 96.



Zhang Thesis at 95 (Fig. 4-12)

Dr. Wheeler explains the above diagram in his declaration:

A POSITA would understand that the first four curves in this plot are obtained by partially elongating a specimen but not to the point of fracture and then stopping the elongation and instead allowing the specimen to relax back to zero stress. A POSITA would further understand that the downward stress-strain path (colored curve) followed during this relaxation is largely elastic. However in the plot we see that the colored relaxation curves are far from straight diagonal lines (constant slope), thus showing that Young's modulus is varying strongly along that path and violating a central assumption of Dr. Pecht's first estimation formula.

Ex. 2015 ¶ 96. In other words, the fact that each of these colored lines in this figure in Zhang has a different curve, a POSITA would note that Young's modulus is not the same at all stress values. *Id.*

Figure 4-12 from the Zhang Thesis also confirms that there is significant elastic strain after the yield point, such that Petitioner's assumption that all strain after the yield point is plastic strain is plainly incorrect. As Dr. Wheeler explains in his declaration, this figure shows the separator being tested at various engineering strains (e.g. 8.6% (0.086, blue), 22.9% (0.229, purple), and 34.3% (0.343, yellow)). Ex. 2015 ¶ 97. At each of these strains, a POSITA could see that there is very different amount of elastic strain. *Id.*⁸ Moreover, these values show that there is a significant amount of elastic deformation after the yield point. *Id.* Thus, the yield point cannot be used as a boundary point between elastic and plastic deformation, as Petitioner wrongly assumes. *Id.*

One other major problem with Petitioner's first estimation calculation is that it uses tensile strength in its formula where it should use rupture (or breakage) strength. *Id.* at ¶¶ 98-99 (citing Ex. 1003 ¶¶ 106-108). This is because the claimed formula requires that the "absolute plastic deformation rate is calculated according to an equation $(L2-L0)/L0 \times 100\%$, where L0 refers to a length of the porous

⁸ For more detailed calculations, see Ex. 2015 ¶ 97.

substrate before stretching and L2 refers to a length of the porous substrate after the porous substrate is stretched to **breakage** and docked along the fracture caused by the breakage and flattened.” *Id.* (quoting Ex. 1001 at Claim 1). Indeed, even Petitioner’s expert first uses “stress at breakage” when developing the first estimation calculation (Ex. 1003 ¶ 61) and only later starts using tensile strength instead when it comes to Nishikawa (Ex. 1003 ¶¶ 106-08). As shown even if the conceptual drawing provided by Petitioner and in the cited references provided by Petitioner, tensile strength and rupture strength are not always the same. Ex. 2015 ¶ 98. Thus, the fact that Petitioner uses tensile strength instead of rupture (or breakage) strength in the first estimation calculation is just another reason why Petitioner’s calculations fail. *Id.* ¶ 99.

Still another reason why Petitioner’s first estimation calculation is unreliable is that Nishikawa does not even provide stress-strain curves for its embodiments. *Id.* ¶ 100. Without such a curve, a POSITA would be unable to draw conclusions about how Nishikawa’s materials behave plastically or elastically. *Id.* This uncertainty is one reason that Petitioner is forced to make unreliable and unsupported assumptions and estimates about Nishikawa’s behavior, because the actual stress-strain behavior of Nishikawa’s materials over the entire curve is unknown. The result is that a POSITA cannot be certain the reported values for tensile strength and Young’s modulus in Nishikawa’s Table 1 are reliable, comparable, or appropriate for use in

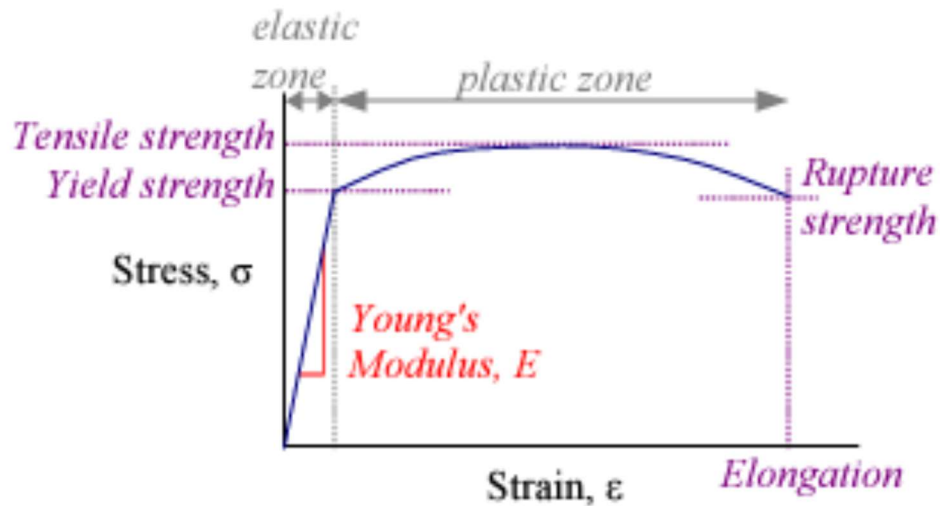
Petitioner's unique calculation that is not taught in Nishikawa or any other cited prior art. *Id.*

The second way Petitioner suggests estimating plastic strain is by using the "0.2% offset method."⁹ Petitioner's expert characterizes this method as follows: "If the yield strength is equal to the tensile strength (and the separator deforms plastically at a stress equal to the tensile strength until breakage), the 0.2% offset line will intersect the stress st[r]ain curve at a strain 0.2% greater than the elastic strain." Ex. 1003 ¶ 109. This second estimation calculation fails for many of the same reasons as the first calculation. Ex. 2015 ¶ 102.

First, the second estimation calculation relies on the stress-strain curve of the polymeric material following the perfect theoretical form, which as illustrated above, porous substrates and polymers do not. *Id.* ¶ 103. Second, by Dr. Pecht's own admissions, this method adds additional unsupported assumptions to the analysis. *Id.* ¶ 104 (citing Ex. 1003 ¶ 109). Dr. Pecht assumes that (1) the yield strength is equal to the tensile strength, and (2) the separator deforms plastically at a stress equal to the tensile strength until breakage. Ex. 1003 ¶ 109. If these assumptions were true, then a POSITA would expect to see a straight line across the top of the stress-strain plot, rather than a curve. Ex. 2015 ¶ 104. This type of behavior is not borne out in

⁹ The 0.2% offset method is referenced herein as the "second estimation calculation."

any of the stress-strain plots Petitioner provides, let alone the conceptual drawing of what would be expected in a perfect world for a metal material. *Id.*



Petitioner provides no reason why these assumptions for the second estimation calculation are likely to be true for the polymeric materials in Nishikawa. Moreover, Petitioner's expert makes incorrect statements based on inapplicable textbooks when relying on the 0.2% offset method. Ex. 2015 ¶¶ 105-06. Dr. Pecht cites Ex. 1018 and Ex. 1021, which are both "mechanics of materials" textbooks and which recommend on pages 61 and 87 to use the 0.2% offset method for *estimating the yield strength of aluminum* due to its ductility, with no mention of its appropriateness for polymers. Ex. 2015 ¶ 106. One of these textbooks, Ex. 1021 at p. 88, even warns a POSITA that polymers (such as natural rubber) *must be treated differently* because they exhibit nonlinear elastic behavior. *Id.* This would be the case for Nishikawa's polymers. *Id.* Dr. Pecht also cites Ex. 1019 at p. 8, which in turn

refers to Ex. 1015 as its source and cites using a “2% offset yield” to estimate tensile strength for polymeric separators. *Id.* Not only is this method not well-explained in either Ex. 1019 p. 8 or the primary source Ex. 1015 p. 4428, but it is also critical that this 2% offset is not the same as Dr. Pecht’s 0.2% offset value. *Id.* Moreover, the 2% method is posed as a method to estimate tensile strength, not yield strength as done by Dr. Pecht. *Id.* Thus, Petitioner cites no teaching that the 0.2% offset method is appropriate for analyzing polymeric materials such as separators, and indeed it would not be because these materials behave so differently from metals like aluminum. *Id.* To the contrary, the literature discloses that “[f]or materials having a nonlinear elastic region (Figure 6.6.) ***use of the strain offset method is not possible.***” Ex. 2030, p. 181; Ex. 2015 ¶ 92.

For these reasons, neither the first estimation method (Plastic strain $\approx$ elongation % $((\text{tensile strength}/\text{Young's modulus}) * 100\%)$) nor the second estimation method (0.2% offset method) accurately reflect the absolute plastic deformation rate of the Nishikawa polymeric materials. Because these calculations are unreliable and unsupported, the Petition fails to disclose the claimed range for absolute plastic deformation rate. *See, e.g., Solus Advanced Materials Co., Ltd. v. SK Nexilis Co., Ltd.*, IPR2024-01460, Paper 14 at 24 (PTAB Apr. 22, 2025) (“Petitioner’s reliance on multiple insufficiently supported assumptions and conclusions is not sufficient to demonstrate a reasonable likelihood that Shinozaki’s

Rpc values are within the claimed range when measured using the reference length and peak-valley counting method specified in the claims.”).

(iii) Petitioner’s Conclusory Statements and Analogies Fail

Petitioner acknowledges that its calculations are estimates, but argues that “the values disclosed in the prior art are so comfortably within the claimed range, a POSA would know that any differences in the method of measurement can be disregarded.” Ex. 1003 ¶ 103; *see also* Pet., 26. This is baseless and conclusory speculation unsupported by any data, such as a standard deviation or another way to adjust for error or the differences between the calculated values. Ex. 2015 ¶ 107. Such sweeping statements without any support do not constitute proof of disclosure by a preponderance of the evidence. 37 C.F.R. § 42.65(a) (“Expert testimony that does not disclose the underlying facts or data on which the opinion is based is entitled to little or no weight.”).

Moreover, Petitioner’s analogies of density and a mercury thermometer are misplaced. Ex. 2015 ¶¶ 108-11. Petitioner first argues that a reference disclosing absolute plastic deformation rate based on Petitioner’s estimation methods is the same as a reference disclosing density by virtue of disclosing mass and volume. This is not the case because unlike the formula for density, Petitioner’s estimations do not accurately reflect the underlying values that would be necessary to calculate absolute

plastic deformation rate. Ex. 2015 ¶ 11. Put differently, Petitioner’s arguments are like using the wrong volume (elongation) and the wrong mass (elastic strain) to arrive at the wrong density (absolute plastic deformation rate). *Id.*

Petitioner next argues that the difference between Nishikawa and the ’927 Patent is akin to the difference between a mercury thermometer and an alcohol thermometer. While Petitioner acknowledges that one is more accurate than the other, it argues that the difference is not enough “to risk bringing the measured value . . . outside the claimed range.” Pet. at 28. This analogy is misplaced because the Petition does not just rely on a different measurement technique for absolute plastic deformation, it relies on unsupported assumptions and incorrect input values that lead to a different calculation entirely. *See, e.g.*, Pet. at 16, 25-32; Ex. 2015 ¶ 109. Moreover, Petitioner provides no reported data showing how far off one calculation is from the other. Ex. 2015 ¶ 110. Thus, it cannot support its baseless argument that its estimations are not far off enough to fall outside the claimed range.

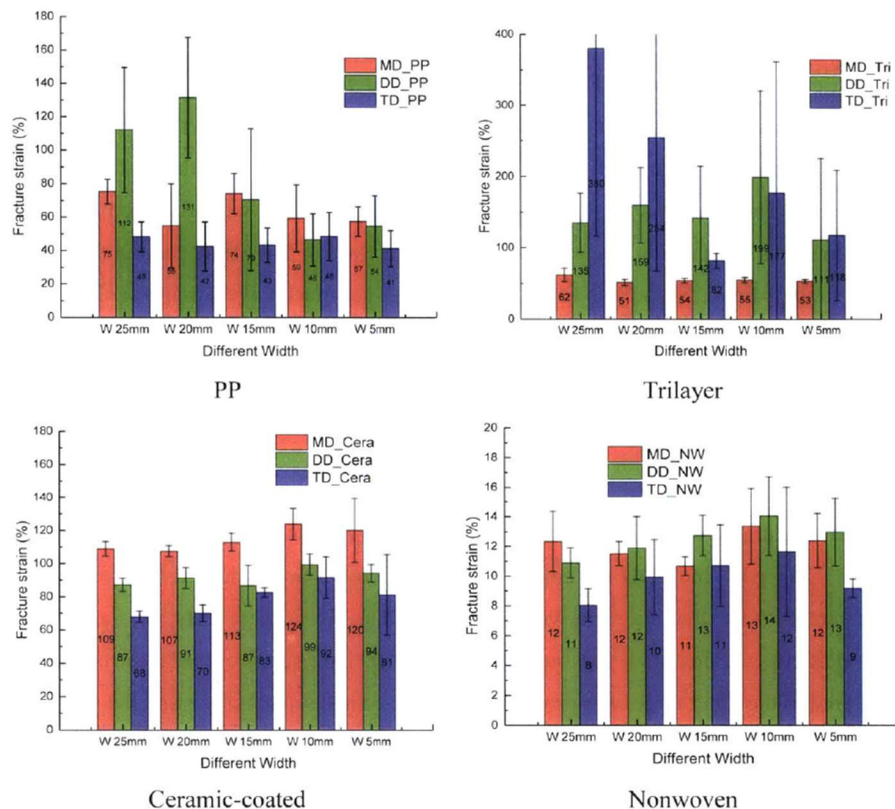
At bottom, because Petitioner relies on incorrect calculations and unsupported assumptions to arrive at its calculated plastic strain values in Nishikawa, these values do not reflect the claimed absolute plastic deformation rate.

c. Petitioner Ignores Parameters that Affect Stress-Strain Behavior

Petitioner's calculations ((1) Plastic strain $\approx$ elongation % – ((tensile strength/Young's modulus)*100%) and (2) the 0.2% offset method) fail for the additional reason that they rely extensively on stress-strain behavior without ever accounting for variables that would impact this behavior. Ex. 2015 ¶ 112. For example, a POSITA would have known that the rate at which one stretches a polymeric sample impacts the deformation properties of that material and thus its stress-strain behavior. *Id.* ¶ 113. If a POSITA were to stretch a polymer slowly, the polymer would yield and it can stretch a long distance. *Id.* If a POSITA were to stretch a polymer quickly, it will snap sooner. *Id.* Despite the impact of rate on a polymer's stress-strain behavior, the Petition fails to acknowledge that the rate at which the sample is stretched in Nishikawa is 100 mm/min, as opposed to the 50 mm/min rate of stretching in the '927 Patent. *Id.* ¶ 117.

Moreover, a POSITA would have recognized that chuck-to-chuck distance and sample size may have an impact on the deformation properties of a polymeric material and thus its stress-strain behavior, when it is stretched all the way to breakage. *Id.* ¶ 114. For example, the longer a sample is (or the longer the chuck-to-chuck distance is), the more likely there will be an imperfection somewhere in the length of the sample that will give way to breakage sooner. *Id.* ¶ 115. The same is

true for the width of the sample. *Id.* ¶ 116. This is even confirmed by Petitioner's own cited reference, the Zhang Thesis. In Figure 3-2 of the Zhang Thesis (below), samples with different widths are shown as having different deformation properties. *Id.* ¶ 116.



Ex. 1007 at Fig. 3-2

But again, despite the effects of these variables on the stress-strain behavior of a polymer that is stretched to breakage, Petitioner does not even attempt to explain the differences in sample size and geometry between Nishikawa and the '927 Patent. Ex. 2015 ¶¶ 118-119. In Nishikawa, the initial distance at which the sample was

tested is 50 mm, whereas it was 40 mm in the '927 Patent. Ex. 1004 at [0133]-[0135]; Ex. 1001 at 10:26-28. And in Nishikawa, the sample dimensions were 100 mm by 10 mm, as opposed to 100 mm by 20 mm in the '927 Patent. Ex. 1004 at [0133]-[0135]; Ex. 1001 at 10:26-28.

For this additional reason, Petitioner's arguments that Nishikawa discloses the claimed absolute plastic deformation rate fail.

d. Nishikawa Does Not Inherently Disclose the Claimed Absolute Plastic Deformation Rate

Petitioner relies on the same arguments addressed above as grounds for inherency, and those arguments are incorrect for the reasons addressed above. Ex. 2015 ¶ 120.

Moreover, Petitioner and its expert argue that, if its other arguments fails, the thermoplastic resin materials in Nishikawa that “necessarily exhibit a large degree of plastic deformation” therefore “necessarily” disclose the precisely claimed range of absolute plastic deformation rates. Ex. 1003 ¶ 112; Pet. at 32-33. This relies on yet another false assumption—that all thermoplastic resins have absolute plastic deformation rates within the specifically claimed range simply because several (but not all) thermoplastic resins have high amounts of plastic strain. Petitioner does not satisfy the stringent requirements of inherency. An inherent limitation must be “necessarily present” in the prior art, and “may not be established by probabilities

or possibilities.” *Allergan, Inc. v. Apotex Inc.*, 754 F.3d 952, 960 (Fed. Cir. 2014); *PAR Pharm., Inc. v. TWI Pharm., Inc.*, 773 F.3d 1186, 1195 (Fed. Cir. 2012) (internal quotation omitted); *Cont’l Can Co. USA, Inc. v. Monsanto Co.*, 948 F.2d 1264, 1269 (Fed. Cir. 1991). It is not enough that the allegedly inherent result would occur often, usually, or typically—the allegedly inherent result “must ***inevitably*** result from the disclosed steps.” *In re Montgomery*, 677 F.3d 1375, 1380 (Fed. Cir. 2012).

Indeed, as Dr. Wheeler explains in his declaration, “[n]ot all thermoplastic resins are created equal.” Ex. 2015 ¶ 122. A POSITA cannot simply assume that a material will fall within the claimed absolute plastic deformation rate range simply ***because*** it is a thermoplastic resin. Indeed, even if a POSITA were to use Dr. Pecht’s and Petitioner’s flawed estimations to arrive at plastic strain, there are many examples of thermoplastic resins that fall outside the claimed range. Ex. 2015 ¶ 123. As shown in the Kalnaus reference cited by Dr. Wheeler, (Ex. 2028), there are examples of common thermoplastic materials that have total strain or deformation less than 40% (even using Dr. Pecht’s flawed estimation methods). Thus, a POSITA would not assume that, just because Nishikawa discloses thermoplastic resins, that it necessarily discloses the claimed range of absolute plastic deformation rate. Ex. 2015 ¶ 124.

3. Claims 2-10 Are Not Unpatentable

Claims 2-10 are not unpatentable for the same reasons as discussed above with respect to independent claim 1. Patent Owner reserves the right to address Claims 2-10 individually if this proceeding is instituted.

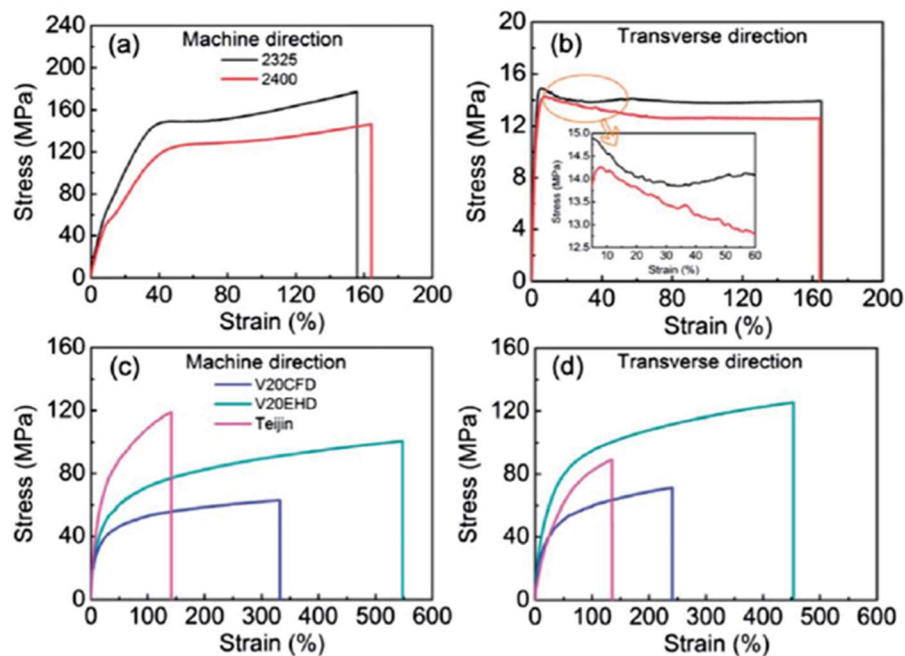
B. Ground 2(A): Nishikawa Does Not Render Obvious Claims 1-10

Petitioner contends that Nishikawa in view of a POSITA's knowledge renders obvious Claims 1-10 of the '927 Patent. Pet., 40-44. In addition to the applicable arguments above for Ground 1, Nishikawa in view of a POSITA's knowledge fails to teach, suggest, disclose, or otherwise render obvious at least element 1.4, which is a required element for all the Challenged Claims.

1. The Challenged Claims Are Not Obvious Over Nishikawa

Petitioner makes three primary arguments in support of its Nishikawa obviousness ground: (1) Nishikawa's substrates "necessarily" have absolute plastic deformation rates within the claimed range, (2) the '927 Patent found no significant difference in absolute plastic deformation rates between separators with and without porous layers, and (3) Nishikawa describes the materials, molecular weight, and preparation process for its porous substrate and a POSITA could simply manipulate the stretching ratio of such materials to arrive at the claimed range. Petition at 43-44. All three are either incorrect or irrelevant.

First, Nishikawa’s substrates do not necessarily have absolute plastic deformation rates within the claimed ranges. As described above with regard to Ground 1(A) and incorporated here by reference, this argument lacks any support and is disproven by the fact that there are a multitude of examples of thermoplastic resins that do not fall within the claimed range, even using Petitioner’s flawed estimations. Ex. 2015 ¶ 128. Moreover, a POSITA would have understood from Petitioner’s own cited references that the deformation properties of porous substrates can vary widely. *Id.* ¶ 129. The below stress-strain plots from Chen, for example, show the wide ranges of properties.



What’s more, Petitioner’s own expert’s calculations show the vast differences in plastic strain between polymeric materials. Ex. 2015 ¶ 130. For Ground 2B, Dr.

Pecht opines that the Teijin separator in Chen “is the same PE substrate disclosed in Nishikawa, made by the same company as the applicant and assignee of the Nishikawa patent.” Ex. 1003 ¶ 160. Despite this unsupported opinion that the Nishikawa and Chen substrates are the same material, Dr. Pecht’s calculations for the plastic strain of these two separators vary widely. Ex. 2015 ¶ 130. Dr. Pecht opines that the Nishikawa substrate has a plastic strain of 72.55-72.75% in the MD direction (Ex. 1003 ¶ 110), whereas the Chen separator is 137.2-141.57% in the MD direction (*id.* ¶ 155). This difference between the allegedly same material underscores the complexity of even using Dr. Pecht’s method to calculate plastic strain. Ex. 2015 ¶ 130. And the large difference in Dr. Pecht’s calculations confirms both that (1) plastic deformation properties are not necessarily the same across porous substrates—or even the same porous substrate; and (2) Dr. Pecht’s stress/strain plot-dependent calculations are not reliable. *Id.* ¶¶ 131-32.

Second, that the ’927 Patent found no significant difference in absolute plastic deformation rates between separators with and without porous layers does not speak to whether the claimed absolute plastic deformation rate range is obvious. *Id.* ¶ 133. According to the ’927 Patent, the fact that there is no significant difference in absolute plastic deformation rates with and without a porous layers means that it is the porous substrate, rather than the porous layer, that matters for absolute plastic deformation rate. Ex. 1001 at 22:65-23:5. This conclusion says nothing about

whether it would be obvious to make a porous substrate with the claimed absolute plastic deformation rate. Ex. 2015 ¶ 133.

Third, that a POSITA *could* arrive at an absolute plastic deformation rate within the claimed range by manipulating stretching ratio does not render the claimed range obvious. Ex. 2015 ¶ 134. In making this argument, the Petition cites to statements allegedly made by the Patent Owner during prosecution of a related Chinese application. Pet. 17-22; 41-44. First, these statements were made in the context of the Chinese application’s specification, which provided a POSITA with more information regarding how to achieve absolute plastic deformation rate than the prior art Nishikawa did. Those statements did not suggest, as Petitioner implies, that a POSITA would know how to arrive at the desired absolute plastic deformation rate *without* having the benefit of the Chinese application’s specification. Second, as explained above in Section VI.2.a, the claims that stood rejected were distinct from those and issue here and were amended. Petitioner must do more than demonstrate that a POSITA *could* arrive at an absolute plastic deformation rate within the claimed range (using the Chinese application’s specification)—it must show that a POSITA *would* be motivated to do so (using Nishikawa). *See, e.g., Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1073 (Fed. Cir. 2015) (“[O]bviousness concerns whether a skilled artisan not only *could have made* but *would have been*

motivated to make the combinations or modifications of prior art to arrive at the claimed invention.”) (emphasis in original).

Here, Petitioner has not cited (and cannot cite) any motivation to modify the Nishikawa materials to arrive at the claimed range. Nishikawa is directed to both a different problem and a different solution than the '927 Patent. Ex. 2015 ¶ 135. In particular, Nishikawa is directed to increasing battery life by achieving certain properties of the *porous layer*, thereby preventing a gap from being formed between the separator and electrode. *Id.* Thus, a POSITA looking to Nishikawa would be focused on adjusting the properties of the porous layer, not the porous substrate. And as explained in the '927 Patent, it is the *porous substrate* that affects absolute plastic deformation rate. *Id.* A POSITA therefore would not have been motivated to adjust the porous substrate materials in Nishikawa to arrive at the claimed absolute plastic deformation rate. Nor does Petitioner give any explanation as to why a POSITA would have had a reasonable expectation of success in doing so.

For at least these reasons (in addition to the reasons identified in Ground 1), Nishikawa in view of a POSITA's knowledge does not render any of the Challenged Claims obvious.

2. Claims 2-10 Are Not Unpatentable

Claims 2-10 are not unpatentable for the same reasons as discussed above with respect to independent claim 1. Patent Owner reserves the right to address Claims 2-10 individually if this proceeding is instituted.

C. Ground 2(B): Nishikawa and Chen Do Not Render Obvious Claims 1-10

Petitioner contends that the combination of Nishikawa and Chen renders obvious Claims 1-10 of the '927 Patent. Pet., 44-56. In addition to the failures identified with respect to Grounds 1 and 2(A), Nishikawa and Chen fail to teach, suggest, disclose, or otherwise render obvious at least element 1.4, which is a required element for all the Challenged Claims.

1. Chen Does Not Disclose or Suggest the Claimed “Absolute Plastic Deformation Rate”

In this ground, Petitioner relies on the Teijin separator in Chen to disclose the claimed absolute plastic deformation rate. The Teijin separator and Chen's disclosures fail for many of the same reasons as Nishikawa in Grounds 1 and 2(a).

a. Chen Does Not Disclose or Suggest “Absolute Plastic Deformation Rate” as Defined in the Claims

All claims of the '927 Patent require that “absolute plastic deformation rate is calculated according to an equation $(\underline{L2}-L0)/L0 \times 100\%$, where $L0$ refers to a length of the porous substrate before stretching and $\underline{L2}$ refers to a length of the porous substrate after the porous substrate is stretched to breakage and docked along the

fracture caused by the breakage and flattened.” *See, e.g.*, Ex. 1001 at Claim 1. There is no dispute that Chen,¹⁰ like Nishikawa, does *not* disclose L2 or (L2-L0)/L0*100%. Ex. 2015 ¶ 148. Because the claims require this specific equation to arrive at the claimed absolute plastic deformation rate, and because Chen does not disclose it, this ground fails for that reason alone. *See, e.g., Western Digital Techs., Inc.*, IPR2024-01449, Paper 10 at 17 (rejecting Petitioner’s argument because “Petitioner does not tie the premise of its obviousness theory regarding barrier height *to the specific equation that the claim requires* be used to obtain the barrier height.”).

b. The Petition Relies on Incorrect Assumptions and Estimates

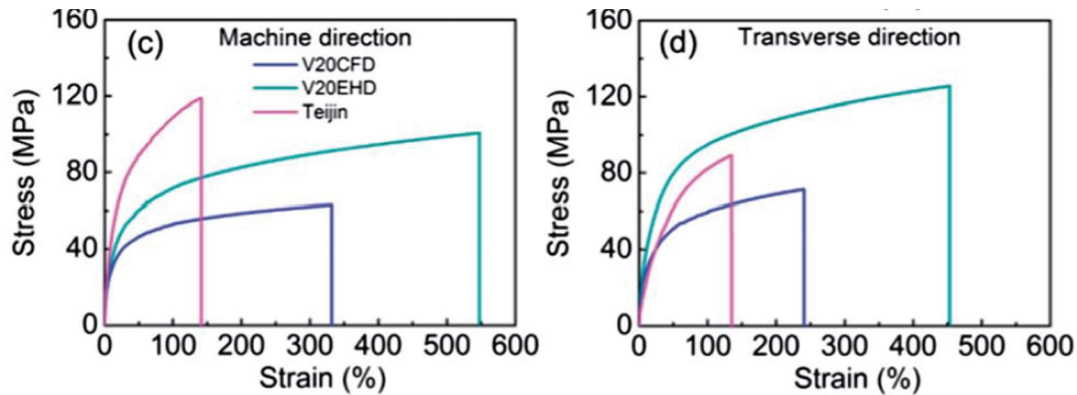
Given that there is no direct disclosure of the claimed equation, the Petition relies on the same estimations that it argues serve as a proxy for the equation in the claims in Grounds 1(a) and 1(b). Pet. 44-51; Ex. 2015 ¶ 149. Even if these estimations could theoretically meet the claims, they would still fail because they are based on the same incorrect and unreliable assumptions discussed above in Section VI.A.2. Ex. 2015 ¶ 150.

¹⁰ A summary of Chen’s disclosures can be found at Ex. 2015 ¶¶38-46.

For this ground, the Petition again cites two different estimation methods ((1) (plastic strain = total strain – elastic strain)¹¹ and (2) the 0.2% offset method), both of which are inaccurate tests for absolute plastic deformation rate. Pet. at 44-51; Ex. 2015 ¶ 151. Petitioner’s **first estimation method** relies on the assumption that the “strain that non-linearity occurred (%) in Chen can be subtracted from “strain at break” to arrive at the plastic strain.” Ex. 2015 ¶ 152. This is unreliable for the same reasons discussed above in Section VI.A.2.b.ii, and those reasons are incorporated here by reference. Ex. 2015 ¶ 152.

For example, the accuracy of this method depends on choosing the correct point where non-linearity occurred. Ex. 2015 ¶ 153. But as shown by the figures in Chen, this point is not clear because the curve of the stress-strain plots is gradual.

¹¹ This is the generic formula that serves as a starting point for both grounds. The difference between the Nishikawa ground and the Chen ground is that for Nishikawa, Petitioner estimates total strain as elongation and elastic strain as tensile strength/Young’s modulus. Pet., 32; *see also* Ex. 2015 ¶ 82. Whereas for the Chen ground, Petitioner estimates total strain as strain at break and elastic strain as “strain that non-linearity occurred.” Pet., 47; *see also* Ex. 2015 ¶ 152.



As another example, the accuracy of this method depends on Petitioner's assumption that there is no elastic strain after the subjective point of non-linearity. Ex. 2015 ¶ 154. This is also not the case for Chen's polymeric materials (as previously discussed with respect to the polymeric materials in the Zhang Thesis). The polymeric materials in Chen do not behave the same way as the conceptual drawing Petitioner cites (which is for metals, not polymers, and is oversimplified). In the stress-strain plots in Chen, there appears to be some linearity (though at a different slope) after the first point of non-linearity. Because of this, it is not clear that everything after the first point of non-linearity is necessarily plastic deformation, rather than (at least some) elastic deformation. Chen further does not provide any relaxation curves, and a POSITA would be unable to determinate how much of the elongation of Chen's materials is plastic and how much is elastic. As a result, Petitioner's assumption that no elastic strain occurs after the alleged yield point in Chen is unsupported. Ex. 2015 ¶ 152.

Petitioner's **second estimation method** is the "0.2% offset" method, which is discussed above with regard to Ground 1(A). Once again, this method is imprecise and inaccurate for the reasons discussed in Section VI.A.2.B.ii. Those reasons are incorporated by reference for this ground. By way of example, this calculation relies not only on choosing the correct slope of the line, but it also adds in additional assumptions that (1) the yield strength is equal to the tensile strength, and (2) the separator deforms plastically at a stress equal to the tensile strength until breakage. Ex. 2015 ¶ 155. These assumptions are not borne out in the stress-strain plots of Chen. If they were, a POSITA would expect to see a plot with a flat horizontal line parallel to the x-axis. *Id.*

Finally, like with Nishikawa in Grounds 1 and 2(a), the Petition does not provide any margin of error for these estimations or any reason why a POSITA would expect them to be accurate enough to allow for variations and still fall within the claimed range, essentially arguing that the inaccurate estimates are "close enough" without any scientific basis. Ex. 2015 ¶ 156. Thus, the Petition has failed to show that these estimations meet the claimed absolute plastic deformation rate, or that the differences between what Dr. Pecht calculates and the claimed absolute plastic deformation rate could be meaningfully determined and compared to the claimed absolute plastic deformation rate.

c. The Petition Improperly Ignores Parameters that Affect Stress-Strain Behavior

Like with Nishikawa in Grounds 1 and 2(a), the Petition does not acknowledge or account for the variables that affect the deformation properties of Chen's separators. Ex. 2015 ¶ 157. This is fatal to Petitioner's arguments because the Petition's estimations rely on the incorrect assumption that the polymeric materials in Chen behave consistently with the ideal conceptual drawing for metals, including that they have a single point of non-linearity and a reliable Young's modulus.

As explained above in Section VI.A.2.c, the variables of stretching rate, initial chuck-to-chuck distance, and sample dimensions all impact the deformation properties of a separator and thus the stress-strain behavior of a polymer. Ex. 2015 ¶ 158. The Petition ignores the differences in these variables between Chen and the '927 Patent. The stretching rate in Chen is 6 mm/min, whereas the stretching rate in the '927 Patent is 50 mm/min. *Compare* Ex. 1005 at 14906 *with* Ex. 1001 at 10:31-33. The initial chuck-to-chuck distance in Chen is 30 mm, as compared to 40 mm in the '927 Patent. *Compare* Ex. 1005 at 14906 *with* Ex. 1001 at 10:28-31. And the sample dimensions in Chen are 50 mm by 10 mm, whereas they are 100 mm by 20 mm in the '927 Patent. *Compare* Ex. 1005 at 14906 *with* Ex. 1001 at 10:26-28. Each of these differences alone or in combination may impact the deformation properties

of the separator when stretched to breakage. Ex. 2015 ¶¶ 158-60. That Petitioner ignores these differences in its analysis is further evidence that the Petition's estimations are unreliable. *Id.* ¶ 161.

**d. Chen Does Not Inherently Disclose the Claimed
“Absolute Plastic Deformation Rate”**

The Petition does not make the same inherency arguments for Chen as it does for Nishikawa. *Compare* Pet. at 23-40 *with id.* at 40-56; Ex. 2015 ¶ 162. Nonetheless, even if it did, those arguments fail for the same reasons set forth above for Nishikawa in Section VI.A.2.d. Ex. 2015 ¶ 163.

**2. Petitioner Has Not Shown a Motivation to Combine
Nishikawa and Chen to Arrive at the Claimed Invention**

Ground 2(b) also fails because a POSITA would not have been motivated to combine Chen with Nishikawa to arrive at the claimed invention. Ex. 2015. ¶ 164. Nishikawa and Chen are not directed to the same problem but instead are directed to unrelated problems and solutions. *Id.* ¶ 167. Nishikawa is directed to the problem of a gap that forms between the separator and electrode during battery operation, thereby decreasing battery life. *Id.* The way Nishikawa suggests solving this problem is to focus on the properties of the porous layer in the separator. *Id.* On the other hand, Chen is directed to the problem of “mechanical failure of polymer separators in Li-ion battery cells can result in internal shorting and initiate thermal runaway.” Ex. 1005 at 14904-14905. Chen proposes addressing that problem by “reveal[ing]

the underlying structural change in membranes during mechanical deformation.” *Id.* at 14905. The Petition provides no reason why a POSITA would have been motivated to look beyond Nishikawa for other separators, let alone why a POSITA would have looked to a reference about mechanical deformation when trying to solve the problem in Nishikawa (gap formation caused by the composition of the porous layer). Ex. 2015 ¶ 168.

Even if a POSITA were motivated to combine Chen with Nishikawa, there would be no reasonable expectation of success in doing so. Ex. 2015 ¶ 169. Petitioner’s expert opines that the Nishikawa and Chen separators are essentially interchangeable. Ex. 1003 at ¶ 169; Ex. 2015 ¶ 169. But at the same time, Dr. Pecht opines that these separators have vastly different plastic strains. Dr. Pecht opines that the Nishikawa separator has a plastic strain of 72.55-72.75% in the MD direction. Ex. 1003 ¶ 110. In contrast, Dr. Pecht opines that the Chen Teijin separator has a plastic strain of 137.2-141.57% in the MD direction. *Id.* This is more than 89% greater (almost twice as much) plastic strain as the Nishikawa separator. Ex. 2015 ¶ 169. Not only does this further illustrate the issues with Petitioner’s estimations, but there is also no reason to suggest that a POSITA would be able to reconcile these two very different amounts of plastic strain. *Id.* ¶ 170.

Finally, the only thing Chen adds to what was disclosed in Nishikawa is that Chen includes stress-strain plots that Nishikawa does not. Ex. ¶ 171. But as

explained at length in Section VI.A.2.b.ii., relying on a stress-strain plot to estimate plastic strain does not give an accurate representation of absolute plastic deformation rate. Thus, Chen's addition of stress-strain plots does not overcome the failures explained in Sections IV.A-B above, each of which still apply to this Ground.

3. Claims 2-10 Are Not Unpatentable

Claims 2-10 are not unpatentable for the same reasons as discussed above with respect to independent claim 1. Patent Owner reserves the right to address Claims 2-10 individually if this proceeding is instituted.

D. Ground 3: Chen and Zhang Do Not Render Obvious Claims 1-10

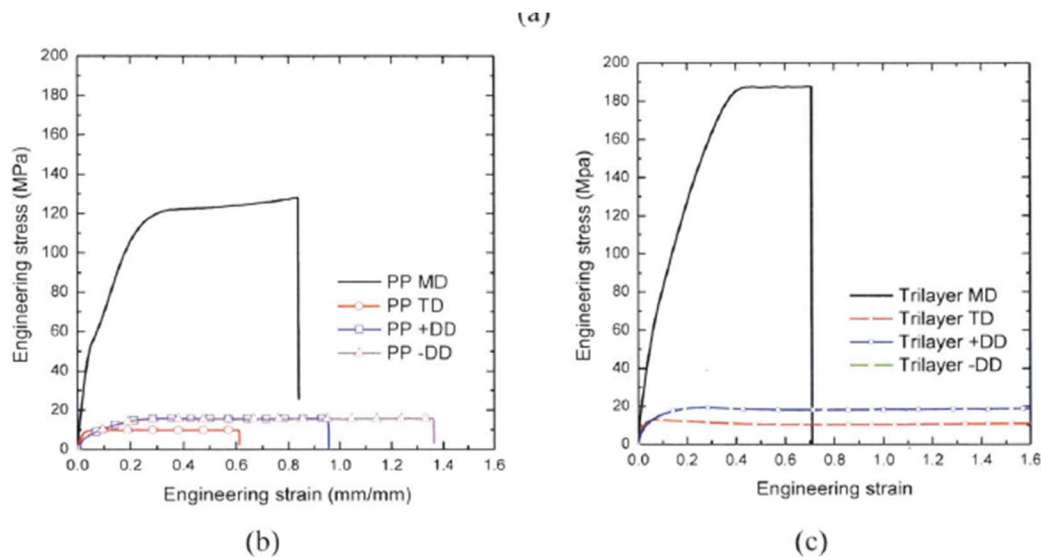
Petitioner contends that the combination of Chen and Zhang renders obvious Claims 1-10 of the '927 Patent. Pet., 56-70. In addition to Chen's failures identified in Ground 2(B), Chen and Zhang fail to teach, suggest, disclose, or otherwise render obvious at least element 1.4, which is a required element for all the Challenged Claims.

1. Neither Chen Nor Zhang Disclose or Suggest the Claimed "Absolute Plastic Deformation Rate"

Like Ground 2(B), Ground 3 of the Petition relies on Chen for the limitation "the porous substrate has an absolute plastic deformation rate in a first direction ranging from about 40% to about 1800%, and wherein the absolute plastic deformation rate is calculated according to an equation $(L2-L0)/L0 \times 100\%$, where $L0$ refers to a length of the porous substrate before stretching and $L2$ refers to a

length of the porous substrate after the porous substrate is stretched to breakage and docked along the fracture caused by the breakage and flattened.” Pet. at 25. This argument fails for the same reasons set forth above in Section VI.C.1 with respect to Ground 2(B), and those reasons are incorporated here.

Petitioner does not (and indeed, cannot) argue that Zhang discloses this limitation. Ex. 2015 ¶ 175. The Zhang Thesis (relied on by Petitioner as background art) even teaches away from this limitation because it teaches stretching separators until breakage and *not* measuring L2. *Id.* Even though the Zhang Thesis stretches certain separators until breakage, it opts not to measure their length after breakage but instead uses the same types of stress-strain plots that Chen uses. *Id.* ¶ 176.



Given this disclosure, a POSITA would have been discouraged from measuring L2 and arriving at the claimed absolute plastic deformation rate. *Id.* ¶ 177. Moreover, as explained at length above and incorporated here, the stress-strain plot estimation

methods relied on by Dr. Pecht and Petitioner do not reliably reflect absolute plastic deformation rate, and Chen and Zhang therefore do not otherwise disclose the claimed absolute deformation rate. *See* discussion *supra* at Section VI.A.2.b.ii.

2. Petitioner Has Not Shown a Motivation to Combine Chen and Zhang to Arrive at the Claimed Invention

Ground 3 fails also fails because a POSITA would not have been motivated to combine Zhang with Chen to arrive at the claimed invention. Chen and Zhang are directed to very different solutions. Ex. 2015 ¶ 178. Chen suggests analyzing and reporting “the mechanical behavior of the polymer separators (tensile and fracture).” Ex. 1005 at 14905; Ex. 2015 ¶ 181. On the other hand, Zhang is focused only on the properties of the *porous layer*, claiming layers that “include one or more particles having an average particle size ranging from 0.01 µm to 5 µm and/or binders that include poly (sodium acrylate-acrylamide-acrylonitrile copolymer.” Ex. 1006 at Abstract; Ex. 2015 ¶ 181. The claims of the ’927 patent are directed to the absolute plastic deformation rate of the *porous substrate*, and the patent explains that the porous layer does not affect absolute plastic deformation rate. Ex. 1001 at 22:14-23, 23:1-5; Ex. 2015 ¶ 182. Thus, a POSITA would not look to a reference like Zhang that is focused on the properties of the *porous layer*. *Id.*

3. Claims 2-10 Are Not Unpatentable

Claims 2-10 are not unpatentable for the same reasons as discussed above with respect to independent claim 1. Patent Owner reserves the right to address Claims 2-10 individually if this proceeding is instituted.

VII. CONCLUSION

Patent Owner respectfully submits that the Board should deny institution.

Dated: June 9, 2025

Respectfully submitted,

By: /Christopher TL Douglas/
Christopher TL Douglas, Reg. No. 56,950

CERTIFICATION UNDER 37 C.F.R. §42.24

Pursuant to 37 C.F.R. §42.24(d), I certify that this preliminary response complies with the type-volume limits of 37 C.F.R. §42.24(b)(1) because it contains 11,937 words, according to the word-processing system used to prepare this preliminary response, excluding the parts of this preliminary response that are exempted by 37 C.F.R. §42.24(b) (including a table of contents, a table of authorities, a listing of facts which are admitted, a certificate of service or this certificate word count, and appendix of exhibits).

Dated: June 9, 2025

By: /Christopher TL Douglas/
Christopher TL Douglas

CERTIFICATE OF SERVICE

Pursuant to 37 C.F.R. §42.6(e), the undersigned hereby certifies that true and correct copies of the foregoing **PATENT OWNER'S PRELIMINARY RESPONSE and NINGDE AMPEREX TECH. EXHIBITS 2015, 2016, and 2025-2031** were served in their entirety on June 9, 2025 by filing this document through the PTAB's P-TACTS Filing System as well as delivering a true and correct copy by electronic mail on Petitioner's lead and backup counsel at the following email addresses (as agreed by counsel for Petitioner):

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