

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ASCEND ELEMENTS, INC.,
Petitioner,

v.

DUESENFELD GMBH,
Patent Owner.

Case No. IPR2024-00948

U.S. Patent No. 11,050,097

PETITIONER'S NOTICE OF APPEAL

Pursuant to 35 U.S.C. §§ 141, 142, and 319, and 37 C.F.R. §§ 90.2-90.3, notice is hereby given that Petitioner Ascend Elements, Inc. appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision of the Patent Trial and Appeal Board (“Board”) entered November 12, 2025 (Paper 57) in IPR2024-00948, and from all underlying orders, decisions, rulings, and opinions. A copy of the Final Written Decision is attached.

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), Petitioner further indicates that the issues on appeal include, but are not limited to: (1) the Board’s determination that claims 1-3 and 7-10 are not unpatentable under 35 U.S.C. § 103 as obvious over Hanisch in view of Dunagan; (2) the Board’s determination that claims 1-3 and 7-10 are not unpatentable under 35 U.S.C. § 103 as obvious over Hanisch in view of Dunagan, Hayashi, and/or Shin; (3) the Board's granting of Patent Owner's contingent motion to amend, replacing claims 12, 13, and 19 with claims 26, 27, and 29, respectively; and (4) all other issues decided adversely to Petitioner in any order, decision, ruling or opinion underlying or supporting the Final Written Decision.

Pursuant to 35 U.S.C. § 142 and 37 C.F.R. § 90.2(a), this Notice is being filed with the Director of the United States Patent and Trademark Office, and a copy of this Notice is being concurrently filed with the Patent Trial and Appeal

Board. In addition, a copy of this Notice and the required docketing fees are being filed with the Clerk's Office for the United States Court of Appeals for the Federal Circuit via CM/ECF.

Respectfully submitted,

Dated: January 14, 2026

/s/ Andrew D. Gish
Andrew D. Gish (Reg. # 67,562)

CERTIFICATE OF SERVICE

The undersigned certifies that, on January 14, 2026, the foregoing
PETITIONER'S NOTICE OF APPEAL was:

(1) electronically filed through the Board's P-TACTS System;
(2) provided to the Director of the USPTO by electronically filing to the email
address as follows:

Director of the United States Patent And Trademark Office
c/o Office of the General Counsel
efileSO@uspto.gov

(3) filed in the U.S. Court of Appeals for the Federal Circuit using the
Court's CM/ECF filing system and pay.gov to pay the filing fee electronically

(4) provided as a courtesy copy via electronic mail to the following attorneys
of record for the Patent Owner listed below:

Steven C. Carlson
Samuel J. LaRoque
ROBINS KAPLAN LLP
scarlson@robinskaplan.com
slaroque@robinskaplan.com
rk-duesefeld@robinskaplan.com

Matthew Smith
Elizabeth Laughton
SMITH BALUCH LLP
smith@smithbaluch.com
laughton@smithbaluch.com

Respectfully submitted,

Dated: January 14, 2026

/s/ Andrew D. Gish
Andrew D. Gish (Reg. # 67,562)

UNITED STATES PATENT AND TRADEMARK OFFICE

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ASCEND ELEMENTS, INC.,
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v.

DUESENFELD GMBH,
Patent Owner.

IPR2024-00948
Patent 11,050,097 B2

Before MEREDITH C. PETRAVICK, CHRISTOPHER M. KAISER, and
KEVIN W. CHERRY, *Administrative Patent Judges*.

KAISER, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining Some Challenged Claims Unpatentable
Granting Patent Owner's Motion to Amend in Part
35 U.S.C. § 318(a)

I. INTRODUCTION

A. Background and Summary

Ascend Elements, Inc. (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting *inter partes* review of claims 1–3, 7–10, 12, 13, and 19 (“the challenged claims”) of U.S. Patent No. 11,050,097 B2 (Ex. 1001, “the ’097 patent”). Duesenfeld GmbH (“Patent Owner”) filed a Preliminary Response (Paper 6, “Prelim. Resp.”). With our authorization, Petitioner filed a Reply to Patent Owner’s Preliminary Response (Paper 7, “Prelim. Reply”), and Patent Owner filed a Corrected Preliminary Sur-Reply (Paper 9, “Prelim. Sur-Reply”). We determined that the information presented established a reasonable likelihood that Petitioner would prevail with respect to at least one of the challenged claims, so we instituted *inter partes* review of all challenged claims based on all the grounds identified in the Petition. Paper 10 (“Inst. Dec.”).

Following institution of *inter partes* review, Patent Owner filed a Response to the Petition (Paper 20, “PO Resp.”), Petitioner filed a Reply to the Response (Paper 31, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 38, “PO Sur-reply”). In addition, Patent Owner filed a Motion to Amend (Paper 21, “Mot. Amend”), Petitioner filed an Opposition to the Motion to Amend (Paper 32, “Pet. Opp.”), and Patent Owner filed a Reply to the Opposition (Paper 39, “PO Reply”). An oral hearing with was held on August 22, 2025, and a transcript of the hearing is included in the record. Paper 56.

We have authority to determine whether Petitioner has established by a preponderance of the evidence that any of the challenged claims is unpatentable. 35 U.S.C. §§ 6(b), 316(c). For the reasons set forth below,

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upon considering the briefing and the evidence of record, we determine that Petitioner has shown the unpatentability of some, but not all, challenged claims. In addition, we grant Patent Owner’s motion to amend in part.

B. Real Parties-in-Interest

Petitioner identifies Ascend Elements, Inc. as the real party-in-interest. Pet. 60. Patent Owner identifies Duesenfeld GmbH as the real party-in-interest. Paper 4, 1.

C. Related Matters

The parties identify the following related court proceeding: *Duesenfeld GmbH v. Ascend Elements, Inc.*, Case No. 1-23-cv-01194 (D. Del.). Pet. 60; Paper 4, 1. In addition, the parties note that the ’097 patent is also being challenged concurrently in IPR2024-00887. Pet. 60; Paper 4, 1.

D. The ’097 Patent

The ’097 patent is titled “Method for the Treatment of Used Batteries, in Particular Rechargeable Batteries, and Battery Processing Installation” and issued on June 29, 2021. Ex. 1001, codes (45), (54). It is directed to “[a] method . . . for the treatment of used batteries, in particular lithium batteries.” *Id.* at code (57).

The ’097 patent describes several prior-art methods of processing used batteries and discusses the disadvantages of each method. *Id.* at 1:25–50. “The invention [of the ’097 patent] aims to reduce” these disadvantages. *Id.* at 1:54–55. To do so, the ’097 patent describes

a method for the treatment of used batteries, in particular used lithium batteries, such as lithium[-]ion batteries, with the steps (a) comminuting the batteries such that comminuted material is obtained, (b) inactivating of the comminuted material such that

an inactive comminuted material is obtained, and (c) filling a transport container with the inactive comminuted material.

Id. at 1:8–15. It also describes

a battery processing installation for the treatment of used batteries, in particular for the treatment of used lithium batteries with (a) a comminuting device for comminuting the batteries such that comminuted material is obtained, (b) an inactivation device for inactivating the comminuted material and (c) a filling device for filling a transport container with the inactivated comminuted material.

Id. at 1:16–23.

According to the '097 patent, “the inactivation occurs . . . by way of drying the comminuted material.” *Id.* at 1:57–58. By doing this, “the amount of electrolyte that can be obtained from the comminuted material . . . is such that an electrochemical reaction is no longer possible, or only to a negligibly small extent.” *Id.* at 1:63–66. “In addition, no flammable or explosive gas phase forms above the battery fragments, as the organic carbonates of the electrolyte have been removed.” *Id.* at 1:66–2:2. This renders the comminuted material “largely inert,” so that it “can be transported safely, especially if it is packed under vacuum.” *Id.* at 2:2–2:4.

E. Illustrative Claims

Petitioner challenges claims 1–3, 7–10, 12, 13, and 19 of the '097 patent. Claims 1 and 12 are independent and illustrative; they are reproduced below.

1. A method for the treatment of used batteries, comprising the steps:
 - (a) comminuting the batteries such that comminuted material is obtained;

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(b) inactivating the comminuted material such that an inactivated comminuted material is obtained, wherein the inactivating step is performed during or after the comminuting step; and

(c) filling a transport container with the inactivated comminuted material;

wherein the inactivating step is performed by drying the comminuted material, and

wherein the drying occurs at a maximum pressure of 300 hPa.

Ex. 1001, 10:45–59.

12. A battery processing installation for treatment of used batteries, comprising:

(a) a comminution unit configured to comminute the batteries such that comminuted material is obtained;

(b) an inactivation device comprising a drying device configured to inactivate the comminuted material, wherein the inactivation device is configured to perform the inactivating step during or after the comminuting step of the comminution unit;

(c) a filling device configured to fill a transport container with the inactivated comminuted material; and

(d) a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device.

Ex. 1001, 11:48–61.

F. Asserted Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability (Pet. 3, 22–52):

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–3, 7–10, 12, 13, 19	103	Hanisch, ¹ Dunagan ²
1–3, 7–10, 12, 13, 19	103	Hanisch, Dunagan, Meador, ³ Shin, ⁴ Hayashi ⁵

In support of its unpatentability arguments, Petitioner relies on the declarations of Walter van Schalkwijk, Ph.D. (Ex. 1003; Ex. 1023). Patent Owner relies on the declarations of Vani Dantam (Ex. 2001; Ex. 2022). There is also fact witness testimony from Lydia Grote (Ex. 2040). The parties additionally filed transcripts of the depositions of Dr. van Schalkwijk (Ex. 2061) and Mr. Dantam (Ex. 1024).

II. ANALYSIS

A. Legal Standards

In *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1 (1966), the Supreme Court set out a framework for assessing obviousness under 35 U.S.C. § 103 that requires consideration of four factors: (1) the “level of ordinary skill in the pertinent art,” (2) the “scope and content of the prior art,” (3) the “differences between the prior art and the claims at issue,” and (4) if in evidence, “secondary considerations” of non-obviousness, such as

¹ US 9,780,419 B2, issued Oct. 3, 2017 (Ex. 1004).

² US 9,450,277 B2, issued Sept. 20, 2016 (Ex. 1018).

³ US 5,632,863, issued May 27, 1997 (Ex. 1011).

⁴ US 10,396,408 B2, issued Aug. 27, 2019 (Ex. 1010).

⁵ US 9,843,077 B2, issued Dec. 12, 2017 (Ex. 1006).

“commercial success, long[-]felt but unsolved needs, failure of others, etc.” *Id.* at 17–18. “While the sequence of these questions might be reordered in any particular case,” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 407 (2007), the U.S. Court of Appeals for the Federal Circuit has repeatedly emphasized that “it is error to reach a conclusion of obviousness until all those factors are considered,” *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1328 (Fed. Cir. 2016). Because Patent Owner does not address objective evidence of non-obviousness, we focus solely on the first three *Graham* factors.

B. Level of Ordinary Skill in the Art

The level of ordinary skill in the pertinent art at the time of the invention is a factor in how we construe patent claims. *See Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (en banc). It is also one of the factors we consider when determining whether a patent claim is obvious over the prior art. *See Graham*, 383 U.S. at 17–18.

Factors pertinent to a determination of the level of ordinary skill in the art include “(1) the educational level of the inventor; (2) type of problems encountered in the art; (3) prior art solutions to those problems; (4) rapidity with which innovations are made; (5) sophistication of the technology; and (6) educational level of active workers in the field.” *Envtl. Designs, Ltd. v. Union Oil Co. of Cal.*, 713 F.2d 693, 696–697 (Fed. Cir. 1983) (citing *Orthopedic Equip. Co. v. All Orthopedic Appliances, Inc.*, 707 F.2d 1376, 1381–82 (Fed. Cir. 1983)). “Not all such factors may be present in every case, and one or more of these or other factors may predominate in a particular case.” *Id.*

Petitioner contends that one of ordinary skill in the art “would have had at least a master’s degree in chemical engineering, mechanical engineering, materials science/engineering, or a related field, and three to five years of experience in design and implementation of battery recycling processes.” Pet. 15–16. Patent Owner argues to the contrary that a person of ordinary skill in the art “would have had at least a Bachelor’s degree in electrical engineering, materials science, chemical engineering, or an equivalent field, as well as at least 2 to 3 years of academic or industry experience in the recycling or processing of lithium-ion batteries.” PO Resp. 7–8. Neither party argues that the result would be any different should we adopt a different definition of a person of ordinary skill in the art.

We adopt Patent Owner’s assessment of the level of ordinary skill in the art, as, on the record developed at trial, it appears consistent with the ’097 patent and the asserted prior art. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001); Ex. 2022 ¶¶ 17–23.

C. Claim Construction

We apply the same claim construction standard used in the federal courts—in other words, the claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b), which is articulated in *Phillips*. *See* 37 C.F.R. § 42.100(b). Under the *Phillips* standard, the “words of a claim ‘are generally given their ordinary and customary meaning,’” which “is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application.” *Phillips*, 415 F.3d at 1312–13.

Petitioner argues that “[t]he ’097 Patent expressly defines ‘drying’ to mean ‘the removal of at least one solvent in the conducting salt.’” Pet. 16 (quoting Ex. 1001, 2:23–25). Petitioner also argues that “[a]ll other terms should be given their plain and ordinary meaning under *Philips* and do not need further construction for the purposes of this Petition.” *Id.* Patent Owner argues that “‘**drying the comminuted material**’ . . . should have its plain and ordinary meaning, which is removing at least one solvent from the comminuted material” and that “‘**drying device configured to inactivate the comminuted material**’ . . . shall have its plain and ordinary meaning, which is a device configured to produce inactivated comminuted material as a result of drying.” PO Resp. 9. Patent Owner also argues that “Claim 1 is broad enough to encompass at least all the[] metrics” the ’097 patent recites for determining if the drying process has reached its inactivation endpoint. *Id.* at 9–10.

On the record developed at trial, we agree with Patent Owner that inactivated material is material that has been not merely dried, but dried until the endpoint of the drying process has been reached. The specification states that “drying . . . results in inactivated . . . material,” as well as that “inactivation occurs . . . by way of drying the . . . material.” Ex. 1001, 1:56–58, 8:54–55. In addition, the ’097 patent repeatedly suggests that the drying process has an endpoint and that there are multiple points in the drying process that might constitute that endpoint. For example, in some embodiments, the endpoint of the drying process is the point where “[t]he comminuted material is . . . largely inert and can be transported safely.” Ex. 1001, 2:2–4; *see id.* at 3:13–14 (“it is advantageous that a comminuted material is obtained that can be transported safely”). In other embodiments,

the endpoint is defined as the point when “an electrolyte content is so low that an electrochemical reaction is not possible.” *Id.* at code (57), 4:5–7.

The endpoint might be reached when “no flammable or explosive gas mixture can form above the comminuted material” or when “a flammable or explosive gas mixture can[not] emerge in the transport container or during the subsequent processing.” *Id.* at 3:49–55. It might be reached when “the build-up of heat is so low that a thermal runaway, i.e., a thermally induced chain reaction, is ruled out for at least two months,” or when “any build-up of hydrogen is also so low that after two weeks, no excess pressure occurs if a negative pressure of 500 hPa is present to begin with.” *Id.* at 4:19–27. Alternatively, it may not be reached “until the electrolyte content of organic components that are volatile at 80° C. has a maximum value of 3% by weight,” “the accumulated content of organic carbonates from the electrolyte that are volatile at 80° C. falls short of 3% by volume in the atmosphere above the comminuted material,” or “the dimethyl carbonate content is lower than 4% by volume . . . and/or the cyclohexylbenzene content is lower than 1% by volume.” *Id.* at 4:28–40. The challenged claims require both “inactivating the comminuted material” and that “the inactivating step is performed by drying the comminuted material.” *Id.* at 10:45–59; *see also id.* at 11:48–61 (reciting “an inactivation device comprising a drying device”). Thus, we conclude that comminuted material is inactivated once it has been dried sufficiently to reach the endpoint of the drying process.

D. Asserted Obviousness over Hanisch, Dunagan, and the Knowledge of a Person of Ordinary Skill in the Art

Petitioner argues that claims 1–3, 7–10, 12, 13, and 19 would have been obvious over Hanisch alone or in combination with Dunagan and in view of the knowledge of a person of ordinary skill in the art. Pet. 22–41; Pet. Reply 4–16. Patent Owner disagrees. PO Resp. 11–24, 55–62; PO Sur-reply 2–10, 20–24.

1. Overview of Hanisch

Hanisch is a U.S. patent titled “Method for Reclaiming Active Material from a Galvanic Cell, and an Active Material Separation Installation, Particularly an Active Metal Separation Installation,” that issued on October 3, 2017. Ex. 1004, codes (45), (54). It relates to “a method for retrieving active material, in particular lithium or lithium compounds, from a galvanic cell.” *Id.* at 1:8–10. The method includes the steps of

(a) crushing the cells, in particular under inert gas, so that solid cell fragments are also formed, (b) heating the solid cell fragments up to the decomposition temperature, which is high enough to make the binder decompose and/or evaporate, such that heat treated cell fragments are formed, and (c) classifying the heat treated cell fragments.

Id. at 1:12–18. “The heating of cell fragments up to the decomposition temperature is preferably carried out under inert gas or in a vacuum.” *Id.* at 4:6–8.

The method of Hanisch additionally “preferably comprises the step that, before heating the cell fragments up to the decomposition temperature, the cell fragments are dried at a drying temperature, so that dry cell fragments and drying vapours are formed, whereby the drying vapours are at least partly condensed.” *Id.* at 3:65–4:2. Hanisch teaches that “[t]his has the

advantage that the electrolyte solvent can be retrieved. It is therefore advantageous for the drying temperature to be below 100° C., in particular below 80° C.” *Id.* at 4:3–5.

2. *Overview of Dunagan*

Dunagan is a U.S. patent titled “Systems for Recycling Volatile Battery Sources,” that was issued on September 20, 2016. Ex. 1018, codes (45), (54). It “is directed to systems and methods for the recycling of lithium ion batteries or the like.” *Id.* at code (57). Dunagan’s method “is employed to safely and economically recover valuable materials from Li-ion or like batteries or power sources.” *Id.* at 6:10–12. The method includes the step of placing “processed material . . . in super sacks or suitable carrier[s], [and] weigh[ing], label[ing] and transport[ing] [it] for end users to reclaim the valuable metals and other materials from the recycled materials.” *Id.* at 6:33–37.

3. *Analysis of Claim 1*

a) *“Inactivating the comminuted material . . . by drying the comminuted material”*

Claim 1 recites “inactivating the comminuted material . . . by drying the comminuted material.” Ex. 1001, 10:49–57. Petitioner contends that Hanisch teaches or suggests this limitation in each of two of its process steps. Pet. 24–27, 29–30; Pet. Reply 5–11. Patent Owner disagrees. PO Resp. 14–17; PO Sur-reply 2–5.

(1) *Hanisch’s low-temperature process*

First, Petitioner argues that Hanisch teaches this limitation by teaching low-temperature drying. Pet. 25–26, 29–30. In particular, Petitioner argues that Hanisch teaches this by disclosing “pre-dryer 28 [that] comprises a

circulation pump 32 and a condenser 34 for condensing electrolyte, which can be removed via the pipe 36.” *Id.* at 26 (quoting Ex. 1004, 5:54–63). Petitioner also argues that Hanisch “claims this limitation in dependent claim 5,” which includes “the steps of: drying the solid cell fragments at a drying temperature to form dry cell fragments and drying vapours and at least partly condensing the drying vapours to retrieve electrolyte solvents.” *Id.* (quoting Ex. 1004, 8:3–10).

As discussed above, we construe inactivation as the end point of the drying process, so merely some amount of drying is not sufficient to teach or suggest inactivation; instead, drying must be continued until the end point has been reached. On the record developed at trial, Petitioner has not shown by a preponderance of the evidence that Hanisch’s disclosure of a pre-dryer—the low-temperature process of Hanisch—teaches or suggests drying until the end point of the process is reached. First, claim 5 of Hanisch recites only “drying the solid cell fragments . . . to form dry cell fragments,” without specifying how completely this drying process dries the fragments or how completely fragments must be dried in order to be described as “dry cell fragments.” Ex. 1004, 8:3–10. Similarly, the other portion of the specification to which Petitioner directs us discloses the removal of some electrolyte via heating and condensing, but it does not disclose how much electrolyte is removed. *Id.* at 5:54–63.

Petitioner also argues that Hanisch teaches “the formation of ‘*dry cell fragments*’” and that this disclosure means that the “Hanisch’s pre-dryer results in inactivated comminuted material because it results in fully *dry* material.” Pet. Reply 6 (quoting Ex. 1004, 3:65–4:1). According to Petitioner, “the fact that ‘*dry*’ cell fragments are formed necessarily means

all the volatile electrolyte has been removed.” *Id.* at 6–7 (citing Ex. 1023 ¶¶ 9–18). The cited evidence does not support Petitioner’s argument. In the cited paragraphs, Dr. van Schalkwijk testifies that the cell fragments in Hanisch must be completely dried by the pre-dryer because any remaining electrolyte in the material emerging from the pre-dryer would affect the operation of the subsequent separators and classifiers, not that the mere use of the word “dry” to describe Hanisch’s pre-dried material means that the drying must be complete. Ex. 1023 ¶¶ 9–18.

Petitioner argues that the existence of “several processing steps” between the outlet of Hanisch’s pre-dryer and the inlet of Hanisch’s decomposition oven means that the pre-dryer must produce “*dry* and electrochemically safe material.” Pet. Reply 7–8 (citing Ex. 1004, 4:19–24, 5:65–66; Ex. 1023 ¶¶ 10–18). In particular, Petitioner argues that Hanisch discloses that the dry cell fragments exiting the pre-dryer are treated using “magnetic separators,” “eddy flow separator[s],” and “zigzag classifier[s]” and that a person of ordinary skill in the art “would have understood that the separators and zigzag classifiers are typically designed to work with *dry* material.” *Id.* In support of this argument, Dr. van Schalkwijk testifies that “*active* lithium-ion battery materials contain volatile electrolytes that can ignite if exposed to heat or friction during classification,” as well as that “[d]amp material tends to clump together due to surface tension imparted by free or adsorbed organic solvents from the battery electrolyte, making it difficult for individual particles to separate properly,” which “can hinder the effectiveness of sorting processes.” Ex. 1023 ¶¶ 16–17. The first of these statements cites Exhibit 1036, which “describes a comparison of cartoned lithium[-]ion . . . batteries and FM Global standard commodities in a rack

storage configuration,” not the flammability of battery materials during classification, as Dr. van Schalkwijk testifies. Ex. 1036, 11; *see* Ex. 1023 ¶ 16. Dr. van Schalkwijk’s second statement, regarding the presence of some amount of electrolyte hindering the effectiveness of sorting, does not cite any supporting evidence. Ex. 1023 ¶ 17. Because there is no evidence supporting this expert testimony, we do not accord it significant weight. 37 C.F.R. § 42.65(a).

Thus, Petitioner has not shown by a preponderance of the evidence that Hanisch’s low-temperature process teaches or suggests drying until the end point of the process is reached.

(2) *Hanisch’s high-temperature process*

Second, Petitioner argues that Hanisch teaches this limitation by disclosing a high-temperature drying process. Pet. 29–30 (citing Pet. 26–27). In particular, Petitioner directs us to Hanisch’s disclosure of “[a]n oven . . . in which there is a decomposition temperature T_z between 400 and 600° C. The binder, for example polyvinylidene fluoride (PVDF), thus decomposes.” *Id.* at 27 (quoting Ex. 1004, 6:8–11). According to Petitioner, a person of ordinary skill in the art “would understand that the temperatures cited would cause the evaporation of the organic solvents from the electrolyte.” *Id.* (citing Ex. 1003 ¶ 103). Patent Owner does not dispute this argument. PO Resp. 11–21.

There is evidence of record that the temperatures present in Hanisch’s decomposition oven would be high enough to cause electrolyte solvents to decompose. Ex. 2001 ¶ 81. According to Mr. Dantam, this decomposition of the solvents would be so complete that “no electrolyte solvents would remain for collection and reuse,” because “the solvents would rapidly

decompose into non-electrolyte gases.” *Id.* ¶ 83. The end result would be that “the electrolyte solvent would be destroyed by pyrolysis and none would remain.” *Id.* Because we construe inactivation to require drying to be continued until the end point has been reached, and because Hanisch’s high-temperature process results in the complete elimination of all electrolyte solvent, we find that the preponderance of the evidence supports Petitioner’s argument that Hanisch teaches inactivation in its high-temperature process.

b) *“Wherein the drying occurs at a maximum pressure of 300 hPa”*

Claim 1 recites that “the drying occurs at a maximum pressure of 300 hPa.” Ex. 1001, 10:58–59. Petitioner contends that Hanisch teaches or suggests this limitation. Pet. 30–32; Pet. Reply 11–15. Patent Owner disagrees. PO Resp. 17–21; PO Sur-reply 6–10.

Petitioner first argues that Hanisch teaches that “the heating up takes place under inert gas or in a vacuum,” and that a person of ordinary skill in the art “would have understood that the pressure of a ‘vacuum’ is below 300 hPa.” *Id.* at 30 (quoting Ex. 1004, 3:6–8; citing Ex. 1003 ¶ 110). We agree with Petitioner that Hanisch teaches operating both its pre-dryer and its decomposition oven at a vacuum. Ex. 1004, 3:6–8, 4:6–8. We are not persuaded, however, that Petitioner has shown sufficiently that a person of ordinary skill in the art “would have understood that the pressure of a ‘vacuum’ is below 300 hPa,” as Petitioner argues. Pet. 30. As support for this contention, Petitioner cites the declaration of Dr. van Schalkwijk, who testifies that “[a] POSITA would have understood that the pressure of a ‘vacuum’ is below 300 hPa.” Ex. 1003 ¶ 110. Dr. van Schalkwijk does not provide any support for this testimony. *Id.*

Petitioner next argues that, “[t]o the extent that Hanisch does not explicitly disclose this claim limitation, it would have been obvious in view of the common knowledge of a POSITA . . . that using pressures at or below 300hP[a] when drying the comminuted material would be desirable.”

Pet. 31 (citing Ex. 1003 ¶¶ 68–70, 113–116). Again, the cited testimony of Dr. van Schalkwijk does not cite any support for the witness’s opinion that “a POSITA, in view of the common knowledge in the field before the effective filing date, would have understood that using pressures at or below 300hP[a] when drying the comminuted material would be desirable.”

Ex. 1003 ¶ 113; *see* Ex. 1003 ¶¶ 68–70, 114–116. Dr. van Schalkwijk provides some reasoning to support the opinion that a person of ordinary skill in the art “would . . . conclude that use of reduced pressure when drying comminuted material would be desirable” and the opinion that the chosen pressure would be “under lower [than] ambient pressure,” but no support for the choice of the maximum of 300 hPa recited in claim 1. *Id.* ¶¶ 114–115.

Petitioner also argues that Hanisch teaches using a drying temperature of less than 80° C, that “it has been well-known for decades, if not longer, that the evaporation of gases, including volatile compounds and gases formed during drying, can be facilitated at lower temperatures when ambient pressure is reduced from normal pressure, because of the reduction in boiling point that occurs,” and that, given these facts, a person of ordinary skill in the art “would have appreciated that, to quickly vaporize the volatile electrolytes and produce ‘dry cell fragments’ at 80° C or lower, vacuum pressures below 300 hP[a] are desirable.” Reply 12 (quoting PO Resp. 31; citing Ex. 1003 ¶¶ 68–70, 114; Ex. 1004, 3:67–4:5). We agree that Hanisch teaches drying at a temperature “below 80° C” and that lowering the

pressure of the drying process would permit drying at a lower temperature. Ex. 1003 ¶¶ 68–70, 114; Ex. 1004, 3:67–4:5. But Petitioner does not direct us to any evidence linking Hanisch’s drying temperature of 80° C with the recited pressure of 300 hPa. Pet. Reply 12–14.

Petitioner argues that a person of ordinary skill in the art “would have understood from these disclosures that it was desirable to use pressures lower than 300 hPa in the decomposition oven because minimizing the atmospheric oxygen in the chamber would promote the best chances of avoiding th[e] oxidization” of copper foils. *Id.* at 14–15 (citing Ex. 1004, 4:6–18; Ex. 1023 ¶¶ 19–27). We do not find this argument persuasive. Hanisch teaches not that running the decomposition under a vacuum would minimize the oxidation of the copper foils, but rather that “[t]he heating of cell fragments up to the decomposition temperature is preferably carried out under inert gas or in a vacuum,” which “has the advantage that copper then does not oxidise.” Ex. 1004, 4:6–18. Thus, although operating Hanisch’s decomposition oven under a vacuum could reduce the risk of oxidation, so could operating it under inert gas. In addition, Dr. van Schalkwijk testifies that “if one uses a pressure of 300 hPa for the high temperature decomposition heating, there will be roughly 3-4 fold less oxygen . . . [in] the chamber atmosphere than compared to 1 atmosphere of pressure,” Ex. 1023 ¶ 25, but he does not provide a non-hindsight reason for choosing the 300-hPa pressure to analyze or explain why a three- to four-fold reduction in oxygen, rather than some lesser reduction, would be necessary to avoid oxidation of the copper foils, *id.* ¶¶ 19–27.

For these reasons, we determine that Petitioner has not shown that Hanisch teaches or suggests that “the drying occurs at a maximum pressure of 300 hPa.”

c) Conclusion Regarding Claim 1

For the reasons discussed above, we determine that Petitioner has not shown that either Hanisch’s low-temperature process or Hanisch’s high-temperature process teaches or suggests both “inactivating the comminuted material . . . by drying the comminuted material” and “the drying occurs at a maximum pressure of 300 hPa.” In addition, Petitioner does not argue that the combination of Hanisch’s low-temperature and high-temperature processes teaches or suggests this combination of limitations. Pet. 22–32. Accordingly, Petitioner has not shown by a preponderance of the evidence that claim 1 would have been obvious over Hanisch alone or in combination with Dunagan and in view of the knowledge of a person of ordinary skill in the art.

4. Claims 2, 3, and 7–10

As discussed above, Petitioner has not shown by a preponderance of the evidence that claim 1 would have been obvious over Hanisch alone or in combination with Dunagan and in view of the knowledge of a person of ordinary skill in the art. Petitioner relies on its arguments with respect to claim 1 in arguing for the obviousness of claims 2, 3, and 7–10, all of which depend from claim 1. Pet. 32–38. Accordingly, Petitioner has not shown by a preponderance of the evidence that claims 2, 3, and 7–10 would have been obvious over Hanisch alone or in combination with Dunagan and in view of the knowledge of a person of ordinary skill in the art.

5. *Analysis of Claim 12*

a) *“Inactivation device comprising a drying device configured to inactivate the comminuted material”*

Claim 12 recites “an inactivation device comprising a drying device configured to inactivate the comminuted material.” Ex. 1001, 11:52–53. Petitioner argues that Hanisch teaches this limitation. Pet. 38 (citing Pet. 24–27, 29–30); Pet. Reply 5–11. Patent Owner does not dispute this argument. PO Resp. 22–24 (citing PO Resp. 17–21). Petitioner relies on its arguments with respect to the “wherein the inactivating step is performed by drying the comminuted material” limitation of claim 1. As discussed above, we determine that Petitioner has shown by a preponderance of the evidence that Hanisch’s decomposition oven teaches that limitation of claim 1. Accordingly, we determine that Petitioner has shown by a preponderance of the evidence that Hanisch’s decomposition oven is “an inactivation device comprising a drying device configured to inactivate the comminuted material.”

b) *“Vacuum installation connected to the drying device and configured to generate a vacuum in the drying device”*

Claim 12 recites “a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device.” Ex. 1001, 11:59–61. Petitioner argues that Hanisch teaches this limitation. Pet. 39–40 (citing Pet. 30–32); Pet. Reply 11–15. Patent Owner disagrees. PO Resp. 22–24 (citing PO Resp. 17–21).

We begin by noting that the vacuum installation of this limitation must be “connected to the drying device,” which is the device “configured to inactivate the comminuted material.” Ex. 1001, 11:48–61. As discussed

above, Petitioner shows by a preponderance of the evidence that Hanisch’s decomposition oven is such a drying device, but Petitioner does not show that Hanisch’s pre-dryer is. Thus, Petitioner must show that Hanisch teaches or suggests a vacuum installation connected to the decomposition oven.

Petitioner argues that Hanisch teaches that “heating up takes place under inert gas or vacuum,” and that a person of ordinary skill in the art “would have understood from this disclosure that a vacuum installation connected to the drying device of Hanisch would be needed to allow heating up to occur under a vacuum.” Pet. 39 (citing Ex. 1003 ¶ 135; Ex. 1004, 3:6–8, 4:6–8). On the present record, we agree that Hanisch teaches operating its decomposition oven under a vacuum. Ex. 1004, 4:6–8 (“[t]he heating of cell fragments up to the decomposition temperature is preferably carried out . . . in a vacuum”). But the cited testimony of Dr. van Schalkwijk does not support Petitioner’s argument that a person of ordinary skill in the art “would have understood from this disclosure that a vacuum installation connected to the drying device of Hanisch would be needed to allow heating up to occur under a vacuum.” Pet. 39 (citing Ex. 1003 ¶ 135). Dr. van Schalkwijk testifies that Hanisch’s disclosure “would lead a POSITA to conclude that Hanisch discloses generating a vacuum in the drying device,” but there is no testimony regarding the need for a vacuum installation to generate the vacuum. Ex. 1003 ¶ 135. Petitioner also cites the testimony of Dr. van Schalkwijk that a person of ordinary skill in the art “would have understood the circulation pump and condenser of Hanisch to be a ‘vacuum installation.’” Pet. 39–40 (citing Ex. 1003 ¶¶ 136–137). But the circulation pump and condenser that Petitioner and Dr. van Schalkwijk refer to are attached to Hanisch’s pre-dryer, not to Hanisch’s decomposition oven.

Pet. 39–40; Ex. 1004, 5:59–61, Fig. 1; Ex. 1003 ¶¶ 136–137. Thus, although Petitioner shows that Hanisch teaches or suggests a vacuum installation attached to Hanisch’s pre-dryer, Petitioner does not show, as it must, that Hanisch teaches or suggests a vacuum installation attached to Hanisch’s decomposition oven.

a) Conclusion Regarding Claim 12

Petitioner has not shown by a preponderance of the evidence that claim 12 is unpatentable as obvious over Hanisch alone or in combination with Dunagan and in view of the knowledge of a person of ordinary skill in the art.

6. Claims 13 and 19

As discussed above, Petitioner does not show by a preponderance of the evidence that claims 1 and 12 would have been obvious over Hanisch alone or in combination with Dunagan and in view of the knowledge of a person of ordinary skill in the art. Petitioner relies on its arguments with respect to claims 1 and 12 in arguing for the obviousness of claims 13 and 19, both of which depend from claim 12. Pet. 41. Accordingly, Petitioner does not show by a preponderance of the evidence that claims 13 and 19 would have been obvious over Hanisch alone or in combination with Dunagan and in view of the knowledge of a person of ordinary skill in the art.

E. Asserted Obviousness Over Hanisch, Dunagan, Hayashi, Meador, and Shin

Petitioner argues that claims 1–3, 7–10, 12, 13, and 19 would have been obvious over Hanisch in view of Dunagan and Hayashi, Meador, or

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Shin. Pet. 41–52; Pet. Reply 16–20. Patent Owner disagrees. PO Resp. 24–55; PO Sur-reply 11–20.

1. Overview of Hayashi

Hayashi is a U.S. patent titled “Method for Processing Fluorine-Containing Electrolyte Solution,” that issued on December 12, 2017. Ex. 1006, codes (45), (54). It “relates to a safe method for processing a nonaqueous electrolyte solution which is used in a lithium ion battery or the like.” *Id.* at 1:7–9. In particular, Hayashi teaches processing electrolyte solutions that include “lithium hexafluorophosphate,” “dimethyl carbonate,” and “ethyl methyl carbonate.” *Id.* at 4:12–17. “[I]n order to take the electrolyte solution out of the lithium ion battery safely,” Hayashi teaches that “[t]he volatile component of the electrolyte solution is gasified by heating the battery under reduced pressure.” *Id.* at 4:24–34. As one example of temperatures and pressures to be used, Hayashi discloses that “the inside of the battery is depressurized to be 5 kPa and is heated at 80° C. to 150° C.,” which allows the dimethyl carbonate, ethyl methyl carbonate, “and the thermally decomposed fluorine compound . . . to be volatilized.” *Id.* at 4:60–67. Hayashi also discloses heating to the same temperature range at a “reduced pressure of less than or equal to 1 kPa.” *Id.* at 3:20–25.

2. Overview of Meador

Meador is a U.S. patent titled “Battery Pyrolysis Process,” that was issued on May 27, 1997. Ex. 1011, codes (45), (54). It “relates to a process and apparatus for reclamation of batteries other than lead-acid batteries and more particular[ly] to reclamation and environmentally safe disposal of nickel cadmium, lithium, carbon-zinc, mercury, alkaline, metal hydride, etc. batteries.” *Id.* at 1:5–9. The process of Meador “comprises continually

introducing previously crushed batteries into a pyrolysis chamber and conveying them by an auger through the pyrolysis chamber.” *Id.* at 3:17–19. “The chamber is maintained under a slight vacuum to withdraw the off-gases for further processing.” *Id.* at 3:25–27. “The pyrolysis chamber . . . would typically be operated in a temperature range between 350° to 650° F,” and “[t]he vacuum pump . . . maintains a vacuum on [the] pyrolysis chamber . . . of approximately one-half inch of mercury.” *Id.* at 5:59–62.

3. *Overview of Shin*

Shin is a U.S. patent titled “Waste Battery Treatment Apparatus Using Continuous Heat Treatment, and Method for Recovering Valuable Metals from Lithium-Based Battery Using Same,” that was issued on August 27, 2019. Ex. 1010, codes (45), (54). It “relates to a treatment apparatus for recovering metals from a waste battery and a method thereof.” *Id.* at 1:9–11. Shin discloses “a continuous heat treatment process” that includes “a vacuum forming step” and “a heat treatment step.” *Id.* at 2:65–3:8.

4. *Analysis of Claim 1*

a) *“Wherein the inactivating step is performed by drying the comminuted material”*

Claim 1 recites that “the inactivating step is performed by drying the comminuted material.” Ex. 1001, 10:56–57. Petitioner contends that Hanisch teaches or suggests this limitation. Pet. 43 (citing Pet. 24–27, 29–30). Patent Owner disagrees. PO Resp. 24–25 (citing PO Resp. 14–17); PO Sur-reply 16–17. With respect to this limitation, Petitioner relies on the same arguments addressed above with respect to the Hanisch/Dunagan ground. Pet. 43 (citing Pet. 24–27, 29–30). For the reasons discussed above with respect to that ground, Petitioner has shown by a preponderance of the

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evidence that Hanisch’s teaching of a high-temperature decomposition oven teaches inactivating comminuted material by drying.

b) *“Wherein the drying occurs at a maximum pressure of 300 hPa”*

Claim 1 recites that “the drying occurs at a maximum pressure of 300 hPa.” Ex. 1001, 10:58–59. Petitioner contends that Hayashi, Meador, and Shin each teach or suggest this limitation and that a person of ordinary skill in the art would have had reason to combine the teachings of these references with those of Hanisch and Dunagan. Pet. 43–46; Pet. Reply 16–20. Patent Owner disagrees. PO Resp. 30–52; PO Sur-reply 11–20.

(1) Combination with Hayashi

Petitioner argues that Hayashi teaches “processing lithium-ion batteries by heating the battery containing the electrolyte solution under reduced pressure, such that the organic solvents of the electrolyte are evaporated.” Pet. 45 (citing Ex. 1006, 4:33–36). According to Petitioner, this heating under reduced pressure includes “examples in which heating is carried out at a pressure ‘less than or equal to 1 kPa’ . . . over temperatures ranging from 80°C to 150°C.” *Id.* (citing Ex. 1006, 3:20–25). Petitioner argues that a person of ordinary skill in the art would have been motivated to combine this teaching with the teachings of Hanisch

because of the advantages of improved electrolyte evaporation at a given temperature when lower ambient pressures are used . . . , the attenuation of toxic hydrogen fluoride production during the heating process . . . , and the control over potentially flammable compounds and gasses generated during such heating.

Id. at 46 (citing Ex. 1003 ¶¶ 67–71, 150–152; Ex. 1006, 4:12–36, 4:43–67, Table 1). Patent Owner disagrees. PO Resp. 37–50.

Petitioner is correct that Hayashi teaches a method in which, “in order to take the electrolyte solution out of the lithium ion battery safely, . . . the electrolyte solution is depressurized and gasified . . . by heating the battery under reduced pressure.” Ex. 1006, 4:24–34. This heating and reduced pressure includes a pressure of “5 kPa” and a temperature of “80° C. to 150° C.,” at which conditions dimethyl carbonate and ethyl methyl carbonate that are “included in the electrolyte solution . . . are able to be volatilized.” *Id.* at 4:60–67. Moreover, Dr. van Schalkwijk testifies that evaporating solvents at lower temperatures, as is permitted by the use of the lower pressures taught by Hayashi, reduces formation of toxic hydrogen fluoride. Ex. 1003 ¶¶ 67–68 (citing Ex. 1005, 1:20–24, 2:2–27; Ex. 1006, 1:26–29, 2:7–11, 4:12–23).

As noted above, however, Hanisch teaches inactivation via drying only in its high-temperature decomposition oven. Hanisch’s oven operates at a temperature of “at least 350° C. and at the most 800° C.” Ex. 1004, 4:25–26. There is evidence of record that the temperatures present in Hanisch’s decomposition oven would be high enough to cause electrolyte solvents to decompose. Ex. 2001 ¶ 81. According to Mr. Dantam, this decomposition of the solvents would be so complete that “no electrolyte solvents would remain for collection and reuse,” because “the solvents would rapidly decompose into non-electrolyte gases.” *Id.* ¶ 83. The end result would be that “the electrolyte solvent would be destroyed by pyrolysis and none would remain.” *Id.* Neither Petitioner nor Dr. van Schalkwijk explains why a person of ordinary skill in the art would apply Hayashi’s lower pressures and the resultant improvements in solvent evaporation to Hanisch’s oven, in which the solvents are decomposed rather than

evaporated. Thus, Petitioner has not shown by a preponderance of the evidence that a person of ordinary skill in the art would have combined the teachings of Hayashi with those of Hanisch in order to arrive at a process that included “drying [that] occurs at a maximum pressure of 300 hPa.”

(2) *Combination with Meador*

Petitioner argues that Meador “teaches that comminuted materials can be introduced into a pyrolysis chamber and heated to decomposition temperatures” and that this heating can occur in a “pyrolysis chamber [that is] maintained under slight vacuum.” Pet. 43–44 (citing Ex. 1011, 3:17–37). According to Petitioner, this vacuum can be “approximately one-half inch of mercury” or “about one-half to one inch of mercury,” which a person of ordinary skill in the art “would have understood to be the mathematical equivalent of pressures ranging from approximately 16 to 33 hPa.” *Id.* at 44 (citing Ex. 1003 ¶ 146; Ex. 1011, 5:59–60, 6:53–59). Petitioner argues that a person of ordinary skill in the art would have been motivated to combine this teaching with the teachings of Hanisch

because of the advantages of improved electrolyte evaporation at a given temperature when lower ambient pressures are used . . . , the attenuation of toxic hydrogen fluoride production during the heating process . . . , and the control over potentially flammable compounds and gasses generated during such heating.

Id. at 46 (citing Ex. 1003 ¶¶ 67–71, 150–152; Ex. 1011, 6:13–49). Patent Owner disagrees. PO Resp. 31–37.

On the record developed at trial, we find that Meador does not teach or suggest a pressure of 300 hPa or less. Dr. van Schalkwijk testified that Meador’s disclosure of a vacuum at one-half to one inch of mercury could be interpreted either as “a very, very . . . intense vacuum” or as “a slight

vacuum.” Ex. 2024, 68:12–69:10. He also testified that “the slight vacuum interpretation is . . . the correct one.” *Id.* at 69:15–70:19. According to Dr. van Schalkwijk, the one-half to one inch of mercury pressure disclosed by Meador should be “interpret[ed] . . . as a relative pressure,” slightly less than atmospheric pressure, rather than as “an absolute pressure” considerably lower than atmospheric pressure. *Id.* at 72:22–73:4; *see also id.* at 112:25–114:13 (confirming that Meador operates only at “a slight vacuum”). Under this testimony, Meador’s absolute operating pressure is between 979 hPa and 1001 hPa, a range that does not overlap the recited range of 300 hPa or less. Ex. 2022 ¶¶ 138–139. Thus, Petitioner has not shown by a preponderance of the evidence that Meador teaches or suggests “drying [that] occurs at a maximum pressure of 300 hPa.”

(3) *Combination with Shin*

Petitioner argues that Shin teaches that “batteries are heated under a vacuum to evaporate gas that is released during the process” of treating them and that “the use of such a vacuum during a heating step is desirable because it reduces risks of explosions and the release of poisonous gases during lithium battery recycling.” Pet. 44 (citing Ex. 1010, 2:65–4:17); *see* Pet. Reply 20 (citing Ex. 1010, 6:33–50, 8:4–15). Petitioner argues that a person of ordinary skill in the art would have been motivated to combine this teaching with the teachings of Hanisch

because of the advantages of improved electrolyte evaporation at a given temperature when lower ambient pressures are used . . . , the attenuation of toxic hydrogen fluoride production during the heating process . . . , and the control over potentially flammable compounds and gasses generated during such heating.

Id. at 46 (citing Ex. 1003 ¶¶ 67–71, 150–152).

We agree with Petitioner that Shin teaches heating batteries under a vacuum. Ex. 1010, 2:65–3:6 (“in the present invention, a method for recovering valuable metals . . . from a lithium-based battery . . . includes . . . a vacuum forming step . . . [and] a heat treatment step”); *see id.* at 10:9–60 (reciting one claim that separates the vacuum forming step and the heat treatment step with an inert gas injection step and one claim that does not include the inert gas injection step). But Petitioner does not even allege, let alone show, that Shin’s vacuum has a pressure of 300 hPa or less. Pet. 44; Pet. Reply 20. Accordingly, Petitioner has not shown by a preponderance of the evidence that Shin teaches or suggests “drying [that] occurs at a maximum pressure of 300 hPa.”

c) Conclusion Regarding Claim 1

For the reasons discussed above, we determine that Petitioner has not shown by a preponderance of the evidence that any of Hayashi, Meador, or Shin both taught a maximum pressure of 300 hPa and would have been combined with Hanisch’s high-temperature process. Accordingly, Petitioner has not shown by a preponderance of the evidence that claim 1 would have been obvious over Hanisch in view of Dunagan and Hayashi, Meador, or Shin.

5. Claims 2, 3, and 7–10

As discussed above, Petitioner has not shown by a preponderance of the evidence that claim 1 would have been obvious over Hanisch in view of Dunagan and Hayashi, Meador, or Shin. Petitioner relies on its arguments with respect to claim 1 in arguing for the obviousness of claims 2, 3, and 7–10, all of which depend from claim 1. Pet. 47–48. Accordingly, Petitioner has not shown by a preponderance of the evidence that claims 2, 3, and 7–10

would have been obvious over Hanisch in view of Dunagan and Hayashi, Meador, or Shin.

6. *Analysis of Claim 12*

a) *“Battery processing installation for treatment of used batteries”*

The preamble of claim 12 recites “[a] battery processing installation for treatment of used batteries.” Ex. 1001, 11:48–49. Petitioner argues that Hanisch teaches the preamble. Pet. 48 (citing Pet. 22, 38). Patent Owner does not dispute this argument. PO Resp. 24–55. Hanisch discloses that its “invention concerns a method for retrieving active material, in particular lithium or lithium compounds, from a galvanic cell” and that “[t]he object of the invention is to improve the retrieval of active material, in particular of lithium or lithium compounds, from old batteries or accumulators.” Ex. 1004, 1:8–10, 1:42–45. Thus, Petitioner has shown by a preponderance of the evidence that Hanisch teaches the preamble of claim 12.

b) *“Comminution unit configured to comminute the batteries such that comminuted material is obtained”*

Claim 12 recites “a comminution unit configured to comminute the batteries such that comminuted material is obtained.” Ex. 1001, 11:50–51. Petitioner argues that Hanisch teaches this limitation. Pet. 48 (citing Pet. 23–24, 38). Patent Owner does not dispute this argument. PO Resp. 24–55. According to Hanisch, there is “a cell crushing device . . . to which galvanic cells . . . are supplied,” and “crushing of the cells is understood in particular to mean cutting, shattering, chaffing or squashing.” Ex. 1004, 2:65–67, 5:37–40, Fig. 1; *see id.* at 5:14–22 (teaching the use of a “shredder and/or cutting device” along with an “impact mill” as “the cell crushing device”).

Thus, Petitioner has shown by a preponderance of the evidence that Hanisch teaches this limitation of claim 12.

c) *“Inactivation device comprising a drying device configured to inactivate the comminuted material”*

Claim 12 recites “an inactivation device comprising a drying device configured to inactivate the comminuted material.” Ex. 1001, 11:52–53. Petitioner argues that Hanisch teaches this limitation. Pet. 48 (citing Pet. 24–27, 29–30, 38); Pet. Reply 5–11. Patent Owner disagrees. PO Resp. 24–25 (citing PO Resp. 14–17); PO Sur-reply 2–6.

(1) *Hanisch’s low-temperature process*

First, Petitioner argues that Hanisch teaches this limitation by teaching low-temperature drying. Pet. 25–26, 29–30. In particular, Petitioner argues that Hanisch teaches this by disclosing “pre-dryer 28 [that] comprises a circulation pump 32 and a condenser 34 for condensing electrolyte, which can be removed via the pipe 36.” *Id.* at 26 (quoting Ex. 1004, 5:54–63). Petitioner also argues that Hanisch “claims this limitation in dependent claim 5,” which includes “the steps of: drying the solid cell fragments at a drying temperature to form dry cell fragments and drying vapours and at least partly condensing the drying vapours to retrieve electrolyte solvents.” *Id.* (quoting Ex. 1004, 8:3–10).

As discussed above, we construe inactivation as the end point of the drying process, so merely some amount of drying is not sufficient to teach or suggest inactivation; instead, drying must be continued until the end point has been reached. On the record developed at trial, Petitioner has not shown by a preponderance of the evidence that Hanisch’s disclosure of a pre-dryer—the low-temperature process of Hanisch—teaches or suggests drying

until the end point of the process is reached. First, claim 5 of Hanisch recites only “drying the solid cell fragments . . . to form dry cell fragments,” without specifying how completely this drying process dries the fragments or how completely fragments must be dried in order to be described as “dry cell fragments.” Ex. 1004, 8:3–10. Similarly, the other portion of the specification to which Petitioner directs us discloses the removal of some electrolyte via heating and condensing, but it does not disclose how much electrolyte is removed. *Id.* at 5:54–63.

Petitioner also argues that Hanisch teaches “the formation of ‘*dry cell fragments*’” and that this disclosure means that the “Hanisch’s pre-dryer results in inactivated comminuted material because it results in fully *dry* material.” Pet. Reply 6 (quoting Ex. 1004, 3:65–4:1). According to Petitioner, “the fact that ‘*dry*’ cell fragments are formed necessarily means all the volatile electrolyte has been removed.” *Id.* at 6–7 (citing Ex. 1023 ¶¶ 9–18). The cited evidence does not support Petitioner’s argument. In the cited paragraphs, Dr. van Schalkwijk testifies that the cell fragments in Hanisch must be completely dried by the pre-dryer because any remaining electrolyte in the material emerging from the pre-dryer would affect the operation of the subsequent separators and classifiers, not that the mere use of the word “dry” to describe Hanisch’s pre-dried material means that the drying must be complete. Ex. 1023 ¶¶ 9–18.

Petitioner argues that the existence of “several processing steps” between the outlet of Hanisch’s pre-dryer and the inlet of Hanisch’s decomposition oven means that the pre-dryer must produce “*dry* and electrochemically safe material.” Pet. Reply 7–8 (citing Ex. 1004, 4:19–24, 5:65–66; Ex. 1023 ¶¶ 10–18). In particular, Petitioner argues that Hanisch

discloses that the dry cell fragments exiting the pre-dryer are treated using “magnetic separators,” “eddy flow separator[s],” and “zigzag classifier[s]” and that a person of ordinary skill in the art “would have understood that the separators and zigzag classifiers are typically designed to work with *dry* material.” *Id.* In support of this argument, Dr. van Schalkwijk testifies that “*active* lithium-ion battery materials contain volatile electrolytes that can ignite if exposed to heat or friction during classification,” as well as that “[d]amp material tends to clump together due to surface tension imparted by free or adsorbed organic solvents from the battery electrolyte, making it difficult for individual particles to separate properly,” which “can hinder the effectiveness of sorting processes.” Ex. 1023 ¶¶ 16–17. The first of these statements cites Exhibit 1036, which “describes a comparison of cartoned lithium-ion . . . batteries and FM Global standard commodities in a rack storage configuration,” not the flammability of battery materials during classification, as Dr. van Schalkwijk testifies. Ex. 1036, 11; *see* Ex. 1023 ¶ 16. Dr. van Schalkwijk’s second statement, regarding the presence of some amount of electrolyte hindering the effectiveness of sorting, does not cite any supporting evidence. Ex. 1023 ¶ 17. Because there is no evidence supporting this expert testimony, we do not accord it significant weight. 37 C.F.R. § 42.65(a).

Thus, Petitioner has not shown by a preponderance of the evidence that Hanisch’s low-temperature process teaches or suggests drying until the end point of the process is reached.

(2) *Hanisch’s high-temperature process*

Second, Petitioner argues that Hanisch teaches this limitation by disclosing a high-temperature drying process. Pet. 29–30 (citing Pet. 26–

27). In particular, Petitioner directs us to Hanisch’s disclosure of “[a]n oven . . . in which there is a decomposition temperature T_z between 400 and 600° C. The binder, for example polyvinylidene fluoride (PVDF), thus decomposes.” *Id.* at 27 (quoting Ex. 1004, 6:8–11). According to Petitioner, a person of ordinary skill in the art “would understand that the temperatures cited would cause the evaporation of the organic solvents from the electrolyte.” *Id.* (citing Ex. 1003 ¶ 103). Patent Owner does not dispute this argument. PO Resp. 11–21.

There is evidence of record that the temperatures present in Hanisch’s decomposition oven would be high enough to cause electrolyte solvents to decompose. Ex. 2001 ¶ 81. According to Mr. Dantam, this decomposition of the solvents would be so complete that “no electrolyte solvents would remain for collection and reuse,” because “the solvents would rapidly decompose into non-electrolyte gases.” *Id.* ¶ 83. The end result would be that “the electrolyte solvent would be destroyed by pyrolysis and none would remain.” *Id.* Because we construe inactivation to require drying to be continued until the end point has been reached, and because Hanisch’s high-temperature process results in the complete elimination of all electrolyte solvent, we find that the preponderance of the evidence supports Petitioner’s argument that Hanisch teaches inactivation in its high-temperature process.

d) *“Wherein the inactivation device is configured to perform the inactivating step during or after the comminuting step of the comminution unit”*

Claim 12 recites that “the inactivation device is configured to perform the inactivating step during or after the comminuting step of the comminution unit.” Ex. 1001, 11:54–56. Petitioner argues that Hanisch

teaches this limitation. Pet. 48 (citing Pet. 23–24, 38). Patent Owner does not dispute this argument. PO Resp. 24–55. According to Hanisch, there is “a cell crushing device . . . to which galvanic cells . . . are supplied,” and “crushing of cells is understood in particular to mean cutting, shattering, chaffing or squashing.” Ex. 1004, 2:65–67, 5:37–40, Fig. 1; *see id.* at 5:14–22 (teaching the use of a “shredder and/or cutting device” along with an “impact mill” as “the cell crushing device”). Thus, Petitioner has shown by a preponderance of the evidence that Hanisch teaches this limitation of claim 12.

e) *“Filling device configured to fill a transport container with the inactivated comminuted material”*

Claim 12 recites “a filling device configured to fill a transport container with the inactivated comminuted material.” Ex. 1001, 11:57–58.

Petitioner argues that Hanisch teaches this limitation. Pet. 48 (citing Pet. 23–24, 38). Patent Owner does not dispute this argument. PO Resp. 24–55. According to Hanisch, there is “a cell crushing device . . . to which galvanic cells . . . are supplied,” and “crushing of cells is understood in particular to mean cutting, shattering, chaffing or squashing.” Ex. 1004, 2:65–67, 5:37–40, Fig. 1; *see id.* at 5:14–22 (teaching the use of a “shredder and/or cutting device” along with an “impact mill” as “the cell crushing device”). Thus, Petitioner has shown by a preponderance of the evidence that Hanisch teaches this limitation of claim 12.

f) *“Vacuum installation connected to the drying device and configured to generate a vacuum in the drying device”*

Claim 12 recites “a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device.”

Ex. 1001, 11:59–61. Petitioner argues that each of Hayashi, Meador, and Shin teaches this limitation and that a person of ordinary skill in the art would have been motivated to combine the teachings of these references with those of Hanisch. Pet. 49–52 (citing Pet. 30–32, 39–40); Pet. Reply 20. Patent Owner disagrees. PO Resp. 25–30, 52–55.

We begin by noting that the vacuum installation of this limitation must be “connected to the drying device,” which is the device “configured to inactivate the comminuted material.” Ex. 1001, 11:48–61. As discussed above, Petitioner shows by a preponderance of the evidence that Hanisch’s decomposition oven is such a drying device, but Petitioner does not show that Hanisch’s pre-dryer is. Thus, Petitioner must show that the combination of Hanisch and at least one of Hayashi, Meador, or Shin teaches or suggests a vacuum installation connected to the decomposition oven.

Petitioner argues that Hanisch itself “teaches that ‘heating of cell fragments up to the decomposition temperature is preferably carried out . . . in a vacuum.’” Pet. 30 (quoting Ex. 1004, 4:6–8). This is correct. According to Hanisch, running the decomposition oven at vacuum pressure “has the advantage that copper then does not oxidise, such that both the anode and the cathode can be processed together,” permitting the copper to “be retrieved with a high degree of purity as a valuable element.” Ex. 1004, 4:6–18. Missing from Hanisch is a teaching of the vacuum installation

recited in challenged claim 12 and needed to generate the vacuum that Hanisch teaches.

Petitioner argues that Meador “teaches that comminuted materials can be introduced into a pyrolysis chamber and heated to decomposition temperatures” and that this heating can occur in a “pyrolysis chamber [that is] maintained under slight vacuum.” Pet. 43–44 (citing Ex. 1011, 3:17–37). According to Petitioner, this vacuum can be “approximately one-half inch of mercury” or “about one-half to one inch of mercury,” which a person of ordinary skill in the art “would have understood to be the mathematical equivalent of pressures ranging from approximately 16 to 33 hPa.” *Id.* at 44 (citing Ex. 1003 ¶ 146; Ex. 1011, 5:59–60, 6:53–59). Petitioner argues that a person of ordinary skill in the art would have been motivated to combine this teaching with the teachings of Hanisch

because of the advantages of improved electrolyte evaporation at a given temperature when lower ambient pressures are used . . . , the attenuation of toxic hydrogen fluoride production during the heating process . . . , and the control over potentially flammable compounds and gasses generated during such heating.

Id. at 46 (citing Ex. 1003 ¶¶ 67–71, 150–152; Ex. 1011, 6:13–49).

As discussed above, we find that Meador does not teach or suggest operating its pyrolysis chamber at a pressure of 300 hPa or less but does teach doing so at a slight vacuum. *See* Ex. 1011, 3:17–37, 5:59–60, 6:53–59; Ex. 2022 ¶¶ 138–139; Ex. 2024, 68:12–69:10, 69:15–70:19, 72:22–73:4, 112:25–114:13. Meador teaches “heating . . . crushed batteries to a temperature sufficient to decompose the crushed batteries in [a] pyrolysis chamber” and “maintaining a vacuum in said pyrolysis chamber sufficient to remove vapors during said decomposition.” Ex. 1011, 6:13–49. According

to Dr. van Schalkwijk, a person of ordinary skill in the art “would have recognized it would be advantageous to apply the teachings of . . .

Meador . . . to Hanisch” because doing so would have “provide[d] the ability to reduce or mitigate formation and potential release of harmful compounds like hydrogen fluoride during the heating process, [as well as] control over potentially flammable compounds and gasses generated during such heating stages.” Ex. 1003 ¶ 151; *see id.* ¶¶ 67–71 (explaining benefits of reduced pressure and temperature when drying battery material). Moreover, Dr. van Schalkwijk testifies that a person of ordinary skill in the art would have understood that implementing Hanisch’s vacuum decomposition using the method of Meador would have required the use of a “vacuum installation . . . configured to generate a vacuum in the drying device.” *Id.* ¶ 165.

Similarly, Petitioner argues that Shin teaches that “batteries are heated under a vacuum to evaporate gas that is released during the process” of treating them and that “the use of such a vacuum during a heating step is desirable because it reduces risks of explosions and the release of poisonous gases during lithium battery recycling.” Pet. 44 (citing Ex. 1010, 2:65–4:17); *see* Pet. Reply 20 (citing Ex. 1010, 6:33–50, 8:4–15). Petitioner argues that a person of ordinary skill in the art would have been motivated to combine this teaching with the teachings of Hanisch

because of the advantages of improved electrolyte evaporation at a given temperature when lower ambient pressures are used . . . , the attenuation of toxic hydrogen fluoride production during the heating process . . . , and the control over potentially flammable compounds and gasses generated during such heating.

Id. at 46 (citing Ex. 1003 ¶¶ 67–71, 150–152).

As discussed above, we find that Petitioner has shown that Shin teaches heating batteries under a vacuum (albeit not a vacuum with a maximum pressure of 300 hPa). Ex. 1010, 2:65–3:6 (“in the present invention, a method for recovering valuable metals . . . from a lithium-based battery . . . includes . . . a vacuum forming step . . . [and] a heat treatment step”); *see id.* at 10:9–60 (reciting one claim that separates the vacuum forming step and the heat treatment step with an inert gas injection step and one claim that does not include the inert gas injection step).

Petitioner argues that Hayashi teaches “processing lithium-ion batteries by heating the battery containing the electrolyte solution under reduced pressure, such that the organic solvents of the electrolyte are evaporated.” Pet. 45 (citing Ex. 1006, 4:33–36). According to Petitioner, this heating under reduced pressure includes “examples in which heating is carried out at a pressure ‘less than or equal to 1 kPa’ . . . over temperatures ranging from 80°C to 150°C.” *Id.* (citing Ex. 1006, 3:20–25). Petitioner argues that a person of ordinary skill in the art would have been motivated to combine this teaching with the teachings of Hanisch “because of the advantages of improved electrolyte evaporation at a given temperature when lower ambient pressures are used . . . , the attenuation of toxic hydrogen fluoride production during the heating process . . . , and the control over potentially flammable compounds and gasses generated during such heating.” *Id.* at 46 (citing Ex. 1003 ¶¶ 67–71, 150–152; Ex. 1006, 4:12–36, 4:43–67, Table 1). Patent Owner disagrees. PO Resp. 37–50.

Petitioner is correct that Hayashi teaches a method in which, “in order to take the electrolyte solution out of the lithium ion battery safely, . . . the electrolyte solution is depressurized and gasified . . . by heating the battery

under reduced pressure.” Ex. 1006, 4:24–34. This heating and reduced pressure includes a pressure of “5 kPa” and a temperature of “80° C. to 150° C.,” at which conditions dimethyl carbonate and ethyl methyl carbonate that are “included in the electrolyte solution . . . are able to be volatilized.” *Id.* at 4:60–67. Moreover, Dr. van Schalkwijk testifies that evaporating solvents at lower temperatures, as is permitted by the use of the lower pressures taught by Hayashi, reduces formation of toxic hydrogen fluoride. Ex. 1003 ¶¶ 67–68 (citing Ex. 1005, 1:20–24, 2:2–27; Ex. 1006, 1:26–29, 2:7–11, 4:12–23). As discussed above, however, Petitioner has not shown that a person of ordinary skill in the art would have combined the teachings of Hayashi with those of Hanisch in order to arrive at a system in which Hanisch’s decomposition oven was operated at the vacuum pressure taught in Hayashi.

Given the teachings of Hanisch, Meador, and Shin, as well as the testimony of Dr. van Schalkwijk, which we credit, we determine that Petitioner has shown by a preponderance of the evidence that the prior art teaches or suggests “a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device” and that a person of ordinary skill in the art would have had reason to combine the relevant teachings of the prior art.

g) Objective Indicia of Nonobviousness

“For objective indicia of nonobviousness to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the claimed invention.” *Lectrosonics, Inc. v. Zaxcom, Inc.*, IPR2018-01129, Paper 33, 32 (PTAB Jan. 24, 2020) (precedential) (citing *ClassCo, Inc. v. Apple, Inc.*, 838 F.3d 1214, 1220 (Fed. Cir. 2016)). A

patentee is entitled to a presumption of nexus “when the patentee shows that the asserted objective evidence is tied to a specific product and that product ‘embodies the claimed features, and is coextensive with them.’” *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (quoting *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1072 (Fed. Cir. 2018) (quoting *Brown & Williamson Tobacco Corp. v. Philip Morris Inc.*, 229 F.3d 1120, 1130 (Fed. Cir. 2000))). “A finding that a presumption of nexus is inappropriate does not end the inquiry into secondary considerations.” *Fox Factory*, 944 F.3d at 1373. “To the contrary, the patent owner is still afforded an opportunity to prove nexus by showing that the evidence of secondary considerations is the ‘direct result of the unique characteristics of the claimed invention.’” *Id.* at 1373–74 (quoting *In re Huang*, 100 F.3d 135, 140 (Fed. Cir. 1996)). “Where the offered secondary consideration actually results from something other than what is both claimed and *novel* in the claim, there is no nexus to the merits of the claimed invention,” meaning that “there must be a nexus to some aspect of the claim not already in the prior art.” *In re Kao*, 639 F.3d 1057, 1068–69 (Fed. Cir. 2011) (emphasis in original). On the other hand, there is no requirement that “objective evidence must be tied exclusively to claim elements that are not disclosed in a particular prior art reference in order for that evidence to carry substantial weight.” *WBIP*, 829 F.3d at 1331. A patent owner may show, for example, “that it is the claimed combination as a whole that serves as a nexus for the objective evidence; proof of nexus is not limited to only when objective evidence is tied to the supposedly ‘new’ feature(s).” *Id.* Ultimately, the fact finder must weigh the secondary considerations evidence presented in the

context of whether the claimed invention as a whole would have been obvious to a skilled artisan. *Id.* at 1331–32.

Here, Patent Owner argues that it “is entitled to the rebuttable presumption of a nexus between the objective evidence of nonobviousness and the Challenged Claims because the evidence is tied to a specific process, Duesenfeld’s battery recycling process at its Wendeburg Plant, and that process is the invention disclosed and claimed in the Challenged Claims.” PO Resp. 60–61 (citing Ex. 2022 ¶¶ 188–189; Ex. 2037, Appx. D; Ex. 2040). The evidence to which Patent Owner directs us includes the testimony of Mr. Dantam that “the Wendeburg Plant . . . practices the ’097 claimed invention.” Ex. 2022 ¶ 189 (citing Ex. 2037, Appx. D; Ex. 2038; Ex. 2040 ¶¶ 6–8; Ex. 2041; Ex. 2053). Both Patent Owner and Mr. Dantam cite the claim chart included in Exhibit 2037,⁶ with Mr. Dantam testifying that the “chart illustrat[es], on a per-limitation basis, how Duesenfeld’s Wendeburg Plant practices Independent Claims 1 and 12 and various dependent claims.” *Id.* Exhibit 2037 contains evidence that the plant in question practices claims 1, 3, 8, 9, 10, 12, and 19 of the ’097 patent. Ex. 2037, 1–23. But a patentee is entitled to a presumption of nexus only “when the patentee shows [both] that the asserted objective evidence is tied to a specific product and that product ‘embodies the claimed features, and is coextensive with them.’” *Fox Factory*, 944 F.3d at 1373. Although the

⁶ Both Patent Owner and Mr. Dantam refer to an “Appendix D” to Exhibit 2037, but the exhibit does not contain any appendices. PO Resp. 60–61; Ex. 2022 ¶ 189; *see* Ex. 2037. We treat the citations to Exhibit 2037 as referring to the claim chart that forms the entire content of the exhibit.

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claim chart of Exhibit 2037 is evidence relating to whether the Wendeburg plant embodies some of the challenged claims, it does not speak to whether the plant is also coextensive with those claims. Ex. 2037, 1–23; *see* Ex. 2022 ¶ 189 (Mr. Dantam testifying only that “the Wendeburg Plant . . . practices the ’097 claimed invention,” not that the plant is also coextensive with any of the challenged claims).

Patent Owner also argues “that the ‘unique characteristics of the claimed invention’ of the ’097 patent are driving the commercial success of Duesenfeld’s battery recycling processes.” PO Resp. 61 (quoting *Volvo Penta of the Ams., LLC v. Brunswick Corp.*, 81 F.4th 1202, 1210 (Fed. Cir. 2023)). In particular, Patent Owner cites evidence that “[a]dvertisements for Dusenfeld’s battery recycling process tout the benefits of the patented ’097 ‘vacuum drying’ technology.” *Id.* at 61–62 (citing Ex. 2012; Ex. 2053, 3, 5). The cited evidence refers to “processes that do not require melting down or high-temperature treatment of batteries,” to “[d]rying below 80 degrees Celsius,” to “the drying process tak[ing] place below 80°C and at a low vacuum,” to “no exhaust gas scrubbing [being] necessary,” to “the solvents of the electrolyte, the graphite and the lithium be[ing] recovered in a purity so that they can be reused,” to “[a] low process temperature prevent[ing] the formation of toxic gases,” and to “[t]he separated solvent ha[ving] a very high purity level because the production of hydrogen fluoride from reaction products is avoided.” Ex. 2012; Ex. 2053, 3, 5. But claim 12 does not recite a lack of “melting down or high-temperature treatment of batteries,” “[d]rying below 80 degrees Celsius,” drying “at a low vacuum,” the lack of a need for “exhaust gas scrubbing,” high-purity recovery of solvents, graphite, or lithium, “[a] low process temperature,” the

prevention of “formation of toxic gases,” or the avoidance of “the production of hydrogen fluoride from reaction products.”⁷ Ex. 1001, 11:48–61. Accordingly, Patent Owner has not shown a nexus between the asserted objective indicia of nonobviousness and claim 12.

h) Conclusion Regarding Claim 12

For the reasons discussed above, we determine that Petitioner has shown by a preponderance of the evidence that claim 12 would have been obvious over Hanisch in view of Dunagan and Hayashi, Meador, or Shin.

7. Claim 13

Claim 13 depends from claim 12 and recites that “the drying device is configured to dry the comminuted material until an electrolyte content in the comminuted material is so low that an electrochemical reaction is impossible.” Ex. 1001, 11:62–12:3. Petitioner argues that Hanisch teaches this limitation. Pet. 32–34, 52. Other than the arguments already discussed above with respect to claim 12, Patent Owner does not dispute Petitioner’s argument with respect to this claim. PO Resp. 24–55. There is evidence of record that the temperatures present in Hanisch’s decomposition oven would be high enough to cause electrolyte solvents to decompose. Ex. 2001 ¶ 81. According to Mr. Dantam, this decomposition of the solvents would be so complete that “no electrolyte solvents would remain for collection and reuse,” because “the solvents would rapidly decompose into non-electrolyte gases.” *Id.* ¶ 83. The end result would be that “the electrolyte solvent would be destroyed by pyrolysis and none would remain.” *Id.* The elimination of

⁷ Claims 13 and 19, the challenged claims that depend from claim 12, also do not recite any of these benefits of Patent Owner’s process. Ex. 1001, 11:62–12:3, 12:25–26.

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the electrolyte solvent would render electrochemical reactions impossible. Thus, Hanisch teaches that “the drying device is configured to dry the comminuted material until an electrolyte content in the comminuted material is so low that an electrochemical reaction is impossible.” Accordingly, Petitioner has shown by a preponderance of the evidence that claim 13 would have been obvious over Hanisch in view of Dunagan and Hayashi, Meador, or Shin.

8. *Claim 19*

Claim 19 depends from claim 12 and recites that “the batteries are lithium batteries.” Ex. 1001, 12:25–26. Petitioner argues that Hanisch teaches this limitation. Pet. 36, 52. Other than the arguments already discussed above with respect to claim 12, Patent Owner does not dispute Petitioner’s argument with respect to this claim. PO Resp. 24–55. Hanisch teaches that its “invention concerns a method for retrieving active material, in particular lithium or lithium compounds, from a galvanic cell.” Ex. 1004, 1:8–10. Thus, Hanisch teaches that “the batteries are lithium batteries.” Accordingly, Petitioner has shown by a preponderance of the evidence that claim 19 would have been obvious over Hanisch in view of Dunagan and Hayashi, Meador, or Shin.

III. MOTION TO AMEND

Patent Owner moves to amend the Challenged Claims, “contingent upon the Board’s determinations of patentability for originally-issued claims.” Mot. Amend 7. In particular, Patent Owner requests replacement “of issued claims 1, 2, 3, 7, 8, 9, 10, 12, 13, and/or 19” with proposed claims 22–31, but Patent Owner requests that we “not consider this motion for any of issued claims 1, 2, 3, 7, 8, 9, 10, 12, 13, and/or 19 that the Board finds to

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be patentable.” *Id.* at 7, 22–30. As discussed above, we determine that Petitioner has not shown the unpatentability of any of claims 1–3 or 7–10, so we do not consider Patent Owner’s motion to amend with respect to the replacement of those claims. We determine that Petitioner has shown, however, the unpatentability of claims 12, 13, and 19, so we proceed to consider Patent Owner’s motion to amend with respect to the replacement of those claims with proposed claims 26, 27, and 29.

A. Legal Standards

“During an inter partes review . . . , the patent owner may file 1 motion to amend the [challenged] patent” by “[c]ancel[ing] any challenged patent claim” or, “[f]or each challenged claim, propos[ing] a reasonable number of substitute claims.” 35 U.S.C. § 316(d)(1). “An amendment . . . may not enlarge the scope of the claims of the patent or introduce new matter.” *Id.* § 316(d)(3). “Any motion to amend may be denied where . . . [t]he amendment does not respond to a ground of unpatentability involved in the trial; or . . . [t]he amendment seeks to enlarge the scope of the claims of the patent or introduce new subject matter.” 37 C.F.R. § 42.121(a)(2). The motion “may cancel a challenged claim or propose a reasonable number of substitute claims. The presumption is that only one substitute claim will be needed to replace each challenged claim, and it may be rebutted by a demonstration of need.” *Id.* § 42.121(a)(3).

Patent Owner bears the ultimate burden to show that its motion to amend complies with the requirements of 35 U.S.C. § 316(d)(1), (3) and 37 C.F.R. § 42.121(a)(2), (a)(3), (b)(1), and (b)(2). 37 C.F.R. § 42.121(d)(1). Petitioner bears the ultimate burden to show that any proposed substitute claims are unpatentable. 37 C.F.R. § 42.121(d)(2).

B. Statutory and Regulatory Requirements

1. Reasonable Number of Substitute Claims

A motion to amend must propose a reasonable number of substitute claims, and there is a presumption that only one substitute claim will be needed to replace each challenged claim. 35 U.S.C. § 316(d)(1)(B); 37 C.F.R. § 42.121(a)(3). Petitioner does not raise any argument on this issue. Pet. Opp. 1–21. Patent Owner proposes ten substitute claims to replace ten challenged claims, and Patent Owner proposes three substitute claims to replace the three challenged claims that we determine Petitioner has shown are unpatentable. Mot. Amend 8–11. Accordingly, Patent Owner has shown it proposes a reasonable number of substitute claims.

2. Response to Ground of Unpatentability

A motion to amend must respond to a ground of unpatentability involved in the proceeding. 37 C.F.R. § 42.121(a)(2)(i). Petitioner does not raise any argument on this issue. Pet. Opp. 1–21. Patent Owner notes that “each of claims 22–31 now contains a limitation requiring a dryer, or drying, operating in a batch mode.” Mot. Amend 18; *see also* Mot. Amend at 22–30 (Claim Listing). Patent Owner contends that “LithoRec’s drying device, however, is not a batch drying device, and LithoRec in fact teaches away from the use of batch drying devices.” *Id.* at 18. Patent Owner contends that “each of the claims excludes Hanisch, and the combination of Hanisch with another reference to reach the new claims would not have the necessary motivation.” *Id.* Accordingly, Patent Owner has shown that the motion to amend responds to a ground of unpatentability involved in this proceeding.

3. *Scope of Amended Claims*

A motion to amend may not enlarge the scope of the claims of the patent. 35 U.S.C. § 316(d)(3); 37 C.F.R. § 42.121(a)(2)(ii). Petitioner does not raise any argument on this issue. Pet. Opp. 1–21. Patent Owner argues that “each Proposed Substitute Claim begins with the language of either independent claim 1 or independent claim 12, and provides only narrowing amendments thereto.” Mot. Amend 13. Our review of proposed claims 26, 27, and 29 shows that Patent Owner is correct in its assertion that each of these claims narrows claim 12. *Id.* at 25–28. Accordingly, Patent Owner’s Motion does not seek to enlarge the scope of the claims of the patent.

4. *New Matter*

A motion to amend may not introduce new subject matter. 35 U.S.C. § 316(d)(3); 37 C.F.R. § 42.121(a)(2)(ii). Petitioner does not raise any argument on this issue. Pet. Opp. 1–21. Patent Owner identifies support in the application that matured into the challenged patent (the ’484 application) for each limitation of each proposed substitute claim. Mot. Amend 13–18. Accordingly, Patent Owner’s Motion does not seek to introduce new subject matter.

C. *Asserted Unpatentability of Claims 26, 27, and 29*

Petitioner argues that claims 26, 27, and 29 are unpatentable because they would have been obvious over various combinations of prior art or are indefinite. Pet. Opp. 2–18. In particular, Petitioner argues that claims 26, 27, and 29 would have been obvious over the combination of Hanisch and Dunagan; that claims 26, 27, and 29 would have been obvious over the combination of Hanisch, Dunagan, Hayashi, and Shin; and that the

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“inactivating” limitations of claims 26, 27, and 29 are indefinite. *Id.* Patent Owner disagrees with each of Petitioner’s arguments. PO Reply 1–11.

1. Asserted Obviousness over Hanisch and Dunagan

Each of claims 26, 27, and 29 recites a limitation requiring “a vacuum installation connected to the drying device and configured to generate a vacuum in the drying device, such that the drying device operates with a pressure of 300 hPa or less.” Mot. Amend 25–28. Relying on its arguments with respect to the original claims, Petitioner argues that “Hanisch alone or in combination with Dunagan and in view of the knowledge of a POSITA renders obvious this limitation.” Pet. Opp. 5–7 (citing Pet. 30–32; Pet. Reply 11–15, 17–20; Ex. 1003 ¶¶ 68–70, 110–116; Ex. 1004, 3:4–9, 4:6–8, 4:55–59, 5:62–63, 8:11–13; Ex. 1023 ¶¶ 36–37). Patent Owner disagrees. PO Reply 4–5.

Above, we discussed the obviousness over the combination of Hanisch and Dunagan of the limitation of claim 1 reciting that “the drying occurs at a maximum pressure of 300 hPa.” We determined that Petitioner had relied on Hanisch as teaching this limitation and had not shown that Hanisch teaches or suggests that “the drying occurs at a maximum pressure of 300 hPa.” For the reasons discussed above, and because Petitioner relies on the same arguments with respect to the proposed amended claims, we determine that Petitioner has not shown by a preponderance of the evidence that claims 26, 27, and 29 would have been obvious over the combination of Hanisch and Dunagan.

2. Asserted Obviousness over Hanisch, Hayashi, Dunagan, and Shin

Each of claims 26, 27, and 29 recites a limitation requiring “a vacuum installation connected to the drying device and configured to generate a

vacuum in the drying device, such that the drying device operates with a pressure of 300 hPa or less.” Mot. Amend 25–28. Relying on its arguments with respect to the original claims, Petitioner argues that “Hanisch alone or in combination with Dunagan and in view of the knowledge of a POSITA renders obvious this limitation.” Pet. Opp. 11–14 (citing Pet. 30–32, 43–46; Pet. Reply 11–15, 17–20; Ex. 1003 ¶¶ 110–116, 145–152; Ex. 1023 ¶ 53). Patent Owner disagrees. PO Reply 4–5.

Above, we discussed the obviousness over the combination of Hanisch, Dunagan, Hayashi, Meador, and Shin of the limitation of claim 1 reciting that “the drying occurs at a maximum pressure of 300 hPa.” We determined that Petitioner had not shown by a preponderance of the evidence that any of Hayashi, Meador, or Shin both taught a maximum pressure of 300 hPa and would have been combined with Hanisch’s high-temperature process. For the reasons discussed above, and because Petitioner relies on the same arguments with respect to the proposed amended claims, we determine that Petitioner has not shown by a preponderance of the evidence that claims 26, 27, and 29 would have been obvious over the combination of Hanisch, Dunagan, Hayashi, and Shin.

3. Asserted Indefiniteness of “Inactivate”

Petitioner argues that claims 26, 27, and 29 are unpatentable as indefinite because a person of ordinary skill in the art “would not have understood from the ’097 Patent the outer boundaries of when comminuted material is considered ‘inactivated.’” Pet. Opp. 14–18. Patent Owner disagrees. PO Reply 9–11.

The specification of a patent “shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the

inventor or a joint inventor regards as the invention.” 35 U.S.C. § 112(b). To satisfy this requirement, “a patent’s claims, viewed in light of the specification and prosecution history, [must] inform those skilled in the art about the scope of the invention with reasonable certainty.” *Nautilus, Inc. v. Biosig Instr., Inc.*, 572 U.S. 898, 910 (2014).

Here, Petitioner argues that Patent Owner’s proposed construction of “inactivate,” which we have adopted, and under which “inactivation is merely ‘the endpoint result of drying, but not specif[ic] [to] the particular metric of drying that must be reached,’ . . . means there is no limitation on how one knows material has been inactivated.” Pet. Opp. 16. This argument is bolstered by the fact that there are several different endpoints described in the ’097 patent’s specification. Ex. 1001, 2:2–4, 3:13–14 (defining endpoint of drying in terms of safety of transportation), 3:49–55 (endpoint reached when “no flammable or explosive gas mixture can form above the comminuted material” or when “a flammable or explosive gas mixture can[not] emerge in the transport container or during the subsequent processing”), 4:5–7 (endpoint reached when “an electrolyte content is so low that an electrochemical reaction is not possible”), 4:19–27 (endpoint reached when “the build-up of heat is so low that a thermal runaway, i.e., a thermally induced chain reaction, is ruled out for at least two months,” or when “any build-up of hydrogen is so low that after two weeks, no excess pressure occurs if a negative pressure of 500 hPa is present to begin with”), 4:28–40 (endpoint reached when “the electrolyte content of organic components that are volatile at 80° C. has a maximum value of 3% by weight,” “the accumulated content of organic carbonates from the electrolyte that are volatile at 80° C. falls short of 3% by volume in the atmosphere above the

comminuted material,” or “the dimethyl carbonate content is lower than 4% by volume . . . and/or the cyclohexylbenzene content is lower than 1% by volume”). But “[j]ust because a term is susceptible to more than one meaning does not render it indefinite.” *ClearOne, Inc. v. Shure Acquisition Holdings, Inc.*, 35 F.4th 1345, 1351 (Fed. Cir. 2022). The fact that reaching various different endpoints of the drying process could satisfy the claims’ requirement for inactivation under differing circumstances, therefore, does not make the claims indefinite.

Petitioner’s argument for indefiniteness is further undermined by the fact that Petitioner’s expert testified that certain disclosures in the prior art fell within the scope of inactivation, suggesting that a person of ordinary skill in the art was capable of determining the scope of that term. For example, Dr. van Schalkwijk testified that “the fact that battery material [in Hanisch] goes from the pre-dryer to the separators and classifier means that the battery material must have been fully dried to the point of inactivation.” Ex. 1023 ¶ 15. Similarly, he testified that, “based on the fact that Hanisch uses the ‘pre-dryer’ to fully dry material before putting it through separators and classifiers, a POSITA would have understood the ‘dry cell fragments’ formed by Hanisch’s low temperature dryer to be . . . inactivated.” *Id.* ¶ 18; *see* Ex. 2061, 3:7–4:19 (confirming this testimony). Use of a term by an expert “provide[s] evidence that a skilled artisan did understand the scope of th[e] invention with reasonable certainty.” *Sonix Tech. Co. v. Publications Int’l, Ltd.*, 844 F.3d 1370, 1380 (Fed. Cir. 2017).

Instead, we see the term “inactivate” in the proposed amended claims as similar to a term of degree. Just as the use of the phrase “substantial increase” in the claims in *In re Marosi* gave rise to the question “How much

is a substantial increase?” the use of the term “inactivate” here gives rise to the question “How dry is material that has been dried to the point of inactivation?” 710 F.2d 799, 802–03 (Fed. Cir. 1983). If the specification “provides ‘a general guideline and examples sufficient to enable a person of ordinary skill in the art to determine [the scope of the claims],’” then “the claims are not indefinite.” *Enzo Biochem, Inc. v. Applera Corp.*, 599 F.3d 1325, 1335 (Fed. Cir. 2010) (quoting *Marosi*, 710 F.2d at 803) (alteration in original). Here, as in *Enzo Biochem*, there is a general guideline regarding the scope of “inactivate”: it means drying to the endpoint of the drying process. And there are many examples of such endpoints that might be used in different contexts. Ex. 1001, 2:2–4, 3:13–14, 3:49–55, 4:5–7, 4:19–40. Thus, we determine that the claims are not indefinite for use of the term “inactivate.”

IV. CONCLUSION

For the reasons set forth above, we determine that (1) Petitioner has established by a preponderance of the evidence that claims 12, 13, and 19 of the ’097 patent are unpatentable; (2) Petitioner has not shown the unpatentability of claims 1–3 and 7–10 of the ’097 patent; and (3) the record supports granting Patent Owner’s Motion to Amend with respect to proposed claims 26, 28, and 29.

In summary, with respect to the challenged claims of the ’097 patent:

Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
1–3, 7– 10, 12,	103	Hanisch, Dunagan	12, 13, 19	1–3, 7–10

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Claim(s)	35 U.S.C. §	Reference(s)/Basis	Claim(s) Shown Unpatentable	Claim(s) Not Shown Unpatentable
13, 19				
1–3, 7– 10, 12, 13, 19	103	Hanisch, Dunagan, Hayashi, Meador, Shin	12, 13, 19	1–3, 7–10
Overall Outcome			12, 13, 19	1–3, 7–10

In summary, with respect to Patent Owner’s Motion to Amend:

Motion to Amend Outcome	Claim(s)
Original Claims Cancelled by Amendment	12, 13, 19
Substitute Claims Proposed in the Amendment	22–31
Substitute Claims: Motion to Amend Granted	26, 27, 29
Substitute Claims: Motion to Amend Denied	
Substitute Claims: Not Reached	22–25, 28, 30, 31

V. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that Petitioner has shown that claims 12, 13, and 19 of the ’097 patent are unpatentable;

FURTHER ORDERED that Petitioner has not shown that claims 1–3 and 7–10 of the ’097 patent are unpatentable;

FURTHER ORDERED that Patent Owner’s Motion to Amend is granted to the extent that claims 12, 13, and 19 shall be replaced with claims 26, 27, and 29, respectively;

FURTHER ORDERED that Patent Owner’s Motion to Amend is moot in all other respects; and

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FURTHER ORDERED that, because this is a Final Written Decision, parties to the proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

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FOR PETITIONER:

Andrew D. Gish
Ryan Iwahashi
Josef B. Schenker
GISH PLLC
andrew@gishpllc.com
ryan@gishpllc.com
josef.schenker@gishpllc.com

FOR PATENT OWNER:

Steven C. Carlson
Samuel J. LaRoque
ROBINS KAPLAN LLP
scarlson@robinskaplan.com
slaroque@robinskaplan.com

Matthew Smith
Elizabeth Laughton
SMITH BALUCH LLP
smith@smithbaluch.com
laughton@smithbaluch.com
rk-duesenfeld@robinskaplan.com