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Paper 14
Date: April 25, 2025

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SOLUS ADVANCED MATERIALS CO., LTD.,
Petitioner,

v.

SK NEXILIS CO., LTD.,
Patent Owner.

IPR2024-01462
Patent 11,346,014 B2

Before JOHN G. NEW, JO-ANNE M. KOKOSKI, and JON B. TORNQUIST, *Administrative Patent Judges.*

KOKOSKI, *Administrative Patent Judge*.

DECISION
Denying Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

Solus Advanced Materials Co., Ltd. ("Petitioner") filed a Petition to institute an *inter partes* review of claims 1–8 ("the challenged claims") of U.S. Patent No. 11,346,014 B2 ("the '014 patent," Ex. 1001). Paper 2 ("Pet."). SK nexilis Co., Ltd. ("Patent Owner") filed a Preliminary Response. Paper 8 ("Prelim. Resp."). With Board authorization, Petitioner filed a Preliminary Reply (Paper 9, "Prelim. Reply"), and Patent Owner filed a Preliminary Sur-reply (Paper 10, "Prelim. Sur-reply"). We also authorized one-page briefs from each party addressing the recent Director Review decision in *Motorola Solutions, Inc. v. Stellar, LLC*, IPR2024-01205, Paper 19 (PTAB March 28, 2025) ("Motorola"). Paper 12 ("Patent Owner's Supplemental Brief" or "Sup. Brief"); Paper 13 ("Petitioner's Response Brief").

Institution of an *inter partes* review is authorized by statute when "the information presented in the petition . . . and any response . . . shows that there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." 35 U.S.C. § 314; *see also* 37 C.F.R. § 42.4. For the reasons discussed below, we deny the Petition and do not institute an *inter partes* review.

A. Real Parties in Interest

Petitioner identifies itself, Volta Energy Solutions Canada Inc., Volta Energy Solutions Europe KFT, Volta Energy Solutions Hungary KFT, and Volta Energy Solutions S.A.R.L. as the real parties in interest. Pet. 76. Patent Owner identifies itself as the real party in interest. Paper 4 (Mandatory Notice), 2.

B. Related Matters

The parties identify the following proceedings as related matters:

- *SK nexilis Co., Ltd. v. Solus Advanced Materials, Co., Ltd.*, No. 2:23-cv-00539 (E.D. Tex.).
- *Solus Advanced Materials Co., Ltd. v. SK nexilis Co., Ltd.*, IPR2024-01460.
- *Solus Advanced Materials Co., Ltd. v. SK nexilis Co., Ltd.*, IPR2024-01461.
- *Solus Advanced Materials Co., Ltd. v. SK nexilis Co., Ltd.*, IPR2024-01463.
- *Solus Advanced Materials Co., Ltd. v. SK nexilis Co., Ltd.*, IPR2024-01464.
- *Solus Advanced Materials Co., Ltd. v. SK nexilis Co., Ltd.*, IPR2025-00005.

Pet. 76; Paper 4, 2.

C. The '014 Patent

The '014 patent is directed to "a copper foil current collector, and more particularly to an electrolytic copper foil that has high force of adhesion with a negative electrode active material of" a lithium secondary battery. Ex. 1001, 1:18–21. The '014 patent explains that an electrolytic copper foil having this property can be achieved "by controlling the surface properties of the copper foil." *Id.* at 1:66–2:3.

The '014 patent describes an electrolytic copper foil having a first protective layer at a first surface side and a second protective layer at a second surface side, with a copper film disposed between the first and second protective layers. Ex. 1001, 2:13–19. The binding coefficient of the copper foil at the first or the second surface is defined by Mathematical Expression 1:

> Binding coefficient = Rp/μm + peak density/30 + amount of attachment of Cr/(mg/m^2)

Id. at 2:19–28. Peak height Rp is measured according to JIS B 0601 (2001) standards, and the peak density is measured according to ASME B46.1 standards. *Id.* at 4:55–56, 4:63–65. The '014 patent teaches that the value of the binding coefficient is 1.5 to 9.4. *Id.* at 2:20–22. According to the '014 patent, when "the binding coefficient (BC) is less than 1.5, the number of active sites of the copper foil capable of contacting a negative electrode slurry is too small," and adhesion is reduced. *Id.* at 5:22–25. When "the binding coefficient exceeds 9.4, affinity between the negative electrode slurry and the copper foil is deteriorated, and irregularities of the surface are excessive," such that "the surface of the copper foil is not uniformly coated with a negative electrode agent" and the "force of adhesion between the copper foil and the negative electrode agent is greatly reduced." *Id.* at 5:25–33.

The '014 patent also describes an electrolytic copper foil manufacturing apparatus in which a positive electrode plate and a rotary negative electrode drum are provided in an electrolytic solution contained in an electrolytic bath "so as to be spaced apart from each other." Ex. 1001, 7:22–28. When power is applied between the negative electrode drum and the positive electrode plate while the negative electrode drum rotates, "plating is performed through electric conduction via the electrolytic solution." *Id.* at 7:28–33. The copper film plated on the negative electrode drum is then wound along a guide roll. *Id.* at 7:33–35.

The '014 patent further explains that, when the concentration of total carbon (TC) in the electrolytic solution is high, the plating is nonuniform and the peak height Rp and peak density increase. Ex. 1001, 8:3–5. When

the concentration of Co^{2+} in the electrolytic solution is increased, uniform plating may occur and the peak height Rp and peak density decrease. *Id.* at 8:5–10. The '014 patent, therefore, teaches that the amount "of TC and $Co^{2\pm}$ is adjusted to control the peak height Rp and the peak density," such that the TC concentration in the electrolytic solution "must be maintained at 0.12 g/L or less, and the concentration of $Co^{2\pm}$ must be maintained at 0.33 g/L or less." *Id.* at 8:10–15. According to the '014 patent, when the concentration of TC and $Co^{2\pm}$ exceeds 0.12 and 0.33 g/L, respectively, "the peak height Rp and the peak density increase in a portion of the copper foil, and the peak height Rp and the peak density decrease in another portion of the copper foil," and "it is not appropriate to use such a copper foil as a negative electrode current collector." *Id.* at 8:15–22.

The '014 patent also teaches that the texture and yield strength of the copper foil may be controlled by the content of a nitride in the electrolytic solution. Ex. 1001, 8:23–28. "[A]t least one nitride selected from the group consisting of diethylenetriamine (DETA), thiourea, gelatin, collagen, glycine, glycogen, polyacrylamide, and propyl amide may be used as a preferred nitride." *Id.* at 8:28–32. The '014 patent teaches that the appropriate concentration of DETA as an additive, for example, is 3.2 to 12.0 ppm, because when the concentration is less than 3.2 ppm, it is difficult to achieve the yield strength of the copper foil, and when it exceeds 12.0 ppm, the yield strength exceed the required level. *Id.* at 8:32–38.

D. Illustrative Claims

Petitioner challenges claims 1–8 of the '014 patent. Claims 1 and 5 are independent and reproduced below.

1. [1pre] An electrolytic copper foil having a first surface and a second surface, the electrolytic copper foil comprising:

[1a] a first protective layer at the first surface;

[1b] a second protective layer at the second surface; and

[1c] a copper film disposed between the first and second protective layers, wherein

[1d] a binding coefficient of the electrolytic copper foil at the first surface or the second surface, defined as Mathematical Expression 1 below, is 1.5 to 9.4,

(Mathematical Expression 1)

Binding coefficient=Rp/μm+ peak density/30+ amount of attachment of Cr/(mg/m^2)

(wherein the Rp(μm) is a peak height measured according to JIS B 0601 (2001) standard, wherein the peak density is a number of peaks per unit length of 4 mm, wherein the peak density is measured according to ASME B46.1 (2009) standard with a peak count level of ±0.5 μm and wherein the amount of attachment of Cr (mg/m^2) is measured by dissolving the first surface or the second surface of the electrolytic copper foil (110) with a nitric acid solution to obtain a dissolved solution, diluting the dissolved solution with water to obtain a diluted solution, and analyzing the diluted solution using an atomic absorption spectrometer).

Ex. 1001, 13:52–13:67, 14:21–28 (bracketed material added by Petitioner).

5. [5pre] A method of manufacturing an electrolytic copper foil, the method comprising:

[5a] electroplating a copper film on a rotary negative electrode drum by applying current between a positive electrode plate and the rotary negative electrode drum disposed in an electrolytic solution contained in an electrolytic bath so as to be spaced apart from each other;

[5b] winding the electroplated copper film; and

[5c] immersing the copper film in an anti-corrosion solution for anti-corrosion treatment,

[5d] wherein, when the electroplating is performed, a concentration of total carbon is maintained at 0.12 g/L or less and

[5e] a concentration of $Co^{2\pm}$ is maintained at 0.33 g/L or less.

Id. at 14:60–15:6 (bracketed material added by Petitioner).

E. Asserted Grounds

Petitioner asserts that claims 1–8 would have been unpatentable on the following grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1, 4, 8	103	Hanafusa,[1] Dobashi[2]
2	103	Hanafusa, Dobashi, Cheng[3]
3	103	Hanafusa, Dobashi, Kim[4]
5, 6	103	Hanafusa, Dobashi, Lee[5]
7	103	Hanafusa, Dobashi, Kajihara[6]

Pet. 1. Petitioner relies on the Declaration of Dr. Jack Josefowicz (Ex. 1003) in support of its contentions.

II. ANALYSIS

A. Level of Ordinary Skill in the Art

Petitioner contends that a person of ordinary skill in the art ("POSITA") "would have had at least an undergraduate degree in materials science, chemical engineering, electrical engineering, or related field, or

[1] US 2010/0136434 A1, published June 3, 2010 ("Hanafusa," Ex. 1004).
[2] US 8,715,836 B2, issued May 6, 2014 ("Dobashi," Ex. 1005).
[3] US 9,209,485 B2, issued Dec. 8, 2015 ("Cheng," Ex. 1007).
[4] US 8,349,518 B2, issued Jan. 8, 2013 ("Kim," Ex. 1008).
[5] US 11,142,838 B2, issued Oct. 12, 2021 ("Lee," Ex. 1006).
[6] US 4,981,560, issued Jan. 1, 1991 ("Kajihara," Ex. 1012).

equivalent knowledge, training, or experience, with at least two years of experience working on the development of materials or components for electronic devices such as batteries." Pet. 2. Petitioner further contends that "[a]dditional education, such as a graduate degree, could compensate for less work experience, and additional work experience could compensate for less formal education." *Id.* Patent Owner states that, "[f]or purposes of this Preliminary Response, Patent Owner applies Petitioner's level of skill for a person of ordinary skill in the art." Prelim. Resp. 4.

For purposes of this Decision, we adopt Petitioner's undisputed proposed definition because it appears to be consistent with the cited prior art and the disclosure of the '014 patent. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (explaining that specific findings regarding ordinary skill level are not required "where the prior art itself reflects an appropriate level and a need for testimony is not shown" (quoting *Litton Indus. Prods., Inc. v. Solid State Sys. Corp.*, 755 F.2d 158, 163 (Fed. Cir. 1985))).

B. Claim Construction

We construe each claim "in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent." 37 C.F.R. § 42.100(b). Under this standard, claim terms are generally given their plain and ordinary meaning as would have been understood by a person of ordinary skill in the art at the time of the invention and in the context of the entire patent disclosure. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313 (Fed. Cir. 2005) (en banc). Only those terms in controversy need to be construed, and only to the extent necessary to resolve the controversy. *Realtime Data LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019).

Petitioner contends that "no formal claim constructions are necessary in this proceeding." Pet. 3. Patent Owner contends that "[t]he Board need not construe any term in order to determine that institution should be denied." Prelim. Resp. 4.

Based on the record before us, we determine that no claim term requires express construction for purposes of this Decision. *See Realtime Data*, 912 F.3d at 1375.

C. Asserted Obviousness over Hanafusa and Dobashi

Petitioner asserts that claims 1, 4, and 8 would have been obvious over the combined teachings of Hanafusa and Dobashi. Pet. 6–34.

1. Overview of Hanafusa

Hanafusa relates to an electrolytic copper foil used for "a negative current collector for a lithium rechargeable (secondary) battery that will not be easily broken due to electrode breakage caused by charge and discharge of the lithium rechargeable battery" and "to a process for producing such an electrolytic copper foil." Ex. 1004 ¶ 1. Hanafusa teaches that an electrolytic copper foil "that has good proof stress and elongation rate and will not be easily broken can be obtained by subjecting the electrolytic copper foil to an annealing treatment at a specified temperature." *Id.* ¶ 8.

Hanafusa teaches that an electrolytic copper foil that has a 0.2% proof stress of 18 to 25 kgf/mm^2 and an elongation rate of 10% or more, preferably 10 to 19%, prevents electrode breakage. *Id.* ¶¶ 9–10. Hanafusa further teaches that "the surface roughness Rz of the copper foil is 1.0 to 2.0 μm." *Id.* ¶ 12. According to Hanafusa, "[l]arge surface roughness is not favorable for prevention of breakage because it could easily cause generation of cracks," and when the surface roughness Rz "is less than 1.0 μm, adhesion to a negative-electrode material tends to decrease."

Id. Hanafusa also teaches that "a rust-proof chromium layer is provided on a surface of the electrolytic copper foil and a deposition amount of chromium in the rust-proof layer is 2.6 to 4.0 mg/m^2." Ex. 1004 ¶ 13. Hanafusa teaches that an electrolytic foil having these properties "is manufactured by subjecting the electrolytic copper foil to an annealing treatment at a temperature within the range of 175° C. to 300° C." *Id.* "The electrolytic copper foil originally has the defect of low flexibility; however, the flexibility and proof stress can be improved by annealing the electrolytic copper foil." *Id.*

Hanafusa also describes an electrolytic copper foil manufacturing apparatus that "is configured so that a cathode drum is set in an electrolytic bath which contains an electrolyte," wherein the cathode drum "is designed to rotate while a part (roughly the lower half part) . . . is immersed in the electrolyte." Ex. 1004 ¶ 18. An insoluble anode "is placed to surround the outside surface of the lower half part of the cathode drum," the electrolyte flows between the cathode and anode in the space between them. *Id.* ¶ 19. When the cathode drum rotates, "the thickness of the copper electrodeposited from the electrolyte increases" and when the thickness reaches a certain value or more, the raw copper foil "is peeled off and continuously wound up." *Id.* ¶ 21. The electrolytic copper foil is then is put in an annealing furnace and an annealing treatment is performed at a temperature within the range of 175° C. to 300° C." *Id.* ¶ 24. Hanafusa teaches that if the annealing treatment is performed at temperature above 350° C, the copper foil will oxidize, and if it is performed at a temperature below 170° C., "residual stress existing in the electrolytic copper foil is high and proof stress . . . is too large, thereby failing to achieve the object of the present invention." *Id.* ¶¶ 24–25. Hanafusa further teaches that surface

oxidation of the electrolytic copper foil can be prevented by "having a rust-proof chromium layer whose chromium deposition amount is 2.6 to 4.0 mg/m^2." *Id.* ¶ 31.

2. Overview of Dobashi

Dobashi "relates to a surface-treated electro-deposited copper foil, an electro-deposited copper foil, and a method for manufacturing the same." Ex. 1005, 1:7–9. Dobashi teaches that "since RSm (JIS B 0601, 2001) obtained by using the stylus-type roughness meter can be adopted as the period of waviness, RSm can also be used as an indicator for judgment of the surface." *Id.* at 6:23–27. Dobashi explains that "[t]he surface has small waviness and is smooth when RSm is large, and the surface has large waviness and is rough when RSm is small." *Id.* at 6:27–29.

3. Analysis

Petitioner contends that the combined teachings of Hanafusa and Dobashi discloses all of the limitations of claims 1, 4, and 8, and that a POSITA would have been motivated to combine Hanafusa and Dobashi with a reasonable expectation of success. Pet. 9–34. Patent Owner responds that Petitioner does not establish that the proposed combination discloses peak density or a sufficient reason to combine Dobashi with Hanafusa, and does not demonstrate a reasonable expectation of success of modifying Hanafusa with Dobashi. Prelim. Resp. 18–46. We focus our discussion on Petitioner's contention that a POSITA would have been motivated to combine Dobashi with Hanafusa with a reasonable expectation of success, as it is dispositive for purposes of this Decision.

a) Motivation to Combine Hanafusa and Dobashi

Petitioner contends that "a POSITA would have recognized that Hanafusa's electrolytic copper foil would be implemented or modified to

have the claimed peak density as taught by Dobashi." Pet. 9 (citing Ex. 1003 ¶ 46). Petitioner contends that

> the resulting electrolytic copper foil would have an Rz value between 1.0 to 2.0 μm (and therefore an Rp value less than the Rz values, . . .) and a range for chromium deposition of 2.6 to 4.0 mg/m^2 . . ., as taught by Hanafusa, and further have the peak density ranging from 10.3 to 28.6, through Dobashi's disclosure of RSm values.

Id. (citing Ex. 1003 ¶ 46).

Petitioner further contends that "a POSITA would have been motivated to apply Dobashi's disclosure of 'RSm' to further achieve Hanafusa's stated purpose." Pet. 10–11 (citing Ex. 1003 ¶¶ 50–51). Petitioner asserts that Hanafusa teaches that the rough surface be low-profile, and "all the known methods for making a rough surface low-profile can be used." *Id.* at 11 (citing Ex. 1004 ¶ 23).[7] Thus, Petitioner contends, "a POSITA would have looked into other references like Dobashi to identify such a known method to make a rough surface low-profile." *Id.* (citing Ex. 1004 ¶ 23; Ex. 1003 ¶ 51). Petitioner also contends that:

> A POSITA would have been further prompted to pursue this implementation of the RSm values (and thus peak density values) of Dobashi's electrolytic copper foil into Hanafusa's electrolytic copper foil as doing so is merely the application of known techniques (e.g., using additives such as MPS and SPS in electrolytic solution for the manufacture of electrolytic copper foil with desirable characteristics) to a known structure (e.g., electrolytic copper foil prepared through electrodeposition process) to yield predictable results (e.g., electrolytic copper foil with desirable characteristics including improved surface roughness properties).

[7] Petitioner cites to paragraph 23 of Exhibit 1005 instead of Exhibit 1004. Pet. 11. We recognize this as a typographical error and use the correct exhibit number.

Id. (citing Ex. 1003 ¶ 52).

To support a showing of obviousness, there has to be articulated reasoning with rational underpinning to support a motivation to combine prior art teachings, and the analysis should be explicit. *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 418 (2007) (citing *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006) ("[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.")); *Regents of Univ. of Cal. v. Broad Inst., Inc.*, 903 F.3d 1286, 1291 (Fed. Cir. 2018) ("An obviousness determination requires finding that [an ordinarily skilled artisan] would have been motivated to combine or modify the teachings in the prior art and would have had a reasonable expectation of success in doing so."). Based on our review of the record, we find that there is insufficient explanation supported by record evidence as to why a person having ordinary skill in the art would have combined Dobashi with Hanafusa as proposed by Petitioner, and why the ordinarily skilled artisan would have had a reasonable expectation of success in doing so.

As an initial matter, we note that Petitioner's contention that Dobashi's disclosure of RSm would further achieve Hanafusa's purpose is akin to saying that Hanafusa and Dobashi are directed to the same field of art. Petitioner's identification of the similarities between Hanafusa and Dobashi, however, is not sufficient, by itself, to support a conclusion of obviousness. *See KSR*, 550 U.S. at 418. The Federal Circuit has said that merely asserting that two references are drawn from the same field of art is "simply too conclusory" to show that the skilled artisan would have combined the references in the way of the claimed invention, because

"[s]uch short-cut logic would lead to the conclusion that any and all combinations of elements known in this broad field would automatically be obvious, without the need for any further analysis." *Securus Techs., Inc. v. Glob. Tel*Link Corp.*, 701 F. App'x 971, 977 (Fed. Cir. 2017); *see Microsoft Corp. v. Enfish, LLC*, 662 F. App'x 981, 990 (Fed. Cir. 2016) (determining that "the Board correctly concluded" that a petitioner "did not articulate a sufficient motivation to combine" where the only reason given was "that the references were directed to the same art or same techniques").

Further, the question of whether the prior art references are in the same field of endeavor as the challenged patent is merely a jumping-off point in the determination of whether a claimed invention is obvious. *See K-Tec, Inc. v. Vita-Mix, Corp.*, 696 F.3d 1364, 1375 (Fed. Cir. 2012) (to qualify as prior art in an obviousness analysis, references must be analogous art—either in the same field of endeavor as the challenged patent, or reasonably pertinent to the problem with which the inventor is involved). Even assuming the references are analogous art to the '014 patent, it is still necessary to show that it would have been obvious to a POSITA to select and combine the teachings of those references in the manner claimed.

Petitioner also focuses on Hanafusa's teaching that all known methods can be used to make a rough surface low-profile, and Dobashi's teaching that RSm can be used as an indicator for judgment of the surface, to support its contention that a POSITA would have been motivated to apply Dobashi's RSm to further achieve Hanafusa's purpose, without explaining how and why that would be the case. In particular, neither Petitioner nor Dr. Josefowicz adequately explain why a POSITA looking for ways to make Hanafusa's surface roughness low-profile would look to methods to achieve

Dobashi's RSm[8] values. Dobashi teaches that because RSm "can be adopted as the period of waviness, RSm can also be used as an indicator for judgment of the surface." Ex. 1005, 2:66–3:1, 6:23–26. Dobashi explains that waviness is "an indicator for determining whether the fine pattern forming performance is good or bad," and "[t]he surface has small waviness and is smooth when RSm is large, and the surface has large waviness and is rough when RSm is small." *Id.* at 3:1–3, 6:27–29. Dobashi also teaches that surface roughness Rzjis is used as a low-profile indicator. Ex. 1005, 2:66–3:1. Dobashi, therefore, teaches that RSm is an indicator of surface waviness, which Dobashi explains is different than surface roughness. *Id.* at 2:66–3:3, 6:23–29. Given these teachings in Dobashi, neither Petitioner nor Dr. Josefowicz sufficiently explains how or why a POSITA would have been motivated to implement Dobashi's RSm values to make Hanafusa's surface roughness low-profile. *See* Pet. 10–12; Ex. 1003 ¶¶ 46–52.

In that regard, Hanafusa teaches that surface roughness Rz is preferably below 2.0 μm in order to avoid crack-forming conditions, and above 1.0 μm to avoid decreasing adhesion to a negative-electrode material. Ex. 1004 ¶ 4; *see also id.* ¶ 23 ("a markedly uneven surface may cause cracks" and "is one of the conditions that should preferably be avoided" and "[t]hus, it is necessary to make the rough surface low-profile"). As a result, the low-profile rough surface that Hanafusa teaches can be made using "all the known methods" and would have a surface roughness Rz of 1.0 to 2.0 μm. *Id.* ¶¶ 4, 23; *see also* Pet. 9 ("the resulting electrolytic copper foil would have an Rz value between 1.0 to 2.0 μm"). Dobashi, however,

[8] Dobashi explains that RSm is measured according to JIS B 0601 (2001), which defines RSm as the "mean value of the profile element widths Xs within a sampling length." Ex. 1005, 6:23–25; Ex. 1010, 14.

teaches that surface roughness Rzjis, which, like Hanafusa's Rz, is an indicator of profile height, is preferably 0.1 to 1.0 μm, because a higher Rzjis requires a longer over-etching time, and may provide insufficient adhesion. Ex. 1005, 8:4–28. Petitioner and Dr. Josefowicz do not address these conflicting Rz values, or explain why a POSITA would look to Dobashi's RSm values to improve Hanafusa, despite the apparent incompatibility of Hanafusa's and Dobashi's Rz values, and Dobashi's teaching that Rz (not RSm) is an indicator of profile height. *See* Pet. 10–12; Ex. 1003 ¶¶ 46–52; Prelim. Resp. 43–44.

Petitioner focuses on Dobashi's RSm value in order to derive the peak density values used to calculate the binding coefficient using Mathematical Expression 1 in claim 1 of the '014 patent. *See* Pet. 9–10 ("[A] POSITA would have readily recognized that the RSm values disclosed by Dobashi are converted into the peak density values that are compared directly to, and satisfy, those of the '014 patent."). In an obviousness determination, we must avoid analyzing the prior art through the prism of hindsight. Instead, we must "cast the mind back to the time the invention was made" and "occupy the mind of one skilled in the art who is presented only with the references, and who is normally guided by the then-accepted wisdom in the art." *W.L. Gore & Assoc., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1553 (Fed. Cir. 1983); *see also Kinetic Concepts, Inc. v. Smith & Nephew, Inc.*, 688 F.3d 1342, 1368 (Fed. Cir. 2012) (quoting *Innogenetics, N.V. v. Abbott Labs.*, 512 F.3d 1363, 1374 n.3 (Fed. Cir. 2008) ("[W]e must still be careful not to allow hindsight reconstruction of references to reach the claimed invention without any explanation as to how or why the references would be combined to produce the claimed invention.")). Here, we interpret Petitioner's position as an attempt to imbue one of ordinary skill in the art

with the knowledge of the claimed invention, when no prior art reference, references of record, or other evidence conveys or suggests that knowledge. Petitioner's proposed rationale relies on general and conclusory statements that are not sufficiently supported in the record, and instead appears to be based on impermissible use of hindsight after the review of the '014 patent, rather than on a supported reason to modify Hanafusa's electrolytic copper foil. *See KSR*, 550 U.S. at 421 (stating that the fact finder must be aware "of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning").

Moreover, Petitioner does not adequately explain why a POSITA would have had a reasonable expectation of success in modifying Hanafusa's electrolytic copper foil in view of Dobashi to achieve the claimed invention. Petitioner argues that a POSITA would have had a reasonable expectation of success "given that both Hanafusa and Dobashi describe manufacture of electrolytic copper foils with desirable surface roughness properties." Pet. 11–12 (citing Ex. 1003 ¶ 52). Although Petitioner relies on Dr. Josefowicz's testimony to support this contention, that testimony repeats what is in the Petition without further discussion or explanation. *See* Ex. 1003 ¶ 52. Petitioner's contention that implementing Dobashi's RSm values into Hanafusa's electrolytic copper foil is the application of known techniques to a known structure to yield predictably results is similarly conclusory and lacking in persuasive explanation. Pet. 11 (citing Ex. 1003 ¶ 52). Such conclusory statements regarding the POSITA's alleged reasonable expectation of success are not sufficient to support a finding of obviousness. Such assertions, lacking factual substantiation, are insufficient for evaluating reasonable expectation of success as part of an

obviousness determination. *Wasica Fin. GmbH v. Cont'l Auto. Sys., Inc.*, 853 F.3d 1272, 1286 (Fed. Cir. 2017).

For these reasons, we are not persuaded that Petitioner sufficiently establishes that a POSITA would have been motivated to modify Hanafusa in light of Dobashi with a reasonable expectation of success as Petitioner contends. Accordingly, we determine that Petitioner fails to demonstrate a reasonable likelihood of prevailing in its assertion that the subject matter of claim 1, and claims 4 and 8 that depend therefrom, would have been obvious over the combined teachings of Hanafusa and Dobashi.

D. Asserted Obviousness over Hanafusa, Dobashi, and Cheng or Kim

Petitioner contends that the subject matter of claim 2 would have been obvious over the combined teachings of Hanafusa, Dobashi, and Cheng, and the subject matter of claim 3 would have been obvious over the combined teachings of Hanafusa, Dobashi, and Kim. Pet. 35–51. Claims 2 and 3 directly depend from claim 1, and Petitioner builds its arguments regarding motivation to combine Hanafusa and Dobashi with Cheng or Kim off of its contention that a POSITA would have been motivated to combine Hanafusa with Dobashi. *See* Pet. 36–39, 45–48. Petitioner's arguments with respect to claims 2 and 3 do not remedy the deficiencies set forth above with respect to claim 1. Accordingly, for the reasons set forth above with respect to claim 1 (§ II.C.3.a), we determine that Petitioner fails to demonstrate a reasonable likelihood of prevailing in its assertion that the subject matter of claim 2 would have been obvious over the combined teachings of Hanafusa, Dobashi, and Cheng, or that the subject matter of claim 3 would have been obvious over the combined teachings of Hanafusa, Dobashi, and Kim.

E. Asserted Obviousness over Hanafusa, Dobashi, and Lee

Petitioner asserts that claims 5 and 6 would have been obvious over the combined teachings of Hanafusa, Dobashi, and Lee. Pet. 51–67.

1. Overview of Lee

Lee relates to "an electrolytic copper foil for a secondary battery having excellent flexural endurance and a method for producing the electrolytic copper foil." Ex. 1006, 1:16–18. Lee teaches that such an electrolytic copper foil is produced from a plating solution "containing total organic carbon (TOC), cobalt and arsenic, by using a drum and is coated with a negative electrode active material, wherein the ratio between the TOC, cobalt and arsenic contained in the electrolytic copper foil follows the following formula 1: TOC/(cobalt+arsenic)=1.30–1.55." *Id.* at code (57). According to Lee, the electrolytic copper foil in which TOC, cobalt, and arsenic are present in the copper electrolytic solution in these specific amounts will "maintain the physical properties of the copper foil to be uniform and thus to have a high flexural endurance." *Id.* at 2:29–36. Lee also teaches that an electrolytic copper foil for a secondary battery with "excellent flexural structural endurance . . . results in excellent battery lifespan." *Id.* at 3:49–53.

2. Analysis

Petitioner contends that the combined teachings of Hanafusa, Dobashi, and Lee discloses all of the limitations of independent claim 5, and claim 6 that depends therefrom, and that a POSITA would have been motivated to combine Hanafusa and Dobashi with Lee with a reasonable expectation of success. Pet. 51–66. Patent Owner responds that Petitioner does not establish that the proposed combination discloses limitations [5d] and [5e], or a sufficient reason to combine Hanafusa, Dobashi, and Lee.

Prelim. Resp. 46–50. We focus our discussion on Petitioner's contention that a POSITA would have been motivated to combine Lee with Hanafusa and Dobashi, as it is dispositive for purposes of this Decision.

a) Motivation to Combine Hanafusa, Dobashi, and Lee

Petitioner contends that "Hanafusa-Dobashi-Lee would have provided a method of manufacturing an electrolytic copper foil, using a plating solution with a specified amount of total organic carbon, cobalt and arsenic, as taught by Lee." Pet. 52 (citing Ex. 1004 ¶ 37; Ex. 1006, Abstract; Ex. 1003 ¶ 124). Petitioner contends that "Hanafusa-Dobashi describes a method of manufacturing an electrolytic copper foil" that includes electroplating a copper film by applying a current between a rotary negative electrode drum and a positive electrode plate "while disposed in an electrolytic solution contained in an electrolytic bath," and providing a rust-proof chromium layer on the surface of the copper film. *Id.* (citing Ex. 1003 ¶ 124; Ex. 1004 ¶¶ 13, 16, 18–21, 37, Fig. 1; Ex. 1005, 8:49–64). Petitioner also contends that, because the Hanafusa-Dobashi electrolytic solution would contain nitride-containing organic compounds and Hanafusa-Dobashi does not describe the specifics of the electrolytic solution, "a POSITA would have looked for other references, such as Lee, to determine an electrolytic solution." *Id.* at 52–53 (citing Ex. 1004 ¶ 37; Ex. 1003 ¶ 125).

According to Petitioner, a POSITA would have been motivated to manufacture Hanafusa-Dobashi's electrolytic foil using Lee's plating solution "to achieve additional benefits provided by Lee's manufacturing solutions." Pet. 53 (citing Ex. 1003 ¶ 127). In particular, Petitioner notes that "Hanafusa recognizes the significance of flexibility in electrolytic copper foil to prevent breakage or cracks," and Lee's plating solution would

allow uniformity of the copper foil's physical properties and thus improve the flexural endurance of the copper foil. *Id.* at 53–54 (citing Ex. 1003 ¶ 127; Ex. 1004 ¶ 26; Ex. 1006, 2:37–41, 4:61–67, 6:5–21). Petitioner asserts that Lee also teaches that improved flexural endurance would improve battery lifespan and prevent cracking. *Id.* at 53 (citing Ex. 1006, 4:61–67). Therefore, Petitioner contends, "a POSITA would have been motivated to produce the electrolytic copper foil for a secondary battery according to Lee's teachings to add these advantages." *Id.* at 53–54 (citing Ex. 1003 ¶ 127).

Noticeably absent from Petitioner's contentions is any persuasive discussion of combining the disclosures of Hanafusa and Dobashi. Pet. 52–54; *see also* Ex. 1003 ¶¶ 124–129 (Dr. Josefowicz's testimony regarding the combination of Hanafusa, Dobashi, and Lee). Petitioner sets forth a "method of manufacturing an electrolytic foil" described by "Hanafusa-Dobashi," but does not otherwise address the combination of Hanafusa and Dobashi with respect to claim 5. Instead, Petitioner seemingly assumes the combination of Hanafusa and Dobashi, without providing more than some information about the resulting manufacturing method. *Id.* In contrast, Petitioner does provide arguments and reasoning with respect to the combination of Lee with Hanafusa-Dobashi. *Id.* at 53–54; Ex. 1003 ¶¶ 124–129.

Petitioner's failure to address reasons to combine Hanafusa and Dobashi with respect to claim 5, and the structure of its arguments regarding the combination of Hanafusa and Dobashi with Lee, suggests that Petitioner is relying on the arguments it made regarding the motivation to combine Hanafusa and Dobashi with respect to claim 1. *See* Pet. 9–12. Indeed, Patent Owner applies its arguments that Petitioner fails to demonstrate a

motivation to combine Hanafusa and Dobashi to both claim 1 and claim 5. *See, e.g.*, Prelim. Resp. 36 ("Both Ground 1A (for independent claim 1) and Ground 1D (for independent claim 5) rely on the Hanafusa-Dobashi combination for obviousness.").

As set forth above with respect to claim 1, we are not persuaded that Petitioner establishes a reasonable likelihood of prevailing in showing that a POSITA would have been motivated to combine Hanafusa and Dobashi. *See* § II.C.3.a, *supra*. Petitioner's arguments with respect to the combination with Lee do not remedy the deficiencies set forth above with respect to the combination of Hanafusa with Dobashi. Because Petitioner relies on the same arguments with respect to the Hanafusa-Dobashi-Lee combination, we are not persuaded that Petitioner sufficiently establishes that a POSITA would have been motivated to combine Hanafusa, Dobashi, and Lee as proposed. *See id.*

Accordingly, we determine that Petitioner fails to demonstrate a reasonable likelihood of prevailing on its assertion that independent claim 5, and claim 6 that depends therefrom, would have been obvious over the combined teachings of Hanafusa, Dobashi, and Lee.

F. Asserted Obviousness over Hanafusa, Dobashi, and Kajihara

Petitioner contends that claim 7 would have been obvious over the combined teachings of Hanafusa, Dobashi, and Kajihara. Pet. 67–74.

1. Overview of Kajihara

Kajihara is directed to the surface treatment of copper foil in which the copper foil "is subjected to electrolysis in an aqueous solution containing diethylenetriamine pentacetic [*sic*] acid and copper ion." Ex. 1012, code (57). In particular, Kajihara teaches a copper treatment "to make a rough surface" in which the copper surface is immersed into aqueous diluted

sulfuric acid solution to clean the surface, and, after rinsing, "is immersed into an aqueous solution containing diethylenetriamine pentaacetic acid and copper ion and electrolysis is conducted by using it as a cathode." *Id.* at 2:21–28.

2. Analysis

Petitioner contends that the combination of Hanafusa, Dobashi, and Kajihara teaches all of the limitations of claim 7. Pet. 72–74. Claim 7 ultimately depends from claim 5 through its dependence from claim 6. Ex. 1001, 15:7–12. Therefore, claim 7 encompasses, in addition to all of the elements of claim 5, "a concentration of a nitrogen compound in the electrolytic solution is 3 to 12 ppm" as recited in claim 6, and "the nitrogen compound comprises DETA, and a concentration of the DETA is 3.2 to 12 mg/L" as recited in claim 7.[9] *Id.* In order to adequately establish that the combined teachings of Hanafusa, Dobashi, and Kajihara disclose all of the limitations of claim 7, it is Petitioner's burden to show that the proposed combination also discloses all of the elements of claims 5 and 6. *See Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) ("In an IPR, the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable." (citing 35 U.S.C. § 312(a)(3) (2012) (requiring IPR petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim"))).

As discussed above, Petitioner contends that the combination of Hanafusa, Dobashi, and Lee teaches all of the limitations of claims 5 and 6. *See* § II.E, supra; Pet. 51–67. Lee, however, is not included in Petitioner's challenge of claim 7. Thus, Petitioner must show that the combination of

[9] The '014 patent identifies diethylenetriamine as "DETA." Ex. 1001, 8:30.

Hanafusa, Dobashi, and Kajihara also teaches the elements of claims 5 and 6. *See* Pet. 1, 67–74. Petitioner's analysis of claim 7, however, is limited to the "the nitrogen compound comprises DETA, and a concentration of the DETA is 3.2 to 12 mg/L" limitation of claim 7. *See id.* at 67–74; Ex. 1003 ¶¶ 157–167. Notably missing from Petitioner's analysis (and Dr. Josefowicz's supporting testimony) is any discussion of the elements of claim 5 for which Petitioner relies on Lee, namely, "when the electroplating is performed, a concentration of total carbon is maintained at 0.12 g/L or less and a concentration of $Co^{2\pm}$ is maintained at 0.33 g/L or less." *Compare* Pet. 67–74 *with id.* at 51–53, 61–66. As a result, we are not persuaded that Petitioner sufficiently establishes that Hanafusa, Dobashi, and Kajihara teaches all of the limitations of claim 7.

Furthermore, Petitioner does not separately argue that a POSITA would have been motivated to combine Hanafusa with Dobashi in the context of claim 7. *See* Pet. 68–72. Rather, Petitioner's assertion that "[i]n addition to meeting the surface roughness characteristics described in the Hanafusa-Dobashi combination, the electrolytic copper foil in the Hanafusa-Dobashi-Kajihara combination would have been subject to a surface treatment process" as taught by Kajihara, signals Petitioner's reliance on the arguments it made regarding the motivation to combine Hanafusa and Dobashi with respect to claim 1. *See* Pet. 9–12, 68.

For the reasons set for above with respect to claim 1, we are not persuaded that Petitioner establishes a reasonable likelihood of prevailing in showing that a POSITA would have been motivated to combine Hanafusa and Dobashi as proposed. *See* § II.C.3.a, supra. Petitioner's arguments with respect to the combination with Kajihara do not remedy the deficiencies set forth above with respect to the combination of Hanafusa with Dobashi.

Because Petitioner relies on the same arguments with respect to the Hanafusa-Dobashi-Kajihara combination, we are not persuaded that Petitioner sufficiently establishes that a POSITA would have been motivated to combine Hanafusa, Dobashi, and Kajihara as proposed. *See id.*

Accordingly, we determine that Petitioner fails to demonstrate a reasonable likelihood of prevailing on its assertion that claim 7 would have been obvious over the combined teachings of Hanafusa, Dobashi, and Kajihara.

III. CONCLUSION

Based on the parties' arguments and the evidence of record, we determine that Petitioner does not establish a reasonable likelihood of prevailing on its challenge that claims 1–8 of the '014 patent are unpatentable.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that the Petition is *denied*, and no trial is instituted.

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