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Paper 7
Date: March 18, 2022

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SCIENTIFIC DESIGN COMPANY, INC.,
Petitioner,

v.

SHELL OIL COMPANY,
Patent Owner.

IPR2021-01537
Patent 8,084,390 B2

Before GRACE KARAFFA OBERMAN, KRISTINA M. KALAN, and JULIA HEANEY, *Administrative Patent Judges*.

KALAN, *Administrative Patent Judge*.

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

I. INTRODUCTION

Scientific Design Company, Inc. ("Petitioner") filed a Petition (Paper 1, "Pet.") requesting *inter partes* review of claims 1–28 of U.S. Patent No. 8,084,390 B2 (Ex. 1001, "the '390 patent"). Shell Oil Company ("Patent Owner") filed a Preliminary Response (Paper 6, "Prelim. Resp.").

To institute *inter partes* review, we must determine that the information presented in the Petition shows "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(a). For the reasons discussed below, after considering the parties' submissions and the evidence of record, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing with respect to at least one claim of the '390 patent. Thus, we institute *inter partes* review of all claims and all grounds asserted in the Petition.[1]

A. Related Proceedings

Petitioner states: "European Patent EP1890807 – the European counterpart to the '390 patent – was revoked by the European Patent Office" over "*inter alia*, a combination of prior art references, which includes Liu and Lockemeyer." Pet. vii (citing Ex. 1017). Patent Owner identifies "International Application No. PCT/US2006/021903, which claims priority from Provisional Application No. 60/688,245" and U.S. Patent Nos. 8,357,813 and 8,357,825 as related matters. Paper 4, 1.

[1] *Guidance on the Impact of SAS on AIA Trial Proceedings* (Apr. 26, 2018), https://www.uspto.gov/patents-application-process/patent-trial-and-appeal-board/trials/guidance-impact-sas-aia-trial ("*SAS* Guidance"); *see also SAS Inst., Inc. v. Iancu*, 138 S. Ct. 1348, 1359–60 (2018).

B. Real Parties-In-Interest

Petitioner identifies itself as the real party-in-interest. Pet. vii. Patent Owner identifies itself as a real party-in-interest. Paper 4, 1.

C. The '390 Patent

The '390 patent is titled "Catalyst, a Process for Preparing the Catalyst and a Process for the Production of an Olefin Oxide, a 1,2-Diol, a 1,2 Diol Ether, or an Alkanolamine," and is directed to a

> catalyst which comprises a carrier and silver deposited on the carrier, which carrier has a surface area of at least 1.3 m^2/g, a median pore diameter of more than 0.8 μm, and a pore size distribution wherein at least 80% of the total pore volume is contained in pores with diameters in the range of from 0.1 to 10 μm and at least 80% of the pore volume contained in the pores with diameters in the range of from 0.1 to 10 μm is contained in pores with diameters in the range of from 0.3 to 10 μm . . . .

Ex. 1001, codes (54), (57). The '390 patent explains the advantages of the catalyst:

> by maximizing for certain high-surface area carriers the number of pores having a diameter in the range of 0.3 to 10 μm, in particular by minimizing the pore volume in pores having diameters less than 0.3 μm, the catalyst based on the carrier is advantaged over catalysts that are prepared from carriers which have a substantial pore volume in pores having diameters less than 0.3 μm.

Id. at 3:10–17. According to the '390 patent, the catalysts of the invention "show excellent activity and selectivity, and they are believed to provide significant improvements in stability under conditions of commercial operation." *Id.* at 3:18–21.

D. Illustrative Claim

Claim 1 is representative of the challenged claims, and is reproduced below:

> 1. A catalyst comprising a carrier and silver deposited on the carrier, which carrier comprises at least 85 weight percent α-alumina and has a surface area of at least 1.3 m^2/g, a median pore diameter of more than 0.8 μm, and a pore size distribution wherein at least 80% of the total pore volume is contained in pores with diameters in the range of from 0.1 to 10 μm and at least 80% of the pore volume contained in the pores with diameters in the range of from 0.1 to 10 μm is contained in pores with diameters in the range of from 0.3 to 10 μm.

Ex. 1001, 18:22–30.

E. The Asserted Grounds of Unpatentability

Petitioner contends that claims 1–28 of the '390 patent are unpatentable on the following grounds. Pet. 1.

Ground	Reference(s)	Basis[2]	Claims Challenged
1	Liu[3]	§ 102/§ 103	1–9, 12–16, 19–20, 23–24
2	Liu	§ 103	17, 22
3	Liu, Lockemeyer-II[4]	§ 103	18, 21
4	Lockemeyer,[5] Liu	§ 103	1–9, 12–24
5	Lockemeyer, Liu,	§ 103	10, 11, 25–28

[2] The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) ("AIA"), amended 35 U.S.C. §§ 102, 103. Because the '390 patent has an effective filing date prior to the effective date of the applicable AIA amendments, we refer to the pre-AIA versions of §§ 102 and 103.
[3] European Patent Application No. 0480538A1 (Ex. 1002).
[4] U.S. Patent No. 5,929,259 (Ex. 1004).
[5] U.S. Patent Application Publication No. US 2003/0162984A1 (Ex. 1003).

Ground	Reference(s)	Basis[2]	Claims Challenged
	Lockemeyer-II, Kowaleski[6]		

In support of its unpatentability arguments, Petitioner relies on the declaration of Dr. Gary L. Haller. Ex. 1014.

II. ANALYSIS

A. Claim Construction

We apply the claim construction standard articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). 37 C.F.R. § 42.100(b) (2020). Under *Phillips*, claim terms are afforded "their ordinary and customary meaning." *Phillips*, 415 F.3d at 1312. The "ordinary and customary meaning of a claim term 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." *Id.* at 1313. Only terms that are in controversy need to be construed, and then only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

Petitioner proposes a construction for "non-platelet morphology" in claim 22 as "the morphology of the carrier when imaged by scanning electron microscopy at a magnification of 2000, and to the substantial absence in such images of structures having substantially flat surfaces." Pet. 10 (citing Ex. 1001, 5:27–31). Patent Owner does not challenge Petitioner's proposed claim interpretation. Prelim. Resp. 19. On this record, we determine that no claim terms require express construction.

[6] International Publication No. WO 97/40933 (Ex. 1005).

B. Level of Ordinary Skill in the Art

Petitioner asserts that a person of ordinary skill in the art "would have held a Bachelor's or Master's degree in chemical engineering or a related discipline with five or more years of experience in the catalyst field." Pet. 10 (citing Ex. 1014 ¶¶ 12–14). Patent Owner does not challenge Petitioner's proposed definition of one of ordinary skill in the art. *See* Prelim. Resp. 19.

In light of the record before us, we adopt Petitioner's proposal regarding the level of one of ordinary skill in the art because it is consistent with the disclosures of the applied prior art references and the '390 patent. The level of ordinary skill in the art is also reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001).

C. Liu-Based Grounds (Grounds 1, 2, and 3)

Petitioner argues that Liu would have anticipated or rendered obvious claims 1–9, 12–16, 19–20, and 23–24 (Pet. 12–14, 18–35) (Ground 1), or would have rendered obvious claims 17 and 22 (Pet. 15, 35–37) (Ground 2), or, in combination with Lockemeyer-II, would have rendered obvious claims 18 and 21 (Pet. 15–16, 37–38) (Ground 3).

1. Liu

Liu is a patent titled "Alkylene oxide catalysts having enhanced activity and/or stability," and is directed to catalysts that "comprise a silver-containing support, and a sufficient amount of cobalt component to enhance at least one of activity and/or efficiency and/or stability as compared to a similar catalyst which does not contain cobalt component." Ex. 1002, codes (54), (57). More particularly, Liu is directed to "silver-containing, supported catalysts for the epoxidation of alkene, especially ethylene, to the

corresponding alkylene oxide, e.g., ethylene oxide, which contain a stability and/or efficiency and/or activity enhancing amount of a cobalt-containing component." *Id.* at 2:3–5.

Liu provides data on eleven examples to demonstrate that a cobalt component increases a catalyst's activity and/or efficiency and/or stability. *Id.* at 17:40–25:18. Liu's data on Carriers S, T, and V is reproduced below.

Physical Properties of Carrier S

Surface Area[(1)]	1.24 m^2/g
Pore Volume[(2)]	0.77 cc/g
Packing Density[(3)]	0.50 g/ml
Medium Pore Diameter[(4)]	1.7 microns

Pore Size Distribution, % Total Pore Volume

Pore Size Microns	% Total Pore Volume
P_1 (<0.1)	0.5
P_2 (0.1-0.5)	3
P_3 (0.5-1.0)	9.5
P_4 (1.0-10)	81
P_5 (10-100)	2
P_6 (>100)	4

Ex. 1002, 18:32–55. The tables reproduced above set forth the properties of surface area, pore volume, packing density, and medium pore diameter for Liu's Carrier S, and show a pore size distribution in which 81% of the total pore volume has a pore size of 1.0–10 microns.

Physical Properties of Carrier T

Surface Area(1)	1.13 m^2/g
Pore Volume(2)	0.75 cc/g
Packing Density(3)	0.51 g/ml
Medium Pore Diameter(4)	2.1 microns

Pore Size Distribution, % Total Pore Volume

Pore Size Microns	% Total Pore Volume
P_1 (<0.1)	0
P_2 (0.1-0.5)	1
P_3 (0.5-1.0)	4.5
P_4 (1.0-10)	90.5
P_5 (10-100)	1.5
P_6 (>100)	2.5

Id. at 19:17–38. The tables reproduced above set forth the properties of surface area, pore volume, packing density, and medium pore diameter for Liu's Carrier T, and show a pore size distribution in which 90.5% of the total pore volume has a pore size of 1.0–10 microns.

Carrier V:

Physical properties	
surface area (1)	1.16 m^2/g
pore volume (2)	0.76 cc/g
packing density (3)	0.50 g/ml
median pore diameter (4)	2.3 microns

Pore size distribution	
pore size, microns	%total pore volume
<0.1	0
0.1-0.5	1
0.5-1.0	5
1.0-10	88
10-100	2
>100	4

Id. at 20:15–34. The tables reproduced above set forth the properties of surface area, pore volume, packing density, and medium pore diameter for Liu's Carrier V, and show a pore size distribution in which 88% of the total pore volume has a pore size of 1.0–10 microns.

2. Petitioner's Arguments

Petitioner argues that Liu discloses or renders obvious all of claim 1's limitations. Pet. 12, 18–25. Below is Petitioner's claim chart identifying where it believes each element of claim 1 is disclosed by Liu.

Claim 1	**Liu**
A catalyst comprising a carrier and silver deposited on the carrier,	Silver-containing, alkylene oxide catalysts, where the silver is deposited on the carrier. Ex. 1002, 6:1-2, 13:29-33.
which carrier comprises at least 85% of α-alumina	The preferred carriers have at least 98 wt. % alpha-alumina. *Id*., 9:37-40. Carriers S, T, and V have α-alumina with purity of 99%. *Id*., 18:23, 19:9, 49
and has a surface area of at least 1.3 m^2/g,	The preferred alpha-alumina carriers have a surface area of from about 0.05-5 m^2/g, preferably from 0.1-3.0 m^2/g, and more preferably from about 0.1-2.0 m^2/g. *Id*., 9:47-49, 53-55. In addition, a POSA would view the 1.24 m^2/g surface area measurement for Carrier S as teaching or suggesting the claimed range. Ex. 1014, ¶ 79.
a median pore diameter of more than 0.8 μm,	The preferred carriers have median pore diameters from about 0.5-50 microns. Ex. 1002, 9:57-58. Carriers S, T, and V have a median pore diameter of 1.7, 2.1, and 2.3 μm, respectively. *Id*., 18:40, 19:24, 20:21.
and a pore size distribution wherein	Carriers, S, T, and V have pore size distributions meeting this limitation. *Id*.,

at least 80% of the total pore volume is contained in pores with diameters in the range of from 0.1 to 10 μm	18:45-55, 19:27-38, 20:24-34; Ex. 1014, ¶¶ 85-86.
and at least 80% of the pore volume contained in the pores with diameters in the range of from 0.1 to 10 μm is contained in pores with diameters in the range of from 0.3 to 10 μm	Carriers, S, T, and V have pore size distributions meeting this limitation. Ex. 1002, 18:45-55, 19:27-38, 20:24-34; Ex. 1014, ¶¶ 87-88.

Id. at 24–25. Regarding the surface area limitation, Petitioner argues that "Liu discloses that the preferred carriers have a surface area of from about 0.1–3.0 m^2/g, preferably about 0.1–2.0 m^2/g" and, thus, "anticipates that limitation." *Id.* at 21 (citing Ex. 1002, 9:53–55; *Genentech, Inc. v. Hospira, Inc.*, 946 F.3d 1333, 1338 (Fed. Cir. 2020) (disclosure of 18–25°C anticipated the claimed range of about 10°C to about 18°C)). Petitioner also argues that Liu's disclosure of a general range of 0.1–3 m^2/g establishes obviousness (Pet. 14, citing *In re Peterson*, 315 F.3d 1325, 1329 (Fed. Cir. 2003)), or that even without complete overlap of prior art range and claimed range, "a minor difference shows a prima facie case of obviousness" (*id.*, citing *In re Harris*, 409 F.3d 1339, 1341 (Fed. Cir. 2005)).

Petitioner also relies specifically on the surface area of Carriers S, T, and V, as shown in the table below.

Carrier	Surface Area (m^2/g)
S	1.24
T	1.13
V	1.16

Id. at 22. Petitioner argues that, because the Brunauer, Emmett and Teller ("BET") method used to measure surface area is "not precise, and its reproducibility is low with a variation that is typically ±5% and as much as ±20%," the "stated 1.24 m^2/g surface area measurement for Carrier S would have at least a 5% variation," such that one of ordinary skill in the art "would also have viewed Liu's Carrier S as disclosing or suggesting the limitation of a surface area of 1.3 m^2/g or more." *Id.* (citing Ex. 1014 ¶¶ 30–42, 78–80). Petitioner also argues that one of ordinary skill in the art "would have been able to achieve the claimed range of at least 1.3 m^2/g with a simple design choice, or to the extent necessary, routine optimization." *Id.* at 23 (citing Ex. 1014 ¶ 82).

Petitioner argues that "Carriers S, T, and V all have pore size distributions that fall within the recited ranges of claim 1." *Id*. at 19. Although Petitioner acknowledges that Liu "does not explicitly state a pore size distribution for pores with diameters from 0.3–10 μm," Petitioner presents a table supporting its argument that "at least 96% of the pore volume contained in the pores with diameters from 0.1–10 μm is contained in pores with diameters from 0.5–10 μm." *Id.* at 20.

Carrier	% pore volume contained in 0.1-10 μm diameter pores that is contained in 0.5-10 μm diameter pores
S	90.5/93.5 = 96.79%

T	95/96 = 98.96%
V	93/94 = 98.93%

Id. According to Petitioner, "it follows mathematically that at least 96% of the pore volume contained in the pores with diameters from 0.1-10 μm is contained in pores with diameters from 0.3-10 μm." *Id.* (citing Ex. 1014 ¶ 88).

Petitioner further identifies where it believes every element of remaining challenged claims 2–9, 12–16, 19–20, and 23–24 (Ground 1) and claims 17 and 22 (Ground 2) are found in Liu, or would have been obvious in view of Liu. *Id.* at 25–37. For Ground 3, based on Liu and Lockemeyer-II, Petitioner argues that the proposed combination discloses all of the challenged dependent claim limitations, and that one of ordinary skill in the art would know how to make "high purity, α-alumina carriers using the appropriate temperature" such that "it would have been obvious to adjust firing temperature and time to achieve the desired result." Pet. 37–38 (citing Ex. 1014 ¶¶ 155–160).

3. Patent Owner's Arguments

Patent Owner argues Petitioner has failed to show that Liu discloses all of the challenged claims' elements "arranged or combined in the same way as recited in the claims," and, thus, does not demonstrate anticipation. Prelim. Resp. 20 (citing *Net MoneyIN v. VeriSign, Inc.*, 545 F.3d 1359, 1370 (Fed. Cir. 2008)). Patent Owner also argues that Petitioner does not establish that Liu renders obvious the subject matter of any challenged claim "as a whole." *Id.* at 21.

First, Patent Owner argues that Liu "does not disclose any carrier meeting *both*" the limitations of "surface area of at least 1.3 m^2/g" and

"Claimed Pore Size Distribution" (defined by Patent Owner as a "pore size distribution wherein at least 80% of the total pore volume is contained in pores with diameters in the range of from 0.1 to 10 μm" and "at least 80% of the pore volume contained in the pores with diameters in the range of from 0.1 to 10 μm is contained in pores with diameters in the range of from 0.3 to 10 μm," Prelim. Resp. 12). *Id.* at 22. Patent Owner argues that Carriers S, T, and V "would have to be modified to meet the claimed minimum surface area of at least 1.3 m^2/g," which "forecloses anticipation." *Id.* at 24. Additionally, Patent Owner argues that Petitioner did not argue or submit evidence that one of ordinary skill in the art would have "at once envisaged" a "carrier having the pore size characteristics of Liu's carrier S, T or V but with a surface area of at least 1.3 m^2/g," because the carrier art is "highly complex and unpredictable." *Id.* at 25 (citing *Microsoft v. Biscotti,* 878 F.3d 1052, 1063, 1068–70 (Fed. Cir. 2017).

Second, Patent Owner criticizes Petitioner's alternative anticipation argument based on Liu's Carrier S alone. *Id.* at 26. According to Patent Owner, the specification of the '390 patent defines the manner in which the claimed surface area value is to be determined, namely, using the BET method, and faults Petitioner for seeking "to inject ambiguity into Liu's disclosure that is not there." *Id.* at 27–28. Moreover, Patent Owner argues, if Liu's surface area measurement of 1.24 m^2/g cannot be accepted at face value, that ambiguity is "fatal to Petitioner's anticipation argument" because an ambiguous reference cannot anticipate a claim. *Id.* (citing *Wasica Finance v. Continental Auto.*, 853 F.3d 1272, 1284 (Fed. Cir. 2017)).

Third, Patent Owner argues Petitioner has failed to show a reasonable likelihood that it would prevail in proving the obviousness of any challenged claim based on Liu. Prelim. Resp. 28. Patent Owner argues that Petitioner engages in a "hindsight-driven approach" that fails to show that any claim challenged "as a whole" would be obvious. *Id.* at 29. Patent Owner alleges that Petitioner needed to, but failed to, "(1) identify some starting carrier in Liu a POSA would have modified, (2) explain some way(s) in which a POSA would have modified that starting carrier with a reasonable expectation of success, and (3) map the challenged claims 'as a whole' to the modified carrier." *Id.* at 30. Additionally, according to Patent Owner, Petitioner did not establish that one of ordinary skill would have modified a Liu carrier to meet all the interdependent claim limitations. *Id.* at 31–37. Patent Owner also argues that Petitioner's allegation of "simple design choice" or "routine experimentation" fails to address any claim as a whole, fails to explain how the result would have been achieved, ignores the interdependency between the variables, and provides only conclusory expert testimony as support. *Id.* at 38–39.

Regarding independent claim 19 and dependent claim 20, which require "bond material," Patent Owner argues that Petitioner fails to show anticipation because Liu's Carriers S, T, and V are fluoride-containing carriers that conventionally have no bond material. *Id.* at 41. Patent Owner also argues that Petitioner fails to show obviousness because Liu's disclosure "that some carriers can be 'bonded together by a bonding agent' (9:38–39) refers to a sintering process not used in forming FMA [fluoride-mineralized α-alumina] carriers like carriers S, T and V." *Id.* at 42.

Regarding independent claim 23, Patent Owner argues that Petitioner fails to support its assumption that "Liu's 'water pore volume' measured in ***cc/g*** is the same measurement as the claimed 'minimum water absorption' measured in ***g/g***." *Id.* at 43. Petitioner's claim 23 anticipation argument fails as well, Patent Owner argues, because Liu's general teaching that carriers can have a particular water pore volume does not teach "all of claim 23's limitations arranged as required by claim 23." *Id.* at 44.

Regarding dependent claim 22 (Ground 2), Patent Owner argues that Petitioner does not explain why one of ordinary skill in the art seeking to make a carrier with "non-platelet morphology" would have "started with fluoride-containing FMA carriers like [Liu's] carriers S, T, or V," rather than "sintered α-alumina carriers that do not have fluoride" as in Lockemeyer-II, which Patent Owner argues cannot have a platelet morphology. Prelim. Resp. 48–49.

4. Analysis

On this record, Petitioner demonstrates a reasonable likelihood of prevailing on its argument that the challenged claims would have been obvious over Liu (Grounds 1 and 2), along with the additional combination of Liu with Lockemeyer-II (Ground 3). We acknowledge Petitioner's anticipation arguments based on Liu (Ground 1) but have questions as to whether Petitioner has demonstrated a reasonable likelihood of prevailing on its anticipation arguments.

Petitioner's anticipation arguments, as noted by Patent Owner, rely alternately on general disclosures of Liu and also, at times, specific disclosures of Liu (i.e., Carriers S, T, and V). We have concerns about whether Petitioner's apparent mixing and matching of general and specific

disclosures is sufficient to establish anticipation by Liu. Although we do not disagree that the general and the specific disclosures may, together, meet the limitations of claim 1, it is unclear on this record that Petitioner's anticipation arguments appropriately rely on both.

Although apparently Carriers S, T, and V meet the Claimed Pore Size Distribution limitation and other limitations of claim 1, Carriers S, T, and V do not on their face meet the surface area limitation. We understand Petitioner's explanation of the irregularities of the BET method, but the fact remains that Carrier S, for example, discloses a surface area of only 1.24 m^2/g when claim 1 requires a surface area of at least 1.3 m^2/g. The surface area measurement of Carriers S, T, and V may have a built-in ambiguity, but Liu does not disclose that any of them has a surface area of at least 1.3 m^2/g, which raises a concern that Petitioner places excessive reliance on the existence of a perceived ambiguity. Because the specific disclosures of Liu's Carriers S, T, and V do not appear to disclose the surface area, they do not necessarily disclose all the limitations arranged as in the claim.

No one particular embodiment of Liu necessarily discloses all of the limitations of claim 1, arranged as in the claim, but Petitioner's obviousness arguments based on Carriers S, T, and V, together with Liu's general disclosures and Petitioner's testimonial evidence, demonstrate a reasonable likelihood that Petitioner would prevail on these Liu-based obviousness contentions. We credit Petitioner's argument that Liu's disclosure of a general surface area range of 0.1–3 m^2/g may establish obviousness, or that even without complete overlap of the prior art range and the claimed range, a minor difference may nevertheless support a conclusion of obviousness. Pet. 14. Regarding Carrier S, we find that the present record supports

Petitioner's argument that "Liu discloses an embodiment with a 1.24 m^2/g surface area and teaches that their invention extends to higher surface area, e.g., 3.0 m^2/g" (Pet. 24, citing Ex. 1002, 9:47–49) which, "even if not anticipatory, renders the 'at least 1.3 m^2/g' limitation obvious" (*id.*, citing Ex. 1014 ¶ 83). At this stage in the proceeding, Petitioner has demonstrated a reasonable likelihood of prevailing on its obviousness contentions as to claim 1. Any final determinations regarding obviousness, however, shall be based on the full trial record, including any information presented by Patent Owner in a timely response to the Petition.

Similarly, at this stage in the proceeding, we are not persuaded that Patent Owner's arguments about hindsight undercut the sufficiency of Petitioner's showing for purposes of trial institution. Petitioner provides sufficient reasoning, on this record, why one of ordinary skill in the art would have been motivated to combine the references with a reasonable expectation of success, supported by expert testimony. Accordingly, Petitioner has provided "some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness," without impermissibly resorting to hindsight. *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006).

Regarding Patent Owner's assertions about FMA and alpha-alumina starting materials and the differences between the two, we have reviewed Dr. Haller's testimony and do not find that Patent Owner's assertions are sufficient to cast doubt on his opinions on this issue. At this stage in the proceeding, this testimony is uncontroverted by anything but attorney argument on the issue of FMA and alpha-alumina starting materials.

Based on the information presented in the Petition and Preliminary Response, as to all the claims challenged in Grounds 1, 2, and 3, we are persuaded at this stage in the proceeding that Petitioner has demonstrated a reasonable likelihood of prevailing on the obviousness contentions presented in Grounds 1, 2, and 3.

D. Lockemeyer-Based Grounds (Grounds 4 and 5)

Petitioner argues that Lockemeyer and Liu would have rendered obvious claims 1–9 and 12–24 (Pet. 16–17, 39–56) (Ground 4), or, in combination with Lockemeyer-II and Kowaleski, would have rendered obvious claims 10–11 and 25–28 (Pet. 17–18, 56–64) (Ground 5).

1. Lockemeyer

Lockemeyer is a patent titled "Catalyst and a Process Using the Catalyst," and is directed to a catalyst "which comprises a carrier and silver deposited on the carrier, which carrier has a surface area of at least 1 m^2/g, and a pore size distribution" in which "pores with diameters in the range of from 0.2 to 10 μm represent at least 70% of the total pore volume and such pores together provide a pore volume of at least 0.27 ml/g, relative to the weight of the carrier." Ex. 1003, codes (54), (57). More particularly, Lockemeyer's catalyst is intended for use in olefin epoxidation, having "excellent activity, selectivity, and unusually prolonged retention of the activity and stability level" due to the "pore size distribution and the pore volume provided by the pores which have a pore size within a defined range." *Id.* ¶¶ 1, 5.

2. Petitioner's Arguments

Petitioner argues that the combination of Lockemeyer and Liu renders obvious all of claim 1's limitations. Pet. 39–48. Petitioner presents

a claim chart identifying where it believes every element of claim 1 is disclosed by Lockemeyer and Liu.

Claim 1	**Prior Art**
A catalyst comprising a carrier and silver deposited on the carrier,	Lockemeyer discloses a catalyst comprising "a carrier and silver deposited on the carrier." Ex. 1003, [Abstract].
which carrier comprises at least 85% of α-alumina	Lockemeyer discloses a carrier comprising "at least 85% w, … frequently up to 99.9% w α-alumina." *Id*., [0032].
and has a surface area of at least 1.3 m^2/g,	Lockemeyer discloses that the surface area is at least 1 m^2/g … and more preferably from 1.4-2.6 m^2/g. *Id*., [0030]. Lockemeyer's Carriers A, B, and C have surface areas of 2.04, 2.11, and 2.51 m^2/g, respectively. *Id*., [0110] (Table I).
a median pore diameter of more than 0.8 μm,	Carrier D of the '390 patent (Carrier A of Lockemeyer) has a median pore diameter of 2.2 μm. Ex. 1001, Table I. Liu discloses that preferred carriers have median pore diameters having a preferred range of from about 0.5-50 μm. Ex. 1002, 9:57-58. Further, Carriers S, T, and V have median pore diameters of 1.7, 2.1, and 2.3 μm, respectively. *Id*., 18:40, 19:24, 20:21.
and a pore size distribution wherein at least 80% of the total pore volume is contained in pores with diameters in the	Lockemeyer discloses that preferably, the pore size distribution is such that the pores with diameters from 0.2-10 μm represent more than 75%, in particular more than 80% of the total pore volume. Ex. 1003, [0026]. Carriers A

range of from 0.1 to 10 μm	and C have pore size distributions meeting this limitation. *Id*., [0110] (Table I); Ex. 1014, ¶¶ 210-11.
and at least 80% of the pore volume contained in the pores with diameters in the range of from 0.1 to 10 μm is contained in pores with diameters in the range of from 0.3 to 10 μm.	Lockemeyer does not disclose a breakdown in the range of pores with diameters of 0.3-10 μm. It, however, discloses that the pore size distribution has "been found to play a significant role" in preparing carriers for catalysts with excellent properties. Ex. 1003, [0005]. A POSA would have been motivated to obtain the pore size distribution that achieves optimal performance with routine experimentation. Ex. 1014, ¶¶ 167-68, 212-13. Liu's Carriers S, T, and V have pore size distributions meeting this limitation. Ex. 1002, 18:45-55, 19:27-38, 20:24-34; Ex. 1014, ¶¶ 87-88, 213.

Id. at 47–48. Although "Lockemeyer does not disclose a breakdown of the percentage of the pores that are contained in pores with diameters from 0.3-10 μm," it "discloses a pore size distribution in the range of 0.2-10 μm," and one of ordinary skill in the art "would have been motivated to modify the pore size distribution of carriers to optimize performance, as a matter of routine." *Id.* at 40 (citing Ex. 1014 ¶¶ 166–168). Additionally, Petitioner argues, "each of Carriers S, T, and V in Liu has a pore size distribution within the ranges taught by Lockemeyer" and Liu teaches that the "nature of the carrier is a factor that impacts 'optimum performance' of the catalyst." *Id.* at 41 (citing Ex. 1014 ¶¶ 171–172). Petitioner argues that this teaching, together with Lockemeyer's teaching that pore size distribution with pore size within a defined range plays "a significant role,"

demonstrates that one of ordinary skill in the art "would have been motivated to use Liu to direct the pore size distribution within the general ranges taught by Lockemeyer." *Id.* at 41–42 (citing Ex. 1014 ¶¶ 173–175). Petitioner further argues catalysts made from Liu's Carrier S, in particular, achieve high selectivity, activity, and stability, which "plays a significant role in achieving the enhanced properties of the catalysts." *Id.* at 42–43 (citing Ex. 1014 ¶¶ 176–178).

Petitioner further identifies where it believes every element of remaining challenged claims 2–9 and 12–24 are found in the combination of Lockemeyer and Liu. *Id.* at 48–56.

Regarding Ground 5, Petitioner presents arguments that the limitations of claims 10, 11, and 25–28 are all found in the combination of Lockemeyer, Liu, Kowaleski, and Lockemeyer-II, particularly the limitation of a bond material comprising an alkaline earth metal silicate. Pet. 56–64. Both Lockemeyer and Liu disclose that a bond material may comprise an alkali metal silicate (*id*. at 56), and Lockemeyer-II and Kowaleski disclose "using an alkaline earth metal silicate as a bond material, which may also contain a hydrated alumina or a zirconium or titanium component" as "conventional" and "taught in prior art." *Id.* at 17. According to Petitioner, because "Lockemeyer-II teaches that calcium silicate and magnesium silicate (as well as alkali metal silicates) are conventional bond materials and Kowaleski teaches that it is desirable to use calcium or magnesium silicate," it would have been obvious to one of ordinary skill in the art "to use calcium or magnesium silicate as a bond material in the carrier of Lockemeyer with a reasonable expectation of success." *Id*. at 57 (citing Ex. 1014 ¶¶ 274).

3. Patent Owner's Arguments

Patent Owner argues that Petitioner's Ground 4 "never establishes (1) a non-hindsight reason that a POSA would have modified Lockemeyer's pore size distribution based on Liu in any way, let alone in a way that would have yielded a catalyst meeting any challenged claim as a whole, or (2) a reasonable expectation of success." Prelim. Resp. 55. More particularly, Patent Owner alleges that Petitioner fails to demonstrate that Liu would have motivated one of ordinary skill in the art to modify Lockemeyer's pore size distribution. *Id.* at 56. Patent Owner also alleges that Petitioner fails to demonstrate or prove that routine optimization would have led one of ordinary skill in the art to the claimed pore size distribution. *Id.* at 58. Additionally, Patent Owner argues that Petitioner fails to establish a reason to modify Lockemeyer's pore size distribution, and fails to establish a reasonable expectation of success. *Id.* at 61–63. Patent Owner again points to the "interdependent variables in a complex and unpredictable art" and argues that the nested range of 0.3 to 10 μm is not disclosed by Lockemeyer. *Id.* at 65–66.

4. Analysis

Because, as discussed above, we determine that Petitioner establishes a reasonable likelihood of unpatentability as to claim 1, we proceed to institute *inter partes* review as to all challenges in the Petition. *See PGS Geophysical AS v. Iancu*, 891 F.3d 1354, 1360 (Fed. Cir. 2018) (indicating that a decision whether to institute an *inter partes* review "require[s] a simple yes-or-no institution choice respecting a petition, embracing all challenges included in the petition"). We add here that, on this record, Petitioner has shown a reasonable likelihood of prevailing in its Ground 4

and Ground 5 obviousness contentions. The portions of Lockemeyer on which Petitioner relies, when combined with Liu (Ground 4), or when combined with Liu, Lockemeyer-II, and Kowaleski (Ground 5), appear on this record to teach all the limitations of the challenged claims. Petitioner also relies on its declarant's supporting testimony regarding the existence of the claim limitations in the cited prior art and regarding motivation to combine the references with a reasonable expectation of success, which we find sufficient at this stage in the proceeding. Pet. 16–18, 39–64; Ex. 1014 ¶¶ 161–201, 264–313.

E. 35 U.S.C. § 325(d)

Patent Owner briefly mentions 35 U.S.C. § 325(d) in the Patent Owner Response, arguing that the Petition makes no attempt to explain how the Examiner materially erred. Prelim. Resp. 3.

In determining whether to institute review, under 35 U.S.C. § 325(d) "the Director may take into account whether, and reject the petition or request because, the same or substantially the same prior art or arguments previously were presented to the Office." The following two-part framework is used to determine whether to exercise discretion under § 325(d) to deny institution:

> (1) whether the same or substantially the same art previously was presented to the Office or whether the same or substantially the same arguments previously were presented to the Office; and (2) if either condition of the first part of the framework is satisfied, whether the petitioner has demonstrated that the Office erred in a manner material to the patentability of the challenged claims.

Advanced Bionics, LLC v. MED-EL Elektromedizinische Geräte GmbH, IPR2019-01469, Paper 6 at 8 (PTAB Feb. 13, 2020) (precedential).

Advanced Bionics explains that the *Becton, Dickinson* factors[7] provide "useful insight" into how to apply the statutory framework and address "challenging factual questions, such as when a ground of unpatentability presents 'substantially the same prior art or arguments' previously presented to the Office." *Id.* at 9.

Under the first part of the *Advanced Bionics* framework, we consider whether the art presented in the Petition is the same or substantially the same as the art previously presented to the Office during examination. Patent Owner argues that the "Petition's grounds rely entirely on prior art Shell submitted to the Office and the Examiner initialed as considered during prosecution of the '390 Patent." Prelim. Resp. 3 (citing Pet. 5; Ex. 1018, 10143 (Lockemeyer, Lockemeyer-II, and Kowaleski), 10147 (Liu); Ex. 1018, 10062, 10066). Thus, the art relied upon in in the Petition was presented to the Office in an IDS during examination.

Under the second part of the *Advanced Bionics* framework, we consider whether the petitioner has demonstrated that the Office erred in a

[7] *Becton, Dickinson* identifies the following non-exclusive factors: (a) the similarities and material differences between the asserted art and the prior art involved during examination; (b) the cumulative nature of the asserted art and the prior art evaluated during examination; (c) the extent to which the asserted art was evaluated during examination, including whether the prior art was the basis for rejection; (d) the extent of the overlap between the arguments made during examination and the manner in which petitioner relies on the prior art; (e) whether petitioner has pointed out sufficiently how the examiner erred in its evaluation of the asserted prior art; and (f) the extent to which additional evidence and facts presented in the petition warrant reconsideration of the prior art or arguments. *Becton, Dickinson and Co. v. B. Braun Melsungen AG*, IPR2017-01586, Paper 8 at 17–18 (PTAB Dec. 15, 2017) (precedential as to § III.C.5, first paragraph).

manner material to the patentability of the challenged claims. Petitioner appears to address the error by explaining the prosecution history of the '390 patent, clarifying that the asserted art was not substantively evaluated during examination (apart from being initialed in an IDS) or a basis for rejection (*Becton Dickinson* factor (c)). Pet. 3–4. The Examiner, apart from initialing the asserted art in an IDS, did not indicate a substantive evaluation of the asserted art and, therefore, we credit Petitioner's argument that, although the references "were cited in a December 5, 2007 IDS, together with 91 references, none of them was used in any rejections, or otherwise addressed by the examiner" (*Becton Dickinson* factor (e)). Pet. 5 (citing Ex. 1018, 10133–50, 10037–54). Relative to *Becton Dickinson* factor (f), as discussed above, "the additional evidence and facts presented in the petition warrant reconsideration of the prior art or arguments." Based on the strength of Petitioner's challenges, we find that Petitioner sufficiently demonstrates that the Examiner erred in overlooking the relevant disclosures of the cited references.

Patent Owner also argues elsewhere that Ground 4 is cumulative of the Examiner's Szymanski-based rejection. Prelim. Resp. 60–61. This argument does not persuade us to exercise our discretion to deny the Petition, at least because Patent Owner's § 325(d) argument based on Szymanski relates to Ground 4 and does not implicate Petitioner's Grounds 1–3. As discussed above for Ground 1, we are persuaded that Petitioner demonstrates a reasonable likelihood that it would prevail in showing that at least claim 1 of the '390 patent is unpatentable. Therefore, under *SAS,* we institute review with respect to all claims and grounds asserted in the Petition.

Having reviewed Patent Owner's argument and determining that Petitioner makes out a particularly strong showing in support of institution, we find Petitioner demonstrates a material Examiner error and decline to exercise our discretion to deny institution under 35 U.S.C. § 325(d).

III. CONCLUSION

For the reasons set forth above, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing with respect to at least one challenged claim of the '390 patent. Thus, we institute *inter partes* review on all challenged claims and on all grounds presented.

At this preliminary stage of the proceeding, we have not made a final determination as to the patentability of any challenged claim or any factual or legal issue underlying the patentability inquiry. Any final determination will be based on the record developed during trial. We place Patent Owner on express notice that any argument not asserted in a timely-filed Response to the Petition, or in another manner permitted during trial, shall be deemed waived, even if that argument was presented in the Preliminary Response.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that *inter partes* review is instituted on each of the grounds asserted in the Petition; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial, which shall commence on the entry date of this decision.

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