

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

UMICORE AG & CO. KG,
Petitioner,

v.

BASF CORPORATION,
Patent Owner.

Case IPR2015-01125
Patent 7,601,662

Before CHRISTOPHER L. CRUMBLEY, JO-ANNE M. KOKOSKI, and
JEFFREY W. ABRAHAM, *Administrative Patent Judges*.

ABRAHAM, *Administrative Patent Judge*.

FINAL WRITTEN DECISION
35 U.S.C. § 318 and 37 C.F.R. § 42.73

I. INTRODUCTION

Umicore AG & Co. KG (“Petitioner”) filed a Petition seeking *inter partes* review of claims 1–24, 30, and 32–50 of U.S. Patent No. 7,601,662 B2 (Ex. 1101, “the ’662 patent”), as amended by *Ex parte* Reexamination Certificate No. US 7,601,662 C1 (“Reexam. Cert.”). Paper 1 (“Pet.”). BASF Corporation (“Patent Owner”) filed a Preliminary Response to the Petition. Paper 8. On October 29, 2015, we instituted an *inter partes* review of claims 1, 2, 5, 6, 12–24, 30, and 32–38 as discussed below. Paper 9 (“Dec. on Inst.”).

After institution, Patent Owner filed a Patent Owner Response (Paper 25, “PO Resp.”), and Petitioner filed a Reply (Paper 37, “Reply”). An oral hearing was held on July 28, 2016, and a transcript of the hearing has been entered into the record of the proceeding as Paper 52 (“Tr.”).

We have jurisdiction under 35 U.S.C. § 6. This Final Written Decision is issued pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons that follow, we determine that Petitioner has shown by a preponderance of the evidence that claims 1, 2, 5, 6, 12–24, 30, and 32–38 are unpatentable.

II. BACKGROUND

A. *Related Proceedings*

Petitioner identifies pending *inter partes* review Case IPR2015-01121, also pertaining to the ’662 patent. Pet. 1. In addition to IPR2015-01121, Patent Owner identifies pending *inter partes* review Cases IPR2015-01123 and IPR2015-01124, pertaining to U.S. Patent No. 8,404,203 B2, which issued from a divisional of the application that issued as the ’662 patent. Paper 6, 2.

B. The '662 Patent

The '662 patent states that “synthetic and natural Zeolites and their use in promoting certain reactions, including the selective reduction of nitrogen oxides with ammonia in the presence of oxygen, are well known in the art,” and that “[m]etal-promoted Zeolite catalysts including, among others, iron-promoted and copper-promoted Zeolite catalysts, for the selective catalytic reduction of nitrogen oxides with ammonia are known.” Ex. 1101, 1:26–33.

The '662 patent discloses catalysts that comprise zeolites having a CHA crystal structure and include copper, which may be part of an exhaust gas treatment system. *Id.* at 1:55–61. According to the '662 patent, “novel copper chabazite catalysts are provided which exhibit improved NH₃ SCR of NO_x.” *Id.* at 1:64–66. Several embodiments described in the '662 patent depict a catalyst comprising a zeolite having the CHA crystal structure, a specific mole ratio of silica to alumina (e.g., greater than about 15), and a specific atomic ratio of copper to aluminum (e.g., greater than about 0.25). *Id.* at 4:24–29.¹ The '662 patent teaches that the catalyst compositions can be disposed on a substrate, which usually comprises a honeycomb structure. *Id.* at 6:55–59. According to the Specification, the CuCHA zeolite catalysts of the '662 patent are said to have increased hydrothermal stability (i.e., greater stability when subjected to thermal aging) as compared to other Cu-zeolite catalysts. *Id.* at 5:1–16, 5:49–52.

¹ For purposes of this decision, we follow the parties' convention of using “SAR” to refer to the mole ratio of silica to alumina, and “Cu/Al ratio” to refer to the atomic ratio of copper to aluminum required in the claims.

C. Illustrative Claim

Claim 1 is the only independent claim challenged, and is reproduced below:

1. A catalyst comprising:

an aluminosilicate zeolite having the CHA crystal structure and a mole ratio of silica to alumina from about 15 to about 150 and an atomic ratio of copper to aluminum from about 0.25 to about 1, the catalyst effective to promote the reaction of ammonia with nitrogen oxides to form nitrogen and H₂O selectively.

Ex. 1101, Reexam. Cert. 1:56–2:3 (annotations and emphasis omitted).

D. References

Petitioner relies on the following references:

Maeshima et al., US 4,046,888, issued September 6, 1977 (“Maeshima,” Ex. 1102).

Breck, deceased et al., US 4,503,023, issued March 5, 1985 (“Breck,” Ex. 1103).

Patchett et al., US 2006/0039843 A1, published February 23, 2006 (“Patchett,” Ex. 1105).

Dedecek, et al., *Siting of the Cu⁺ ions in dehydrated ion exchanged synthetic and natural chabasites: a Cu⁺ photoluminescence study*, 32 MICROPOROUS AND MESOPOROUS MATERIALS 63, (1999) (“Dedecek,” Ex. 1107).

E. Reviewed Grounds of Patentability

The Board instituted trial to review the patentability of the challenged claims on the following grounds:

References	Statutory Basis	Claims Challenged
Maeshima and Breck	§ 103	1, 2, 5, 6, and 30
Maeshima, Breck, and Patchett	§ 103	12–24 and 32–38
Dedecek and Breck	§ 103	1, 2, 5, 6, and 30
Dedecek, Breck, and Patchett	§ 103	12–24 and 32–38

F. Level of Ordinary Skill in the Art

Petitioner’s declarant, Dr. Lercher, testifies that a person of ordinary skill in the art “would have at least a Master’s degree in chemistry or a related discipline, and have knowledge of the structure and chemistry of molecular sieves like zeolites, including factors that impact their stability and activity.” Ex. 1108 (“Lercher Declaration”) ¶ 66. Patent Owner’s declarant, Dr. Tsapatsis, stated that he agrees with the level of ordinary skill in the art advanced by Dr. Lercher. Ex. 2018 (“Tsapatsis Declaration”) ¶ 22.

We credit the testimony provided by the declarants for both parties and hold that one of skill in the art would possess at least a Master’s degree in chemistry or a related discipline, and have knowledge of the structure and chemistry of molecular sieves like zeolites, including factors that impact their stability and activity. This level of ordinary skill is reflected not only by the information presented by the parties, but also by the prior art of record. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art itself can reflect the appropriate level of ordinary skill in the art).

III. ANALYSIS

A. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are interpreted according to their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); see *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of the broadest reasonable interpretation standard). We determine that no express claim construction is required for purposes of this Decision. See *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.”).

B. References

1. Maeshima

Maeshima “relates to a method for selectively reducing nitrogen oxides contained in exhaust gases from stationary sources, such as flue gas from the combustion furnace of power plants, by using ammonia as a reducing agent.” Ex. 1102, 2:9–13. According to Maeshima, this is accomplished by contacting a gaseous exhaust mixture with a catalyst in the presence of ammonia. *Id.* at 2:6–8. Maeshima teaches that the catalyst can be a crystalline aluminosilicate or a “product obtained by exchanging an alkali metal ion in a crystalline alumino-silicate with at least one metal cation having an activity of reducing nitrogen oxides.” *Id.* at 3:33–38. Maeshima lists “Chabazite,” among others, as a suitable natural zeolite to be used in the described method. *Id.* at 4:6–12. Maeshima includes copper in its list of the most preferred metal components that can be incorporated into the zeolite catalysts (*id.* at 6:4, 4:51–52), noting that “[t]he ion exchange

ratio is not particularly critical, but it is generally preferred that the ion exchange ratio be about 60 to about 100%” (*id.* at 4:44–50), and also disclosing that the amount of the active metal component in the catalyst may be a “catalytically effective amount,” ranging from about 1 to about 20% by weight, preferably about 2 to about 10 % by weight (*id.* at 6:13–17).

2. Breck

Breck relates to “zeolite compositions topologically related to prior known zeolites but which have substantially greater $\text{SiO}_2/\text{Al}_2\text{O}_3$ molar ratios than the heretofore known zeolite species.” Ex. 1103, 1:11–14. Breck states that naturally-occurring or synthetic zeolites are well-known in the art and can be used as starting materials for the claimed process, and identifies chabazite as one of several especially preferred zeolite species. *Id.* at 4:50–63. Breck teaches that the stability of zeolites is partly a function of the $\text{SiO}_2/\text{Al}_2\text{O}_3$ ratio (*id.* at 3:9–10), and that:

[t]he novel zeolite compositions of the present invention are useful in all adsorption, ion-exchange and catalytic processes in which their less siliceous precursors have heretofore been suitably employed. In general, because they are more highly siliceous than their precursors they are not only more thermally and hydrothermally stable than those prior known materials but also have increased resistance toward acidic agents such as mineral and organic acids, SO_2 , SO_3 , NO_x and the like.

Id. at 47:44–53. Breck discloses examples of “more siliceous forms of the prior known zeolite mineral chabazite,” and describes these as having SAR values between 8 and 20. *Id.* at 18:3–15.

3. Patchett

Patchett relates to an emissions treatment system and method for reducing nitrogen oxides emissions in the exhaust stream produced from an internal combustion engine. Ex. 1105 ¶ 1. Patchett teaches that “[a] proven

NO_x abatement technology applied to stationary sources with lean exhaust conditions is Selective Catalytic Reduction (SCR) using ammonia (NH₃) or an NH₃ precursor.” *Id.* ¶ 3.

Patchett discloses one embodiment of an emissions treatment system that includes an injector for inserting ammonia into an exhaust stream upstream from a first substrate with an SCR catalyst composition and an NH₃ destruction catalyst composition (comprising a platinum group metal component) disposed thereon. *Id.* ¶¶ 18–19. Patchett teaches that the SCR catalyst composition can contain a copper-exchanged zeolite and the substrate may be a honeycomb flow-through substrate. *Id.* ¶¶ 21, 23. According to Patchett, a copper-exchanged zeolite “typically [has] an effective SCR catalyst operating temperature range of from about 150 to 550 °C.” *Id.* at ¶ 69.

4. Dedecek

Dedecek generally relates to a study of the siting and coordination of Cu⁺ ions in zeolites.² In the section titled “Introduction,” Dedecek discloses that “[z]eolites containing Cu ions attract attention owing to their high catalytic activity in NO and N₂O decomposition and selective catalytic reduction (SCR) of NO with ammonia and hydrocarbons.” Ex. 1107, 63 (internal citations omitted). Dedecek refers to previous studies conducted on aluminum-rich chabazites, and describes experiments conducted on chabazite materials having Cu concentrations ranging from 0.20 to 7.60 wt

² According to Dr. Lercher, “[s]iting of copper ions” means locating “[w]here in a zeolite lattice the copper ions are stabilized.” Ex. 2027, 77:12–17.

%, including examples of chabazites having Cu/Al ratios ranging from 0.01 to 0.38. *Id.* at 64–66.

C. Analysis of Grounds of Unpatentability

1. Claims 1, 2, 5, 6, and 30 over Maeshima and Breck

As noted above, independent claim 1 recites a catalyst having the CHA crystal structure and specific SAR (15–150) and Cu/Al values, which is effective to promote the reaction of ammonia with nitrogen oxides. Dependent claims 2, 5, and 6 recite narrowed SAR (15–100) and Cu/Al values, and dependent claim 30 recites an exhaust gas treatment system that comprises the catalyst of claim 2. Petitioner argues that the subject matter of claims 1, 2, 5, 6, and 30 would have been obvious over Maeshima in view of Breck.

Petitioner provides detailed explanations and the declaration of Dr. Lercher to show how the references disclose or suggest each claim limitation. Pet. 10–23. In our Decision on Institution, we determined that Petitioner had made a threshold showing that the prior art discloses or suggests all limitations of claims 1, 2, 5, 6, and 30 sufficient for us to conclude that there was a reasonable likelihood that Petitioner would prevail in showing that the subject matter of these claims would have been obvious in view of Maeshima and Breck. Dec. on Inst. 8–18.

In its Response, Patent Owner does not challenge Petitioner’s arguments and evidence demonstrating that the prior art discloses or suggests all limitations of the challenged claims. To the contrary, Patent Owner acknowledges that the limitations in the claims were well-known in the art. *E.g.*, PO Resp. 39 (“[I]t is undisputed that a high SAR CHA zeolite and the ion-exchange of copper in zeolite catalysts were well known in the

art since at least 1985”); Tr. 8:11–14, 38:9–14. Thus, the record contains the same arguments and evidence regarding whether the prior art discloses or suggests the limitations of claims 1, 2, 5, 6, and 30 as it did at the time of our Decision on Institution.

Based upon our review of the totality of the record after trial, we agree with Petitioner’s arguments and evidence presented in the Petition regarding whether Maeshima and Breck disclose or suggest the limitations of claims 1, 2, 5, 6, and 30. *See* Pet. 10–23. Thus, we determine that the preponderance of the evidence supports a finding that Petitioner has demonstrated that all limitations of claims 1, 2, 5, 6, and 30 are disclosed or suggested by Maeshima and Breck.

In view of this, in our analysis below, we focus on the following issues disputed by the parties, namely (i) whether Petitioner has shown why one of ordinary skill in the art would have “start[ed] with a CuCHA zeolite for the NH₃ SCR of NO_x based on the teachings of Maeshima and Breck” (PO Resp. 28; Pet. 15–17) and (ii) whether Petitioner has shown that a person of ordinary skill in the art would have had a reasonable expectation of success in combining Maeshima and Breck (PO Resp. 28–30; Pet. 17–18).

Petitioner argues that Maeshima discloses aluminosilicate zeolites with the CHA crystal structure, the claimed proportion of copper, and an SAR greater than 2, but does not explicitly state that its zeolites have a SAR in the claimed ranges. Pet. 1, 16. Petitioner contends that Breck “discloses that the SAR of a chabazite zeolite can be increased to within the claimed range.” *Id.* (citing Ex. 1103, 18:3–15). Petitioner further contends that “[o]ne of ordinary skill in the art as of February 2007 would have been

motivated to combine Maeshima with Breck to arrive, with a reasonable expectation of success, at the subject matter of the claims.” *Id.* at 15–16 (internal footnote omitted).

According to Petitioner, “Maeshima explains that an exhaust gas stream ‘generally contains . . . sulfur oxides and oxygen in addition to nitrogen oxides’ and it is ‘necessary to perform removal of nitrogen oxides while eliminating influences’ of these materials.” *Id.* at 16 (quoting Ex. 1102, 2:34–38). In view of this, Petitioner asserts that a person of ordinary skill in the art would “readily appreciate that Breck’s increased SAR zeolites would be particularly well suited for use with Maeshima” because Breck teaches that increasing the proportion of silica in a zeolite increases its resistance to acidic agents such as sulfur oxides in addition to providing thermal and hydrothermal stability. *Id.* at 16–17. Petitioner notes that Breck discloses CHA zeolites with SARs ranging from 8–20. *Id.* at 11, 19; Reply 20. Petitioner asserts that the combination of Maeshima and Breck “would render Maeshima’s catalysts and the processes in which they are employed more resistant to sulfur oxides in a gas stream, more effective across a broader temperature range, and more resistant to hydrothermal aging.” Pet. 17 (citing Ex. 1108 ¶ 163).

Petitioner further contends that it was well-known that larger amounts of copper ions enhance the effectiveness of a zeolite when catalyzing the reduction of nitrogen oxides, and, therefore, a person of ordinary skill in the art would have recognized the benefits of following Maeshima’s instructions regarding copper loading when adding copper to higher silica zeolites, such as those set forth in Breck. *Id.* (citing Ex. 1018 ¶¶ 164–165). Petitioner also argues that Maeshima and Breck are in the same technical field (zeolite

catalysts and the use of these catalysts) and directed to solving the same technical problem (identifying effective materials for catalyzing the reduction of NO_x), which would further motivate a person of ordinary skill in the art to combine the references. *Id.* at 17–18.

As to an expectation of success, Petitioner contends that a person of ordinary skill in the art would have had “every reason to believe that increasing the SAR of Maeshima’s zeolites catalysts as instructed by Breck would succeed.” *Id.* at 17. Specifically, Petitioner argues that Breck explains that increasing the proportion of silica in a zeolite does not detrimentally affect the ability to ion-exchange the zeolite, or the utility of that zeolite in catalytic processes for which “lower silica precursors” had previously been used. *Id.* (citing Ex. 1103, 47:44–47; Ex. 1108 ¶¶ 166–168). Additionally, Petitioner argues that

the combination of Maeshima and Breck amounts to nothing more than the application of one particular known modification to catalytic zeolites with a known benefit—increasing the silica of chabazite zeolites to improve stability as taught by Breck—to the very materials to which this modification is meant to be applied—Maeshima’s copper-promoted aluminosilicate zeolites for use in SCR processes.

Id. at 18 (citing Ex. 1108 ¶ 170). Petitioner contends that a person of ordinary skill in the art would have been aware of various methods and techniques for making synthetic zeolites with SARs in the claimed range. Reply 22 (citing Ex. 1119 110:19–22, 111:15–112:25).

Patent Owner argues that Petitioner has failed to explain why a person of ordinary skill in the art reading Maeshima and Breck would have started with a Cu-zeolite having the CHA structure for the SCR of NO_x in the presence of ammonia. PO Resp. 28. Patent Owner argues that Maeshima

lists nine zeolites and four preferred metals, and teaches the use of a large pore size zeolite for the NH_3 SCR of NO_x . *Id.* Patent Owner also argues that Breck discloses ten different zeolites. *Id.* According to Patent Owner, neither Maeshima nor Breck “provides any motivation to use a CuCHA zeolite for the NH_3 SCR of NO_x .” *Id.* (citing Ex. 2018 ¶ 119).

Patent Owner further argues that a person of ordinary skill in the art would not have had a reasonable expectation of success in combining the teachings of Maeshima and Breck. *Id.* Patent Owner contends that Petitioner’s argument is “based on the faulty premise that the de-alumination technique in Breck ‘does not detrimentally affect the ability to ion-exchange the zeolite, or the utility of the zeolite in catalytic processes in which lower silica precursors have been employed.’” *Id.* at 28–29 (quoting Pet. 17). Patent Owner contends that de-aluminating a zeolite will detrimentally impact the zeolite’s ability to ion-exchange and the zeolite’s catalytic activity. According to Dr. Tsapatsis,

[a]lthough Breck does contend that higher SAR may improve stability, there is a diverging effect of de-alumination that is not addressed by Breck. Specifically, the removal of aluminum leaves fewer extra framework ions present in the catalyst, thereby reducing the catalytic activity of the zeolite. Thus, while de-alumination may improve stability, it can also destroy the catalytic activity of the zeolite.

Ex. 2018 ¶ 122.

Patent Owner also argues that Dr. Lercher conceded at his deposition that de-aluminating does have a detrimental effect on the ability of a zeolite to ion exchange and on the activity of the zeolite. PO Resp. 29 (citing Ex. 2027, 94:23–95:25). Thus, according to Patent Owner, “combining the teachings of Maeshima and Breck would not predictably enhance a zeolite,

nor has Petitioner shown that a person of ordinary skill in the art would have a reasonable expectation of success in combining these references.” *Id.*

Patent Owner points out that Breck discloses only a single example of increasing the SAR of a CHA zeolite, from 8.52 to 11.18, and argues that Breck “explicitly teaches that the de-alumination technique is not efficient for the CHA framework.” *Id.* Patent Owner also notes that Breck does not include an example of increasing SAR from below 8 to above 15, as required by the claims of the ’662 patent. *Id.* at 29–30. Therefore, according to Dr. Tsapatsis, “a person of ordinary skill in the art would have no expectation that the zeolites disclosed in Maeshima having a SAR between 2 and 6 could be de-aluminated to have a SAR greater than 15.” Ex. 2018 ¶ 121; Pet. 30.

Patent Owner also disagrees that Maeshima and Breck are directed at solving the same problem. According to Patent Owner, Maeshima relates to the NH₃ SCR of NO_x in a stationary source, whereas Breck is about de-alumination of zeolites to increase SAR, and contains no teachings regarding NH₃ SCR of NO_x. PO Resp. 30; Ex. 2018 ¶ 124.

After considering the record as a whole, we agree with Petitioner that a person of ordinary skill in the art would have been motivated to use a CuCHA zeolite for the NH₃ SCR of NO_x based on the teachings of Maeshima and Breck, and would have had a reasonable expectation of success in achieving the claimed invention.

As noted above, Maeshima describes chabazite as a suitable catalyst for the selective catalytic reduction of nitrogen oxides in the presence of ammonia. Ex. 1102, 2:4–9, 4:6–11. Maeshima lists copper as an especially preferred “active metal component having an activity of reducing nitrogen

oxides” (*id.* at 6:1–4), and further describes a generally preferred ion exchange ratio and “catalytically effective” weight percent amount of the active metal component (*id.* at 4:48–50, 6:13–17). Maeshima also explains that an exhaust gas stream “generally contains . . . sulfur oxides and oxygen in addition to nitrogen oxides” and it is “necessary to perform removal of nitrogen oxides while eliminating influences of sulfur oxides.” *Id.* at 2:34–38).

Breck teaches increasing the SAR value of zeolites including chabazites, and that these zeolites can be ion exchanged. Ex. 1103, 4:50–52, 60–63. Breck also teaches that its zeolite catalysts are useful in “catalytic processes in which their less siliceous precursors have heretofore been suitably employed” and “have increased resistance toward acidic agents such as . . . SO₂, SO₃ . . . and the like.” *Id.* at 47:44–53. The evidence of record thus suggests that a person of ordinary skill in the art, upon reviewing Maeshima and Breck, would have been motivated to use a CuCHA catalyst for the NH₃ SCR of NO_x. The fact that Maeshima and Breck disclose other types of zeolites does not diminish the fact that they expressly identify chabazite as an acceptable catalyst. *See Allergan, Inc. v. Apotex Inc.*, 754 F.3d 952, 964 (Fed. Cir. 2014) (the “mere disclosure of alternative preferences does not teach a person of ordinary skill away from the broad swath of compounds within the scope of the [claims at issue]”); *Merck & Co. v. Biocraft Labs. Inc.*, 874 F.2d 804, 807 (Fed. Cir. 1989) (“[I]n a section 103 inquiry, ‘the fact that a specific [embodiment] is taught to be preferred is not controlling, since all disclosures of the prior art, including unpreferred embodiments, must be considered.’” (quoting *In re Lamberti*, 545 F.2d 747, 750 (CCPA 1976))); *see also In re Fulton*, 391 F.3d 1195,

1201 (Fed. Cir. 2004) (“The prior art’s mere disclosure of more than one alternative does not constitute a teaching away from any of these alternatives because such disclosure does not criticize, discredit, or otherwise discourage the solution claimed . . .”).

As to an expectation of success, our reviewing court has held that “the person of ordinary skill need only have a reasonable expectation of success of developing the *claimed invention*.” *Allergan, Inc. v. Sandoz Inc.*, 726 F.3d 1286, 1292 (Fed. Cir. 2013) (emphasis added). Claims 1, 2, 5, 6, and 30 require a CHA zeolite having a SAR value and Cu/Al ratio falling within certain ranges that is “effective to promote the reaction of ammonia with nitrogen oxides to form nitrogen and H₂O selectively.” At his deposition, Dr. Tsapatsis stated that this means that the catalyst must be able to “promote the reaction of ammonia with NO_x to form nitrogen and water” and does not require a particular amount of NO_x conversion. Ex. 1119, 184:21–185:12.

In view of this, Patent Owner’s argument that “combining the teachings of Maeshima and Breck would not predictably enhance a zeolite” is unavailing, as the claims do not require enhancing a zeolite. PO Resp. 29. Additionally, obviousness does not require absolute predictability. *In re Lamberti*, 545 F.2d 747, 750 (CCPA 1976). Only a reasonable expectation that the beneficial result will be achieved is necessary to show obviousness. *In re Longi*, 759 F.2d 887, 897 (Fed. Cir. 1985). Here, the “beneficial result,” according to the claims of the ’662 patent, is a catalyst that can promote the reaction of ammonia with NO_x to form water and nitrogen.

In view of Maeshima’s teaching that chabazites are suitable catalysts for the NH₃ SCR of NO_x, coupled with Breck’s disclosure that its highly

siliceous catalysts “are useful in all . . . ion-exchange and catalytic processes in which their less siliceous precursors have heretofore been suitably employed” (Ex. 1103, 47:44–47), we credit Dr. Lercher’s testimony that “[i]ncreasing the SAR of the zeolite utilized by Maeshima would not detrimentally impact the usefulness of that zeolite in a process for reducing nitrogen oxides.” Ex. 1108 ¶ 167–168.

As to Patent Owner’s argument that Dr. Lercher offered contradictory testimony, where he allegedly “conceded at his deposition that de-aluminating **does** have a detrimental effect on the ability to ion-exchange and the activity of the zeolite,” (PO Resp. 29), we note that Dr. Lercher’s deposition testimony reveals he acknowledged that de-alumination “impacts” both activity and stability of the zeolite, but agreed only that “[a]luminating the zeolite *can* decrease the activity” (Ex. 2027, 94:23–95:25) (emphasis added). This is consistent with testimony from Dr. Tsapatsis that “the resulting properties of a particular zeolite for a particular reaction after de-alumination are not predictable” because of “*the possible detrimental effect* on ion-exchange capacity and activity.” Ex. 2018 ¶ 94 (emphasis added). Obviousness, however, “cannot be avoided simply by a showing of some degree of unpredictability in the art so long as there was a reasonable probability of success.” *Allergan*, 726 F.3d at 1292 (citing *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1364 (Fed. Cir. 2007)). Here, as Petitioner and Dr. Lercher contend, Breck provides a reasonable probability that increasing the SAR of Maeshima’s CHA zeolite in view of the teachings of Breck would result in a high-SAR zeolite that is “useful in all . . . ion-exchange and catalytic processes in which their less siliceous precursors have heretofore

been suitably employed,” which, according to Maeshima, includes NH₃ SCR of NO_x.

Patent Owner’s argument that “there is no evidence that a zeolite having a SAR of 2–6, as disclosed in Maeshima, could be de-aluminated to above 15 using the technique in Breck” is based, at least in part, on the premise that Maeshima teaches using zeolites only having a SAR of 2–6. PO Resp. 30. Maeshima, however, generally teaches that its zeolites preferably have a SAR greater than 2.³ Ex. 1102, 3:67–4:3. It is only with regard to “especially preferred” embodiments that Maeshima discusses the specific SAR range of 2–6. *Id.* at 4:36–43. Moreover, Breck discloses CHA zeolites having an SAR greater than 8, preferably in the range of 8–20. Ex. 1103, 18:4–16; Ex. 1108 ¶ 157. Neither Patent Owner nor Dr. Tsapatsis address adequately these portions of Breck and Maeshima in concluding that Maeshima’s zeolites could not be de-aluminated to have a SAR above 15, instead choosing to focus on the single example of a CHA zeolite discussed in Breck and the specific range of the “especially preferred” embodiments in Maeshima. PO Resp. 29–30; Ex. 2018 ¶¶ 92–97; 121–122.

As to Patent Owner’s argument regarding the relatively low efficiency of Breck’s de-alumination method for CHA zeolites, we note that Breck indicates that “with chabazite, silicon does replace the removed aluminum in the framework.” Ex. 1103, 38:48–49. Thus, although it may be less efficient for chabazite, the evidence of record suggests that Breck’s de-alumination method does work for CHA zeolites, and Breck’s preferred

³ As Petitioner points out, Dr. Tsapatsis testified at his deposition that as of 2007, a person of ordinary skill in the art would have known how to make synthetic CHA zeolites with an SAR in the range of 30–50. Ex. 1119, 111:23–112:25.

SAR for CHA zeolites after de-alumination is 8–20, which overlaps the claimed range.

Furthermore, we agree with Petitioner that Maeshima and Breck are at least directed to the same technical field, zeolite catalysts (including chabazites) and their uses. Ex. 1102, Abstract, 1:55–63; Ex. 1103, 4:50–63, 47:44–47; Ex. 1108 ¶ 169.⁴

For all of the foregoing reasons, based upon consideration of the evidence in this record, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that a person of ordinary skill in the art would have had a reason to combine Maeshima and Breck, and would have had a reasonable expectation of successfully combining Maeshima and Breck to arrive at a high SAR CHA zeolite that can promote the NH₃ SCR of NO_x.

2. *Claims 12–24 and 32–38 over Maeshima, Breck, and Patchett*

Claims 12–24 and 32–38 depend from claim 2, and recite additional limitations such as the catalyst being deposited on a honeycomb substrate (claim 12), the honeycomb substrate comprising a wall flow filter substrate (claim 13) or a flow through substrate (claim 14), coating a portion of the flow through or wall flow substrate with Pt and CuCHA adapted to oxidize ammonia in the exhaust gas stream (claims 16 and 17), placing the catalyst downstream from a diesel engine and an injector that adds a reductant to an exhaust gas stream (claims 21–24), and including a catalyzed soot filter (claim 32). Ex. 1101, 23:48–24:23, 24:49–65; Reexam. Cert. 2:12–13.

⁴ Patent Owner does not address whether these references are directed to the same technical field. Rather, Patent Owner argues only that they are not directed at solving the same problem. PO Resp. 30.

Petitioner provides detailed explanations and the declaration of Dr. Lercher to show how the references disclose or suggest each limitation of claims 12–24 and 32–38. Pet. 24–42. In its Response, Patent Owner does not challenge Petitioner’s arguments and evidence demonstrating that the prior art discloses or suggests all limitations of these claims. Thus, the record contains the same arguments and evidence regarding whether the prior art discloses or suggests the limitations of the challenged claims as it did at the time of our Decision on Institution.

Based upon our review of the totality of the record after trial, we agree with Petitioner’s arguments and evidence presented in the Petition regarding whether Maeshima, Breck, and Patchett disclose or suggest the limitations of claims 12–24 and 32–38. See Pet. 24–42. Thus, we determine that the preponderance of the evidence supports a finding that Petitioner has demonstrated that all limitations of these claims are disclosed or suggested by Maeshima, Breck, and Patchett.

In view of this, in our analysis below, we focus on the following disputed issues, namely (i) whether Petitioner has shown why one of ordinary skill in the art would have been motivated to combine the teachings of Maeshima, Breck, and Patchett to arrive at the claimed invention (PO Resp. 33–34; Pet. 29–31) and (ii) whether Petitioner has shown that a person of ordinary skill in the art would have had a reasonable expectation of success in combining Maeshima, Breck, and Patchett (PO Resp. 34–36; Pet. 31–32).

i. Motivation to Combine Maeshima, Breck, and Patchett

Petitioner argues that a person of ordinary skill in the art “would have been motivated to use the high silica, copper promoted zeolites with the

CHA crystal structure set forth in Maeshima and Breck as part of Patchett's SCR system to arrive, with a reasonable expectation of success, at the claimed subject matter." Pet. 29. Petitioner notes that Patchett teaches the use of a copper-exchanged zeolite to reduce nitrogen oxides in diesel engine exhaust. *Id.* Petitioner states that Patchett does not specifically reference a CHA zeolite or the claimed SAR and Cu/Al ratios, but does "identify the characteristics of the zeolite that should be employed." *Id.* According to Petitioner, these characteristics include copper present in an amount of 1–5 % by weight, and an SAR greater than 10. *Id.* Petitioner notes that Patchett also explains that the zeolites should be resistant to sulfur poisoning and sustain a high level of activity when exposed to high temperatures and hydrothermal conditions. *Id.*; Ex. 1105 ¶ 66; Ex. 1108 ¶ 257.

Petitioner asserts that Maeshima and Breck disclose catalytic material having Patchett's desired characteristics, namely an SAR of up to 20, approximately 2–10% copper by weight, improved resistance to sulfur oxides, and enhanced hydrothermal stability. Pet. 30; Ex. 1108 ¶ 262; Ex. 1103, 18:3–20, 47:44–53; Ex. 1102, 6:13–17. Therefore, Petitioner contends that "one of ordinary skill in the art would be directed to the catalytic material of Maeshima and Breck when attempting to implement Patchett's process." Pet. 30; Ex. 1108 ¶¶ 261–262.

According to Petitioner, Patchett notes that "SCR catalysts have traditionally been used to remove nitrogen oxides from the gas streams emitted by 'stationary sources,'" and "then explains that this same technology is being expanded to 'mobile applications.'" Pet. 30 (citing Ex. 1105 ¶ 3). Petitioner asserts that Maeshima and Breck disclose catalysts that can be used in SCR processes that treat exhaust gas emitted from stationary

sources, which would “further motivate one of ordinary skill in the art to consider Maeshima and Breck’s materials for use with Patchett.” Ex. 1108 ¶ 263; Pet. 30.

Petitioner also argues that a person of ordinary skill in the art would have been motivated to combine Maeshima, Breck, and Patchett because these references are “in the same technical field (catalysts and catalytic processes) and are directed to solving the same types of problems (identifying materials and other components that can be used for catalyzing the reduction of nitrogen oxides in gas streams).” Pet. 31 (citing Ex. 1108 ¶ 264.) Petitioner contends that the specific limitations included in claims 12–24 and 32–38, such as coated flow through and wall flow substrates, are “only obvious design choices . . . routinely included as part of an exhaust system.” *Id.* (citing Ex. 1108 ¶¶ 266–267).

Patent Owner argues that Petitioner ignores the fact that paragraph 66 of Patchett explains that suitable zeolites have a pore size of a least 7 Angstroms. PO Resp. 33–34 (citing Ex. 1105 ¶ 66). Patent Owner further argues that Byrne⁵ and Speronello,⁶ incorporated by reference in Patchett and characterized as describing “suitable SCR catalyst compositions” that may be used in Patchett’s system, promote the use of zeolites having large pore sizes. *Id.* (citing Ex. 1110, Abstract; Ex. 1111, 6:28–59). Additionally, Patent Owner argues that Byrne teaches away from the use of copper-exchanged naturally occurring chabazite for NH₃ SCR of NO_x because of susceptibility to sulfate poisoning caused by the small pore size of CHA zeolites. *Id.* at 4–5, 33. Patent Owner asserts that Petitioner has not

⁵ Byrne, U.S. Patent No. 4,961,917, issued Oct. 9, 1990 (Ex. 1110).

⁶ Speronello, U.S. Patent No. 5,516,497, issued May 14, 1996 (Ex. 1111).

provided an explanation (other than hindsight) for why a person of ordinary skill in the art would disregard the teachings of Patchett, Byrne, and Speronello, and use Maeshima and Breck's CHA zeolite having a small pore size. *Id.* at 34.

As Petitioner points out, however, Maeshima and Breck disclose the use of a high SAR, copper-loaded CHA zeolite for NH₃ SCR of NO_x. Pet. 10, 30; Ex. 1103, 18:3–20; Ex. 1102, 1:55–63, 4:6–11, 4:44–53, 6:13–17. Breck teaches that an increased level of silica (i.e., high SAR) in the chabazite zeolites of Maeshima results in improved resistance to sulfur poisoning and hydrothermal stability. Ex. 1108 ¶ 262; Ex. 1103, 4:60–63, 47:44–53.

We credit Dr. Lercher's testimony that zeolites suitable for use in Patchett's system (1) incorporate an active metal such as copper, (2) have an SAR above 10, (3) are resistant to sulfur poisoning, and (4) retain catalytic activity when subject to high temperatures and hydrothermal conditions. Ex. 1108 ¶ 257–260. We also credit Dr. Lercher's explanation that a person of ordinary skill in the art would consider the zeolites of Maeshima and Breck for use in Patchett's system because they possess the aforementioned properties of a catalyst suitable for use in Patchett's system, and relate to NO_x abatement technology applied to stationary sources, which, according to Patchett, is "under development for mobile applications." Ex. 1105 ¶ 3; Ex. 1108 ¶¶ 261–262.

As to Patent Owner's arguments regarding pore size, Patchett explains that

[i]t has been found that zeolites which are highly resistant to sulfate poisoning and provide good activity for both the SCR process and the oxidation of ammonia with oxygen, and which

retain good activity even when subject to high temperatures, hydrothermal conditions and sulfate poisons, are zeolites which have pores which exhibit a pore diameter of at least about 7 Angstroms and are interconnected in three dimensions.

Ex. 1105 ¶ 66. Although clearly recognizing a correlation between larger pore size and the desired properties of a zeolite catalyst, we do not consider this language in Patchett to require the use of zeolites having a pore size of at least 7 Angstroms. This is consistent with the fact that Speronello, incorporated by reference in Patchett, discloses the use of “medium to large pore zeolites having pore openings of at least about 4 Angstroms in diameter.” Ex. 1111, 6:28–30; PO Resp. 26; Ex. 1105 ¶ 65.

We next address Patent Owner’s argument that “Byrne teaches away from using copper-exchanged naturally occurring chabazite for the NH₃ SCR of NO_x.” PO Resp. 33. Byrne discloses that “naturally occurring chabazite” showed a reduction in SCR process activity upon exposure to a gas stream containing varying amounts of SO₂, and, therefore, promotes the use of a large pore size zeolite framework. Ex. 1110, 4:57–5:26; Ex 2018 ¶ 133. Byrne, however, also teaches that “the utilization of high ratios of silica to alumina is known to enhance acid resistance of the zeolite and to provide enhanced resistance of the zeolite to acid sulfur poisoning.” Ex. 1110, 5:39–43. We are thus not persuaded that a person of ordinary skill in the art, upon reading Byrne, “would be led in a direction divergent from the path that was taken by the applicant,” namely the use of *high SAR* CHA zeolites to treat engine exhaust. *Ricoh Co., Ltd. v. Quanta Computer Inc.*, 550 F.3d 1325, 1332 (Fed. Cir. 2008). To the contrary, we credit Dr. Lercher’s testimony that one of ordinary skill in the art would consider the zeolites resulting from the combined teachings of Maeshima and Breck to be

suitable for use in Patchett's system due to their high SAR. Ex. 1108 ¶ 262; Reply 24; Ex. 1103, 47:44–53.

Thus, despite the fact that the CHA zeolites in Maeshima and Breck have a smaller pore size than those promoted in Patchett, Byrne, and Speronello, we are persuaded by Petitioner's evidence and arguments demonstrating that a person of ordinary skill in the art would be motivated to combine Maeshima, Breck, and Patchett based on the desired properties of suitable catalysts for use in Patchett, and the corresponding properties being shown in the zeolites resulting from the combined teachings of Maeshima and Breck. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 421 (2007) (“A person of ordinary skill is also a person of ordinary creativity, not an automaton.”).

For all of the foregoing reasons, based upon consideration of the evidence in this record, we determine that Petitioner has demonstrated, by a preponderance of the evidence, that a person of ordinary skill in the art would have had a reason to combine Maeshima, Breck, and Patchett to arrive at the claimed subject matter.

ii. *Reasonable Expectation of Success in Combining Maeshima, Breck, and Patchett*

Petitioner argues that a person of ordinary skill in the art would have had a reasonable expectation of success in combining Maeshima, Breck, and Patchett because they all relate to catalytic materials for SCR processes. Pet. 31–32 (citing Ex. 1102, 2:9–21, 3:33–38; Ex. 1105 ¶¶ 1, 18–34); Ex. 1108 ¶¶ 268–270. Petitioner further argues that

Maeshima explains that its process can be employed at a “gas space velocity of about 2,000 to about 100,000 V/H/V.” (Ex. 1102, Maeshima, at 3:25–27.) This range embraces the gas space velocity of the exhaust of an internal combustion engine,

and would indicate to one of ordinary skill in the art that the catalytic process of Maeshima and Breck has applicability beyond the treatment of gas streams emitted by stationary sources. (See Ex. 1108, Lercher Dec. at ¶ 270.)

Pet. 32.

In general, Patent Owner argues that Petitioner and Dr. Lercher provide only a cursory opinion regarding an expectation of success, and ignore the reasons stated in the prior art that a CHA material would be unsuitable for use in Patchett's system. PO Resp. 34–35 (citing Exhibit 1105 ¶ 66; Exhibit 1110, 4:57–5:25; Exhibit 1111, 6:28–59; Ex. 2018 ¶ 137). For the reasons discussed above, we find that Maeshima, in combination with Breck, discloses high SAR, copper-loaded zeolites that are suitable for use in Patchett's system. We also credit Dr. Lercher's uncontested testimony regarding applicability of Maeshima beyond the treatment of gas streams emitted by stationary sources in view of the gas space velocity range disclosed in Maeshima. Ex. 1108 ¶ 270.

Patent Owner makes a separate argument with regard to claims 13, 18–20, 23, and 24, which require, *inter alia*, disposing the catalyst on a wall flow filter. For these claims, Patent Owner argues that Dr. Lercher and Petitioner rely on the disclosure of paragraph 63 of Patchett. PO Resp. 35–36; Ex. 2018 ¶ 134. According to Patent Owner, paragraph 63 of Patchett incorporates by reference a patent application (Ex. 1106) that sets forth specific requirements for the SCR catalyst disposed on a wall flow filter, namely that it “maintains its SCR catalytic activity even after prolonged exposure to higher temperatures that are characteristic of filter regeneration. For example, combustion of the soot fraction of the particulate matter often

leads to temperatures above 700° C.” PO Resp. 36 (quoting Ex. 1106 ¶ 11); Ex. 2018 ¶ 134; Ex. 1105 ¶ 63.

Patent Owner argues that Petitioner does not explain why a person of ordinary skill in the art would have had a reasonable expectation of successfully combining Maeshima and Breck to meet this high temperature requirement. PO Resp. 35. Patent Owner reiterates that a person of ordinary skill in the art would not expect the de-alumination process of Breck to produce a catalytically active zeolite after hydrothermal aging due to the detrimental effects of de-alumination on activity and stability. PO Resp. 29–30, 35–36. Patent Owner further argues that Maeshima explicitly limits the reaction temperature for its SCR catalysts to between 200 °C and 500 °C. *Id.* at 36 (citing Ex. 2018 ¶ 83).

As discussed above, “the person of ordinary skill need only have a reasonable expectation of success of developing the *claimed invention*.” *Allergan*, 726 F.3d at 1292 (emphasis added). Claims 13, 18–20, 23, and 24 do not contain a limitation regarding hydrothermal stability, let alone a requirement for thermal stability up to a temperature of 700 °C. Instead, these claims require the catalyst described in claim 1 of the ’662 patent be disposed on a wall flow filter.

For the reasons described above, including those addressing Patent Owner’s de-alumination argument, we find that Petitioner has established that a person of ordinary skill in the art would have had a reasonable expectation of success in combining Maeshima and Breck to arrive at a zeolite that is catalytically active for the NH₃ SCR of NO_x as required in claim 1. Furthermore, the combined teachings of Maeshima and Breck demonstrate that high SAR, copper-loaded CHA zeolites can be used to treat

exhaust from a stationary source, which Patchett states is technology being developed for use in mobile applications. Ex. 1105 ¶ 3; Ex. 1103, 47:44–47; Ex. 1102, 9–13. In this context, Patchett describes coating a wall flow substrate with a high SAR, copper-loaded zeolite catalyst as part of an emissions treatment system for reducing NO_x emissions in the exhaust stream produced from an internal combustion engine. Ex. 1105 ¶¶ 1, 25. These teachings in the prior art provide a reasonable expectation of success in achieving the subject matter of claims 13, 18–20, 23, and 24.

Additionally, as Petitioner points out, Breck indicates that high SAR chabazites demonstrate improved hydrothermal stability. Ex. 1103, 47:44–53. Moreover, in the section titled “SCR Catalyst Compositions,” Patchett states that its copper-exchanged zeolites that are used as coatings “typically have an effective SCR catalyst operating temperature range of from 150 to 550 °C.” Ex. 1105 ¶ 69. We note that this temperature range corresponds to the operating temperature range expressly disclosed in Maeshima. Ex. 1102, 2:48–53. This evidence further suggests that a person of ordinary skill in the art would have had a reasonable expectation of success even though neither Maeshima nor Breck explicitly states that its zeolites are able to be used at temperatures above 700 °C. *See* Reply 25.

Accordingly, Petitioner has demonstrated by a preponderance of the evidence that a person of ordinary skill in the art would have had a reasonable expectation of success in combining Maeshima, Breck, and Patchett to arrive at the claimed subject matter.

3. *Grounds Based on Dedecek.*

Petitioner argues that the subject matter of claims 1, 2, 5, 6, and 30 would have been obvious over Dedecek in view of Breck, and the subject

matter of claims 12–24 and 32–38 would have been obvious over Dedecek in view of Breck and Patchett. Pet. 42–54. Petitioner provides detailed explanations and the declaration of Dr. Lercher to show how the references disclose or suggest each claim limitation. *Id.* at 42–54.

Petitioner contends that “Dedecek generally relates to copper containing aluminosilicate zeolites that have ‘high catalytic activity in NO . . . and N₂O decomposition’ and can be used in the ‘selective catalytic reduction (SCR) of NO with ammonia’” *Id.* at 42 (quoting Ex. 1107, 63); *see also id.* at 43 (relying on this sentence to support the argument that Dedecek discloses the requirement in claim 1 that the catalyst be “effective to promote the reaction of ammonia with nitrogen oxides to form nitrogen and H₂O selectively”). Additionally, Petitioner points out that Dedecek identifies chabazite zeolite catalytic materials having Cu/Al ratios of 0.28, 0.32, 0.34, and 0.38. *Id.*

As to Breck, Petitioner reiterates its arguments made with regard to the combination of Maeshima and Breck discussed above, namely that Breck discloses high-silica chabazites with SARs in the range of 8 to 20, and that these zeolites are highly stable and can be used in the same catalytic processes as their lower silica precursors. *Id.* at 42–43.

Petitioner contends that a person of ordinary skill in the art would have been motivated to combine Dedecek with Breck, and Dedecek with Breck and Patchett, to arrive at the subject matter of the claims, and would have done so with a reasonable expectation of success, again primarily relying on arguments similar to those made regarding the combination of Maeshima and Breck discussed above. *Id.* at 46–47.

Patent Owner challenges Petitioner's combination of Dedecek and Breck, arguing that neither Dedecek nor Breck teach using a copper chabazite for NH_3 SCR of NO_x . Tr. 91:4–10; PO Resp. 30–31. According to Dr. Tsapatsis, “Dedecek is a paper directed to study of the siting of Cu^+ ions in the chabazite framework. Breck is a patent directed to a process for increasing the SAR of a zeolite by de-alumination.” Ex. 2018 ¶ 126; PO Resp. 30–31. Patent Owner also notes that Dr. Lercher admitted at his deposition that “Dedecek is about materials; he does not address reactions.” PO Resp. 30 (citing Ex. 2027, 79:17–18).

As Patent Owner points out, “Petitioner places great emphasis on the first sentence in the Introduction of Dedecek” (PO Resp. 22), which states that “[z]eolites containing Cu ions attract attention owing to their high catalytic activity in NO [1-5] and N_2O decomposition [6] and selective catalytic reduction (SCR) of NO with ammonia [7-9] and hydrocarbons [10-12]” (Ex. 1107, 1). It is undisputed that references 7–9 cited in this statement are directed to the Cu-ZSM-5 zeolite, which does not have the CHA framework. PO Resp. 23; Tr. 90:25–91: see Ex. 2028; Ex. 2029; Ex. 2030. The discussion of chabazite in Dedecek relates only to the siting and coordination of Cu^+ zeolites. See Ex. 1107, 1.

Breck indicates that its zeolite compositions can be used in “ion-exchange and catalytic processes in which their less siliceous precursors have heretofore been suitably employed” (Ex. 1103, 47:44–47), but does not explicitly reference NH_3 SCR of NO_x . Because neither Dedecek nor Breck link CHA zeolites with the NH_3 SCR of NO_x (as Maeshima does, for example), we agree with Patent Owner neither Dedecek nor Breck disclose or suggest using a copper chabazite for ammonia SCR.

Based upon consideration of the evidence in this record, we determine that Petitioner has not demonstrated by a preponderance of the evidence that a person of ordinary skill in the art would have had a reason to combine Dedecek and Breck. Accordingly, we find that Petitioner has not demonstrated that the subject matter of claims 1, 2, 5, 6, and 30 would have been obvious over Dedecek in view of Breck, or the subject matter of claims 12–24 and 32–38 would have been obvious over Dedecek in view of Breck and Patchett.

4. *Objective Indicia of Non-obviousness*

Patent Owner argues that objective indicia of skepticism, unexpected results, and commercial success direct a finding of non-obviousness. PO Resp. 38–55.

a. Commercial Success

Patent Owner states that it sells the claimed catalyst for use in the NH_3 SCR of NO_x in diesel engines.⁷ PO Resp. 45. Patent Owner contends that the global market for SCR catalysts in diesel engines has doubled in the last five years, and provides evidence of “the estimated market share that has been satisfied with the claimed CuCHA catalyst.” PO Resp. 46 (citing Ex. 2034 ¶¶ 6–7).

Patent Owner’s evidence of the percentage of the global market satisfied by the claimed catalyst is based on sales of “BASF CuCHA catalysts” and “estimates regarding the sales by BASF licensees.” Ex. 2034 ¶ 7. As Petitioner correctly notes, and Patent Owner admits, there is no

⁷ Patent Owner argues that the catalyst it sells is coextensive with the claims of the ’662 patent, and, therefore, the commercial success is presumed to be due to the patented invention. PO Resp. 46

evidence in the record demonstrating that the sales by BASF licensees involve products that fall within the scope of the claims. Reply 18; Tr. 88:21–22. Moreover, Patent Owner has not provided evidence demonstrating what percentage of sales can be attributed to “BASF CuCHA catalysts” as opposed to “sales by BASF licensees.” Ex. 2034 ¶ 7; Reply 18; Tr. 88:15–89:6. We, therefore, agree with Petitioner that “it is impossible to determine from the evidence [Patent Owner] has presented what percentage of the global SCR market is actually accounted for by claimed products.” Reply 18–19. The lack of specific proof regarding sales of claimed products and market share renders Patent Owner’s evidence insufficient for purposes of establishing commercial success. *See In re Applied Materials, Inc.*, 692 F.3d 1289, 1300 (Fed. Cir. 2012); *see also In re Huang*, 100 F.3d 135, 140 (Fed. Cir. 1996) (“The more probative evidence of commercial success relates to whether the sales represent a substantial quantity in th[e] market.”).

b. Skepticism

Patent Owner cites to several documents as evidence of “[s]kepticism about the viability of copper exchanged zeolites.” PO Resp. 40–42 (citing Ex. 2012; Ex. 2001; Ex. 2026; Ex. 2021).

Petitioner argues that the documents Patent Owner cites address the commercial viability of copper exchanged zeolites based on hydrothermal stability. Reply 12–13. Petitioner notes that the challenged claims do not require a commercially viable catalyst or a catalyst that exhibits any particular degree of hydrothermal stability. *Id.* at 12.

We have reviewed Patent Owner’s evidence of skepticism and find it to be insufficient, as it fails to show the skepticism has a sufficient nexus to

the claimed invention. *See Muniauction, Inc. v. Thompson Corp.*, 532 F.3d 1318, 1327–28 (Fed. Cir. 2008) (indicating that the requirement of a nexus between the claimed invention and evidence of secondary considerations applies equally to skepticism). To the contrary, the evidence of record shows that doubts about hydrothermal stability and the resulting commercial applicability of copper-zeolite catalysts prompted the skepticism.⁸ For example, the Centi paper published in 1995 states that “for practical applications their *low hydrothermal stability* may prevent a *commercial use*.” Ex. 2012, 184 (emphasis added). According to the declaration of Mr. Roth, a Department of Energy grant proposal was wait-listed because “Cu-exchanged zeolites lack the *hydrothermal stability* needed to be *commercially viable* for SCR of NO_x with ammonia for diesel engines.” Ex. 2001 ¶ 4 (emphasis added).⁹ The other articles Patent Owner cites similarly refer to the lack of a “commercial breakthrough” and limited hydrothermal stability. PO. Resp. 40–41 (citing Ex. 2026, 182; Ex. 2021, 218). As Petitioner points out, the claims require only a CHA zeolite that is effective for the NH₃ SCR of NO_x.

⁸ We find this evidence sufficient to rebut any presumption of a nexus between the claimed invention and skepticism that may exist based upon Patent Owner’s argument that it is entitled to such a presumption with regard to commercial success. *WBIP, LLC v. Kohler Co.*, 829 F.3d 1317, 1330 n. 4 (Fed. Cir. 2016).

⁹ This evidence contradicts Patent Owner’s argument that “[t]he skepticism was whether you could use a zeolite catalyst in a diesel engine.” Tr. 76:21–23. The evidence of record indicates that the skepticism was based on the *hydrothermal stability* and *commercial viability* of catalysts used with diesel engines. We recognize that certain claims (e.g., 21–24) recite using the claimed catalyst downstream from a diesel engine. These claims, however, do not require a specific level of catalyst activity, hydrothermal stability, or commercial viability.

c. Unexpected Results

Patent Owner contends that “[t]he unexpected properties of the claimed CuCHA catalyst for the SCR of NO_x are demonstrated by substantial evidence.” PO Resp. 42. As evidence of unexpected results, Patent Owner relies on the performance properties (e.g., low temperature activity, high temperature activity and degradation due to hydrothermal aging) of Examples 2, 3, and 4 presented in Table 1 of the ’662 patent. PO Resp. 42–43; Ex. 1101, 13:15–37, Table 1.

These Examples each involve a catalyst having a SAR of 30, and a Cu/Al ratio in the range of 0.33–0.44. Ex. 1101, 11:39–12:19, Table 1; Reply 14. Claim 1 of the ’662 patent, however, encompasses SAR values from about 15 to about 150, and Cu/Al ratios from about 0.25 to about 1. Patent Owner admits that “the examples in table 1 are not of the same scope as claim 1.” Tr. 86:23–24. Thus, it is undisputed that Patent Owner’s evidence of unexpected results is not commensurate in scope with independent claim 1. Instead, Patent Owner argues that the Examples in Table 1 “line up with the dependent claims.” *Id.* at 86:24–25.

The claims of the subject patent must be shown to be commensurate in scope with the asserted showing of unexpected results advanced by Patent Owner. *See In re Grasselli*, 713 F.2d 731, 743 (Fed. Cir. 1983); *In re Peterson*, 315 F.3d 1325, 1330 (Fed. Cir. 2003) (“the applicant’s showing of unexpected results must be commensurate in scope with the claimed range”); *In re Clemens*, 622 F.2d 1029, 1035 (CCPA 1980) (“In order to establish unexpected results for a claimed invention, objective evidence of non-obviousness must be commensurate in scope with the claims which the evidence is offered to support.”). Patent Owner, however, does not specify

which dependent claims “line up” with Examples 2, 3, and 4 for purposes of establishing unexpected results, or provide any further information or argument.

Patent Owner also directs us to Byrne and a 2015 paper as additional evidence of unexpected results. PO Resp. 44–45. In response, Petitioner notes that, in view of at least Breck, a person of ordinary skill in the art “would not have found it unexpected that a CHA zeolite could be useful as a catalyst.” Reply 16. For the reasons discussed above, we agree. Petitioner also correctly criticizes Patent Owner’s reliance on an article from 2015 to show the claimed process yielded unexpected results. *See Bristol-Myers Squibb Co. v. Teva Pharm. USA, Inc.*, 769 F.3d 1339, 1340–41 (Fed. Cir. 2014) (per curiam) (Dyk, J., concurring) (“This case presents a question of obviousness, in particular whether evidence postdating the invention can be used to establish unexpected results. The panel holds that it cannot be considered in the circumstances of this case.”). Even if we did consider it, Patent Owner has not explained sufficiently why an article debating the mechanism behind *why* CHA zeolites work for NH₃ SCR constitutes evidence of unexpected results regarding *how well* the CHA zeolites perform, especially considering the mechanism is not recited in the claims.

In view of the foregoing, we determine that Patent Owner has not offered sufficient evidence to establish unexpected results.

IV. CONCLUSION

Based on the undisputed evidence that all elements of claim 1, 2, 5, 6, 12–24, 30, and 32–38 are in the prior art, our determination that a person of ordinary skill in the art would have had reason to combine the references with a reasonable expectation of success, and the lack of any persuasive

evidence of objective indicia of nonobviousness, we determine that the subject matter of claims 1, 2, 5, 6, 12–24, 30, and 32–38 would have been obvious to a person of ordinary skill in the art.

V. PETITIONER’S MOTION TO EXCLUDE EVIDENCE

Petitioner filed a Motion to Exclude (Paper 43) in which Petitioner seeks to exclude several paragraphs from the Declaration of Dr. Tsapatsis (Ex. 2018), paragraph 11 of the Declaration of Dr. Moini (Ex. 2019), and paragraph 7 of the Declaration of Olivia Schmidt (Ex. 2034). Paper 43, 1.

We do not reach the merits of Petitioner’s Motion to Exclude because, as explained above, even if the disputed evidence is considered, Petitioner has shown by a preponderance of evidence that claims 1, 2, 5, 6, 12–24, 30, and 32–38 are unpatentable as obvious. Accordingly, Petitioner’s Motion to Exclude is dismissed as moot.

VI. MOTION TO SEAL

Patent Owner filed an unopposed Combined Motion to Seal and Motion for Protective Order. Paper 24. In its motion, Patent Owner seeks entry of a proposed Protective Order that “is consistent with the Default Protective Order of this Board with certain edits applicable to this case.” Paper 24, 5. Patent Owner moves to seal portions of Exhibits 2019 and 2034, and asserts that these exhibits contain non-public technical and business information that is confidential to Patent Owner. Paper 24, 3. Petitioner filed a Motion to Seal Exhibit 1120, which contains deposition testimony relating to the confidential information in Exhibit 2034. Paper 39, 1. Patent Owner filed redacted versions of Exhibits 2019 and 2034, and Petitioner filed a redacted version of Exhibit 1120.

Upon review, good cause exists to enter the proposed Protective Order and seal the above information as set forth in the above motions.

VII. ORDER

For the reasons given, it is hereby

ORDERED that claims 1, 2, 5, 6, 12–24, 30, and 32–38 of U.S. Patent No. 7,601,662 B2 are *unpatentable*;

FURTHER ORDERED that Petitioner’s Motion to Exclude Evidence (Paper 43) is *dismissed as moot*;

FURTHER ORDERED that Patent Owner’s Motion to Seal and Motion for Protective Order (Paper 24) is *granted*;

FURTHER ORDERED that Petitioner’s Motion to Seal (Paper 39) is *granted*; and

FURTHER ORDERED that, because this is a Final 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.

IPR2015-01125
Patent 7,601,662

PETITIONER:

Elizabeth Gardner
Richard L. DeLucia
Orrick, Herrington & Sutcliffe LLP
rdelucia@kenyon.com
E1APTABDocket@orrick.com

PATENT OWNER:

Brian E. Ferguson
Anish Desai
Weil Gotshal & Manges LLP
Brian.ferguson@weil.com
anish.desai@weil.com