UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

UMICORE AG & CO. KG,
Petitioner,

v.

BASF CORPORATION,
Patent Owner.

Case IPR2015-01124
Patent No. 8,404,203

PATENT OWNER BASF CORPORATION'S NOTICE OF APPEAL UNDER 37 C.F.R. § 90.2(a)

Pursuant to 37 C.F.R. § 90.2(a), notice is hereby given that Patent Owner BASF Corporation ("BASF") appeals to the United States Court of Appeals for the Federal Circuit from the Final Written Decision (Paper No. 54) (the "Final Written Decision"), in IPR2015-01124, entered on October 31, 2016, by the United States Patent and Trademark Office, Patent Trial and Appeal Board ("PTAB"), and from all underlying orders, decisions, rulings, and opinions. A copy of the Final Written Decision is attached hereto as Exhibit A.

In accordance with 37 C.F.R. § 90.2(a)(3)(ii), BASF further indicates that the issues on appeal may include, but are not limited to, the PTAB's determination that claims 1-16, 19, 20, and 23-31 of U.S. Patent Number 8,404,203 have been shown to be unpatentable under 35 U.S.C. § 103 in view of the grounds of unpatentability identified in the Board's Final Written Decision, challenges to any findings supporting the determination, the Board's failure to properly consider evidence of record, the Board's legal errors in undertaking the obviousness analysis, the Board's finding that conflict with the evidence of record and are not supported by substantial evidence, and other issues decided adversely to Patent Owner.

Simultaneous with this submission, a copy of this Notice of Appeal is being filed with the PTAB through the Patent Trial and Appeal Board End to End ("PTAB E2E") System. In addition, a copy of the Notice of Appeal, along with the required docketing fee, are being filed with the Clerk's office for the United States Court of Appeals for the Federal Circuit.

Dated: December 27, 2016

Respectfully submitted,

/ Anish R. Desai /

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CERTIFICATE OF FILING

It is certified that, in addition to being filed electronically through the PTAB E2E System, the original version of Patent Owner BASF Corporation's Notice of Appeal has been sent via priority mail on December 27, 2016 with the Director of the United States Patent and Trademark Office, at the following address:

Office of the General Counsel
United States Patent and Trademark Office
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CERTIFICATE OF FILING

It is certified that a true and correct copy of Patent Owner BASF Corporation's Notice of Appeal has been filed via CM/ECF on December 27, 2016, with the Clerk's Office of the United States Court of Appeals for the Federal Circuit.

CERTIFICATE OF SERVICE

The undersigned hereby certifies that on December 27, 2016, the foregoing **PATENT OWNER BASF CORPORATION'S NOTICE OF APPEAL** was served via electronic mail, upon the following:

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EXHIBIT A

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

UMICORE AG & CO. KG,
Petitioner,

v.

BASF CORPORATION,
Patent Owner.

Case IPR2015-01124
Patent 8,404,203 B2

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

KOKOSKI, *Administrative Patent Judge.*

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

I. INTRODUCTION

Umicore AG & Co. KG ("Petitioner") filed a Petition ("Pet.") to institute an *inter partes* review of claims 1–31 of U.S. Patent No. 8,404,203 B2 ("the '203 patent," Ex. 1101). Paper 1. On November 2, 2015, we instituted an *inter partes* review of claims 1–31 on four grounds of unpatentability. (Paper 8, "Dec. on Inst."). On November 16, 2015, BASF Corporation ("Patent Owner") filed a Request for Rehearing of our Decision to institute *inter partes* review as to claims 17, 18, 21, and 22 (Paper 11), which we granted on December 7, 2015 (Paper 14, "Dec. on Reh'g"). Patent Owner filed a Patent Owner Response (Paper 26, "PO Resp."). Petitioner filed a Reply (Paper 38, "Reply").

Petitioner supports its Petition with Declarations by Johannes A. Lercher, Ph.D. ("the Lercher Declaration," Ex. 1108) and Dr. Frank-Walter Schütze ("the Schütze Declaration," Ex. 1115). Patent Owner relies on Declarations by Dr. Michael Tsapatsis ("the Tsapatsis Declaration," Ex. 2018), Dr. Ahmad Moini ("the Moini Declaration," Ex. 2019), and Olivia Schmidt ("the Schmidt Declaration," Ex. 2034).

Petitioner filed a Motion to Exclude (Paper 44) certain paragraphs of the Tsapatsis Declaration, the Moini Declaration, and the Schmidt Declaration. Patent Owner filed an Opposition (Paper 48), and Petitioner filed a Reply (Paper 49).

An oral hearing was held on July 28, 2016. A transcript of the hearing is included in the record (Paper 53, "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 1–16, 19, 20, and 23–31 are unpatentable.

A. The ’203 Patent

The ’203 patent, titled “Processes for Reducing Nitrogen Oxides Using Copper CHA Zeolite Catalysts,” is directed to methods of manufacturing copper CHA zeolite[1] catalysts and their use in exhaust gas treatment systems. Ex. 1101, 1:19–22. The Specification describes embodiments where the “catalyst compris[es] a zeolite having the CHA crystal structure and a mole ratio of silica to alumina greater than about 15 and an atomic ratio of copper to aluminum exceeding about 0.25.” *Id.* at 2:13–16. The catalyst can be “deposited on a honeycomb substrate,” which can comprise a wall flow substrate or a flow through substrate. *Id.* at 2:41–45. The ’203 patent also describes embodiments where “at least a portion of the flow through substrate is coated with CuCHA adapted to reduce oxides of nitrogen contained in a gas stream flowing through the substrate,” and those where “at least a portion of the flow through substrate is coated with Pt and CuCHA adapted to oxidize ammonia in the exhaust gas stream.” *Id.* at 2:45–51; *see also id.* at 2:53–58 (describing embodiments where at least a portion of the wall flow substrate “is coated with CuCHA adapted to reduce oxides of nitrogen contained in a gas stream flowing through the substrate,” and those where “at least a portion of the wall flow substrate is coated with Pt and CuCHA adapted to oxidize ammonia in the exhaust gas stream.”).

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[1] The parties agree that CHA crystal structure is defined by the International Zeolite Association, and that zeolites having the CHA crystal structure are also known as “chabazite.” Pet. 8; PO Resp. 12.

The ’203 patent further describes “a process for the reduction of oxides of nitrogen contained in a gas stream in the presence of oxygen wherein said process comprises contacting the gas stream with the catalyst described above.” *Id.* at 3:8–11. Figure 10A of the ’203 patent is reproduced below:

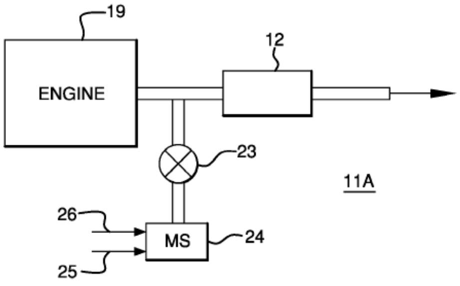

FIG. 10A

Figure 10A is a schematic depiction of an embodiment of the emissions treatment system described in the ’203 patent. *Id.* at 4:11–13. Engine 19 emits an exhaust stream containing gaseous pollutants and particulate matter, which is conveyed to a position downstream from engine 19 “where a reductant, i.e., ammonia or an ammonia-precursor, is added to the exhaust stream.” *Id.* at 21:61–66. Aqueous urea, for example, is an ammonia precursor that enters mixing station 24 on line 25 and is mixed with air from line 26. *Id.* at 22:1–3. Valve 23 is used to meter precise amounts of aqueous urea to be added to the exhaust stream, and then the aqueous urea is converted to ammonia in the exhaust stream. *Id.* at 22:3–5. The exhaust stream containing ammonia is then conveyed to “catalyst substrate 12 (also referred to herein including the claims as ‘the first substrate’) containing CuCHA in accordance with one or more embodiments.” *Id.* at 22:6–9. “On passing through the first substrate 12, the NOx component of the exhaust stream is converted through the selective catalytic reduction of NOx with NH_3 to N_2 and H_2O." *Id.* at 22:9–12.

The '203 patent also describes an embodiment that "contains a second substrate 27 interposed between the NH_3 injector and the first substrate 12." *Id.* at 22:18–21, Fig. 10B. The second substrate is coated with a catalyst composition that can be the same as, or different from, that coated on the first substrate. *Id.* at 22:21–24. In another embodiment, an oxidation catalyst is included "upstream of the site of ammonia/ammonia precursor injection." *Id.* at 22:49–51, Fig. 10C. The "oxidation catalyst is disposed on a catalyst substrate 34," and the system can also include first substrate 12 and second substrate 27. *Id.* at 22:51–54. In this embodiment, the exhaust stream is conveyed first through catalyst substrate 34, "where at least some of the gaseous hydrocarbons, CO and particulate matter are combusted to innocuous components." *Id.* at 22:54–57. According to the '203 patent, "the first substrate 12 could be a catalyzed soot filter" with the CuCHA catalyst disposed thereon, and "the second substrate 27 comprising" a CuCHA catalyst "may be located upstream from catalyst substrate 34." *Id.* at 22:62–67.

Claims 1 and 26 are independent claims. Claims 2–16, 19, 20, and 23–25 depend, directly or indirectly, from claim 1, which is reproduced below:

> 1. A process for the reduction of oxides of nitrogen contained in a gas stream in the presence of oxygen wherein said process comprises contacting the gas stream with a catalyst comprising a zeolite having the CHA crystal structure and a mole ratio of silica

> to alumina from about 15 to about 100 and an atomic ratio of copper to aluminum from about 0.25 to about 0.50.

Ex. 1101, 23:9–15.

Claims 27–31 depend, directly or indirectly, from claim 26, which is reproduced below:

> 26. A process for the reduction of oxides of nitrogen contained in a gas stream in the presence of oxygen wherein said process comprises adding a reductant to the gas stream and contacting the gas stream containing the reductant with a catalyst comprising a 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.

Id. at 24:29–36.

B. The Prior Art

The pending grounds of unpatentability in this *inter partes* review are based on the following prior art:

Reference	**Description**	**Date**	**Exhibit No.**
Maeshima	US 4,046,888	Sept. 6, 1977	1102
Breck	US 4,503,023	Mar. 5, 1985	1103
Patchett	US App. 2006/0039843 A1	Feb. 23, 2006	1105
Dědeček	*Siting of the Cu^+ ions in dehydrated ion exchanged synthetic and natural chabasites: a Cu^+ photoluminescence study,* MICROPOROUS AND MESOPOROUS MATERIALS 32: 63–74	1999	1107

C. Pending Grounds of Unpatentability

This *inter partes* review involves the following grounds of unpatentability:

References	**Basis**	**Claims Challenged**
Maeshima and Breck	§ 103(a)	1, 14, 15, 19, 20, 26, 27
Maeshima, Breck and Patchett	§ 103(a)	2–13, 16, 23–25, 28–31
Dědeček and Breck	§ 103(a)	1, 14, 15, 19, 20, 26, 27
Dědeček, Breck, and Patchett	§ 103(a)	2–13, 16, 23–25, 28–31

Dec. on Reh'g 3–4.

II. ANALYSIS

A. Claim Interpretation

We interpret claims of an unexpired patent using the "broadest reasonable construction in light of the specification of the patent in which [the claims] appear[]." 37 C.F.R. § 42.100(b); *see also Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) ("We conclude that [37 C.F.R. § 42.100(b)] represents a reasonable exercise of the rulemaking authority that Congress delegated to the Patent Office."). The Board, however, may not "construe claims during IPR so broadly that its constructions are *unreasonable* under general claim construction principles. . . . '[T]he protocol of giving claims their broadest reasonable interpretation . . . does not include giving claims a legally incorrect interpretation.'" *Microsoft Corp. v. Proxyconn, Inc.*, 789 F.3d 1292, 1298 (Fed. Cir. 2015) (citation omitted). "Rather, 'claims should always be read in light of the specification and teachings in the underlying patent'" and "[e]ven under the broadest reasonable interpretation, the Board's construction 'cannot be divorced from the specification and the record evidence.'" *Id.* (citations omitted). Only those terms in controversy need to be construed, and only to the extent necessary to resolve the controversy. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

In the Decision on Institution, we determined that the terms in the challenged claims did not need to be construed expressly, and we see no reason to modify that determination in light of the record developed at trial.

B. Level of Ordinary Skill in the Art

The parties agree that a person having 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." Pet. 14 n. 2 (citing Ex. 1108 ¶ 69); Ex. 2018 ¶¶ 21–22. This level of skill is consistent with the subject matter before us, the '203 patent, and the prior art of record. Accordingly, we adopt the level of ordinary skill in the art as described by Petitioner and Dr. Lercher, and agreed to by Dr. Tsapatsis, as further explained by the references themselves. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the level of ordinary skill in the art is usually evidenced by the references themselves).

C. Obviousness over Maeshima and Breck

Petitioner contends that the subject matter of claims 1, 14, 15, 19, 20, 26, and 27 would have been obvious under 35 U.S.C. § 103(a) over the combination of Maeshima and Breck. Pet. 10–21. Petitioner provides claim charts and relies on the Lercher and Schütze Declarations in support of its contentions. *Id.*

To prevail on its patentability challenge, Petitioner must establish facts supporting its challenge by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d). A claim is unpatentable under 35 U.S.C. § 103 if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious to a person having ordinary skill in the art to which the subject matter pertains. *KSR Int'l Co. v. Teleflex, Inc.*, 550 U.S. 398, 406 (2007). A party that petitions the Board for a determination of obviousness must show that "a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skilled artisan would have had a reasonable expectation of success in doing so." *Procter & Gamble Co. v. Teva Pharm. USA, Inc.*, 566 F.3d 989, 994 (Fed. Cir. 2009) (quoting *Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1361 (Fed. Cir. 2007)).

1. Overview of Maeshima

Maeshima is directed to a process of using catalytic reduction to reduce the concentration of nitrogen oxide in a gaseous mixture. Ex. 1102, 1:6–10. According to Maeshima, "nitrogen oxides are removed from a gas containing the nitrogen oxides and oxygen by contacting the resulting gaseous mixture with a catalyst in the presence of ammonia to reduce the nitrogen oxides selectively." *Id.* at 2:4–8. The gaseous mixture can be exhaust gases from stationary sources, such as flue gases from the combustion furnaces in power plants. *Id.* at 2:9–12.

Maeshima describes a process where the catalyst "is contacted with ammonia in an amount excessive over the stoichiometric amount necessary for reduction of nitrogen oxides in an exhaust gas to thereby activate the catalyst" before reducing the amount of ammonia to "a minimum amount necessary for reduction of the nitrogen oxides to thereby effect the catalytic reduction." *Id.* at 2:15–21. The catalyst can be a crystalline aluminosilicate having a ratio of silicon oxide to aluminum oxides above 2, and can be a chabazite zeolite. *Id.* at 3:67–4:11. The zeolite catalyst also can have an active metal ion, such as copper, incorporated therein, and although "[t]he ion exchange ratio is not particularly critical . . . it is generally preferred that the ion exchange ratio be about 60 to about 100%." *Id.* at 4:44–52.

2. Overview of Breck

Breck is directed to zeolite compositions and methods for their preparation. Ex. 1103, 1:9–11. In particular, Breck describes "a method for removing framework aluminum from zeolites having SiO_2/Al_2O_3 molar ratios of about 3 or greater and substituting therefor silicon from a source extraneous to the starting zeolite." *Id.* at 3:24–28. Breck teaches that synthetic analogs of chabazite are among the "[e]specially preferred zeolite species" used in the process. *Id.* at 4:60–63. Breck describes "novel zeolites denominated as LZ-218 [that] are the more siliceous forms of the prior known zeolite material chabazite" and have a SiO_2/Al_2O_3 mole ratio "of greater than 8, preferably in the range of 8 to 20, and the characteristic crystal structure of chabazite." *Id.* at 18:3–16. According to Breck, the described zeolites "have increased resistance toward acidic agents such as mineral and organic acids, SO_2, SO_3, NO_x and the like" and "are thus highly useful as selective adsorbents for these materials from, for example, gas streams containing same in contact sulfuric acid plants." *Id.* at 47:47–56.

3. Analysis

Patent Owner, in its Patent Owner Response, does not challenge Petitioner's arguments and evidence that Maeshima and Breck disclose or suggest all of the elements of the challenged claims. On the contrary, Patent Owner acknowledges that at least some of the limitations[2] in the claims were known in the prior art, stating, for example, that "it 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." PO Resp. 37–38. Thus, with respect to whether Maeshima and Breck disclose or suggest all of the elements of the challenged claims, we are left to consider only the evidence of record as presented in the Petition. *See* Pet. 10–21.

Based on the complete record, we find that Petitioner has presented sufficient evidence showing that Maeshima and Breck disclose or suggest all of the limitations of the challenged claims. For example, claim 1 recites that the zeolite having the CHA crystal structure has a mole ratio of silica to alumina of about 15 to about 100, and an atomic ratio of copper to aluminum of about 0.25 to about 0.50. As Petitioner alleges, "Maeshima states that the zeolite catalysts employed in its process should have a SAR ratio greater than 2," and identifies copper as a metal having an activity for reducing nitrogen oxides that "can be incorporated into the zeolite via ion exchange." Pet. 10. Also, Breck teaches chabazite zeolites that have greater SAR ratios "than the heretofore known zeolite species," and "provides a specific example… of a chabazite catalyst with a SAR ratio 'greater than 8, preferably in the range of 8 to 20.'" *Id.* at 11 (quoting Ex. 1103, 1:9–17,

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[2] As the parties do in their papers, we refer to the "mole ratio of silica to alumina" recited in claims 1 and 26 as "SAR" throughout this Decision.

18:3–15). We also have reviewed Petitioner's arguments and evidence for claims 14, 15, 19, 20, 26, and 27 (*id.* at 13–21), and find that Petitioner has met its burden of establishing that Maeshima and Breck disclose or suggest all of the limitations of those claims as well. Accordingly, we determine that the preponderance of the evidence supports a finding that Petitioner has demonstrated that all of the limitations of claims 1, 14, 15, 19, 20, 26, and 27 are disclosed or suggested by Maeshima and Breck.

Petitioner contends that it would have been obvious "to utilize Breck's higher silica zeolites with Maeshima's catalytic process to arrive, with a reasonable expectation of success, at the subject matter of the claims." Pet. 14. Petitioner contends that "Maeshima discloses all the other required claim limitations" except "zeolites with a SAR within the claimed ranges" and states that:

> Breck discloses that the SAR of a chabazite zeolite can be increased to within the claimed range. Further, Maeshima and Breck together provide one of ordinary skill in the art with motivation to use an increased silica zeolite in Maeshima's process. 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. Breck's higher silica zeolites accomplish this.

Id. at 14–15 (internal citations omitted). Petitioner further contends that Maeshima and Breck are "in the same technical field (zeolite catalysts and the use of these catalysts) and are directed to solving the same problem (identifying materials that can be effectively used in a process for catalyzing the reduction of nitrogen oxides)," which "would further motivate [the] combination." *Id.* at 16. Petitioner also contends that a person having ordinary skill in the art would have a reasonable expectation "that use of

Breck's zeolites in Maeshima's process would succeed" because Breck "explains that increasing the proportion of silica in its zeolites does not detrimentally effect the ability to ion-exchange the zeolites, or the utility of the zeolites in catalytic processes in which lower silica precursors have been employed." *Id.*

Patent Owner argues that Petitioner "fails to explain why a person of ordinary skill in the art would start with a CuCHA zeolite for the SCR of NOx based on the teachings of Maeshima and Breck." PO Resp. 26. Patent Owner argues that Petitioner "presumes" that a person having ordinary skill in the art "would ignore the teaching in Maeshima of using a large pore size zeolite for the SCR of NOx, and choose to modify a CuCHA zeolite from among the nine zeolites and four preferred metals in Maeshima, and the ten zeolites in Breck." *Id.* (internal citations omitted). According to Patent Owner, neither Maeshima nor Breck "provides any motivation to use a CuCHA zeolite for the NH_3 SCR of NOx." *Id.*

Patent Owner further argues that "Petitioner's argument that success would be expected is based on the faulty premise that the de-alumination technique in Breck" does not detrimentally effect the ability to ion-exchange the zeolite, or the utility of the catalytic process. PO Resp. 26–27. Patent Owner points to Dr. Tsapatsis's testimony to support its contention that "de-aluminating a zeolite (*i.e.*, removing aluminum and replacing with silicon) will detrimentally impact the ability to ion-exchange, and while the removal of aluminum may improve stability, it comes at the cost of catalytic activity." *Id.* at 27 (citing Ex. 2018 ¶ 122). Patent Owner argues that "Breck explicitly teaches that the de-alumination technique is not efficient for the CHA framework," and that "there is no example [in Breck] of increasing the SAR by de-alumination from a starting SAR below 8 to an ending SAR above 15." *Id.* 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.* at 27.

The Supreme Court requires an expansive and flexible approach in determining whether a patented invention would have been obvious at the time it was made. *See KSR*, 550 U.S. at 415 (2007). The existence of a reason for a person having ordinary skill in the art to modify a prior art reference is a question of fact. *See In re Constr. Equip. Co.*, 665 F.3d 1254, 1255 (Fed. Cir. 2011). In an obviousness analysis, some kind of reason must be shown as to why a person having ordinary skill in the art would have thought of combining or modifying the prior art to achieve the patented invention. *See Innogenetics, N.V. v. Abbott Labs.*, 512 F.3d 1363, 1374 (Fed. Cir. 2008). A reason to combine or modify the prior art may be found explicitly or implicitly in market forces, design incentives, the "'interrelated teachings of multiple patents'; 'any need or problem known in the field of endeavor at the time of invention and addressed by the patent'; and the background knowledge, creativity, and common sense of the person of ordinary skill." *Perfect Web Techs., Inc. v. InfoUSA, Inc.*, 587 F.3d 1324, 1328–29 (Fed Cir. 2009) (quoting *KSR*, 550 U.S. at 418–21).

Based on our review of the complete record, we find that a person having ordinary skill in the art would have looked to use a high-SAR CuCHA zeolite for the NH_3 SCR of NOx based on the teachings in Maeshima and Breck, and would have had a reasonable expectation of success in combining the teachings of Maeshima and Breck to arrive at the claimed subject matter. Maeshima teaches (1) that chabazites are suitable catalysts for the NH_3 SCR of NOx, (2) that copper is a preferred active metal component having activity to reduce nitrogen oxides, and (3) a generally preferred ion exchange ratio and catalytically effective weight percent amount of the active metal. Ex. 1102, 2:4–9, 4:6–11, 4:48–50, 6:1–4, 6:13-17. Breck describes chabazite zeolites having a SAR up to 20 that can be ion-exchanged, and "have increased resistance toward acidic agents such as mineral and organic acids, SO_2, SO_3, NO_x and the like." Ex. 1103, 4:56–63, 18:3–16, 47:47–53.

In light of these disclosures in Maeshima and Breck, the evidence of record suggests that a person having ordinary skill in the art, upon reviewing Maeshima and Breck, would have been motivated to use a CuCHA catalyst for the NH_3 SCR of NOx. 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]"); *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1166 (Fed. Cir. 2006) (explaining that in an obviousness analysis, "the prior art must be considered *as a whole* for what it teaches"); *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))).

We are not persuaded by Patent Owner's argument that "combining the teachings of Maeshima and Breck would not predictably enhance a zeolite," because the claims do not require enhancing a zeolite. PO Resp. 27; *see Allergan, Inc. v. Sandoz Inc.*, 726 F.3d 1286, 1292 (Fed. Cir. 2013) ("the person of ordinary skill need only have a reasonable expectation of success of developing the claimed invention"). Claims 1, 14, 15, 19, 20, 26, and 27 of the '203 patent only require a CHA zeolite having a SAR value and Cu/Al ratio falling within certain ranges that is used in a process for the reduction of oxides of nitrogen contained in a gas stream in the presence of oxygen, that, in certain claims, also includes adding a reductant to the gas stream. Moreover, obviousness does not require absolute predictability. *In re Lamberti*, 545 F.2d at 750. Only a reasonable expectation that a 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 '203 patent, is a process for reducing NOx contained in a gas stream using a CHA zeolite with the recited SAR and Cu/Al ratio.

Based on our review of the complete record, including Maeshima's teaching that CHA zeolites are suitable for the NH_3 SCR of NOx and Breck's teaching 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 ¶ 164; *see id.* ¶ 165.

With respect to Patent Owner's argument that Dr. Lercher "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. 27), we note that Dr. Lercher's cited testimony, read in its entirety, reveals that he acknowledged that de-alumination "impacts" both activity and stability of the zeolite, but agreed only that "de-[al]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 NH_3 SCR of NOx. *See* Pet. 16; Ex. 1108 ¶¶ 163–165.

We do not agree with 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." PO Resp. 27–28. In making this argument, Patent Owner ignores the complete disclosure of Maeshima, which teaches the use of chabazites for the SCR of NOx using zeolites with a SAR values greater than 2. Ex. 1102, 3:68–4:11(crystalline aluminosilicates, such as chabazite, “having pore diameters in the range of about 3–15 A and SiO_2/Al_2O_3 molar ratios of above about 2 are preferred”). Breck also teaches CHA zeolites having a SAR greater than 8, and preferably in the range of 8–20. Ex. 1103, 18:3–16. Furthermore, as Petitioner points out (Reply 22), Dr. Tsapatsis testified at his deposition that as of 2007, a person having ordinary skill in the art would have known how to make synthetic CHA zeolites with SARs of 30–50. Ex. 1119, 110:19–22, 111:15–112:25. Thus, contrary to Patent Owner’s argument, the evidence of record demonstrates that the combined teachings of Maeshima and Breck disclose using a chabazite having a SAR of about 15 or greater, which is all the challenged claims require.

With respect to Patent Owner’s argument regarding the relatively low efficiency of Breck’s de-alumination method for CHA zeolites (PO Resp. 27–28), 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, the evidence of record suggests that Breck’s de-alumination method does work for CHA zeolites, and Breck’s preferred SAR for CHA zeolites after de-alumination is 8–20, which overlaps the claimed range.

Patent Owner also argues that Maeshima and Breck are not directed to solving the same problem, because “Maeshima is about the NH_3 SCR of NOx in a stationary source” and “makes no reference to the issue of hydrothermal stability,” and “Breck is about a process for de-aluminating a zeolite to increase the SAR, but has no teachings regarding the NH_3 SCR of NOx.” PO Resp. 28. Breck, however, teaches 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), and, as Petitioner notes, both Maeshima and Breck “discuss many of the same types of catalytic materials” (Reply 23). We therefore 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 ¶ 166.

Accordingly, after considering Petitioner’s and Patent Owner’s positions, as well as the evidence of record, we determine that Petitioner has shown, by a preponderance of the evidence, that a person having ordinary skill in the art would have had a reason to combine the teachings of Maeshima and Breck to arrive at the claimed subject matter, and would have had a reasonable expectation of success in doing so.

D. Obviousness over Maeshima, Breck, and Patchett

Petitioner contends that the subject matter of claims 2–13, 16, 23–25, and 28–31 would have been obvious under 35 U.S.C. § 103(a) over the combination of Maeshima, Breck, and Patchett. Pet. 22–41. Petitioner provides claim charts, and relies on the Lercher and Schütze Declarations in support of its contentions. *Id.*

1. Overview of Patchett

Patchett is directed to an emissions treatment system and method for reducing nitrogen oxides in an exhaust stream produced by an internal combustion engine. Ex. 1105 ¶ 1. According to Patchett, “Selective Catalytic Reduction (SCR) using ammonia (NH_3) or an NH_3 precursor” is “[a] proven NOx abatement technology applied to stationary sources with lean exhaust conditions." *Id.* ¶ 3. Patchett also states that "SCR is under development for mobile applications, with urea (typically present in an aqueous solution) as the source of ammonia." *Id.*

The Patchett treatment system includes "an injector for periodically metering ammonia or an ammonia precursor into an exhaust stream" and "a first substrate with a first SCR catalyst composition" positioned downstream from the injector. *Id.* ¶ 18. The first substrate has an inlet end and an outlet end, with the first SCR catalyst composition being "disposed on the wall elements from the inlet end toward the outlet end to a length that is less than the substrate's axial length to form an inlet zone." *Id.* The first SCR catalyst composition can be a copper-exchanged zeolite. *Id.* ¶ 21. An ammonia destruction catalyst composition, preferably containing a platinum component, is disposed on the wall elements of the first substrate from the outlet end toward the inlet end, forming an outlet zone. *Id.* ¶¶ 19–20. Patchett states that first substrate can be a honeycomb flow-through substrate or a honeycomb wall flow substrate. *Id.* ¶ 23.

Patchett also teaches that the described treatment system can have "a second substrate interposed and in fluid communication with the injector and the first substrate." *Id.* ¶ 25. The second substrate can be "selected from the group consisting of a honeycomb flow-through substrate, an open-cell foam substrate and a honeycomb wall flow substrate," but preferably "is a honeycomb flow-through substrate with a second SCR catalyst composition." *Id.* The first and second SCR catalyst compositions may be the same or different, but are the same in a preferred embodiment. *Id.* Patchett also describes an embodiment with an oxidation catalyst, disposed on a catalyst substrate, located upstream of the site of the ammonia/ammonia precursor injection. *Id.* ¶ 64. In this embodiment, the exhaust stream first contacts the oxidation catalyst substrate "where at least some of the gaseous hydrocarbons, CO and particulate matter are combusted to innocuous components" before the exhaust stream is conveyed to the ammonia/ammonia precursor injection site and on to the first and second catalyst substrates. *Id.*

2. Analysis

Patent Owner, in its Patent Owner Response, does not challenge Petitioner's arguments and evidence that the combined teachings of Maeshima, Breck, and Patchett disclose or suggest all of the elements of the challenged claims. Thus, with respect to whether Maeshima, Breck, and Patchett disclose or suggest all of the elements of the challenged claims, we are left to consider only the evidence of record as presented in the Petition. *See* Pet. 22–41.

Based on the complete record, we find that Petitioner has presented sufficient evidence showing that the combined teachings of Maeshima, Breck, and Patchett disclose or suggest all of the limitations of the challenged claims. For example, claim 2, which depends from claim 1, further requires that the gas stream be from an internal combustion engine, and that the catalyst is disposed on a honeycomb flow through filter. As Petitioner alleges, Patchett "explains that its system is specifically designed to treat diesel engine exhaust," and teaches the use of a honeycomb flow through substrate "coated with an SCR catalyst." Pet. 24–25. We also have reviewed Petitioner's arguments and evidence for claims 3–13, 16, 23–25, and 28–31 (*id.* at 25–41), and find that Petitioner has met its burden of establishing that the combined teachings of Maeshima, Breck, and Patchett disclose or suggest all of the limitations of those claims as well. Accordingly, we determine that the preponderance of the evidence supports a finding that Petitioner has demonstrated that all of the limitations of claims 2–13, 16, 23–25, and 28–31 are disclosed or suggested by the combination of Maeshima, Breck, and Patchett.

The parties focus their arguments on two main issues: (a) whether Petitioner has shown why a person having ordinary skill in the art would have had reason to combine the teachings of Maeshima, Breck, and Patchett (Pet. 28–31; PO Resp. 31–32); and (b) whether Petitioner has shown that a person having ordinary skill in the art would have a reasonable expectation of success in combining Maeshima, Breck, and Patchett (Pet. 31–32; PO Resp. 4–6, 32–33; Reply 23–25). We address these arguments in turn below.

a. Reason to Combine Maeshima, Breck, and Patchett

Petitioner contends that a person having 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. 28. Petitioner contends that "Patchett describes the use of a copper-exchanged zeolite as a catalyst in an SCR process to reduce nitrogen oxides in diesel engine exhaust," and "explains that the zeolite should, among other things, be 'resistant to sulfur poisoning' and 'sustain a high level of activity for the SCR process' even when subjected to 'high temperatures' and 'hydrothermal conditions.'" *Id.* at 28–29 (quoting Ex. 1105 ¶ 66). Petitioner contends that Patchett cites to examples of suitable catalyst compositions that "have a SAR greater than 10," and states "[c]opper is preferably present in an amount of 'about 1 to 5 percent by weight.'" *Id.* at 29 (quoting Ex. 1105 ¶ 65). According to Petitioner, "Maeshima and Breck describe this very type of catalytic material," and "one of ordinary skill would be directed to the catalytic material of Maeshima and Breck when attempting to implement Patchett's process." *Id.*

Patent Owner argues that Patchett incorporates Byrne[3] by reference with respect to suitable SCR catalyst compositions, and "Byrne teaches away from using copper-exchanged naturally occurring chabazite for the NH_3 SCR of NOx." PO Resp. 31 (citing Ex. 1110, 4:57–5:26). Patent Owner argues that Patchett, Byrne, Speronello[4] (incorporated by reference into Patchett), and Maeshima "all expressly promote the use [of] a large pore size zeolite framework." *Id.* at 32. According to Patent Owner, "[t]here is no explanation, other than hindsight, for why a person of ordinary skill in the art would disregard the teachings of these four patent publications—all of which pertain directly to the NH_3 SCR of NOx *and* undermine the use of small pore size zeolites such as CHA zeolite." *Id.*

Based on our review of the complete record, we find that a person having ordinary skill in the art would have looked to use the catalytic material taught by Maeshima and Breck in the Patchett process. As Petitioner notes, Maeshima and Breck disclose the use of a high SAR, copper-loaded CHA zeolite for NH_3 SCR of NOx. Pet. 29; 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

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

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

Maeshima results in improved resistance to sulfur poisoning and hydrothermal stability. Ex. 1108 ¶ 251; Ex. 1103, 4:60–63, 47:44–53.

In light of the disclosures in the prior art, 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 a SAR above 10, (3) are resistant to sulfur poisoning, and (4) retain catalytic activity when subjected to high temperatures and hydrothermal conditions. Ex. 1108 ¶¶ 246–251. We also credit Dr. Lercher's explanation that a person having ordinary skill in the art would consider the zeolites of Maeshima and Breck for use in Patchett's process because Patchett

> explains that SCR catalysts have been used to treat the exhaust gas emitted by "stationary sources" in the past but that use of these materials has been expanded to "mobile applications" like automobiles. Thus, one of ordinary skill in the art would consider the types of catalytic materials used to treat the exhaust gas of "stationary sources" when implementing [Patchett's] system and process. Maeshima and Breck disclose these types of materials and state that their catalytic materials can be used in SCR processes designed to treat the exhaust of stationary sources like power stations.

Ex. 1108 ¶ 252.

With respect to Patent Owner's argument that Patchett "promote[s] the use [of] a large pore size zeolite framework" (PO Resp. 32), we note that Patchett explains:

> It 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. While Patchett recognizes a correlation between larger pore size and the recited properties of the zeolite catalyst, we do not understand Patchett to require the use of zeolites having a pore size of at least 7 Angstroms. In particular, Speronello, which Patchett incorporates by reference as describing "[s]uitable SCR catalyst compositions that may be used to coat the inlet zone of the first substrate and/or the second substrate" (Ex. 1105 ¶ 65), teaches the use of "medium to large pore zeolites having pore openings of at least about 4 Angstroms in diameter." Ex. 1111, 6:28–30. According to Dr. Tsapatsis, CHA zeolites have "a small pore size of approximately 3.8 Angstroms (0.38 nm)." Ex. 2018 ¶ 59; *see* PO Resp. 3 n. 2.

We are similarly unpersuaded by Patent Owner's argument that Byrne "teaches away from using copper-exchanged naturally occurring chabazite for the NH_3 SCR of NOx." PO Resp. 31. As an initial matter, demonstrating there are differences between the prior art references is insufficient, by itself, to conclude the references teach away from Petitioner's proposed combination. *See In re Beattie*, 974 F.2d 1309, 1312–13 (Fed. Cir. 1992). "Under the proper legal standard, a reference will teach away when it suggests that the developments flowing from its disclosure are unlikely to produce the objective of the [patented] invention." *Syntex (U.S.A.) LLC v. Apotex, Inc.*, 407 F.3d 1371, 1380 (Fed. Cir. 2005). A prior art reference must be considered for everything it teaches by way of technology and is not limited to the particular invention it is describing and attempting to protect. *See EWP Corp. v. Reliance Universal Inc.*, 755 F.2d 898, 907 (Fed. Cir. 1985).

In addition to disclosing that "naturally occurring chabazite" shows a reduction in SCR process activity when exposed to a gas stream containing varying amounts of SO_2, thereby promoting the use of a large pore size zeolite framework (Ex. 1110, 4:57–5:26), Byrne also states 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" (*id.* at 5:39–44). Reading Byrne for everything it teaches, we are not persuaded that Byrne "suggests that the developments flowing from its disclosure are unlikely to produce the objective of the [patented] invention," which, in this case, is the use of high SAR CHA zeolites to catalytically reduce NOx in a gas stream. *Syntex*, 407 F.3d at 1380; *see also In re Gurley*, 27 F.3d at 553 ("A reference may be said to teach away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant."). As set forth above, we credit Dr. Lercher's testimony that a person having ordinary skill in the art would consider the zeolites of Maeshima and Breck suitable for use in Patchett's system. Ex. 1108 ¶¶ 251–252.

Despite the fact that the CHA zeolites in Maeshima and Breck have a smaller pore size than those 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*, 550

U.S. at 421 ("A person of ordinary skill is also a person of ordinary creativity, not an automaton.").

Accordingly, after considering Petitioner's and Patent Owner's positions, as well as the evidence of record, we determine that Petitioner has shown, by a preponderance of the evidence, that a person having ordinary skill in the art would have had a reason to combine the teachings of Maeshima, Breck, and Patchett to arrive at the claimed subject matter.

b. Reasonable Expectation of Success

Petitioner contends that a person having ordinary skill in the art would have a reasonable expectation of success in combining the teachings of Maeshima, Breck, and Patchett because they "all relate to catalytic materials for SCR processes," and "Maeshima explains that its process can be employed at 'gas space velocity of about 2,000 to about 100,000 V/H/V,'" which "embraces the gas space velocity of the exhaust of an internal combustion engine." Pet. 31. According to Petitioner, this "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." *Id.* at 31–32.

Patent Owner reiterates its argument that the prior art demonstrates "that a CHA material would be unsuitable for use" in Patchett's system. PO Resp. 33–34. As set forth above, this argument is unpersuasive because the totality of the evidence demonstrates that the Maeshima and Breck zeolites would be suitable for use in Patchett's system. *See supra* Section II.D.2.a.

With respect to claims 5–7, 24, and 30,[5] "which require disposing the claimed CuCHA catalyst on a wall flow filter," Patent Owner points out that a prior art patent application (Ex. 1106) that is incorporated by reference into Patchett requires that the catalyst maintain catalytic activity after sustained exposure to the higher temperatures of filter regeneration, which can be above 700° C. PO Resp. 33 (quoting Ex. 1106 ¶ 11). Patent Owner argues that "Petitioner does not explain why a person of ordinary skill in the art would have a reasonable expectation of success combining Maeshima and Breck to meet this requirement." *Id.* According to Patent Owner,

> one of ordinary skill in the art would not have a reasonable expectation of success that the de-alumination process disclosed in Breck would result in a catalytically active zeolite after hydrothermal aging because of the opposing effects de-alumination has on activity and stability. Additionally, Maeshima explicitly limits the reaction temperature for its SCR catalysts to between 200° C and 500° C.

Id. at 33–34.

We do not consider Patent Owner's argument to be persuasive because, as Petitioner notes (Reply 3–5), enhanced hydrothermal stability and reaction temperature are not elements of the claims. *See Allergan*, 726 F.3d at 1292. In addition to the SAR and Cu/Al ratios recited in claims 1 and 26 from which the instant claims depend, the claims only require that the catalyst be disposed on a honeycomb wall flow substrate (claims 5–7), or

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[5] In making this argument, Patent Owner identifies claims 13, 18–20, 23, and 24 as the claims that require disposing the claimed CuCHA catalyst on a wall flow filter. PO Resp. 33. As these claims include claims that are either not at issue or do not recite a wall flow filter, we determine this to be typographical error and instead apply the argument to claims in the '203 patent that recite the wall flow filter element.

a honeycomb wall flow filter substrate (claims 24 and 30). Moreover, obviousness does not require absolute predictability. *In re Lamberti*, 545 F.2d at 750. Only a reasonable expectation that a beneficial result will be achieved is necessary to show obviousness. *In re Longi*, 759 F.2d at 897. Here, the "beneficial result," according to the claims 5–7, 24, and 30 of the '203 patent, is a process for reducing NOx contained in a gas stream using a CHA zeolite with the recited SAR and Cu/Al ratio that is 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 can be used in a process for the reduction of NOx in a gas stream in the presence of oxygen, as required by independent claims 1 and 26. 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 NOx 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 5–7, 24, and 30.

Moreover, as Petitioner points out (Reply 24–25), Breck indicates that high SAR chabazites demonstrate improved hydrothermal stability.

Ex. 1003, 47:44–53. Further, 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 from 150 to 550° C.” Ex. 1105 ¶ 69. We note that this temperature range corresponds to the operating temperature range taught in Maeshima. *See* 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 24–25.

After considering Petitioner’s and Patent Owner’s positions, as well as the evidence of record, we determine that Petitioner has shown, by a preponderance of the evidence, that a person having ordinary skill in the art would have had a reasonable expectation of success in combing the teachings of Maeshima, Breck, and Patchett to arrive at the claimed subject matter.

E. Grounds Based on Dědeček

Petitioner contends that the subject matter of claims 1, 14, 15, 19, 20, 26, and 27 would have been obvious under 35 U.S.C. § 103(a) over the combination of Dědeček and Breck, and claims 2–13, 16, 23–25, and 28–31 would have been obvious under § 103(a) over the combined teachings of Dědeček, Breck, and Patchett. Pet. 41–54. Petitioner provides claim charts and relies on the Lercher and Schütze Declarations in support of its contentions. *Id.*

1. Overview of Dědeček

Dědeček describes studies where “Cu^+ emission spectra of Cu^{2+} ion exchanged and reduced natural and synthetic CuNa-, CuCa-, CuCs- and

CuBa-chabasites were used to identify cationic sites of the Cu^+ luminescence centres in this zeolite." Ex. 1107, Abs. Dědeček states that zeolites containing copper ions have "high catalytic activity in NO and N_2O decomposition and selective catalytic reduction (SCR) of NO with ammonia and hydrocarbons." *Id.* at 63 (internal citations omitted). Dědeček describes synthetic chabazite[6] and natural sedimentary chabazite having 63.89 wt% SiO_2 and 17.48 wt% Al_2O_3. *Id.* at 64. Dědeček also describes chemical compositions of Cu^{2+} chabazites having ratios of copper to aluminum of 0.28, 0.32, 0.34, and 0.38. *Id.* at 66, Table 3.

2. Analysis

Petitioner contends that Dědeček teaches the use of chabazite zeolites in the SCR process, and includes "examples of chabazite zeolites with Cu/Al ratios of 0.28, 0.32, 0.34, and 0.38, all of which are within the claimed ranges." Pet. 42 (internal citation omitted). Petitioner further contends that "Breck discloses a high-silica chabazite with a SAR in the range of 8 to 20," which "are highly stable, and can be ion-exchanged and used in catalytic processes just like lower silica precursors." *Id.* According to Petitioner, "[i]ncorporation of Breck's chabazite zeolite into Dedecek, while maintaining the Cu/Al ratios set forth in Dědeček, results in a catalyst with the claimed proportions of silica, alumina, and copper." *Id.* at 42–43.

Petitioner further contends that a person of ordinary skill in the art would have been motivated to combine Dědeček with Breck, and Dědeček with Breck and Patchett, to arrive at the subject matter of the claims, and would have done so with a reasonable expectation of success, primarily

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[6] Dědeček uses the spelling "chabasite;" for consistency with the '203 patent and other prior art, we will refer to "chabazite."

relying on arguments similar to those made regarding the combinations of Maeshima and Breck, and Maeshima, Breck, and Patchett, discussed above. Pet. 43–45, 51–53.

Patent Owner argues that neither Dědeček nor Breck teaches the use of CuCHA zeolites for the SCR of NOx. PO Resp. 28–29. To support this argument, Patent Owner relies on Dr. Tsapatsis's testimony that

> Dedecek is a paper directed to the study of the siting of Cu^+ ions in the chabazite framework. Breck is patent directed to a process for increasing the SAR of a zeolite by de-alumination. While both deal in zeolites, they are not directed to solving the same problem, and neither is about the use of zeolites for the SCR of NOx.

Ex. 2018 ¶ 126. Patent Owner also points to Dr. Lercher's deposition testimony that "Dedecek is about materials; he does not address reactions." PO Resp. 28 (citing Ex. 2027, 79:17–18).

As Patent Owner notes, "Petitioner places great emphasis on the first sentence of the Introduction of Dedecek," 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]." PO Resp. 20; Ex. 1107, 1. Although the three papers that correspond to the "[7–9]" cite in Dědeček do discuss the SCR of NOx, they are directed to the use of ZSM-5 zeolites, which do not have the CHA framework. *See* Ex. 2029, 1 ("The aim of this study is to show differences in the character of the Cu sites active" in the SCR of NO "by investigating the Cu siting in Cu-ZSM-5 of various Cu/Al" and SAR.); Ex. 2030, 1 (applying Cu^{2+}-exchanged ZSM-5 zeolites to the SCR of NOx with ammonia in the presence of oxygen); Ex. 2031, 137 (testing the activity of "Cu-ZSM-5 featuring > 100% ion exchange” for SCR of NOx). Dědeček uses CuCHA zeolites only to determine the cationic sites of the Cu^+ ions incorporated therein. Ex. 1107, 1.

Breck teaches 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), but does not specifically identify the SCR of NOx. Thus, the evidence of record demonstrates that neither Dědeček nor Breck explicitly teach the use of CuCHA zeolites for the SCR of NOx. This is in contrast to the combination of Maeshima and Breck, discussed above, because Maeshima teaches that “nitrogen oxides are removed from a gas containing the nitrogen oxides and oxygen by contacting the resulting gaseous mixture with a catalyst in the presence of ammonia to reduce the nitrogen oxides selectively,” wherein the catalyst can be a copper-exchanged CHA zeolite. Ex. 1102, 2:4–8, 3:67–4:11, 4:44–52.

Petitioner’s arguments regarding the motivation to combine Dědeček and Breck are premised on its contention that the references teach the use CuCHA zeolites for the SCR of NOx. Because the evidence of record does not support this contention, we determine that Petitioner does not provide sufficient reasoning as to why one of ordinary skill in the art would combine Dědeček and Breck, or Dědeček, Breck, and Patchett, to arrive at the claimed subject matter.

Accordingly, on the record before us, we find that Petitioner has not demonstrated by a preponderance of the evidence that the subject matter of claims 1, 14, 15, 19, 20, 26, and 27 would have been obvious over the combined teachings of Dědeček and Breck, or that the subject matter of claims 2–13, 16, 23–25, and 28–31 would have been obvious over the combined teachings of Dědeček, Breck, and Patchett.

F. Secondary Considerations of Nonobviousness

As part of our obviousness analysis, we consider the evidence and arguments submitted by Patent Owner regarding secondary considerations of non-obviousness. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966) (secondary considerations include commercial success, long-felt but unsolved needs, failure of others, and unexpected results). Here, Patent Owner raises arguments relating to skepticism, unexpected results, and commercial success. PO Resp. 36–45.

1. Skepticism

Patent Owner cites to several documents as evidence of "[s]kepticism about the viability of copper-exchanged zeolites." PO Resp. 38–40 (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, "[b]ut, none of the claims at issue in this IPR require a commercially viable catalyst, let alone a catalyst that exhibits any particular degree of hydrothermal stability." Reply 11–12.

We have reviewed Patent Owner's evidence of skepticism and find it to be insufficient, as it fails to show 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). Instead, the evidence of record shows that doubts about hydrothermal stability and the resulting commercial viability of copper-zeolite catalysts prompted the skepticism.[7] 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). Evidence also shows that Patent Owner's proposal for funding to study copper-loaded zeolites for the SCR of NOx was wait-listed by the Department of Energy because "Cu-exchanged zeolites lack the *hydrothermal stability* needed to be *commercially viable* for SCR of NOx with ammonia for diesel engines." Ex. 2001 ¶ 4 (emphasis added).

This 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. The other articles Patent Owner cites similarly refer to the lack of a "commercial breakthrough" and limited hydrothermal stability. PO. Resp. 39–40 (citing Ex. 2026, 182; Ex. 2021, 218). As Petitioner points out, "[t]he claims require only a CuCHA zeolite catalyst that can be used as part of a process for reducing nitrogen oxides." Reply 12.

Accordingly, we are find that the evidence presented does not amount to a sufficient showing of skepticism attributable to the claimed invention.

2. Unexpected Results

Patent Owner contends that "[t]he unexpected properties of the claimed CuCHA catalyst for the SCR of NOx are demonstrated by

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[7] 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).

substantial evidence." PO Resp. 40. 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 '203 patent. PO Resp. 40–41; Ex. 1101, 11:40–12:22 (Examples 2, 3, and 4), 14:19–67 (Table 1).

As Petitioner points out, these Examples each involve a catalyst having a SAR of 30, and a Cu/Al ratio in the range of 0.33–0.44. Reply 14; *see* Ex. 1101, 11:40–12:22, 14:19–67, Table 1. The two independent claims of the '203 patent, however, encompasses SARs from about 15 to about 100 (claim 1) or about 15 to about 150 (claim 26), and Cu/Al ratios from about 0.25 to about 0.5 (claim 1) and about 0.25 to about 1 (claim 26). Thus, Patent Owner's evidence of unexpected results is not commensurate in scope with independent claims 1 and 26.

Patent Owner's "showing of unexpected results must be commensurate in scope with" the claims of the '203 patent. *See In re Peterson*, 315 F.3d 1325, 1330 (Fed. Cir. 2003); *see also 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 any claims of the '203 patent that are commensurate in scope 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 (Ex. 2020) as additional evidence of unexpected results. PO Resp. 42–43. Petitioner responds, citing Breck, that it was known that higher SAR zeolites were less susceptible to sulfate poisoning, and a person having ordinary skill in the art "would not have found it unexpected that a CHA zeolite could be useful as a catalyst." Reply 15–16. 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. *Id.; 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 were to consider the 2015 paper as evidence of unexpected results, Patent Owner has not explained sufficiently why an article debating the mechanism behind *why* CHA zeolites work for NH_3 SCR constitutes evidence of unexpected results regarding *how well* the CHA zeolites perform, especially considering the mechanism is not recited in the claims. *See* Ex. 2020. Accordingly, we find that the evidence presented does not amount to a sufficient showing of unexpected results.

3. Commercial Success

Patent Owner states that it sells the claimed catalyst for use in the NH_3 SCR of NOx in diesel engines, and because "the product sold by Patent Owner, a CuCHA catalyst having a SAR falling within the claimed ranges, is coextensive with the claims of the [']203 patent," "the commercial success is presumed to be due to the patented invention." PO Resp. 43–44. Patent Owner provides evidence purporting to show that the "size of the global market for SCR catalysts in diesel engines has doubled over the last five years," and that Patent Owner's claimed CuCHA catalyst has satisfied a substantial market share. *Id.* at 44 (citing Ex. 2034 ¶¶ 6–7). According to Patent Owner, "[t]he combination of the increasing market size and substantial market share of the claimed CuCHA catalyst are sufficient to demonstrate that the product has been commercially successful." *Id.* at 43–44.

Patent Owner's evidence of the percentage of the global market satisfied by the claimed catalyst is based on sales of Patent Owner's CuCHA catalysts and estimates regarding the sales by Patent Owner's licensees. Ex. 2034 ¶ 7. As Petitioner notes, and Patent Owner admits, there is no evidence in the record demonstrating that the sales by Patent Owner's licensees involve products that fall within the scope of the claims. Reply 18; Tr. 88:21–22. While Patent Owner provided evidence that Johnson Matthey Inc. is a licensee to related U.S. Patent No. 7,601,662 (Ex. 2034 ¶ 3, n. 1; Ex. 2028), Patent Owner did not provide evidence or definitively confirm that Johnson Matthey is also a licensee to the '203 patent. *See* Tr. 79:1–7 (expressing the belief that Johnson Matthey is a licensee to the '203 patent "[b]ecause [it is] part of the same family" as U.S. Patent No. 7,601,662).

Moreover, Patent Owner has not provided evidence demonstrating what percentage of sales can be attributed to Patent Owner's CuCHA catalysts as opposed to sales by Patent Owner's licensees. Ex. 2034 ¶ 7; Reply 18; Tr. 88:15–89:6. We agree, therefore, 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.").

III. CONCLUSION

For the foregoing reasons, Petitioner has shown, by a preponderance of the evidence, that claims 1, 14, 15, 19, 20, 26, and 27 of the '203 patent are unpatentable under 35 U.S.C. § 103 as obvious over the combined teachings of Maeshima and Breck, and that claims 2–13, 16, 23–25, and 28–31 of the '203 patent are unpatentable under 35 U.S.C. § 103 as obvious over the combined teachings of Maeshima, Breck, and Patchett.

IV. PETITIONER'S MOTION TO EXCLUDE

Petitioner moves to exclude (1) paragraphs 28, 48, 54, 55, 62–71, 79, 147–150, and 168–177 of the Tsapatsis Declaration (Ex. 2018), (2) paragraph 11 of the Moini Declaration (Ex. 2019), and (3) paragraph 7 of the Schmidt Declaration (Ex. 2034). Paper 44, 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 the evidence that claims 1–16, 19, 20, and 23–31 of the '203 patent are unpatentable as obvious. Accordingly, Petitioner's Motion to Exclude is dismissed as moot.

V. MOTIONS TO SEAL

Patent Owner filed a Combined Motion to Seal and Motion for Protective Order. Paper 25. In its motion, Patent Owner seeks entry of the modified protective in Addendum A to its motion that "is consistent with the Default Protective Order of this Board with certain edits applicable to this case." *Id.* at 5. Patent Owner submitted a red-lined version of the modified protective order as Addendum B to its motion, showing the changes made to the Board's default protective order. *Id.* 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. *Id*. at 3. Petitioner did not file an opposition to Patent Owner's Combined Motion to Seal and Motion for Protective Order.

Petitioner filed a Motion to Seal Exhibit 1120, which contains deposition testimony given by Olivia Schmidt relating to the confidential information in Exhibit 2034. Paper 40, 1. Petitioner argues that "in the event the Board grants [Patent Owner's] motion to seal, the Schmidt transcript should be sealed along with the other exhibits [Patent Owner] identifies in its motion." *Id.* 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.

VI. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–16, 19, 20, and 23–31 of the ’203 patent are deemed to be *unpatentable*;

FURTHER ORDERED that Petitioner’s Motion to Exclude (Paper 44) is *dismissed as moot*;

FURTHER ORDERED that Patent Owner’s Combined Motion to seal and Motion for Protective Order (Paper 25) is *granted*;

FURTHER ORDERED that the proposed Protective Order (Paper 25, Addendum A) is hereby entered and shall govern the conduct of this proceeding unless otherwise modified;

FURTHER ORDERED that Petitioner’s Motion to Seal (Paper 40) is *granted*;

FURTHER ORDERED that the following documents shall be sealed as “Board and Parties Only,” and will be kept under seal: the unredacted copies of Exhibits 1120, 2019, and 2034; and

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

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