

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

UMICORE AG & CO. KG,
Petitioner,

v.

BASF CORPORATION,
Patent Owner.

Case IPR2015-01123
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. 1001). Paper 1. On November 2, 2015, we instituted an *inter partes* review of claims 1–31 on two grounds of unpatentability. (Paper 8, “Dec. on Inst.”). BASF Corporation (“Patent Owner”) filed a Patent Owner Response (Paper 24, “PO Resp.”). Petitioner filed a Reply (Paper 34, “Reply”).

Petitioner supports its Petition with Declarations by Johannes A. Lercher, Ph.D. (“the Lercher Declaration,” Ex. 1008) and Dr. Frank-Walter Schütze (“the Schütze Declaration,” Ex. 1015). 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 40) certain paragraphs of the Tsapatsis Declaration, the Moini Declaration, and the Schmidt Declaration. Patent Owner filed an Opposition (Paper 44), and Petitioner filed a Reply (Paper 45).

An oral hearing was held on July 28, 2016. A transcript of the hearing is included in the record (Paper 50, “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 1–31 of the ’203 patent 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 CHA¹ zeolite catalysts and their use in exhaust gas treatment systems. Ex. 1001, 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.”).

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

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. 11.

described above.” *Id.* at 3:8–11. Figure 10A of the ’203 patent is reproduced below:

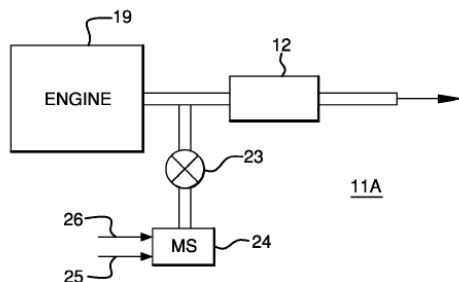


FIG. 10A

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 along 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; 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 NO_x component of the exhaust stream is converted through the selective catalytic reduction of NO_x with NH₃ to N₂ and H₂O.” *Id.* at 22:9–12.

The ’203 patent also describes an embodiment that “contains a second substrate 27 interposed between the NH₃ 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 2–25 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. 1001, 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	Publication	Date	Exhibit No.
Maeshima	US 4,046,888	Sept. 6, 1977	1002
Zones	US 6,709,644 B2	Mar. 23, 2004	1004
Patchett	U.S. App. 2006/0039843 A1	Feb. 23, 2006	1005

C. Pending Grounds of Unpatentability

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

References	Basis	Claims Challenged
Zones and Maeshima	§ 103(a)	1, 14, 15, 17–22, 26, 27
Zones, Maeshima, and Patchett	§ 103(a)	2–13, 16, 23–25, 28–31

Dec. on Inst. 17–18.

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. 12 (citing Ex. 1008 ¶ 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 Zones and Maeshima*

Petitioner contends that the subject matter of claims 1, 14, 15, 17–22, 26, and 27 would have been obvious under 35 U.S.C. § 103(a) over the combination of Zones and Maeshima. Pet. 9–20. 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 Zones*

Zones is directed to crystalline zeolites that have the CHA structure and a mole ratio of silicon oxide to aluminum oxide greater than 10.

Ex. 1004, 1:7–10. Zones states that the zeolites “can also be made with a mole ratio of silicon oxide to aluminum oxide of at least 30,” *id.* at 4:7–9, and describes zeolites that are prepared from a reaction mixture having a ratio of silicon oxide to aluminum oxide of 20–50. *Id.* at 2:24–34.

Zones also describes “an improved process for the reduction of oxides of nitrogen contained in a gas stream in the presence of oxygen” using the described zeolites. *Id.* at 1:54–61. According to Zones, “[t]he zeolite may contain a metal or metal ions (such as cobalt, copper or mixtures thereof) capable of catalyzing the reduction of the oxides of nitrogen, and may be conducted in the presence of a stoichiometric excess of oxygen.” *Id.* at 1:61–65. Zones states that, “[i]n a preferred embodiment, the gas stream is the exhaust stream of an internal combustion engine.” *Id.* at 1:65–67.

2. Overview of Maeshima

Maeshima is directed to using catalytic reduction to reduce the concentration of nitrogen oxide in a gaseous mixture. Ex. 1002, 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 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 oxide 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.

3. *Analysis*

In the Petition, Petitioner challenges the patentability of claims 1, 14, 15, 17–22, 26, and 27 of the ’203 patent as obvious under 35 U.S.C. § 103(a) over the combined teachings of Zones and Maeshima. Pet. 9–20. After considering the arguments and evidence presented in the Petition and the Preliminary Response, we instituted trial against claims 1, 14, 15, 17–22, 26, and 27, determining that Petitioner was likely to prevail in showing that the subject matter of the challenged claims would have been obvious over the combined teachings of Zones and Maeshima. Dec. on Inst. 8–13, 17.

Patent Owner, in its Patent Owner Response, does not challenge Petitioner’s arguments and evidence that Zones and Maeshima disclose or suggest all of the elements of the challenged claims. On the contrary, Patent Owner acknowledges that at least some of the limitations² in the claims were known in the prior art, stating, for example, that “[t]here was certainly nothing new in 2004 about a zeolite having the CHA structure and a SAR up to 50,” and “[i]t was already well known that CHA zeolites *can* contain a metal or metal ions.” PO Resp. 18; *see also id.* at 22 (“[I]t was known decades earlier, in 1985, that a high SAR CHA zeolite can be metal

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.

exchanged.”), 30 (“It is undisputed that it was known that zeolites *can* be metal ion-exchanged at a ratio between 60–100%, and that metal-exchanged zeolites are catalytically active.”), 36 (“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”). Thus, with respect to whether Zones and Maeshima 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. 9–20.

Based on the complete record, we find that Petitioner has presented sufficient evidence showing that Zones and Maeshima 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 is used in a process for the reduction of nitrogen oxides in a gas stream. As Petitioner alleges, Zones describes “an aluminosilicate zeolite, such as SSZ–62 which has the chabazite crystal structure” and also describes “reaction mixtures of zeolite catalysts that have a SAR value greater than 10, ranging from 20–50, and more preferably ranging from 25–40.” Pet. 9. Also, Maeshima teaches crystalline aluminosilicate zeolite catalysts, including chabazites, for use in the catalytic reduction of nitrogen oxides in the presence of ammonia. *Id.* at 10. We also have reviewed Petitioner’s arguments and evidence for claims 14, 15, 17–22, 26, and 27 (*id.* at 11–20), and find that Petitioner has met its burden of establishing that Zones and Maeshima 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, 17–22, 26, and 27 are disclosed or suggested by Zones and Maeshima.

The parties focus their arguments on three 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 Zones and Maeshima (Pet. 12–15; PO Resp. 2–3, 24–30; Reply 21–22); (b) whether Petitioner has shown that a person having ordinary skill in the art would have a reasonable expectation of success in combining Zones and Maeshima (Pet. 12–15; PO Resp. 3–4, 44–52; Reply 22–23); and (c) whether the objective indicia of skepticism, unexpected results, and commercial success support a finding of non-obviousness (PO Resp. 35–44; Reply 10–20). We address arguments (a) and (b) in turn below, and address the parties’ arguments regarding objective indicia of non-obviousness in Section II.E, *infra*.

a. Reason to Combine Zones and Maeshima

Petitioner contends that a person having ordinary skill in the art “would have been motivated to utilize copper exchanged zeolites in processes for SCR [selective catalytic reduction] in the presence of ammonia using Zones’ higher SAR chabazite zeolites to arrive, with a reasonable expectation of success, at the subject matter of the claims.” Pet. 12–13. Petitioner contends that “Zones discloses all the other required claim limitations” except “zeolites with Cu/Al ratios within the claimed ranges,” and states that

[o]ne of ordinary skill in the art would also understand that it would be beneficial to follow Maeshima’s instruction to use a 60% to 100% ion-exchange rate when adding copper to Zone[s]’ zeolite. It was well known that larger amounts of copper ions, including that achieved by copper loading up to the 100% ion-

exchange rate, enhance the effectiveness of a zeolite when catalyzing the reduction of nitrogen oxides.

Id. at 13 (citing Ex. 1008 ¶¶ 147–148). According to Petitioner, “[b]y directing one of ordinary skill to include copper in its zeolites to render them able to reduce NO_x in diesel exhaust, Zones sufficiently motivates those of skill to look to prior art references like Maeshima that discuss appropriate levels of copper loading to apply to an SCR catalyst.” Reply 22.

Patent Owner argues that a person having ordinary skill in the art would not have been motivated to combine Zones and Maeshima “because neither reference provides any suggestion that doing so would improve the zeolite for the SCR of NO_x.” PO Resp. 24. Patent Owner argues that “there is nothing in Zones that suggests to one of ordinary skill in the art that the CHA framework or the high SAR of SSZ-62 will improve the activity or stability of a zeolite for the SCR of NO_x.” *Id.* at 25. Patent Owner further argues that, “[a]s further contrast to the silence in Zones regarding the properties of a CHA zeolite for the NH₃ SCR of NO_x,” Byrne³ “teaches that small pore zeolites, including a CHA zeolite, should not be used for the NH₃ SCR of NO_x because of susceptibility to sulfate poisoning.” *Id.* (citing Ex. 1010, 4:57–5:26; Ex. 2018 ¶¶ 75, 105).

Patent Owner also argues that Maeshima “does not include any teachings about the properties of a CuCHA with regard to the SCR of NO_x,” and that it “points to a low SAR (2–6), large pore size (6–13 Angstroms) zeolite, such as zeolite Y, and *only* provides examples of that type of metal-exchanged zeolite for the NH₃ SCR of NO_x.” *Id.* at 26 (citing Ex. 1002, 4:36–43, 8:11–10:2). Patent Owner argues that neither Zones nor Maeshima

³ Byrne, U.S. Patent No. 4,961,917, issued Oct. 9, 1990 (Ex. 1010).

“suggests that the CHA structure, high SAR, or ion-exchange ratio will improve the activity or stability of the zeolite for the NH_3 SCR of NO_x .” *Id.* at 27 (citing Ex. 2018 ¶¶ 110–11). Thus, according to Patent Owner,

there is no explanation, other than hindsight, for why a person of ordinary skill in the art would have selected the small pore size CHA structure and high SAR from Zones, disregarded the teachings for a low SAR and large pore size in Maeshima, and applied the ion-exchange ratio disclosed in Maeshima.

Id.

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, 1329 (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 the copper ion exchange ratios in Maeshima in the CHA zeolites of Zones in a process for

the reduction of nitrogen oxides in a gas stream in the presence of oxygen. Zones describes “an improved process for the reduction of oxides of nitrogen contained in a gas stream in the presence of oxygen” with a zeolite, where the zeolite is “a zeolite having the CHA crystal structure” and a SAR “greater than about 10,” which “may contain a metal or metal ions” such as copper. Ex. 1004, 1:54–62. Zones also states that the zeolite is “capable of catalyzing the reduction of oxides of nitrogen,” and describes a preferred embodiment where “the gas stream is the exhaust stream of an internal combustion engine.” *Id.* at 1:63–67.

Similarly, Maeshima describes removing nitrogen oxides from a gas “by contacting the resulting gaseous mixture with a catalyst in the presence of ammonia to reduce the nitrogen oxides, selectively.” Ex. 1002, 2:4–8. Maeshima teaches that the catalyst can be “a product obtained by exchanging an alkali metal ion in a crystalline alumino-silicate with at least one metal cation having an activity for reducing nitrogen oxides,” and that the crystalline alumino-silicate can be a natural zeolite such as chabazite. *Id.* at 3:35–38, 4:3–11. Maeshima further teaches preparing a zeolite catalyst having an active metal incorporated therein “by contacting a crystalline aluminosilicate with an aqueous or organic solution of an active metal compound,” and that “it is generally preferred that the ion exchange ratio be about 60% to about 100%.” *Id.* at 4:44–50. Copper is one example of an active metal that can be incorporated in the zeolite catalyst. *Id.* at 4:51–52.

In light of these disclosures in Zones and Maeshima, we are persuaded by Dr. Lercher’s testimony that

it was well known in the prior art that copper should be beneficially incorporated into a catalyst in an amount approaching a 100% ion-exchange rate. It was also well known

that up to a point, increased amounts of copper, including that achieved by utilizing a 100% ion-exchange ratio or rate, enhance the effectiveness of a zeolite when catalyzing the reduction of nitrogen oxides. This is stated in Maeshima, which explains that when incorporating copper into a zeolite, “it is generally preferred that the ion exchange ratio be about 60% to about 100%.” Use of these known ion exchange ratios with Zones’ zeolite produces a catalyst with the claimed CHA crystal structure, SAR, and Cu/Al ratio that can be used as part of a process to selectively reduce nitrogen oxides in a gas stream that contains oxygen.

Ex. 1008 ¶ 147 (internal citation omitted). Dr. Lercher’s testimony is consistent with the disclosures in the prior art references. It is also consistent with Dr. Tsapatsis’s testimony that it was well-known that metals, such as copper, can be introduced into zeolites and make a zeolite active for the SCR of NO_x (Ex. 1019, 113:25–114:14; Ex. 2018 ¶ 94), and that a person having ordinary skill in the art would have known that a 60% to 100% ion-exchange ratio could be used to incorporate copper into a zeolite (Ex. 1019, 114:23–115:19). Consequently, we find that the prior art references themselves, as well as the knowledge of a person of ordinary skill in the art, provide adequate reasons to combine Zones and Maeshima.⁴

We are not persuaded by Patent Owner’s argument that a person having ordinary skill in the art would not be motivated to combine the high SAR and CHA framework of Zones with the ion exchange ratio of

⁴ We are not persuaded by Patent Owner’s argument that Petitioner does not explain “what a person of ordinary skill in the art would be attempting to achieve in combining Zones and Maeshima.” PO Resp. 28. Patent Owner cites to no legal authority establishing that this particular question, separate and apart from the question of whether Petitioner has established a reason to combine the prior art references, is part of an obviousness inquiry under 35 U.S.C. § 103.

Maeshima because “neither reference provides any suggestion that doing so would improve the zeolite for the SCR of NO_x.” PO Resp. 24. As Petitioner notes, “[t]he ’203 patent’s claims are directed to a ‘process for the reduction of oxides of nitrogen contained in a gas stream in the presence of oxygen’ using a catalyst with the CHA structure, a SAR in the range of 15–150 (or 100), and a Cu/Al ratio in the range of 0.25–1 (or 0.5),” and “no further functional or performance properties are required.” Reply 3. Moreover, even if the problem the inventors of the ’203 patent were trying to solve was improving zeolites for the SCR of NO_x, “[t]he skilled artisan need not be motivated to combine [the prior art] for the same reason contemplated by the [inventors].” *In re Kahn*, 441 F.3d 977, 990 (Fed. Cir. 2006); *see also KSR*, 550 U.S. at 420 (stating that it is error to look “only to the problem the patentee was trying to solve”).

Patent Owner’s argument that Maeshima points a person having ordinary skill in the art to low SAR (2–6), large pore size (6–13 Angstroms) zeolites, and not to the small pore size, high SAR zeolites described in Zones, is similarly unavailing. PO Resp. 26 (citing Ex. 1002, 4:36–43, 8:11–10:2). In making this argument, Patent Owner ignores the complete disclosure of Maeshima, which teaches the use of chabazites for the SCR of NO_x using zeolites with a SAR values greater than 2. Ex. 1002, 3:68–4:11 (crystalline aluminosilicates, such as chabazite, “having pore diameters in the range of about 3–15 Å and SiO₂/Al₂O₃ molar ratios of above about 2 are preferred”); *see also 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))). Thus, contrary to Patent Owner’s argument, the combined teachings of Zones and Maeshima disclose using a high SAR chabazite for ammonia SCR.

With respect to Patent Owner’s contention that Byrne teaches “that small pore size zeolites, such as a CHA zeolite, *should not* be used for the NH₃ SCR of NO_x because of the susceptibility to sulfate poisoning” (PO Resp. 16), we note that 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” (Ex. 1010, 5:39–44). *See also id.* at 5:48–50 (“A conversion efficiency of 77% was attained by a fresh copper promoted ZSM-5 zeolite having a silica to alumina ratio of 46.”). We further note that Breck,⁵ also a prior art reference, discloses silicon substituted zeolites (including chabazites) that “have increased resistance toward acidic agents such as mineral and organic acids, SO₂, SO₃, NO_x and the like” by being “more highly siliceous than their precursors.” Ex. 1003, 47:44–53; *see also id.* at 4:50–63 (identifying chabazite in a list of “[e]specially preferred zeolite species” that are “used as starting materials in the present process”).⁶ In any event, “[a] known or

⁵ Breck, U.S. Patent No. 4,503,023, issued March 5, 1985 (Ex. 1003).

⁶ Patent Owner argues that “[y]ou cannot translate what was taught in Breck to catalytic activity, because that’s not what is said in Breck.” Tr. 69:24–25. Breck, however, states 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.” Ex. 1003, 47:44–47 (emphasis added).

obvious composition does not become patentable simply because it has been described as somewhat inferior to some other product for the same use.” *In re Gurley*, 27 F.3d 551, 554 (Fed. Cir. 1994). This reasoning applies to Patent Owner’s arguments regarding additional publications allegedly describing the limited usefulness of metal-exchanged zeolites for the NH₃ SCR of NO_x. See PO Resp. 16–18.

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 Zones and Maeshima 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 every reason to believe that use of the copper content of Maeshima in the zeolites of Zones in an SCR process in the presence of ammonia for treating combustion exhaust gases would succeed.” Pet. 13 (citing Ex. 1008 ¶ 149). Petitioner notes that, “as acknowledged in the ’203 patent’s Background section ‘[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.’” *Id.* (quoting Ex. 1001, 1:34–37). Petitioner also points to Maeshima’s teachings that metal cations having activity for reducing nitrogen oxides “should be incorporated into the zeolite by ion exchange” in the amount of 60% to 100%. *Id.* at 13–14. Additionally, according to Petitioner, because Zones and Maeshima are “in the same technical field (zeolite catalysts and

the use of these catalysts) and are directed to solving the same problem (catalyzing the reduction of nitrogen oxides),” the combination

amounts to nothing more than the application of one particular known modification to catalytic zeolites with a known benefit—increasing the copper content of aluminosilicate chabazite zeolites to improve catalytic activity as taught by Maeshima—to the very materials to which this modification is meant to be applied—Zones high SAR copper-promoted aluminosilicate zeolites for use in SCR processes. Thus, application of Maeshima to Zones would be considered nothing more than a routine optimization and an obvious design choice.

Id. at 14 (citing Ex. 1008 ¶¶ 152–154).

Patent Owner argues that “there is simply no reasonable expectation” that combining the teachings of Zones and Maeshima would “enhance the effectiveness of a zeolite catalyst by improving the hydrothermal stability in comparison to known zeolites.” PO Resp. 4. Patent Owner argues that Zones does not teach hydrothermal stability (*id.* at 29), and that Maeshima “does not teach that increasing the copper content or using a CuCHA will solve the problem of hydrothermal stability for the NH₃ SCR of NO_x” (*id.* at 30). Therefore, according to Patent Owner, a person having ordinary skill in the art would not have a reasonable expectation of success in combining the teachings of Zones and Maeshima “to make a zeolite catalyst that is active for NH₃ SCR of NO_x and exhibits improved hydrothermal stability as compared to other known zeolites.” *Id.* at 29.

We do not consider Patent Owner’s argument to be persuasive, because, as Petitioner notes (Reply 3–5), enhanced hydrothermal stability is not an element of the claims. *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”).

Patent Owner does not argue that a person having ordinary skill in the art would have been unable to incorporate the copper content of Maeshima in the zeolites of Zones for use in a process for the reduction of nitrogen oxides contained in a gas stream, nor is there any evidence that a person having ordinary skill in the art would have expected such incorporation to be unsuccessful. *See KSR*, 550 U.S. at 421 (“A person of ordinary skill in the art is also a person of ordinary creativity, not an automaton.”).

Moreover, Patent Owner’s argument that there would not be a reasonable expectation of success in combining Zones and Maeshima because the references do not teach enhancing hydrothermal stability conflates the reason for the current invention with the expectation a person of ordinary skill would have in successfully making the combination of the teachings of the references. Neither the patentee’s particular motivation, nor its avowed purpose, controls the obviousness inquiry. *Id.* at 419.

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 combining the teachings of Zones and Maeshima to arrive at the claimed subject matter.

D. Obviousness over Zones, Maeshima, 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 Zones, Maeshima, and Patchett. Pet. 20–38. Petitioner 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. 1005 ¶ 1. According to Patchett, “Selective Catalytic Reduction (SCR) using ammonia (NH₃) or an NH₃ precursor” is “[a] proven NO_x 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 the 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 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 Zones, Maeshima, and Patchett disclose or suggest all of the elements of the challenged claims. Thus, with respect to whether Zones, Maeshima, 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. 20–38.

Based on the complete record, we find that Petitioner has presented sufficient evidence showing that the combined teachings of Zones, Maeshima, 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. 23. We also have reviewed Petitioner’s arguments and evidence for claims 3–13, 16, 23–25, and 28–31 (*id.* at 23–38), and find that Petitioner has met its burden of establishing that the combined teachings of Zones, Maeshima, 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 Zones, Maeshima, and Patchett.

The parties focus their arguments on three 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 Zones, Maeshima, and Patchett (Pet. 26–28; PO Resp. 31–33); (b) whether Petitioner has shown that a person having ordinary skill in the art would have a reasonable expectation of success in combining Zones, Maeshima, and Patchett (Pet. 28–29; PO Resp. 4–6, 33–34; Reply 24–25); and (c) whether the objective indicia of skepticism, unexpected results, and commercial success support a finding of non-obviousness (PO Resp. 35–44; Reply 10–20). We address arguments (a) and (b) in turn below, and address the parties’ arguments regarding objective indicia of non-obviousness in Section II.E, *infra*.

a. Reason to Combine Zones, Maeshima, 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 Zones and Maeshima as part of

Patchett's SCR system to arrive, with a reasonable expectation of success, at the claimed subject matter." Pet. 26. Petitioner contends that Patchett describes catalytic material "suitable use in connection with an internal combustion engine," in which "[c]opper is preferably present in an amount of 'about 1 to about 5 percent by weight'," and have a SAR greater than 10, and that "Zones and Maeshima describe this very type of catalytic material." *Id.* at 27 (quoting Ex. 1005 ¶ 65). Therefore, according to Petitioner, a person having ordinary skill in the art "would be directed to the catalytic material of Zones and Maeshima when attempting to implement Patchett's process, rendering the combination of these reference particularly obvious and straightforward." *Id.* Petitioner also contends that "Zones, Maeshima, and Patchett are also in the same technical field (catalysts and catalytic processes) and are directed to solving the same problem (catalyzing the reduction of nitrogen oxides in gas streams)," which "would further motivate the combination." *Id.* at 28.

Patent Owner argues that Patchett incorporates Byrne by reference with respect to suitable SCR catalyst compositions, and "Byrne teaches away from using copper-exchanged naturally occurring chabazite for the NH₃ SCR of NO_x." PO Resp. 31 (citing Ex. 1010, 4:57–5:26). Patent Owner argues that Patchett, Byrne, Speronello⁷ (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 NH₃ SCR of NO_x *and* undermine the use of small pore size zeolites

⁷ Speronello, U.S. Patent No. 5,516,497, issued May 14, 1996 (Ex. 1011).

such as CHA zeolite—and instead adopt the zeolite disclosed in Zones, which does not provide any teachings that would counter what is disclosed in [Patchett], Byrne, Speronello, and Maeshima.

Id. at 32–33.

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 copper ion exchange ratios in Maeshima in the CHA zeolites in Zones, and use the resulting zeolite in the Patchett process. As Petitioner notes (Pet. 27), Zones teaches the use of a high SAR, copper-loaded CHA zeolite in a process for “the reduction of the oxides of nitrogen contained in a gas stream,” where, in a preferred embodiment, “the gas stream is the exhaust stream of an internal combustion engine.” Ex. 1004, 1:54–67. Evidence in the record also supports Petitioner’s contention that an increased level of silica (i.e., high SAR) in the chabazite zeolites of Zones and Maeshima results in improved resistance to sulfur poisoning and increased hydrothermal stability. Ex. 1008, ¶ 237; Ex. 1003, 4:60–63, 47:44–53; Ex. 1010, 1:28–33, 5:39–44. For example, Breck discloses silicon substituted zeolites (including chabazites) that “have increased resistance toward acidic agents such as mineral and organic acids, SO₂, SO₃, NO_x and the like” by being “more highly siliceous than their precursors.” Ex. 1003, 47:44–53; *see also id.* at 4:50–63 (identifying chabazite in a list of “[e]specially preferred zeolite species” that are “used as starting materials in the present process”).

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 subject to high

temperatures and hydrothermal conditions. Ex. 1008 ¶¶ 232–234. We also credit Dr. Lercher’s explanation that a person of ordinary skill in the art would consider the zeolites of Zones and Maeshima for use in Patchett’s system because they can be used to treat the exhaust of an internal combustion engine and possess the aforementioned properties of a catalyst suitable for use in Patchett’s system. Ex. 1008 ¶ 237.

With respect to Patent Owner’s argument that Patchett “promotes 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. 1005 ¶ 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. 1005 ¶ 65), teaches the use of “medium to large pore zeolites having pore openings of at least about 4 Angstroms in diameter.” Ex. 1011, 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. 3.

We are similarly unpersuaded by Patent Owner's argument that Byrne "teaches away from using copper-exchanged naturally occurring chabazite for the NH₃ SCR of NO_x." 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 SO₂, thereby promoting the use of a large pore size zeolite framework (Ex. 1010, 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 treat 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 Zones and Maeshima suitable for use in Patchett’s system. Ex. 1008 ¶ 237.

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 Zones, Maeshima, 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 Zones, Maeshima, and Patchett because they “generally relate to catalytic materials than can be used as part of an SCR process,” and “Zones explains that its catalyst can be used in an internal combustion engine.” Pet. 28–29. According to Petitioner, “[t]his would indicate to one of ordinary skill in the art that the zeolites of Zones and Maeshima have applicability in and would be successfully used with Patchett.” *Id.* at 29.

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 Zones and Maeshima 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 30,⁸ “which require disposing the claimed CuCHA catalyst on a wall flow filter,” Patent Owner points out that a prior art patent application (Ex. 1006) 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. 34 (quoting Ex. 1006 ¶ 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 Zones and Maeshima to meet this requirement.” *Id.* According to Patent Owner, Zones not teach hydrothermal stability for the NH₃ SCR of NO_x, and Maeshima “limits the reaction temperature for its SCR catalysts to between 200° C and 500° C.” *Id.*

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 a honeycomb wall flow filter substrate (claims 24 and 30). Patent Owner does not argue that a person having ordinary skill in the art would have been unable to incorporate the copper content of Maeshima in the zeolites of

⁸ In making this argument, Patent Owner identifies claims 13, 18–20, 23, 24, 39, 44–46, 49, and 50 as the claims that require disposing the claimed CuCHA catalyst on a wall flow filter. PO Resp. 34. As these claims include claims that are either not at issue or do not exist in the ’203 patent, 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.

Zones, and then dispose the resulting zeolite on a honeycomb wall flow substrate or a honeycomb wall flow filter substrate, nor is there any evidence that a person having ordinary skill in the art would have expected such incorporation to be unsuccessful. *See KSR*, 550 U.S. at 421 (“A person of ordinary skill in the art is also a person of ordinary creativity, not an automaton.”).

Moreover, Patent Owner’s argument that there would not be a reasonable expectation of success in combining Zones, Maeshima, and Patchett because the references do not teach enhancing hydrothermal stability conflates the reason for the current invention with the expectation a person of ordinary skill would have in successfully making the combination of the teachings of the references. Neither the patentee’s particular motivation nor its avowed purpose controls the obviousness inquiry. *Id.* at 419.

Nevertheless, 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. 1005 ¶ 69. We note that this temperature range corresponds to the operating temperature range taught in Maeshima. *See* Ex. 1002, 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 Zones nor Maeshima explicitly states that its zeolites are able to be used at temperatures above 700° C. *See* Reply 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 combining the teachings of Zones, Maeshima, and Patchett to arrive at the claimed subject matter.

E. 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. 35–44.

1. Skepticism

Patent Owner cites to several documents as evidence of “[s]kepticism about the viability of copper-exchanged zeolites.” PO Resp. 37–39 (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 require a commercially viable catalyst, or 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.⁹ 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 NO_x was wait-listed by the Department of Energy 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).

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. 38–39 (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 find that the evidence presented does not amount to a sufficient showing of skepticism attributable to the claimed invention.

⁹ 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).

2. *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. 39. 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. 39–40; Ex. 1001, 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. 1001, 11:40–12:22, 14:19–67, Table 1. The two independent claims of the ’203 patent, however, encompass SAR values 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 as additional evidence of unexpected results. PO Resp. 41–42. Petitioner responds, citing Breck, that it was known that higher SAR zeolites were less susceptible to sulfate poisoning, and “one of skill in the art would not have found it unexpected that a CHA zeolite could be useful as a catalyst.” Reply 17. 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 NH₃ SCR constitutes evidence of unexpected results regarding *how well* the CHA zeolites perform, especially considering the mechanism is not recited in the claims. 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 NH₃ SCR of NO_x 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. 42–43. 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 43 (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 19; 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 they are part of the same family”).

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 19; 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 20. 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, 17–22, 26, and 27 of the ’203 patent are unpatentable under 35 U.S.C. § 103 as obvious over the combined teachings of Zones and Maeshima, 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 Zones, Maeshima, 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 40, 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 1–31 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 an unopposed Combined Motion to Seal and Motion for Protective Order. Paper 23. 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 filed a Motion to Seal Exhibit 1020, which contains deposition testimony given by Olivia Schmidt relating to the confidential information in Exhibit 2034. Paper 36, 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 1020.

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 1–31 of the '203 patent are deemed to be *unpatentable*;

FURTHER ORDERED that Petitioner's Motion to Exclude (Paper 40) is *dismissed as moot*;

FURTHER ORDERED that Patent Owner's Combined Motion to seal and Motion for Protective Order (Paper 23) is *granted*;

FURTHER ORDERED that the proposed Protective Order (Paper 23, 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 36) 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 1020, 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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