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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

JOHNSON MATTHEY INC., and JOHNSON MATTHEY PLC,
Petitioners,

v.

BASF CORPORATION,
Patent Owner.

Case IPR2015-01266
Patent 9,039,982 B2

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

ABRAHAM, *Administrative Patent Judge.*

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

I. INTRODUCTION

Johnson Matthey Inc., and Johnson Matthey Plc (collectively "Petitioner") filed a Petition seeking *inter partes* review of claims 1–27 of U.S. Patent No. 9,039,982 B2 (Ex. 1001, "the '982 patent"). Paper 1 ("Pet."). BASF Corporation ("Patent Owner") filed a Preliminary Response to the Petition. Paper 7. On December 4, 2015, we instituted an *inter partes* review of claims 1–27. Paper 8 ("Dec. on Inst.").

After institution, Patent Owner filed a Patent Owner Response (Paper 20, "PO Resp."), and Petitioner filed a Reply (Paper 23, "Reply"). An oral hearing was held on August 23, 2016, and a transcript of the hearing has been entered into the record of the proceeding as Paper 34 ("Tr.").

Patent Owner filed a Motion to Exclude certain paragraphs of the Declaration of Dr. David L. Tennent (Ex. 1003, "the Tennent Declaration"). Paper 27. Petitioner filed an Opposition (Paper 29), and Patent Owner filed a Reply (Paper 31).

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 failed to show by a preponderance of the evidence that claims 1–27 are unpatentable.

II. BACKGROUND

A. Related Proceedings

Petitioner identifies pending *inter partes* review Cases IPR2015-01265 and IPR2015-01267, pertaining to U.S. Patent No. 8,899,023 ("the '023 patent") and U.S. Patent No. 9,032,709 ("the '709 patent"), respectively.

Petitioner indicates that the ’982 patent issued from Application No. 14/497,454, which was a continuation of Application No. 13/274,635 (issued as the ’023 patent), which itself was a continuation of Application No. 11/676,798 (issued as the ’709 patent), itself a divisional of Application No. 10/634,659 (now issued as U.S. Patent No. 7,229,597). Pet. 2. Petitioner also identifies pending *inter partes* reexamination proceedings pertaining to U.S. Patent No. 7,229,597 (Reexam No. 95/001,745) and another patent in the same family, U.S. Patent No. 7,902,107 (Reexam No. 95/001,744). *Id.*

B. The ’982 Patent

The ’982 patent, titled “Catalyzed SCR Filter and Emission Treatment System,” issued on May 26, 2015. Ex. 1001, (54), (45). The ’982 patent discloses “a catalyst article for simultaneously remediating the nitrogen oxides (NOx), particulate matter, and gaseous hydrocarbons present in diesel engine exhaust streams.” *Id.* at (57).

The ’982 patent teaches that several filter structures effective in physically removing particulate matter from diesel exhaust were known in the art. *Id.* at 2:13–29. According to the Specification, these filters were capable of removing over 90% of the particulate matter from diesel exhaust. *Id.* One example of these known filters, also suitable for use in the claimed invention, is a wall flow filter. *Id*. A wall flow filter is illustrated in Figures 2 and 3 of the ’982 patent, reproduced below.

Figure 2

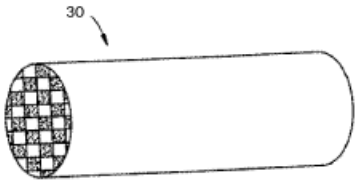

Figure 3

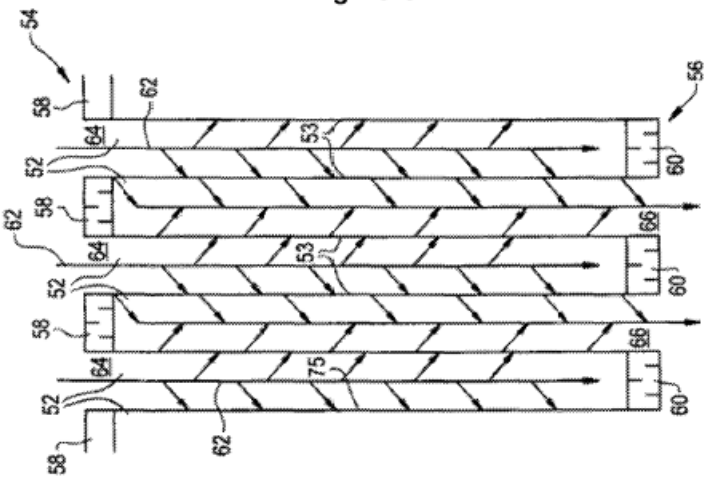

Figure 2 shows a "perspective view" of wall flow filter substrate 30, and Figure 3 shows a cross sectional view of the substrate shown in Figure 2. *Id.* at 5:64–67, 9:10–20. As shown in these figures, substrate 30 has inlet end 54, outlet end 56, and a plurality of fine, substantially-parallel gas flow passages extending along the longitudinal axis of the substrate. *Id.* at 8:62–65, Figs. 2, 3. Alternate passages are plugged at the inlet end with plugs 58, and at the outlet end with plugs 60. *Id.* at 9:13–16. This forms a checkerboard pattern (as depicted in figure 2) at inlet end 54 and outlet end 56. *Id.* In this configuration, a gas stream cannot enter and exit the substrate through the same passage. *Id.* at 9:16–20. Instead, a gas stream entering through an unplugged channel inlet (e.g., 64) is stopped by outlet plug 60 in

that passage, and must diffuse through a porous channel wall (e.g., 53) in order to exit out of channel outlet 66. *Id.* As the gas passes through the porous channel wall, particulate matter in the gas is trapped therein.

The ’982 patent teaches that as particulate matter accumulates on the filter, the back pressure from the filter on the engine increases. *Id.* at 2:21–24. Therefore, these particles must be continuously or periodically burned out of the filter to maintain an acceptable back pressure. *Id.* at 2:24–26. This is referred to as filter regeneration. *Id.* at 2:38–39. Typically, a temperature in excess of 500 °C is required to burn the carbon soot particles, which is above the temperature normally present in diesel exhaust. *Id.* at 2:26–29. Therefore, provisions, such as a catalyst, are generally introduced to lower the soot burning temperature to those present under normal diesel engine operating conditions. *Id.* at 2:30–39.

The ’982 patent also describes Selective Catalytic Reduction (“SCR”), a process wherein NOx is reduced with ammonia to nitrogen in the presence of a catalyst typically composed of base metals, as a “proven NOx abatement technology applied to stationary sources,” and discloses that SCR is under development for mobile applications. *Id.* at 1:19–20, 2:40–50.

The ’982 patent explains that a sufficient loading of SCR catalyst composition is required to achieve NOx reduction goals on a coated soot filter, but cautions that higher catalyst coatings can lead to unacceptable back pressure within the exhaust system. *Id*. at 3:4–6. The Specification also teaches that a durable SCR catalyst, e.g., one that maintains catalytic activity after exposure to high temperatures and has a wider operating temperature range, is desirable. *Id.* at 3:13–25.

According to the ’982 patent, “[i]ntegration of NOx reduction and particulate removal functions into a single catalyst article is accomplished using a wall flow substrate coated with an SCR catalyst composition.” *Id.* at 6:30–32. The claimed invention requires wall flow substrates to be coated with practical levels of SCR catalyst to achieve desired NOx reduction levels and effectively remove particulate matter without causing excessive backpressure, while also lowering the combustion temperature of the soot fraction trapped on the filter. *Id.* at 6:33–48, 7:36–38. To achieve this, the ’982 patent teaches depositing SCR catalysts at a concentration of at least 1.3 g/in^3, preferably between 1.6 and 2.4 g/in^3 (*id.* at 8:54–61), and using a wall flow substrate having a preferred pore size of at least 5 microns and porosity of at least 50% (*id.* at 9:37–40).

C. Illustrative Claim

Claims 1, 16, and 22 are independent claims. Claim 1 is illustrative, and is reproduced below:

> 1. A catalyst article consisting essentially of a wall flow monolith and a catalytic material, wherein the wall flow monolith has a plurality of longitudinally extending passages formed by longitudinally extending walls bounding and defining said passages, wherein the passages comprise inlet passages having an open inlet end and a closed outlet end, and outlet passages having a closed inlet end and an open outlet end, the wall flow monolith has a porosity of from 50% to 60% and an average pore size of from 10 to 25 microns, and the wall flow monolith contains the catalytic material;
>
> wherein the catalytic material comprises an SCR catalyst composition including a slurry-loaded washcoat of a zeolite and base metal selected from copper, the washcoat permeating the walls at a loading up to 2.4 g/in^3, the wall flow monolith

> having integrated, NOx and particulate removal efficiency in which presence of the catalytic material in the wall flow monolith catalyzes the oxidation of soot.

Ex. 1001, 15:47–64. Independent claims 16 and 22 are substantially similar to claim 1, with claim 16 additionally reciting that "the washcoat permeating the walls at a loading up to 1.3 g/in^3" (*id*. at 16:46–64), and independent claim 22 requiring only that the catalyst article contains a washcoat, without reciting a particular loading amount (*id*. at 17:13–18:5). The dependent claims of the '982 patent recite further requirements of the wall flow filter or the SCR catalyst composition.

D. References

Petitioner relies on the following references:

Speronello et al., US 5,516,497, issued May 14, 1996 ("Speronello," Ex. 1008).

Georg Hüthwohl et al., *The SCRT® system – a combination particle filter with SCR catalyst – enables both particle and NOx emission to be reduced simultaneously in commercial vehicle diesel engines*, Dresdner Motorkolloquium, May 20–21, 1999 at 129 ("Hüthwohl," Ex. 1006; certified translation provided at Ex. 1005).

S. Hashimoto et al., *SiC and Cordierite Diesel Particulate Filters Designed for Low Pressure Drop and Catalyzed, Uncatalyzed Systems*, Diesel Exhaust Emission Control 2002: Diesel Particulate Filters (SP-1673), *reprinted in* SAE Technical Paper Series 2002-01-0322 ("Hashimoto," Ex. 1007).

Yasutake Teraoka et al., *Simultaneous Catalytic Removal of Nitrogen Oxides and Soot by Copper-Loaded MFI Zeolites*, CHEMISTRY LETTERS 2001 at 604 ("Teraoka," Ex. 1009).

E. The Instituted Grounds of Unpatentability

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

References	Statutory Basis	Claims Challenged
Hüthwohl, Speronello, Hashimoto, and Teraoka	§ 103	1–27

III. ANALYSIS

A. Claim Construction

In an *inter partes* review, claim terms in an unexpired patent are interpreted according to their broadest reasonable construction in light of the specification of the patent in which they appear. 37 C.F.R. § 42.100(b); *see Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016) (upholding the use of the broadest reasonable interpretation standard). 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. *See Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) ("[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.").

B. Principles of Law

To prevail in this *inter partes* review of the challenged claims, Petitioner must prove unpatentability by a preponderance of the evidence. 35 U.S.C. § 316(e); 37 C.F.R. § 42.1(d).

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of skill in the art; and (4) objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

"[A] patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art." *KSR*, 550 U.S. at 418. "[I]t can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine elements in the way the claimed new invention does." *Id.* Moreover, a person of ordinary skill in the art must have had a reasonable expectation of success of doing so. *PAR Pharm., Inc. v. TWi Pharms., Inc.*, 773 F.3d 1186, 1193 (Fed. Cir. 2014).

Thus, 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)). "[C]ase law is clear that obviousness 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." *Pfizer*, 480 F.3d at 1364 . Furthermore, "[t]here is no requirement that one of ordinary skill have a reasonable expectation of success in

developing [a commercial product] . . . [but] need only have a reasonable expectation of success of developing the claimed invention." *Allergan, Inc. v. Sandoz Inc.*, 726 F.3d 1286, 1292 (Fed. Cir. 2013).

In conducting an obvious analysis, it is important to "be aware . . . of the distortion caused by hindsight bias and . . . be cautious of arguments reliant upon *ex post* reasoning." *KSR*, 550 U.S. at 421; *see also In re Kubin*, 561 F.3d 1351, 1359 (Fed. Cir. 2009) (stating that "courts should not succumb to hindsight claims of obviousness"). In that regard, "[t]he expectation of success must be found in the prior art, not in the applicant's disclosure." *In re Dow Chemical Co.*, 837 F.2d 469, 473 (Fed. Cir. 1988). Additionally, "patents are not barred just because it was obvious 'to explore a new technology or general approach that seemed to be a promising field of experimentation, where the prior art gave only general guidance as to the particular form of the claimed invention or how to achieve it.'" *Procter & Gamble*, 566 F.3d at 997 (quoting *In re O'Farrell*, 853 F.2d 894, 903 (Fed. Cir. 1988)).

We analyze the instituted grounds of unpatentability in accordance with the above-stated principles.

C. Level of Ordinary Skill in the Art

Petitioner's declarants, Dr. Tennent and Dr. Harold, state that a person of ordinary skill in the art would have "at least a BS or MS in chemistry, chemical engineering, material science, or a related field and [at] least three years of experience or training in researching, studying, designing, or manufacturing diesel exhaust treatment systems." Ex. 1003 ¶ 13; Ex. 1004 (the "Harold Declaration") ¶ 13. According to Patent Owner's declarant, Dr. Crocker, a person of ordinary skill in the art would have had "at least a

Bachelor's degree in chemical engineering or a related discipline, and would have been exposed to the basic concepts of diesel exhaust treatments through either a year of coursework or field research." Ex. 2045 (the "Crocker Declaration") ¶ 42. Dr. Crocker also identifies several specific "skills and beliefs" that a person of ordinary in the art would have possessed "as a result of his/her training and experience, and what was known in the art at the time of the BASF patents." *Id.* at ¶¶ 42–46.

Thus, at a minimum, the parties agree that a person of ordinary skill in the art would be a person with a bachelor's degree in chemical engineering or a related field, and some experience or training in diesel exhaust systems. We find additional consistency between Petitioner's position that a person of ordinary skill in the art would have at least three years of experience or training in researching, studying, designing, or manufacturing diesel exhaust treatment systems, and Patent Owner's position that a person of ordinary skill in the art would have knowledge of certain "skills and beliefs as a result of his/her training and experience, and what was known in the art at the time of the BASF patents." Accordingly, we hold that one of skill in the art would possess at least a bachelor's degree in chemical engineering or a related discipline, and would have at least three years of experience or training in researching, studying, designing, or manufacturing diesel exhaust treatment systems. This level of ordinary skill is reflected not only by the information presented by the parties, but also by the prior art of record. *Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art itself can reflect the appropriate level of ordinary skill in the art).

D. Overview of Prior Art References

1. Hüthwohl

Hüthwohl explains that, in 1998, the EU Environment Council agreed on new limits for nitrogen oxides and particle emissions for heavy commercial vehicles, such as city buses. Ex. 1005, 2.[1] These new emission standards were scheduled to take effect in 2005 and 2008. *Id.* at 3. Hüthwohl describes a system introduced in 1995, referred to as the CRT system, which includes a highly active oxidation catalyst and a series-connected particle filter. *Id.* According to Hüthwohl, the CRT system was capable of achieving low emissions from an engine running on a certain type of fuel, but for diesel engines, excellent emission values "can only [be] achieved by combining a particle filter with an SCR catalyst. The combination of SCR catalyst and particle filter is known as the **SCRT**® system." *Id.* at 4.

In the SCRT system, the soot filter of the CRT system is impregnated with SCR-active material. *Id.* This combination aids in reducing the required physical volume of the system, and allows the system to be installed in a city bus. *Id.* Based on data from tests conducted on the SCRT system, Hüthwohl determines that the SCRT system "reduces the emission of carbon monoxide, particles, hydrocarbons and nitrogen oxides." *Id.* at 9. Hüthwohl ultimately concludes that "[b]y further optimization of the system, a significant improvement of the NOx conversion can be expected, so that in [the] future it will be possible to comply with" the 2005 and 2008 European emission standards. *Id.* at 14.

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[1] Citations to page numbers for this exhibit refer to those appearing at the bottom center of each page of the exhibit.

2. Speronello

Speronello discloses, *inter alia*, a "catalyst composition effective for reducing nitrogen oxides with ammonia in a gaseous stream." Ex. 1008, 3:44–47. Included in this composition are zeolites that may contain iron and/or copper. *Id.* at 3:49–58. Speronello states that the zeolite catalysts described therein demonstrate sufficient thermal and hydrothermal stability, providing "an acceptably long life and efficiency of the catalysts" even after exposure to gaseous streams at temperatures up to about 600° C. *Id.* at 6:17–25. Speronello also describes zeolite catalysts that demonstrate resistance to sulfur poisoning and NOx reduction/conversion efficiencies around 90%. *Id.* at 6:34–7:3.

Speronello teaches that "[a]ny suitable physical form of the catalyst may be utilized, such as a monolithic honeycomb-type body containing a plurality of fine, parallel gas flow passages extending therethrough, the walls of which are coated with the zeolite catalytic material." *Id.* at 7:10–15. Speronello further states that:

> [t]he physical configuration of the catalyst used in a given case will depend on a number of factors such as the space available for the catalytic reactor . . . and the permitted or desired amount of pressure drop across the catalyst bed. When catalysts are used to treat engine exhausts . . . it is usually desired to minimize pressure drop in order to enhance the efficiency of the engine. In such cases, the preferred physical configuration of the catalyst is one which provides parallel flow passageways for the gas, such as those found in the above-described honey-comb-type catalysts.

Id. at 7:30–41.

In the Examples, Speronello describes coating a honeycomb ceramic support with a washcoat of synthetic zeolite by immersing the support in a

zeolite-containing slurry, resulting in loading amounts ranging from 1.5 g/in^3 to 2.0 g/in^3. *Id.* at 8:18–12:48.

3. Hashimoto

Hashimoto relates to diesel particulate filters, noting that "[t]ighter PM emission regulations will be introduced in Europe, United States and Japan on passenger cars and trucks over the next 7 years. DPF (diesel particulate filter) has been the primary technology considered in meeting these tight PM emission limits." Ex. 1007, 1.[2] Hashimoto discloses that the addition of a DPF exhaust system increases back engine pressure, and the limited amount of space available for DPFs in automobiles makes it difficult to provide a sufficient filtration area. *Id.* Thus, according to Hashimoto, "optimizing pressure-drop and trapping efficiency simultaneously is a notable challenge for DPF systems." *Id.* Hashimoto states that "[a] catalyzed DPF system has been proposed as a future PM emission control technology." *Id.*

Hashimoto studies the factors that influence pressure drop and filtration efficiency of a DPF, and seeks to develop a design and select materials for use in DPFs that will minimize pressure drop while maintaining the ability to trap particulate matter. *See generally id.*

Based on tests conducted on uncatalyzed DPFs, Hashimoto states that "it was concluded that a material with high porosity and with high pore sizes is desirable to have low pressure drop performance." *Id.* at 7. Specifically, Hashimoto concludes that the optimum pore size is between 10μm and

[2] Consistent with the practice of the Petitioner regarding this reference, page numbers for this exhibit refer to those appearing at the top center of each page.

70µm. *Id.* Hashimoto discloses DPF filters having porosity values from 53% to 65%, and mean pore sizes ranging from 15µm to 35µm. *Id.* at 10, Table 3 (reporting values for DHC-558 and DHC-611).

With regard to catalyzed DPF systems, Hashimoto teaches that applying the catalyst washcoat inside the pores reduces the porosity of the DPF material and changes the post-coated pore size distribution. *Id.* at 12. Hashimoto measured the pressure-drop across two coated DPFs, DHC-558 and DHC-611, with a washcoat loading of 100 g/L on each filter. Hashimoto compared the performance of the coated filters with the performance of the uncoated filters, and noted that the coated filters showed an increased pressure drop of 170% and 100%, respectively, over uncoated filters. *Id.* at 13. Because the filter with higher porosity (DHC-611) showed a smaller increase in pressure-drop, Hashimoto states that these test results "indicate[] that high porosity DPF material has an advantage for a catalyzed DPF system," that "porosity and mean pore size of the DPF materials are critical for the catalyzed DPF system," and that "high porosity material can be coated with significantly higher wash coat loading without adversely effecting pressure-drop." *Id.* Ultimately, Hashimoto states that "SiC and Cordierite DPF designed for low pressure-drop are prime candidates for the catalyzed system." *Id.*

4. Teraoka

Teraoka teaches that "Cu-loaded MFI zeolites showed the catalytic activity for the oxidation of soot and reduction of NO_x simultaneously in the soot-NO_x-O_2 reaction system." Ex. 1009, 604. Similar to the other references discussed herein, Teraoka begins by explaining that nitrogen oxides and soot particulates emitted from diesel exhaust contribute greatly to

environmental pollution, and notes the tightening regulation of diesel emissions with regard to NOx and particulate matters. *Id.* Teraoka describes studies regarding the simultaneous NOx–soot removal reaction, and reports on the "catalytic property of Cu-loaded MFI for the simultaneous NO_x–soot removal reaction." *Id.*

Teraoka states that the catalytic activity for the simultaneous NOx–soot removal was evaluated by packing a mixture of catalyst and activated carbon in a reactor, heating the reactor while flowing NO-O_2-He gas through it, and analyzing the outlet gas. *Id.* According to Teraoka, the soot that was pre-mixed with the catalyst was oxidized by either NOx or O_2 to produce CO_2, and the NOx was reduced by the soot into N_2 and N_2O. *Id.* Based on this study, Teraoka states that "Cu introduced in MFI zeolites effectively works as a catalyst for the simultaneous NO_x–soot removal reaction." *Id.*

Teraoka concludes that a Cu MFI zeolite "is a promising NO_x–soot removal catalyst showing medium soot ignition activity and high selectivity to N_2 formation." *Id.* at 605.

E. Analysis of Grounds of Unpatentability

Petitioner argues that the subject matter of claims 1–27 would have been obvious over Hüthwohl[3] in view of Hashimoto and Speronello, and further in view of Teraoka. After considering the arguments and evidence presented in the Petition and the Preliminary Response, we instituted trial against claims 1–27, determining that Petitioner was reasonably likely to prevail in showing that the subject matter of the challenged claims would

[3] Petitioner contends that Hüthwohl was not relied upon during prosecution of the application leading to the '982 patent or the related reexaminations. Pet. 17.

have been obvious over the combined teachings of Hüthwohl, Hashimoto, Speronello, and Teraoka. Dec. on Inst. 13–21.

With the exception of claim 15, Patent Owner does not challenge Petitioner's evidence and arguments that the combined teachings of Hüthwohl, Speronello, Hashimoto, and Teraoka disclose or suggest all of the limitations of the challenged claims. Thus, with respect to claims 1–14 and 16–27, we are left to consider only the evidence of record as presented in the Petition. *See* Pet. 16–51.

Based on the complete record, we find that Petitioner has presented sufficient evidence demonstrating that the combined teachings of Hüthwohl, Speronello, Hashimoto, and Teraoka disclose or suggest all of the limitations of claims 1–14 and 16–27. Generally, Petitioner directs us to specific portions of Hüthwohl, Hashimoto, and Speronello in arguing that the claims of the '982 patent simply combine well-known elements of the prior art to yield predictable results. Pet. 1, 41–49. For example, Petitioner argues that the independent claims of the '982 patent require a wall flow filter having an SCR catalyst composition permeating the walls of the filter. *Id.* at 12–13. Petitioner points out that the '982 patent itself recognizes that DPFs were a "key technology" already in use, including wall flow filters (*id.* at 5, 13–14; Ex. 1001, 2:13–14, 20–21, 9:49–50; Ex. 1005 (describing CRT system using wall flow DPF)), and that SCR was a "proven NOx abatement technology" (Pet. 10, 13–14; Ex. 1001, 2:41–44, 8:1–4; Ex. 1005).

Petitioner argues that Hüthwohl teaches loading an SCR catalyst onto a wall flow filter, but acknowledges that Hüthwohl is silent with regard to the details of the SCR catalyst and the filter. *See* Pet. 19, 23–24, 37, 41 (claim chart). Petitioner, however, asserts that Hashimoto discloses a wall

flow monolith having a plurality of longitudinally extending passages where some passages are blocked at the upstream end and unblocked at the downstream end, and other passages are unblocked at the upstream end and blocked at the downstream end. *Id.* at 41. Petitioner further asserts that Hashimoto discloses filters with porosity and mean pore size values (e.g., DHC-611 filter with 59% porosity and 25 µm pore size) that fall within the ranges required in the challenged claims. *Id.* at 42 (citing Ex. 1007, 13).

With regard to the details of the SCR catalyst, Petitioner asserts that Speronello discloses a catalyst formed by dipping a substrate into an iron and/or copper-promoted zeolite slurry. *Id.* (citing Ex. 1008, 7:23–25). Petitioner further asserts that Speronello discloses the slurry permeating the walls at loadings ranging from 1.5 to 2.0 g/in^3, which falls within the claimed ranges. *Id.* at 43 (citing Ex. 1008, 8:57–60, 9:26–29, 9:60–64, 10:26–30, 10:64–67, 11:39–42, 12:45–48).

Petitioner also asserts that Teraoka's disclosure of Cu-loaded MFI zeolites having "catalytic activity for the oxidation of soot and reduction of NOx simultaneously" corresponds to the requirement that the claimed wall flow monolith has "integrated, NOx and particulate removal efficiency in which the presence of the catalytic material in the wall flow monolith catalyzes the oxidation of soot." *Id.* at 44 (citing Ex. 1009, Abstract); Ex. 1001, 15:61–64.

Accordingly, we find that the preponderance of the evidence supports a finding that Petitioner has demonstrated that all of the limitations of claims 1–14 and 16–27 are disclosed or suggested by the combined teachings of

Hüthwohl, Speronello, Hashimoto, and Teraoka.[4] As a result, we focus on the parties' arguments directed to whether Petitioner has shown that a person of ordinary skill in the art would have had reason to combine the teachings of the prior art references, and whether, in doing so, a person of ordinary skill in the art would have had a reasonable expectation of success in arriving at the claimed subject matter. Pet. 16–37; PO Resp. 1–49; Reply 1–18.

1. Petitioner's Arguments

According to Petitioner, the patentability of the challenged claims depends on whether it would have been obvious to select two well-known elements—a wall flow filter and a copper zeolite SCR catalyst—and combine them into a single unit. Pet. 14. Petitioner argues that there was a known problem that provided a reason for combining the claimed elements, namely the newly proposed emission standards. *Id.* at 22–23 (noting that "[t]here was a problem (the need to simultaneously lessen NOx and particulate matter emissions) and a 'market pressure to solve [that] problem' (such an emission treatment system would be needed in every new commercial vehicle after 2008)"), 37. Petitioner argues that Hüthwohl expressly describes combining these claimed elements, noting that Hüthwohl states that reduced emission values can "only [be] achieved by combining a particle filter with an SCR catalyst" and that Hüthwohl discloses an emission treatment system that loads an SCR catalyst into the wall flow filter (the SCRT system). *Id.* at 19 (citing Ex. 1005, 3), 22–23 (noting that Hüthwohl teaches using "the volume of the soot filter for the SCR reaction").

[4] Patent Owner presents separate arguments regarding claim 15. In view of our discussion below, however, we need not address those arguments.

Petitioner also contends that space constraints for exhaust systems on vehicles made combining an SCR and soot filter into one system the only feasible option. *Id.* at 23; Reply 4.

Petitioner relies on the results disclosed in Hüthwohl, namely the system's overall reduction of particulate matter emissions by over 90% and NOx emissions by over 47%, in asserting that Hüthwohl demonstrated its system worked, and, therefore, a person of ordinary skill in the art would have had a reasonable expectation of success in combining an SCR catalyst into a soot filter to simultaneously reduce NOx and particulate matter. Pet. 24.

Petitioner contends that a person of ordinary skill would have been motivated to "combine Speronello's SCR catalysts (which possess characteristics particularly well suited for use on a wall flow filter) with Hashimoto's wall flow filter (which in 2002 taught how to accommodate a thick catalyst washcoat without getting clogged and causing high back pressure) for use in Huthwohl's [sic] system." *Id.* at 26. According to Petitioner, it was known that (1) wall flow filters could be subjected to high temperatures in order to regenerate the filter by burning off soot, (2) diesel exhaust streams typically contained sulfur, and (3) a catalyst should be able to function over a broad temperature range in order to treat diesel exhaust. *Id.* at 26–27; Ex. 1004 ¶¶ 41–44; Ex. 1011, 189, 200–201, 206. Petitioner's declarant, Dr. Harold, states that the "industry appreciated that these three catalyst characteristics were crucial when developing a diesel exhaust treatment system." Ex. 1004 ¶ 38. Petitioner argues that Speronello's catalysts were "the logical choice for use in diesel particulate filters as taught by Huthwohl [sic]" because "(1) they were known to be stable at high

temperatures, (2) they were known to be resistant to degradation by sulfur, and (3) they were known to efficiently catalyze the reduction of NOx over a wide range of temperatures." Pet. 20, 26–29 (arguing, *inter alia*, that the Speronello zeolite catalysts would have been preferred over other SCR catalysts used as of 2003, such as vanadium catalysts, due to their ability to operate over a temperature range of 200–600 °C); Ex. 1008, 6:22–49.

Petitioner argues that "the prior art taught that zeolites displayed the best thermal stability among known SCR catalysts." Reply 11–12 (citing Ex. 1011, 205–206; Ex. 1032 ¶¶ 14, 93). According to Petitioner, as of 2003, copper zeolites had been studied, their characteristics were well-established, and there was nothing inventive about focusing on these characteristics when selecting an SCR composition to load onto a wall flow filter. Pet. 26–29; Ex. 1004 ¶¶ 38, 41–44; Ex. 1011, 189, 200–201, 206.

Petitioner further argues that "[b]y 2002, industry had recognized that meeting the newly proposed emissions standards required applying some relatively high catalyst washcoat loadings, such as those taught by Speronello, into a wall flow filter." Pet. 31 (citing Ex. 1003 ¶¶ 18–27). Petitioner asserts that Hashimoto discloses a high porosity filter designed to accommodate high catalyst washcoat loadings and achieve acceptable back pressure. *Id.* at 30–31 (explaining that too much washcoat can clog the pores of a wall flow filter leading to high back pressure, which is undesirable because it can reduce engine power and increase fuel consumption). Specifically, Petitioner contends that "Hashimoto found, and taught, that 'high porosity [diesel particulate filter] material has an advantage for a catalyzed [diesel particulate filter] system[,]'" and that "[t]hese new high porosity filters . . . were 'prime candidates' for future use

as a catalyzed diesel particulate filter." *Id.* at 32 (citing and quoting Ex. 1007, 13); Ex. 1003 ¶¶ 35–38, 40.

According to Petitioner, Hashimoto focuses on the amount of catalyst loaded, not the type of catalyst, and therefore a person of ordinary skill in the art would not have understood Hashimoto as being limited to any particular type of catalyst system. Pet. 33. Additionally, Dr. Tennent testified that a person of ordinary skill in the art "would have recognized that washcoats applied to a flow-through, honeycomb substrate could have been applied to a wall-flow filter, given that the filter possessed adequate porosity, pore size, or other characteristics," and that "a specific catalyst composition known to work when applied to a flow-through substrate would be expected to work in a similar manner when applied to a wall-flow filter." Ex. 1003 ¶ 23; Pet. 34.

Petitioner contends that it was known in the art that copper oxidizes NO to NO_2, and that NO_2 was known to oxidize dry carbon soot. Pet. 34. According to Petitioner, "[i]t was thus hardly surprising when, in 2001, Teraoka expressly taught that a copper zeolite composition catalyzes the oxidation of soot." *Id.* at 35. Petitioner contends that a person of ordinary skill in the art "would have understood that a copper zeolite would catalyze the oxidation of soot, regardless of whether the system used ammonia as the SCR reductant (like the claims of the '982 patent) or reduced the NOx with a hydrocarbon such as soot (like Teraoka)." Pet. 35; Ex. 1004 ¶ 60 (stating that Teraoka's teaching "would have been expected to apply to an ammonia-based SCR system").

Therefore, Petitioner asserts that "[c]opper zeolite catalysts, such as those taught by Speronello, were known to 'show[] the catalytic activity for

the oxidation of soot and reduction of NOx simultaneously.'" Pet. 34 (quoting Ex. 1009, 604). In view of this, Petitioner asserts that a person of ordinary skill "would have reasonably expected that a copper zeolite loaded into a wall flow filter would serve two needed functions simultaneously: the reduction of NOx emissions and the reduction of particulate matter emissions." *Id.* at 35–36 (citing Ex. 1004 ¶¶ 60–61).

Petitioner ultimately concludes that, in view of the teachings of Teraoka, a person of ordinary skill in the art would have expected the system resulting from the combined teachings of Hüthwohl, Speronello, Hashimoto, and Teraoka to lessen NOx emissions while simultaneously catalyzing the oxidation of soot from the filter, and, therefore, the claimed invention "did not have any unexpected results; instead, it was 'merely the combination of familiar elements to yield predictable results.'" *Id.* at 37 (quoting *Ecolab, Inc. v. FMC Corp.*, 569 F.3d 1335, 1350 (Fed. Cir. 2009)).

Petitioner asserts that Patent Owner's arguments regarding the reasonable expectation of success are improperly directed to a commercially operational filter and characteristics that are not claimed. Reply 2–3, 7. Petitioner points out that the independent claims do not have a temperature limitation, and for the dependent claims that require thermal stability above 650 °C, directs us to prior art disclosing a Y zeolite displaying catalytic activity up to 750 °C (*id.* at 13 (citing Ex. 1033, 2:42–44, 4:23–24)) and zeolite catalysts resisting thermal degradation at 650 °C (*id.* at 13–14 (citing Ex. 1030, Figs. 3, 5, 8; Ex. 1033)). Petitioner further argues that Speronello does not recite a definite upper temperature limit for its zeolite catalysts. *Id.* at 14–15. Additionally, Petitioner argues that the claims "do not require a particular mode of filter regeneration or performance of the filter during

filter regeneration" and "do not require that the wall-flow filter exhibit a particular thermo-mechanical durability." *Id.* at 3.

2. Patent Owner's Arguments

Patent Owner argues that despite Hüthwohl's disclosure of an SCR-coated soot filter, this was not the prevailing view in the industry, and there are several reasons why a person of ordinary skill in the art would not have had a reasonable expectation of success. PO Resp. 21.

For example, Patent Owner argues that Hüthwohl fails to disclose essential details regarding the SCR-coated soot filter, such as the type of SCR catalyst, type of filter, type of filter regeneration, performance of the filter during regeneration, information regarding back pressure, and the level of coating on the filter. *Id.* at 36–37. According to Patent Owner, Hüthwohl at best provides "only general guidance as to the particular form of the claimed invention or how to achieve it," which falls short of what is required to establish obviousness. *Id.* at 37 (citing *Procter & Gamble*, 566 F.3d at 997). In support of this, Patent Owner directs us to the deposition testimony of Dr. Harold, who testified that Hüthwohl is a "proof of concept" that would lead a person of ordinary skill in the art "to do some testing in one's own lab." *Id.* (quoting Ex. 2025, 205:5–9).

Patent Owner also asserts that there are "numerous impediments to applying a high washcoat loading of an SCR catalyst to a soot filter," such as competing coupled reactions, and, therefore, coating a soot filter with an SCR catalyst would have been unpredictable and would not have been "obvious to try." *Id.* at 37–38 (citing *Abbott Labs. v. Sandoz, Inc.*, 544 F.3d 1341, 1352 (Fed. Cir. 2008)). For example, according to Patent Owner, a person of ordinary skill in the art would have known of and appreciated the

role of NO_2 in the oxidation of soot filters, and would have been concerned about incorporating an SCR catalyst, which consumes NO_2, into this oxidizing environment. *Id.* at 21–23. Patent Owner further asserts that a person of ordinary skill in the art would have been concerned about poor NOx conversion because NH_3 is required as a reagent for the SCR of NOx, but NH_3 can be directly oxidized to N and H_2O in the diesel exhaust environment. *Id.* at 23–24 (citing Ex. 2045 ¶¶ 65–66; Ex. 2031, 2; Ex. 2025, 113:14–18, 116:8–14, 251:16–23). Therefore, the NH_3 oxidation reaction and the SCR reaction compete for the ammonia, and, according to Patent Owner, the art does not explain how these competing reactions could effectively be balanced. *Id.* Patent Owner thus contends that "the skilled artisan could not have predicted how the system would behave upon introducing ammonia as a reducing agent in the highly oxidizing environment of diesel exhaust." *Id.* at 25–26 (citing Ex. 2025, 117:6–21; Ex. 2045 ¶ 66; *Sanofi-Synthelabo v. Apotex, Inc.*, 550 F.3d 1075, 1088 (Fed. Cir. 2008)).

Patent Owner also points out that Hüthwohl uses both an SCR-coated soot filter and an additional downstream SCR catalyst on a substrate without soot-filtering capabilities, but "provides no information regarding how much NOx reduction, if any, is actually taking place on the coated soot filter relative to the downstream SCR catalyst." *Id.* at 33–34 (noting that Hüthwohl does not provide data regarding the content of the emissions in the region between the two components). Instead, Hüthwohl only provides emissions information for the overall system. Patent Owner argues that Dr. Harold confirmed that a person of ordinary skill in the art "cannot rule out

the possibility that *no* NOx reduction is happening on the coated soot filter." *Id.* at 34–35 (citing Ex. 2025, 196:11–197:6, 198:22–192:2, 199:18–23).

Patent Owner notes that Speronello discloses coating a flow through monolith, not a soot filter, and "provides no guidance regarding whether his catalysts could be coated on a soot filter to achieve adequate catalytic activity without creating excessive back pressure." *Id.* at 31. Patent Owner contends that the inventors of the '982 patent were the first to recognize that Speronello's catalysts would be suitable for treatment of diesel exhaust, including having the ability to survive high temperatures of filter regeneration, and that Petitioner's arguments directed towards the fact that the '982 patent cites Speronello "demonstrate[] the hindsight bias that runs through the Petition." *Id.* at 31–32 (citing *Otsuka Pharm. Co. v. Sandoz, Inc.*, 678 F.3d 1280, 1296 (Fed. Cir. 2012)).

Patent Owner further argues that "[i]f, as Petitioner contends, the skilled artisan would have chosen a catalyst with filter regeneration in mind, they surely would have also chosen a filter with filter regeneration in mind," but asserts that Hashimoto fails to disclose information regarding whether its filters would perform under conditions of filter regeneration. *Id.* at 45–47; Ex. 2045 ¶¶ 94. Patent Owner further argues that in 2003, conventional wisdom was that "filter survivability during active filter regeneration required a large mass—the exact opposite of high porosity." PO Resp. 47, 11–12 (citing Ex. 1011). Patent Owner contends that "the behavior of a filter under soot-loaded conditions was not predictable in 2003 and was the subject of intense study." *Id.* at 12–13.

Patent Owner also contends that Petitioner offers no evidence to support the position that it would have been routine to ensure that a high

porosity filter would not crack during filter regeneration. *Id.* at 45–46. To the contrary, Patent Owner asserts that balancing porosity and thermo-mechanical durability was a challenging problem. *Id.* at 46 (citing Ex. 2045 ¶ 95; Ex. 2025, 209:14–210:16). Therefore, according to Patent Owner, "there would not have been either a motivation to combine Hashimoto with Hüthwohl nor a reasonable expectation that this would be successful for treating diesel exhaust, which undisputedly requires filter regeneration." *Id.* at 47 (citing Ex. 2045 ¶¶ 92–97).

Patent Owner contends that Teraoka fails to establish a reasonable expectation of success because it describes a set of experiments not carried out under real-world exhaust conditions and uses the ZSM-5 catalyst that persons of skill in the art would have recognized as being "unsuitable for diesel exhaust treatment." *Id.* at 48 (citing Ex. 2025, 235:17–24, 251:1–10). Patent Owner also points out that Teraoka does not use ammonia as the reductant for NOx. *Id.* at 49. According to Patent Owner,

> [v]iewing Teraoka in the most favorable light, all it establishes is that the Cu/ZSM-5 zeolite catalyst—which was known to be unsuitable for diesel exhaust treatment—showed activity for simultaneous oxidation of soot and reduction of NO_x in an ammonia-free environment unlike the environment actually needed for carrying out SCR. *See* Crocker Decl. ¶ 100. This falls short of providing the skilled artisan with a reasonable expectation that a zeolite catalyst could be used to simultaneously treat soot and NO_x using NH_3-based SCR on a soot filter. Indeed, none of the complications that the skilled artisan would have perceived with this process are addressed anywhere in the art.

Id.

3. Analysis

The claims of the ’982 patent require a wall flow monolith having specific porosity and pore size values, coated with a specific SCR catalyst composition that includes a zeolite and base material selected from copper, such that the wall flow monolith demonstrates “integrated, NOx and particulate removal efficiency in which presence of the catalytic material in the wall flow monolith catalyzes the oxidation of soot.” Ex. 1001, 15:47–64 (independent claim 1), 16:46–64 (independent claim 16), 17:13–18:5 (independent claim 22). For the reasons discussed below, we find that Petitioner has failed to show that the skilled artisan would have had a reasonable expectation of successfully arriving at the specific wall flow filter coated with the specific zeolite catalyst that demonstrates integrated NOx and particulate removal and catalyzes the oxidation of soot, as required by the claims.

As evidence that a person of ordinary skill in the art would have had a reasonable expectation that Hüthwohl successfully worked to simultaneously reduce NOx and particulate matter, Petitioner relies on the emissions reduction data provided in Hüthwohl. Pet. 24 (citing Ex. 1005, 8–9). Petitioner argues that Hüthwohl “unambiguously teaches that the SCR catalyst inside the wall-flow filter reduces NOx emissions” based on the statement in Hüthwohl that “the volume of the soot filter will be already utilized for the SCR reaction,” and that a “proportionately smaller” SCR reaction catalyst is connected downstream. Reply 9.

As Patent Owner points out, however, although Hüthwohl discloses that its overall system reduced emissions to levels acceptable by European emission standards, Hüthwohl does not measure emissions levels in the area

between the SCR-coated wall flow filter and the downstream SCR catalyst. PO Resp. 34–36. Therefore, as confirmed by declarants from both parties, there is no evidence in the record regarding how much NOx reduction, if any, is actually taking place on Hüthwohl's SCR-coated wall flow filter. *Id.*; Ex. 2045 ¶ 79; Ex. 2025, 196:11–197:6, 198:22–199:2, 199:18–23.

Petitioner points out that Dr. Harold said it is "not likely" that no NOx reduction occurs in the SCR-coated filter, and Dr. Crocker cites no evidence to support a conclusion of zero SCR activity. Reply 10. It is Petitioner's burden to prove that a person of ordinary skill in the art would have had a reasonable expectation that NOx reduction occurs on Hüthwohl's SCR-coated filter. Petitioner provides no data supporting this contention, and Petitioner's own declarant testified that the absence of NOx reduction "can't be ruled out." Ex. 2025, 196:11–197:6. Thus, although it appears that Hüthwohl intended for the volume of the SCR filter to be used for NOx reduction, the evidence of record does not establish, by a preponderance of evidence, that it actually occurred at that stage, or that a person of ordinary skill in the art would have had a reasonable expectation that it would.

Nevertheless, even if we were to infer that some NOx reduction occurs in Hüthwohl's SCR-coated filter, we are not persuaded that Petitioner has shown, by a preponderance of the evidence, a reasonable expectation of successfully achieving *the claimed invention*, which requires integrated NOx and particulate reduction while catalyzing the oxidation of soot using a specific type of SCR catalyst and wall flow filter having specific characteristics. As Patent Owner points out, Hüthwohl does not provide details regarding the SCR catalyst or the wall-flow filter used in its system. PO Resp. 36–37. In that regard, Dr. Harold characterized Hüthwohl as a

"proof of concept" that would lead a person of ordinary skill in the art to conduct testing. PO Resp. 37; Ex. 2025, 205:5–9. Given the vague nature of Hüthwohl's disclosure, we view Hüthwohl as simply providing incentive "to explore a new technology or general approach that seemed to be a promising field of experimentation," and agree with Patent Owner that Hüthwohl, at best, provides "only general guidance as to the particular form of the claimed invention or how to achieve it." *Procter & Gamble*, 566 F.3d at 997; PO Resp. 37. Thus, upon reviewing Hüthwohl, a person of ordinary skill in the art would still have had to identify an acceptable combination of an SCR catalyst and wall flow filter, decide how much SCR catalyst to apply to the filter, and determine if the wall flow filter coated with the SCR catalyst provided integrated NOx and particulate removal efficiency while also catalyzing the oxidation of soot.

In this regard, even if a person of ordinary skill in the art would have been motivated to coat Hashimoto's filter with Speronello's catalyst for use in Hüthwohl's system, we are not persuaded that Petitioner has shown by a preponderance of the evidence that a person of ordinary skill in the art would have had a reasonable expectation of successfully arriving at a coated filter that would provide integrated NOx and particulate removal efficiency, and act as a catalyst for the oxidation of soot, as required by the claims.

We credit Dr. Crocker's explanation of the competing reactions that can take place when an SCR catalyst using NH_3 as a reductant is placed in an oxidizing environment, namely NH_3 oxidation and the SCR reaction itself. Ex. 2045 ¶¶ 65–66. Dr. Harold considered these competing reactions to be complications (Ex. 2025, 116:8–14), stating that "whenever you combine two things together, you don't really know what the outcome is

going to be because of all the synergies and couplings" (*id.* at 117:6–21). Dr. Harold also testified that the only way to know how much of each reaction will occur is by "throwing everything together and measuring the outcome." *Id.* As such, the evidence of record suggests that a person of ordinary skill in the art would not have known the result of introducing Speronello's catalyst and NH_3 into the highly oxidizing environment of any soot filter, but instead would have had to conduct testing to understand how such a system would perform. We view this as evidence of more than "some degree of unpredictability." *Pfizer*, 480 F.3d at 1364.

Moreover, the present case is distinguishable from cases such as *Pfizer* and *In re Corkill*, 771 F.2d 1496, 1500 (Fed. Cir. 1985), in which the record contained evidence of at least an expectation within the prior art that the claimed material would work for its intended purpose. *See Pfizer*, 480 F.3d at 1364–65; *Corkill*, 771 F. 2d at 1500 (noting that despite evidence that "it cannot be predicted how any candidate will work in a detergent composition, but that it must be tested, this does not overcome [the prior art] teaching that hydrated zeolites will work"). Here, however, Petitioner has not provided comparable evidence regarding the performance of zeolite catalysts, such as those disclosed by Speronello, in a soot oxidizing environment. Instead, Petitioner provides only evidence that such catalysts would have been "the best option for use in a wall flow filter." Pet. 26–30.

We are not persuaded by Dr. Harold's testimony that "Hüthwohl showed you can do it" (Ex. 2025, 17:6–21), or Petitioner's arguments that Hüthwohl's disclosure of a SCR-coated soot filter undermines Patent Owner's assertions regarding complications based on introducing a reductant in an oxidizing environment (Tr. 31:1–11). As discussed above,

Hüthwohl fails to provide data regarding the NOx and particulate reduction performance of the SCR-coated soot filter itself—separate and apart from the performance of the system (including the downstream SCR catalyst) as a whole. Hüthwohl also fails to identify the specific SCR catalyst used. We note that both parties have relied on a prior art reference that demonstrates different SCR catalysts perform differently under varying conditions. *See, e.g.*, Ex. 1011, 205–206.

Nor are we persuaded by Petitioner's argument that Hashimoto teaches that its filters are "prime candidates for the catalyzed system . . . without placing any limitations on the type of catalyst system" (Pet. 33), or the argument that there is nothing in Hashimoto "to suggest that you could use it for one type of catalyst but not the other" (Tr. 29:1–2). After stating that its filters are "prime candidates for the catalyzed system," Hashimoto states that "[t]he pressure-drop and filtration performance of the catalyzed DPF's will be carefully investigated in the next phase of development because *the catalyst will change the pore size characteristics*." Ex. 1007, 13 (emphasis added). Hashimoto thus suggests that the type of catalyst applied to Hashimoto's filter would impact the performance of the filter. Petitioner does not direct us to any evidence that Hashimoto reported filter performance data generated from tests conducted on a SCR-coated filter. Rather, as Petitioner acknowledges, Hashimoto is vague about what type of catalyst is used to produce the pressure drop measurements reported in the reference. Tr. 28:24–29:2. Petitioner does not dispute that Hashimoto cites to a specific reference that applied a washcoat containing a catalyst for soot oxidation inside the pores of a DPF. Tr. 28:16–24; *see* Ex. 1007, 12. The only other catalyzed system discussed in the Hashimoto reference is a NOx

adsorption catalyst–which is distinct from an SCR catalyst. Ex. 1007, 12; Ex. 1011, 206–07; PO Resp. 13–14.

Furthermore, as Patent Owner points out, Speronello teaches the use of certain coating weights on a flow through monolith, "which acts as a substrate for the catalyst but has no soot trapping function." PO Resp. 31. We agree with Patent Owner that Speronello provides no express guidance "regarding whether his catalysts could be coated on a soot filter to achieve adequate catalytic activity without creating excessive back pressure." *Id.* Further, as noted above, Speronello states that:

> [t]he physical configuration of the catalyst used in a given case will depend on a number of factors such as the space available for the catalytic reactor . . . and the permitted or desired amount of pressure drop across the catalyst bed. When catalysts are used to treat engine exhausts . . . it is usually desired to minimize pressure drop in order to enhance the efficiency of the engine. In such cases, the preferred physical configuration of the catalyst is one which provides parallel flow passageways for the gas, such as those found in the above-described honey-comb-type catalysts.

Ex. 1008, 7:30–41. Although Dr. Tennent states that "a specific catalyst composition known to work when applied to a flow-through substrate would be expected to work in a similar manner when applied to a wall-flow filter," he does not provide any underlying facts or data to support this conclusion. Ex. 1003 ¶ 23. Pursuant to 37 C.F.R. § 42.65(a), such testimony is entitled to little or no weight. Dr. Tennent also fails to address whether this statement holds true when the flow through substrate and the wall flow substrate are subjected to distinct environmental conditions.

Petitioner presents Teraoka as evidence that the zeolites taught by Speronello were known to show simultaneous catalytic activity for the

reduction of NOx and oxidation of soot. Pet. 34. It is undisputed, however, that Teraoka did not test the catalytic performance of a copper zeolite in a "system us[ing] ammonia as the SCR reductant (like the claims of the '982 patent)." *Id.* at 35*;* PO Resp. 49; Ex. 1004 ¶ 60 (stating that Teraoka shows the SCR reaction without ammonia, but "would have been expected to apply to an ammonia-based SCR system, such as the one claimed by the '982 patent"). In support of Petitioner's argument, Dr. Harold states that

> [t]o better show the direct effect of copper and NOx on soot oxidation, Teraoka shows the SCR reaction without ammonia (e.g. using a hydrocarbon reductant). Its teaching, however—that a copper zeolite catalyzes the oxidation of soot by NOx—would have been expected to apply to an ammonia-based SCR system, such as the one claimed by the '982 patent. That is, one of ordinary skill in the art would expect NOx to be reduced through reaction with soot and ammonia in the presence of a copper zeolite catalyst, as shown by Speronello. As both Heck and Teraoka teach, a copper zeolite will catalyze the oxidation of NO to NO_2 with the NO_2 then catalyzing the oxidation of soot. This same principle would have applied when using ammonia as the reductant for the SCR reaction, as the claims of the '982 patent do. Ammonia would react with some of the NOx while soot would react with NO_2.

Ex. 1004 ¶ 60. Dr. Harold, however, fails to provide underlying facts or data to support the conclusion presented here, namely that Teraoka's teachings would apply equally to an ammonia-based SCR system; therefore, his testimony is entitled to little or no weight. 37 C.F.R. § 42.65(a). As discussed above, we find that as of the filing date of the '982 patent, a person of ordinary skill in the art would have understood the unpredictable nature of placing an SCR catalyst using NH_3 as a reductant in an oxidizing environment. *E.g.*, PO Resp. 23–24; Ex. 2045 ¶¶ 65–66; Ex. 2025, 117:6–21; 116:8–14; 251:16–23.

During the hearing, counsel for Petitioner characterized Patent Owner's argument regarding Teraoka's lack of testing in an ammonia environment as "unfair," noting that Example 3 in the '982 patent, "which is what [Patent Owner] relies on to show that the zeolites also do oxidation," involved a test that was not conducted in an ammonia-based SCR system. Tr. 26:19–27:1. This argument, however, ignores Example 4 of the '982 patent, titled "Evaluation of NOx Conversion and Particulate Removal for Coated Soot Filters," in which "[t]he filtration efficiency and simultaneous NOx reduction was determined," and urea was introduced upstream of a catalyzed soot filter. Ex. 1001, 14:10–15:35. It also improperly relies on hindsight. *See* Otsuka, 678 F.3d at 1296 ("The inventor's own path itself never leads to a conclusion of obviousness; that is hindsight. What matters is the path that the person of ordinary skill in the art would have followed, as evidenced by the pertinent prior art.").

Based on the foregoing, we find that Petitioner has failed to demonstrate, by a preponderance of the evidence, that a person of ordinary skill in the art would have had a reasonable expectation of success in arriving at the specific wall flow filter coated with the specific zeolite catalyst that demonstrates integrated NOx and particulate removal and catalyzes the oxidation of soot, as required by the claims, based on the combined teachings of Speronello, Hashimoto, Hüthwohl, and Teraoka.

IV. MOTION TO EXCLUDE

Patent Owner filed a Motion to Exclude paragraphs 26–30 of Dr. Tennent's Declaration. Paper 30, 1. We do not reach the merits of Patent Owner's Motion because, as explained above, even if the disputed evidence is considered, Petitioner has failed to show by a preponderance of

evidence that claims 1–27 are unpatentable as obvious. Accordingly, Patent Owner's Motion to Exclude is dismissed as moot.

V. CONCLUSION

Upon consideration of the arguments and evidence presented during trial, we determine that Petitioner failed to establish by a preponderance of the evidence that claims 1–27 of the '982 patent are unpatentable under 35 U.S.C. § 103(a) as obvious over the combined teachings of Hüthwohl, Speronello, Hashimoto, and Teraoka.

VI. ORDER

For the reasons given, it is hereby

ORDERED that Petitioner has not shown by a preponderance of the evidence that claims 1–27 of the '982 patent are unpatentable;

FURTHER ORDERED that Patent Owner's Motion to Exclude (Paper 27) is *dismissed as moot*; 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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