

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SYMRISE AG AND SYMRISE INC.

PETITIONER,

v.

INOLEX INVESTMENT CORPORATION,

PATENT OWNER.

IPR2023-01035
Patent 10,995,048

**OPPOSITION TO PATENT OWNER'S NON-CONTINGENT MOTION TO
AMEND AND REQUEST FOR PRELIMINARY GUIDANCE**

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LIST OF EXHIBITS

Exhibit No.	Description
Exhibit 1001	U.S. Patent No. 10,995,048 (“the ’048 Patent”)
Exhibit 1002	Declaration of Dr. Douglass F. Taber
Exhibit 1003	U.S. Provisional Patent Application No. 62/623,985
Exhibit 1004	File History of U.S. Patent No. 10,882,803
Exhibit 1005	File History of U.S. Patent No. 10,995,048
Exhibit 1006	File History of U.S. Patent No. 11,414,365
Exhibit 1007	U.S. Patent Publication No. 2011/0196114A1 (“Le”)
Exhibit 1008	U.S. Patent Publication. No. 2005/0065389A1 (“De Bruyn”)
Exhibit 1009	U.S. Patent Publication. No. 2012/0238788 (“Wright ’788”)
Exhibit 1010	U.S. Patent No. 6,528,665 (“Cheng”)
Exhibit 1011	PCT Written Opinion of the International Searching Authority, PCT/US2015/014943. Issued April 29, 2015
Exhibit 1012	U.S. Patent No. 8,912,373 (“Wright ’373”)
Exhibit 1013	U.S. Patent No. 8,173,850 (“Furuya”)
Exhibit 1014- Exhibit 1019	<i>Reserved</i>
Exhibit 1020	U.S. Patent No. 10,894,750 (“Vecchini”)

Exhibit 1021	U.S. Patent No. 9,908,837 (“Colby”)
Exhibit 1022	U.S. Patent No. 8,765,430 (“Parekh”)
Exhibit 1023	U.S. Patent No. 8,597,922 (“Alibhai”)
Exhibit 1024	U.S. Patent No. 7,795,484 (“Koivusalmi”)
Exhibit 1025	U.S. Patent No. 4,234,752 (“Wu”)
Exhibit 1026	German Patent DE3915493 (“Voeste”) (translation)
Exhibit 1027	N.P Makgoba et al “ <i>Silication of - γ -alumina catalyst during the dehydration of linear primary alcohols,</i> ” Applied Catalysis A: General 297 (2006) 145-150 (“Makgoba”)
Exhibit 1028	W.G. Appleby et al. “ <i>Vapor Phase Dehydration of 1-Heptanol over Activated Alumina,</i> ” J. AM. CHEM. SOC. 66: 1938-1939, 1944 (“Appleby”)
Exhibit 1029	V. I. Komarewsky et al. “ <i>Catalytic Dehydration of 1-Hexanol and 1-Octanol,</i> ” J. AM. CHEM. SOC. 67: 557-558, 1945 (“Komarewsky”)
Exhibit 1030	L. G. Wade, Jr. Organic Chemistry, Chapters 7 and 8 (8th Ed. 2013) (“Wade”)
Exhibit 1031	JAOCS Vol. 62, No. 2, 355-365 (1985) (“Reck”)
Exhibit 1032	JAOCS Vol. 61, No. 2, 343-347 (1984) (“Kreutzer”)
Exhibit 1033	W. E. Schiegl and J. C. Vogel “ <i>Deuterium Content of Organic Matter,</i> ” EARTH AND PLANETARY SCIENCE LETTERS 7:303-313, 1970 (“Schiegl”)
Exhibit 1034	Harmon Craig, “ <i>Standard for Reporting Concentrations of Deuterium and Oxygen-18 in Natural Waters,</i> ” SCIENCE 133: 1833-1834, 1961 (“Craig”)

Exhibit 1035	WO 2001/044145 (“Tiitta”)
Exhibit 1036	U.S. Patent No. 9,029,619 (“Vermeiren”)
Exhibit 1037	WIPO Publication WO 2004/078336 (“Ziehe”)
Exhibit 1038	Second Declaration of Dr. Douglass F. Taber
Exhibit 1039	WIPO Publication WO 2015/130451 (“Wright ’451”)
Exhibit 1040	Deposition Testimony of Michael E. Wright, Ph.D
Exhibit 1041	Sivaraj Chokkaram <i>et al.</i> “ <i>Conversion of 2-octanol over nickel-alumina, cobalt-alumina, and alumina catalysts,</i> ” Journal of Molecular Catalysis A: Chemical 121:157-169, 1997 (“Chokkaram”)
Exhibit 1042	G. G. Cortez <i>et al.</i> “ <i>Study of the Poisoning of γ-Al₂O₃ by Alkali Metals Addition,</i> ” J. Chem. Tech. Biotechnol., 53:177-180, 1992 (“Cortez”)
Exhibit 1043	P. Berteau and B. Belmon “ <i>Modified Aluminas : Relationship Between Activity in 1-Butanol Dehydration and Acidity Measured by NH₃ TPD,</i> ” Catalysis Today, 5:121-137, 1989 (“Berteau”)

I. Introduction

Petitioner opposes Patent Owner's ("PO") Non-Contingent Motion to Amend ("MTA"), because the claims as amended are not supported by the original disclosure of the '048 patent and are not patentable over the prior art of record or the additional prior art submitted with this Opposition.¹

In particular, the PO amended the claims to recite broad limitations encompassing any base-treated catalyst despite Dr. Wright's (an inventor of the '048 Patent and PO's expert witness) admission that using different base-treated catalysts would have unpredictable results. PO failed to satisfy its burden explaining how the inventors were in possession of such broad claim scope to practice the method recited in the amended claims with any base-treated catalyst in accordance with 35 U.S.C. §112.

In addition, PO's assertions that the amendments are not obvious over the prior art cited in the Petition wrongly focuses on what is explicitly disclosed in those references rather than what is taught to a POSITA. Nonetheless, Petitioner has submitted new prior art grounds that expressly disclose the new limitations amended into the claims as well as teach the other limitations of the amended claims. As noted

¹ PO did not file a Response to the Institution Decision, therefore, the Petition demonstrates that the unamended claims are unpatentable. See MTA at 1, FN2.

in the Petition, the specification of the '048 Patent discloses well-known chemical reactions that are applied in a conventional manner, and as such, there is a plethora of relevant prior art to address potential amendments. Indeed, there is little, if anything, disclosed in the '048 Patent specification that would be non-obvious over Dr. Wright's prior applications disclosing overlapping subject matter with the '048 Patent but assigned to different entities than the PO. Ex. 1009; Ex. 1012; Ex. 1039; *see also* Ex. 1004 at 5, 127, and 168-246 (Examiner discussing teachings of prior Wright applications). For these reasons detailed below, the MTA should be denied.

II. Identification of Claims Being Challenged

Petitioner asserts that Substitute Claims 29-44 of the '048 Patent are unpatentable based at least on the following grounds:²

Ground	Basis	Basis	Claims Challenged
1	No Written Description Support	§112	29-44
2	Le in view of De Bruyn	§103	29-44
3	Wright '788	§103	29-44
4	Wright '451	§103	29-44
5	Wu in view of Chokkaram	§103	29-44

² Petitioner cannot reasonably raise all grounds of unpatentability for Substitute Claims 29-44 within the 25-page limit for this Opposition. *See* 37 CFR §42.24.

III. HOW THE AMENDED CLAIMS ARE TO BE CONSTRUED UNDER 37 C.F.R. §42.104(b)(3)

PO's amendments may require the Board to consider the scope of the following terms in resolving the validity of the amendments.

A. “base-treated and calcined γ -alumina catalyst”

Substitute independent claim 29 refers to a “base-treated and calcined γ -alumina catalyst.” Dr. Wright understands this clause has a specific order where the catalyst is first treated with a base and then calcined. Ex. 1040 at 19:20-20:10. However, Dr. Wright's understanding is incorrect since the claim language does not have limitations that require the base treatment to happen before the calcination. *Compare* '048 Original Claims 11, 13, and 14 reciting limitations having a particular order of steps *with* Substitute Claim 29. In addition, there is no disclosure in the specification that requires a specific order to these steps. While examples provided in the specification of the '048 Patent cited by PO first base-treat the catalyst and then calcine it, the claims cannot be limited to those exemplary embodiments. *See* MTA at 7; *WesternGeco LLC v. Ion Geophysical Corp*, 889 F.3d 1308, 1323-24 (Fed. Cir. 2018) (“It is well established that claims are not limited to preferred embodiments, unless the specification clearly indicates otherwise.”).

The amended language only requires that the two steps (base treating and calcining) take place but does not limit the order in which these steps occur. The

'048 specification does not support this broad limitation, as discussed below.

B. “calcined”

Dr. Wright states that “calcined” is “heating to a sufficient temperature that chemical changes result into the catalyst itself.” Ex. 2001 at ¶19. Calcined should be interpreted to be sufficient heating to complete the chemical change to the catalyst. Ex. 1038. At ¶20. This is consistent with Dr. Wright’s Declaration, Dr. Taber’s Declaration, and the specification of the ‘048 patent. Ex. 1001 at 17:27-37.

C. “catalyst has not been silanized”

Dr. Wright also testified that “silanized” requires an affirmative step during the catalyst preparation. Ex. 1040 at 23:14-24:2. Petitioner agrees that silanization requires an affirmative preparation step. Ex. 1038 at ¶21; *see In re Kollar*, 286 F.3d 1326, 1332 (Fed.Cir.2002) (“[A] process ... consists of a series of acts or steps.... It consists of doing something, and therefore has to be carried out or performed”). Accordingly, a “catalyst has not been silanized” means “no affirmative step is taken to silanize the catalyst”.

IV. HOW THE CONSTRUED CLAIMS ARE UNPATENTABLE UNDER 37 C.F.R. §42.104(b)(4)

A. Level of Skill in the Art

All parties agree with the Board’s definition of a person of ordinary skill in the art (“POSITA”). Ex. 1002 at ¶16; Ex. 1038 at ¶16; Ex. 2001, ¶32, 33; Ex. 1040 at 47:3-48:7.

B. Overview of the Invalidity Arguments

The Substitute Claims, as amended, are not supported by the specification of the '048 patent. The claims are also rendered obvious by the already applied prior art as well as newly cited prior art. While the art applied in the Petition renders obvious the amended limitations, the newly cited prior art teaches specific examples encompassing the amended subject matter.

V. Claims 29-44 are invalid under 35 USC §112

35 USC §112(a) states “The specification shall contain a written description of the invention,...” The Federal Circuit has stated that “to satisfy §112, a patent's written description ‘must ‘clearly allow persons of ordinary skill in the art to recognize that [the inventor] invented what is claimed.’” *Novozymes v. DuPont Nutrition Biosciences APS*, 723 F.3d 1336, 1346 (Fed. Cir. 2013) (internal citations omitted); *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1352 (Fed. Cir. 2010) (en banc) (internal citations omitted)(“... the specification itself that must demonstrate possession.). Patent Owner failed to carry its burden to identify where the subject matter of the Substitute Claims is supported in the original disclosure of the '048 Patent. 37 CFR §42.121(b)(1) and (d)(1).

A. Claim 29: “base-treated”

The specification of the '048 patent does not indicate possession of all base-treated γ -alumina catalysts that achieve a 95% conversion and a 92-99%

regioselectivity as claimed in Substitute Claim 29.

As the Federal Circuit has stated “A patentee will not be deemed to have invented species sufficient to constitute the genus by virtue of having disclosed a single species when ... the evidence indicates ordinary artisans could not predict the operability in the invention of any species other than the one disclosed.” *In re Curtis*, 354 F.3d 1347, 1358 (Fed. Cir. 2004). The Federal Circuit has further stated the written description requirement guards against claims that “merely recite a description of the problem to be solved while claiming all solutions to it and . . . cover any compound later actually invented and determined to fall within the claim’s functional boundaries.” *Ariad*, 598 F.3d at 1353.

Here the claims identify the “problem to be solved”, i.e., how to create a “bio-alkene [that] has a carbon chain of 6 to 14 carbon atoms and is produced in a conversion of at least 95%, and has a bio-1-alkene regioselectivity of 92% to about 99%” while claiming all solutions to this problem, i.e., all “base-treated and calcined γ -alumina catalyst, wherein the catalyst has not been silanized”. However, the PO did not invent all base-treated catalysts that solve the identified problem and instead merely discussed one potential solution, treating a catalyst with calcium acetate, without further base treatment details. Ex. 1038 at ¶35.

The ’048 specification states that “[t]he catalyst may be a γ -alumina catalyst treated with a base to form a modified γ -alumina catalyst.” Ex 1001 at 8:33-34; see

also PO MTA at 7, “[29a]”. The plain and ordinary meaning of a “base” is a substance that can accept protons and the specification specifically references “a Group I or Group II metal”. Ex. 1001 at 8:32-35; Ex. 1038 at ¶35. Regardless of the definition used, the specification does not support the inventor possessing all compounds covered by Substitute Claim 29.

The specification provides only one example “treatment” involving a base, calcium acetate. Ex. 1001 at 16:5-8; PO MTA at 7, “[29a]”; Ex. 1038 at ¶36. Because there is no guide to treatment with any other Group I or Group II metals achieving 95% conversion and 92-99% regioselectivity, a POSITA would be forced to develop and run experiments to test each base separately as acknowledged Dr. Wright. Ex. 1040 at 141:11-142:22 (“...one would have to investigate that and find out if there is ... a promoter that promotes selectivity and reaction....”); Ex. 1038 at ¶36.

Experimentation is required because the outcomes of a dehydration reaction from the '048 patent with different bases is unpredictable according to Dr. Wright. Ex. 1040 at 42:2-22, 43:18-44:15, 139:2-20, 144:18-145:14; Ex. 1038 at ¶37. Without experimental results, it is not known if a specific base treatment would promote a catalyst. Further, Dr. Wright, was unclear if a different Group II metal, e.g., barium, would modify a catalyst to achieve the conversion and regioselectivity claimed. *Id.* (“I wouldn't be convinced that I could produce it with barium.”); Ex. 1038 at ¶37. For example, when asked if the '048 disclosure extended beyond

calcium, Dr. Wright stated “[w]ould they work as well as the calcium? I would not want to have to predict that.” Ex. 1040 at 144:22-145:13. Accordingly, for every base, a POSITA would need to determine reaction and catalyst characteristics.

As such, a POSITA would not know if they could make any Group I or Group II metal treated catalyst perform as recited in Substitute Claim 29 based on the singular example with calcium acetate provided by the '048 specification. Ex. 1040 at 61:9-63:16; Ex. 1038 at ¶¶38-40. Furthermore, the '048 specification only provides results for a γ -alumina catalyst with 1.5 weight percent CaO after calcination. Ex. 1001 at 27:13-35. A POSITA would not understand the inventor to have possession of any other CaO percentages that potentially achieve 95% conversion of a 1-alcohol and a 92-99% regioselectivity to the 1-alkene. Ex. 1038 at ¶41; Ex. 1040 at 61:9-63:16, 140:16-20 (Dr. Wright admitting that 0.01 weight percent calcium is probably not a promoter); *see also* 139:1-140:15. By only describing a single species of a base that includes calcium, the specification has not shown possession of all γ -aluminas treated with all calcium compounds or all γ -aluminas treated with Group I or Group II metal salts and then calcined.

A POSITA reviewing the '048 specification would find little to no physical or reactivity data associated with its catalyst to provide an understanding that the claims are broader than the example provided. Ex. 1001 at 15:45-49 (specific brand of γ -alumina and calcium acetate); 17:13-14 (some surface area data); 27:12-19

(specific brand of γ -alumina and calcium acetate); Ex. 1038 at ¶42. In Examples 1, 2, and 10 there is no specific catalyst mentioned. Ex. 1001 at 26:40-51; 28:55-58.

Because the '048 specification lacks guidance to determine what bases are promoters, e.g., improve conversion and selectivity, the inventor never had possession of every base-treated γ -alumina catalyst recited in Substitute Claim 29. Left for the POSITA to discover are specific characteristics of the base, the catalyst, the conversion rate, and the regioselectivity. Ex. 1038 at ¶¶43-44. By broadly claiming bases, conversion, and regioselectivity, the Substitute Claims exceed the support of the '048 specification, failing the requirements of 35 USC §112(a).

B. Claim 29: “base-treated and calcined” catalyst

As discussed above, Dr. Wright contends that the claims should be interpreted to require a specific order where the catalyst is first treated with a base and then calcined. As amended, however, the claims are not limited to this specific order. Given the lack of specificity, the amended claims are invalid under §112 since the '048 Patent provides no support for first calcining and then base-treating a catalyst.

The specification of the '048 patent does not indicate that Dr. Wright was in possession of a calcined and then base-treated γ -alumina catalyst that achieves a 95% conversion and a 92-99% regioselectivity, as encompassed by Substitute Claim 29. While the '048 patent does describe first base-treating and then calcining a γ -alumina catalyst, the specification is silent as to first calcining and then base-treating a γ -

alumina catalyst. Ex. 1001 at 15:45-58, 16:4-22, 26:40-29:42; Ex. 1038 at ¶¶31-32. Dr. Wright agrees without an order, the claims are not supported in the '048 Patent specification. Ex. 1040 at 20:6-10 (impacts to dehydration unknown).

The test for determining compliance with the written description requirement is whether the disclosure of the application as originally filed reasonably conveys to a person of ordinary skill in the art that the inventor had possession at the time of filing of the claimed subject matter. *Ariad*, 598 at 1351. Accordingly, since the inventor of the '048 Patent doesn't know the dehydration reaction outcome using a calcined and then base-treated γ -alumina catalyst, it is not possible for the inventor to possess such an invention when the '048 Patent was filed. Ex. 1038 at ¶¶33-34.

As such, the inventor of the '048 Patent was not in possession of the claimed subject matter encompassing a calcined and then base treated γ -alumina catalyst.

VI. Substitute Claims 29-44 are Obvious over the Prior Art

PO's distinctions over Le, De Bruyn, and Wright '788 focus on what is expressly disclosed in examples rather than what is obvious over their teachings. In addition, Petitioner submits additional prior art that further teaches the limitations of the substitute claims, including the proposed amendments. Ex. 1038 at ¶60.

A. Le in View of De Bruyn render Substitute Claims 29-44 Obvious

PO argues that Le and De Bruyn are silent about the chemical modification of their catalysts and the conversion of their processes. PO MTA at 14-17. However,

the combination addresses both identified distinctions.

First, Le teaches that “...a basic catalyst, for example a barium-doped γ -alumina...” to further increase dehydration selectivity.” Ex. 1007 at [0064]. Barium is a Group II metal available to modify commercial γ -alumina catalysts taught by Le. Ex. 1039 at ¶46. Le teaches a regioselectivity of greater than 95%. Ex. 1007 at [0012], [0021], [0181]; Ex. 1038 at ¶46. De Bruyn teaches a calcium-modified γ -alumina catalyst and a reaction where “[a] total of 94% of the 1-hexanol was converted to alkenes, with a selectivity towards hexenes of 98.6%, of which 97.5% was 1-hexene.” Ex. 1008 at [0037], [0053]; Ex. 1038 at ¶¶50-51. De Bruyn teaches a POSITA at least 95% conversion of the 1-alcohol because if 94% of the 1-hexanol is converted to alkenes, the overall conversion must have been at least 95% because by-products are also produced in a dehydration reaction. Ex. 1038 at ¶46.

Le in view of De Bruyn specifically describes a γ -alumina catalyst that was prepared by calcium treatment and then calcination. Ex. 1008 at [0037]; Ex. 1038 at ¶¶50-51. Widely known and used methods of base-treating a γ -alumina catalyst, including impregnation and deposition/precipitation involve a standard calcination step after treatment. Ex. 1038 at ¶¶ 22-28, 51; Ex. 2002 at 2002-88 – 2002-91; Ex. 1040 at 19:14-19 (confirming calcination was known to take place at 200-600 C). So, when the barium-modified γ -alumina catalyst of Le or the calcium-modified catalyst of De Bruyn is created, a calcination step at 200-600 C would be a standard

process to follow. Ex. 1038 at ¶51. Applying these catalysts to the dehydration reaction of Le and De Bruyn would result in at least 95% conversion and greater than 92% regioselectivity towards 1-alkenes. Ex. 1008 at [0053] Ex. 1038 at ¶51.

In addition to the Board's findings, and as stated above, Le in view of De Bruyn discuss creating bio-1-octene using a γ -alumina catalyst that is first base-treated and then calcined at 200-600 °C to achieve at least 95% conversion and greater than 95% regioselectivity of the bio-1-alkene. Institution Decision at 13-16 (findings of octene, regioselectivity, reaction temperature); Ex. 1007 at [0064]; Ex. 1008 at [0053]; Ex. 1039 at [0067]; Ex. 1038 at ¶52. Accordingly, Le in view of De Bruyn teaches all the elements of Substitute Claims 29-44.

B. Wright '788 render Substitute Claims 29-44 Obvious

Wright '788 teaches all the elements of claims 29-44. The only distinction alleged by PO is that Wright '788 requires silanization. PO MTA at 20-21. However, Wright '788 does not require silanization. Ex. 1009 at [0008] (discussing embodiment with no silanization), Claims 1 and 5; Ex. 1038 at ¶¶53-55. Silanization is only advantageous under specific circumstances, for example, when a wet feed is used, and thus a POSITA would have reason to use a catalyst without silanization when the reaction is not subject to those specific circumstances. Ex. 1038 at ¶56 (explaining why a POSITA would avoid silanization when used with a dry 1-alcohol feed). Wright '788 teaches a POSITA to create a catalyst without silanization and,

therefore, teaches each of the Substitute Claims, including temperatures, conversion, and regioselectivity. Further, this is supported by the Board's findings with respect to Wright '788. Institution Decision at 19-22. Wright teaches its catalyst can "produce the respective α -olefin with 92-99% regiochemical selectivity and in a single pass over the catalyst system afford a chemical conversion of greater than 95%" at temperatures of 300-420 °C. Ex. 1009 at [0008], [0022]; Ex. 1038 at ¶55. Calcination at specific temperatures was well-known in the art after a base wash and would be obvious considering the teachings of Wright '788. Ex. 1009 at [0020] ("the base is selected from sodium or potassium hydroxide at concentrations in water of 1 to 20 wt-%"); Ex. 1009 at [0067]; Ex. 1040 at 110:3-117:11; Ex. 1038 at ¶¶22-28, 57-59. Accordingly, Wright '788 renders Substitute Claims 29-44 obvious.

C. Claims 29-44 are obvious over Wright '451

Wright '451 is another prior art reference listing Dr. Wright as an inventor, but unlike Wright '788 the Wright '451 Patent provides an example using a non-silanized base-treated catalyst. Wright '451 was filed on February 8, 2015, published on September 3, 2015, and claims priority to a provisional application filed on February 27, 2014, all before the earliest priority date of the '048 patent of January 30, 2018, making it prior art under 35 U.S.C. §102(a) and (b).

29. A method for making a bio-alkene, comprising: dehydrating a bio-1-alcohol by heating the bio-1-alcohol in a reactor with a base-treated and calcined γ -alumina catalyst, wherein the catalyst has

not been silanized, and

Wright '451 discloses a dehydration process in a reactor for the “conversion of terminal alcohols to the corresponding terminal alkenes with high regioselectivity at high conversion.” Ex. 1039 at [0002], [0017], [0020] (starting alcohols can be bio-1-alcohols.); Ex. 1040 at 105:22-106:7, 117:14-119:2; Ex. 1038 at ¶61. The γ -alumina is “...modified with Ca^{+2}” Ex. 1039 at [0014] (“ Ca^{+2} is the modifier and the Ca^{+2} compound is calcium acetate ($\text{Ca}(\text{OAc})_2$)”), [0066]; Ex. 1038 at ¶62; Ex. 1040 at 107:12-108:2. Wright '451 also teaches that the γ -alumina catalyst, after modification, is calcined. Ex. 1039 at [0067] (the promoted catalyst is “...typically followed by a drying or calcination process”); *see also* [0065] (additional calcium containing compounds); Ex. 1038 at ¶¶22-28, 63; Ex. 1040 at 110:3-117:11, 120:11-121:10. The calcination process takes place in a vessel “at about 100 °C to about 900 °C” “for a period of time of about 1h to about 8h”. Ex. 1039 at [0067]. Silanization is an affirmative step, which is not undertaken here. Ex. 1038 at ¶64.

wherein the resulting bio-alkene has a carbon chain of 6 to 14 carbon atoms and is produced in a conversion of at least 95%, and has a bio-1-alkene regioselectivity of 92% to about 99%.

Wright '451 teaches a dehydration reaction that achieves a bio-1-alkene regioselectivity of 92% to about 99% at a 95% alcohol conversion. Wright '451 teaches a “bio-1-alkene” product that results from a dehydration reaction that takes place at 220-440 °C and achieves a “chemical conversion of greater than about 95%”

and produces a “terminal olefin” “with about 90% to 99% regiochemical selectivity.” Ex. 1039 at [0013], [0022] (< about 5% unreacted 1-alcohol is greater than 95% conversion); [0082] (greater than 95% conversion), [0083]; Ex. 1038 at ¶65; Ex. 1040 at 106:11-107:12; 109:2-19.

A POSITA would understand that Wright ‘451 dehydrates bio-1-hexanol and bio-1-octanol. Ex. 1039 at [0078] (general formula for alcohols); Ex. 1040 at 119:3-21; Ex. 1038 at ¶¶66, 69 (alkene same length as alcohol); Ex. 1040 at 119:19-120:3.

Tables 1 and 2 provide conversion and regioselectivity results from different dehydration experiments that use a base-treated and calcined γ -alumina catalyst, dehydrating alcohols at between 360-400 °C and achieving 95% conversion and 92 to 99% selectivity. *See e.g.*, Ex. 1039 at Table 1 and Table 2 at Examples 1, 2, 3, 8, 9, 10, 12-19 Ex. 1038 at ¶67.

Accordingly, Wright ‘451 teaches dehydration reactions that achieve at least 95% conversion and at least 92% regioselectivity of bio-1-alkenes having a carbon chain between 6 and 14 atoms long. Ex. 1038 at ¶68.

1. Claims 30-32

30/[31]. The method of claim 29, wherein the bio-alkene has a carbon chain of 6 to 10[/8] carbon atoms.

32. The method according to claim 29, wherein the bio-alkene is bio-octene.

As discussed above with respect to claim 29, Wright ‘451 teaches dehydrating

bio-1-hexanol and bio-1-octanol. Ex. 1039 at [0078] (general formula for alcohols). The resulting bio-1-alkene will have the same carbon chain length as the initial bio-1-alcohol. Accordingly, Wright '451 discloses the bio-alkene has a carbon chain of 6 to 10 carbon atoms, 6 to 8 carbon atoms, and is bio-octene. Ex. 1038 at ¶¶ 69-71.

2. Claims 33, 36, 39, 42

33[/36/39/42]. The method according to claim 29[/30/31/32], wherein the reactor is heated at about 240 °C to about 360 °C.

Wright '451 includes a product of "bio-1-alkene" that results from a dehydration reaction that takes place at 220-440 °C. Ex. 1039 at [0013], [0027] (300°C to about 420°C), [0042]-[0046], [0049], [0077], [0082], [0097]; Tables 1 and 2; FIGs 9-13. For example, Example 2, the reaction temperature is 360 °C and the reaction achieves a 99.6% conversion and a 93.8% regioselectivity. Ex. 1039 at [0094]; *see also* [0104]-[0106] and Table 2; Ex. 1040 at 121:11-122:6. It would be obvious to a POSITA that the examples provided for butanol would be applicable to longer chain bio-1-alcohols and a POSITA would expect to achieve similar results for those longer alcohols. Ex. 1038 at ¶¶ 72, 78, 84, 91; Ex. 1040 at 132:18-134:2.

Wright '451's disclosed range includes the claimed range of 240 °C to 360 °C and achieves the claimed regioselectivity and conversion of claim 29 when the bio-alkene has a carbon chain of 6 to 10 carbon atoms, 6 to 8 carbon atoms, or is bio-octene. Ex. 1038 at ¶¶ 72, 73, 78, 79, 84, 85, 91, 92.

3. Claims 34, 37, 40, 43

34[/37/40/43]. The method according to claim 33[/36/39/42], wherein prior to the dehydrating, the catalyst has been calcined at a temperature of about 400 °C to about 480 °C.

Wright '451 discloses that the catalyst is calcined, prior to the dehydration reaction of alcohols, at temperature ranges that include 400 °C to 480 °C. Ex. 1039 at [0014], [0015], [0035], [0042], [0043], [0045], [0067](calcination typically part of process), [0093]-[0095], [0098], [0100], [0102]-[0104], [0107]-[0111]; FIG. 2; Ex. 1038 at ¶¶22-28, 74, 80, 86, 93.

Wright '451 provides an embodiment where the catalyst “can be further heated in a second apparatus (205) to provide drying or calcination,” which can be carried out at “200 °C to 600 °C”. Ex. 1039 at [0067]. It would be obvious to a person of ordinary skill in the art that to calcine at between 400 °C and 480 °C based on the teaching of 200 °C to 600 °C. Ex. 1038 at ¶¶75, 81, 87, 94.

Accordingly, Wright '451 discloses prior to the dehydrating, the catalyst has been calcined at a temperature of about 400 °C to about 480 °C and the bio-alkene has a carbon chain of 6 to 10 carbon atoms, 6 to 8 carbon atoms, and is bio-octene. Ex. 1038 at ¶¶76, 82, 88, 95.

4. Claims 35, 38, 41, 44

35[/38/41/44]. The method according to claim 34[/37/40/43], wherein the bio-alkene has a bio-1-alkene regioselectivity of 95% to about 99%.

Wright '451 discloses after calcining at 400 °C to about 480 °C, a dehydration

reaction operating at about 240 °C to about 360 °C producing a bio-1-alkene at a regioselectivity of 95% to about 99%. Ex. 1039 at [0067], [0078]. The dehydration reaction of Wright can achieve “the alkene product with about 90% to about 98% or greater regioselectivity for the terminal alkene.” Ex. 1039 at [0082]; *see also* [0004], [0013], [0042]-[0046]; [0050], [0059]; Tables 1 and 2; FIG. 9-13; Ex. 1038 at ¶¶77, 83, 89, 90, 96, 97. Wright ’451 teaches a dehydration reaction achieving a regioselectivity of 95% to about 99% for a bio-alkene having a carbon chain of 6 to 10 carbon atoms, 6 to 8 carbon atoms, and is bio-octene.

D. Claims 29-44 are Obvious over Wu in view of Chokkaram

U.S. Patent 4,234,752 to Wu *et al.* was filed on September 28, 1979, and issued on November 18, 1980. Chokkaram was published in the Journal of Molecular Catalysis A in 1997. Both were published prior to the ’048 patent priority date of January 30, 2018, making them 35 U.S.C. §102(a) and (b) prior art.

A POSITA would be motivated to combine Wu with Chokkaram because Wu provides a roadmap for base treatment that delivers a base-treated catalyst that dehydrates the starting alcohol to the 1-alkene with a regioselectivity in excess of 97%. Ex. 1025 at 2:5-13, 3:39-4:21. However, the conversion using the modified catalysts was not mentioned. The POSITA would therefore turn to Chokkaram. Chokkaram provides the details to take advantage of the catalysts taught by Wu. For example, Chokkaram teaches that the “activity and selectivity of these catalysts for

2-octanol conversion are dependent on reaction temperature, liquid hour space velocity (LHSV) as well as on the calcination temperature.” Chokkaram at Abstract. A POSITA would be motivated to combine the calcination steps taught by Chokkaram with the base treatment taught by Wu to achieve high conversion while maintaining high selectivity for the dehydration of longer straight-chain alcohols. Ex. 1038 at ¶¶22-28. Chokkaram provides details as experimental results that would make it easier to implement the full scope of Wu’s process while achieving the desired high conversion and selectivity. Chokkaram teaches that calcining a γ -alumina catalyst at 673k (400 °C) and then dehydrating an octanol at 270-280 °C achieves conversions of 95-97% while maintaining high regioselectivity. Chokkaram at p 165, Table 3. Therefore, a POSITA would understand that calcination leads to a catalyst that effects dehydration with high conversion while maintaining high regioselectivity. A POSITA would therefore be motivated to combine Chokkarams’ implementation details with Wu’s highly regioselective dehydration of longer alcohols, including n-octanol. Ex. 1038 at ¶98.

29. A method for making a bio-alkene, comprising: dehydrating a bio-1-alcohol by heating the bio-1-alcohol in a reactor with a base-treated and calcined γ -alumina catalyst, wherein the catalyst has not been silanized, and

Wu teaches dehydration in a reactor of “straight chain” alcohols which “can contain from 2 to about 20 carbon atoms” including “n-octanol”. Ex. 1025 at 1:59-

2:4; Ex. 1038 at ¶99. The dehydration is “in the presence of gamma-alumina which may be base treated.” Ex. 1025 at Abstract. Wu teaches that the acidic sites of the catalyst can be “neutralized by treatment of the alumina with aqueous potassium hydroxide or aqueous sodium hydroxide, followed by washing with water and subsequent drying, or otherwise altered” but does not silanize the catalyst. Ex. 1025 at 2:23-36, 3:39-4:21; Ex. 1038 at ¶99. Accordingly, Wu teaches a base-treated γ -alumina catalyst to dehydrate a bio-1-alcohol to a bio-1-alkene. Ex. 1038 at ¶100.

Wu can be combined with Chokkaram, which teaches that calcination temperature can be used to optimize dehydration reactions of n-octanol using metal oxide catalysts. Ex. 1041 at 157, Col. 1 and 2, 164 col. 2; Ex. 1038 at ¶¶22-28, 101. Chokkaram also teaches that calcining the γ -alumina leads to a catalyst that effects dehydration of the 1-alcohol in high conversion and with high regioselectivity. Ex. 1041 at p 165, Table 3 Ex. 1038 at ¶¶101-102.

Accordingly, Wu in view of Chokkaram teaches a POSITA to use calcination with metal oxide catalysts, e.g., γ -alumina treated with a metal salt, to achieve increased selectivity and conversion.

wherein the resulting bio-alkene has a carbon chain of 6 to 14 carbon atoms and is produced in a conversion of at least 95%, and has a bio-1-alkene regioselectivity of 92% to about 99%.

Wu teaches a dehydration of “straight chain” alcohols “contain[ing] from 2 to about 20 carbon atoms” including “n-octanol”. Wu at 1:59-2:4. Ex. 1025 at 1:59-63;

Ex. 1038 at ¶103. The bio-1-alcohol dehydrates to a same length bio-1-alkene. The reactions achieve yields “well in excess of 90%”. Ex. 1025 at Abstract. The Examples explain that the untreated γ -alumina catalyst yields the desired 1-alkene at 96.4% selectivity and a 93.4% conversion. Ex. 1025 at 3:9-27. Further, an improved “base-treated” catalyst achieves a regioselectivity of 97.7% and “high conversion”. Ex. 1025 at 4:5-21. A POSITA would understand that base-treating the γ -alumina catalyst improves regioselectivity and conversion. Ex. 1025 at 2:24-36; 4:11-13 and Abstract; Ex. 1038 at ¶103.

Further, Chokkaram teaches a POSITA that selectivity can be optimized based on catalyst calcination temperature and reaction temperature, amongst other variables. Ex. 1041 at 164 col. 2; Ex. 1038 at ¶104. Chokkaram also teaches that calcining the treated γ -alumina leads to a catalyst that effects dehydration of n-octanol with conversion in excess of 95% when the reaction is run at 270 °C to 280 °C. Ex. 1041 at p 165, Table 3. In one specific example, after drying the catalyst at 373K (about 100 °C) and calcining the γ -alumina catalyst at 673 K (400 °C), Chokkaram achieves a conversion of 97.4% at a reaction temperature of 553k (280 °C). Ex. 1041 at Table 3. Chokkaram Table 3 also teaches that at a reaction temperature of 280 °C, the byproduct formation, e.g., alkene migration and ether formation, is less than 1%. Ex. 1038 at ¶104; Ex. 1043 at 133. A POSITA combining Wu with Chokkaram would expect to achieve at least 95% conversion of the bio-1-

alcohol and 97.7% regioselectivity for the desired bio-1-alkene.

Accordingly, a POSITA would be motivated and expect to succeed in running a dehydration reaction that achieves in excess of 95% conversion while maintaining the 97.7% regioselectivity taught by Wu in view of Chokkaram. Ex. 1038 at ¶105. For example, when the teachings are combined, a POSITA would understand that by adding a calcining step at about 400-550 °C to the base-treated catalyst taught by Wu, the POSITA would expect to dehydrate a bio-1-alcohol at about a 97% conversion with about 97% regioselectivity to the bio-1-alkene. Ex. 1038 at ¶¶22-28. Combining the teachings of Chokkaram with the teachings of Wu, teach a POSITA that a 1-alcohol can be converted to a 1-alkene at a conversion in excess of 95% while maintaining a regioselectivity above 95%. Ex. 1038 at ¶105.

1. Claims 30-32

30/[31]. The method of claim 29, wherein the bio-alkene has a carbon chain of 6 to 10[/8] carbon atoms.

32. The method according to claim 29, wherein the bio-alkene is bio-octene.

Wu in view of Chokkaram both teach dehydrating octanol. Ex. 1025 at 1:59-2:4; Ex. 1041 at p 165, Table 3. The bio-1-alcohol dehydrates to a same length bio-1-alkene. Therefore, Wu in view of Chokkaram teaches wherein the bio-alkene has a carbon chains of 6 to 10 atoms, 6 to 8 carbon atoms, and octene. Ex. 1025 at Abstract, 4:5-14; Ex. 1041 at p 165, Table 3; Ex. 1038 at ¶¶106-108.

2. Claims 33, 36, 39, 42

33[/36/39/42]. The method according to claim 29[/30/31/32], wherein the reactor is heated at about 240 °C to about 360 °C.

Wu in view of Chokkaram teaches that the “temperatures in the range of from about 200 °C to 500 °C are suitable for the desired dehydration reaction to occur. It is currently preferable, however, to employ temperatures in the range of 300-450 °C.” Ex. 1025 at 2:51-54; *see also* 3:14-6, 4:6-7. Further, Chokkaram teaches that calcining a γ -alumina catalyst, allows a dehydration reaction to achieve a conversion of at least 95% when the reaction is run at 270 °C to 280 °C. Ex. 1041 at p 165, Table 3; Ex. 1038 at ¶¶109, 115, 122, 129. Accordingly, Wu in view of Chokkaram teach dehydrating octanol at temperatures between 240 °C to about 360 °C, wherein the bio-alkene has a carbon chain of 6 to 10 carbon atoms, 6 to 8 carbon atoms, and is bio-octene. Ex. 1038 at ¶¶109, 116, 123, 130.

3. Claims 34, 37, 40, 43

34[/37/40/43]. The method according to claim 33[/36/39/42], wherein prior to the dehydrating, the catalyst has been calcined at a temperature of about 400 °C to about 480 °C.

Wu in view of Chokkaram teaches calcination temperatures from 473 K to 1173 K. Ex. 1025 at 3:43-4:7; Ex. 1041 at 158, 2.1. Chokkaram teaches a POSITA that catalyst calcination temperature impacts selectivity. Ex. 1041 at 164 col. 2. Chokkaram specifically teaches the efficacy of calcination at 673 K (about 400 °C) for dehydration reactions. Ex. 1041 at 160, col. 1 and Table 1; Ex. 1038 at ¶¶22-28,

110, 117, 124, 131. A POSITA wanting to increase selectivity and conversion of the dehydration reaction based on the teachings of Wu in view of Chokkaram would be motivated to run the dehydration reaction with a base-treated γ -alumina catalyst calcined between 400-550 °C. Ex. 1038 at ¶¶22-28.

The POSITA contemplating the dehydration of bio-1-octanol to bio-1-octene would understand calcination and would be motivated to learn the appropriate calcination time and temperature. Chokkaram teaches that calcining the treated γ -alumina at 400 C for four hours yields an effective catalyst for dehydration. Ex. 1041 at 158 at 2.1. In one specific example, after drying the catalyst at 373K (about 100 °C) and calcining the γ -alumina catalyst at 673 K (400 °C), Chokkaram achieves a conversion of 97.4% at a reaction temperature of 553k (280 °C) with less than 1% alkene migration. Ex. 1041 at 165, Table 3; Ex. 1038 at ¶¶111, 118, 125, 132.

The combination of Wu with Chokkaram would teach a POSITA to run the dehydration reaction of bio-1-alcohol with a base-treated γ -alumina catalyst calcined at 400 °C and expect high conversion (i.e., at least 95%) and high regioselectivity (i.e., greater than 92%). Ex. 1038 at ¶¶112, 119, 126, 133.

4. Claims 35, 38, 41, 44

35[/38/41/44]. The method according to claim 34[/37/40/43], wherein the bio-alkene has a bio-1-alkene regioselectivity of 95% to about 99%.

Wu in view of Chokkaram teaches the recited calcination and reaction

temperatures. Further, Wu teaches that an untreated γ -alumina catalyst achieved 96.4% selectivity, while a “base-treated” catalyst achieves an improved regioselectivity of 97.7%”. Ex. 1025 at 3:9-27, 4:5-21. Chokkaram teaches that calcining the treated γ -alumina at 400 C for four hours yields an effective catalyst for dehydration. Ex. 1041 at 158 at 2.1. In one specific example, after drying the catalyst at 373K (about 100 °C) and calcining the γ -alumina catalyst at 673 K (400 °C), Chokkaram achieves a conversion of n-octanol of 97.4% at a reaction temperature of 553k (280 °C) with less than 1% alkene migration. Ex. 1041 at 165, Table 3; Ex. 1038 at ¶¶113, 120, 127, 134.

Accordingly, a POSITA would understand from the teachings of Wu in view of Chokkaram that a dehydration reaction can achieve at least 95% conversion and a regioselectivity of 95% to about 99%. Ex. 1038 at ¶¶114, 121, 128, 135.

VII. CONCLUSION

In view of the foregoing, Substitute Claims 29-44 of the '048 Patent are not patentable, and Petitioner requests Patent Owner's Motion to Amend be denied as the claims are not patentable over the currently applied art and the claims are not supported in the originally filed specification. Ex. 1038 at ¶136.

Date:

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CERTIFICATE OF SERVICE UNDER 37 CFR §42.6(e)(4)

The undersigned hereby certifies that a copy of the accompanying Opposition to PO Motion to Amend and all accompanying exhibits, has been served via email on May 2, 2023, upon the following service email addresses provided in Patent Owner's mandatory notices:

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