

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SAUDI ARABIAN OIL COMPANY,
Petitioner,

v.

SK INNOVATION CO., LTD.,
Patent Owner.

Case IPR2018-00159
Patent 9,023,979 B2

Before JO-ANNE M. KOKOSKI, JON B. TORNQUIST, and
MONTÉ T. SQUIRE, *Administrative Patent Judges*.

SQUIRE, *Administrative Patent Judge*.

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

DECISION ON MOTION TO AMEND
35 U.S.C. § 316(d) and 37 C.F.R. § 42.121

I. INTRODUCTION

We have jurisdiction to conduct this *inter partes* review under 35 U.S.C. § 6, and this Final Written Decision is issued pursuant to 35 U.S.C. § 318(a). Having considered the evidence of record, and for the reasons set forth below, we determine that Petitioner has shown, by a preponderance of the evidence, that claim 2 of U.S. Patent No. 9,023,979 B2 (Ex. 1001, “the ’979 patent”) is unpatentable. In addition, for the reasons that follow, we grant Patent Owner’s Motion to Amend and order cancellation of claim 2 and replacement of claim 2 by new/substitute claim 5.

A. Procedural History

Saudi Arabian Oil Company (“Petitioner”) filed a Petition to institute an *inter partes* review of claim 2 of U.S. Patent No. 9,023,979 B2 (Ex. 1001, “the ’979 patent”). Paper 2 (“Pet.”). SK Innovation Co., Ltd. (“Patent Owner”) did not file a Patent Owner Preliminary Response to the Petition.

Applying the standard set forth in 35 U.S.C. § 314(a), which requires demonstration of a reasonable likelihood that Petitioner would prevail with respect to at least one challenged claim, we granted Petitioner’s request and instituted an *inter partes* review for challenged claim 2. Paper 9 (“Institution Dec.”).

Following institution of trial, Patent Owner filed a Patent Owner Response (Paper 15, “PO Resp.”) and a contingent Motion to Amend seeking to substitute claim 5 for original claim 2 (Paper 17, “Mot. Amend”). Petitioner filed a Reply to Patent Owner’s Response (Paper 18, “Pet. Reply”) and an Opposition to Patent Owner’s Motion to Amend (Paper 19, “Opp. Mot. Amend”).

Patent Owner's Response "offers no additional argument or evidence with respect to" the instituted grounds. PO Resp. 2. Likewise, "Petitioner takes no position as to whether" proposed substitute claim 5 is patentable. Opp. Mot. Amend. 3. Neither party filed a request for oral hearing.

B. Related Proceedings

The parties do not identify any related proceedings. Pet. 80; PO Resp. 2. Petitioner, however, "provides notice that U.S. Patent Application No. 13/927,485, which issued as the '979 patent, claims priority to U.S. Patent Application No. 12/952,642, which issued as U.S. Patent No. 8,530,616." Pet. 80.

C. Real Parties in Interest

Petitioner identifies the following real parties in interest: (1) Saudi Arabian Oil Company; (2) Saudi Aramco Technologies Company; (3) Aramco Services Company; and (4) Aramco Performance Materials LLC. Pet. 80. Patent Owner identifies no additional real parties in interest. PO Resp. 2.

D. The '979 Patent

The '979 patent, titled "Precise Control of Molecular Weight and Chain Shape Control in Carbon Dioxide/Epoxy Alternating Copolymerization and Preparation of Low Molecular Weight Poly(Alkylene Carbonate) Thereby," issued on May 5, 2015.¹ Ex. 1001, at (54), (45).

¹ The '979 patent claims priority to Korean Patent Application No. 10-2010-0031457, filed April 6, 2010. Ex. 1001, 1:17-18; Ex. 1011; Ex. 1012.

The '979 patent relates

to a method of preparing poly(alkylene carbonate) that has a molecular weight and polymer chain structure precisely controlled by adding a chain transfer agent composed of a compound having an alcohol or carboxylic acid functional group upon alternating copolymerization of an epoxide compound and carbon dioxide using a catalyst composed of a trivalent metal complex compound synthesized from a quaternary ammonium salt-containing Salen type ligand, and to a polymer compound prepared thereby.

Id. at Abstract, 1:24–33, 4:32–41.

The '979 patent discloses that the low molecular weight poly(alkylene carbonate) is formed from the copolymerization reaction of carbon dioxide and epoxide using the highly active catalyst in the presence of a chain transfer agent (“CTA”). *Id.* at 7:42–51, 24:30–34. The '979 patent states that the “molecular weight and chain shape of the resulting polymer may be adjusted depending on the amount and structure of the added chain transfer agent.” *Id.* at 8:2–5; *see also id.* at 24:35–39 (“[A] chain transfer agent is added to the copolymerization of carbon dioxide and epoxide, and thus poly(alkylene carbonate) in which the molecular weight and polymer chain shape are precisely controlled depending on the amount and shape of the chain transfer agent can be prepared.”). The '979 patent further states that the molecular weight distribution of the resulting poly(alkylene carbonate) polymer is “considerably narrow when performing polymerization using a batch reactor ($M_w/M_n < 1.2$).” *Id.* at 14:34–38.

The '979 patent also states that the “[p]oly(alkylene carbonate) is a polymer which is easily biodegradable and useful as an exemplary example of a packaging or coating material” and that the “[p]reparation of poly(alkylene carbonate) from an epoxide compound and carbon dioxide is

very environmentally friendly.” *Id.* at 1:35–39. According to the ’979 patent, “[t]he low-molecular-weight poly(alkylene carbonate) has an –OH terminal group and can be used alone as a coating agent, etc., and also in mixtures with an isocyanate compound.” *Id.* at Abstract. The ’979 patent explains that because “the polymer prepared using the above method has an alcohol terminal group,” the resulting polymer can be “easily utilized to prepare polyurethane.” *Id.* at 24:44–46.

The ’979 patent discloses using a compound represented by the formula “J(LH)_c” (“Formula 5”) as a chain transfer agent according to the claimed invention. *Id.* at 7:35–36. In the formula, “J is a C₁–C₆₀ hydrocarbyl c-valent radical with or without an ether group, an ester group or an amine group; LH is —OH or —CO₂H; and c is an integer from 1 to 10, in which LH may be identical or different when c is 2 or more.” *Id.* at 7:35–41. The ’979 patent states that “the polymer compound in which c is 2 or more is regarded as novel.” *Id.* at 13:50–51.

The ’979 patent discusses prior art methods used for producing poly(alkylene carbonate) compounds from an epoxide compound and carbon dioxide, and the problems associated with such methods. *Id.* at 1:42–44, 341–4:27. The ’979 patent acknowledges that the copolymerization of carbon dioxide and epoxide using a highly active catalyst may be generally known in the art, but states that “copolymerization of carbon dioxide and epoxide using the compound represented by Formula 5 as a chain transfer agent according to the present invention is not known.” *Id.* at 7:42–50, 12:24–26 (“copolymerization using the compound represented by Formula 5 as a chain transfer agent and then separation of the catalyst are not known”).

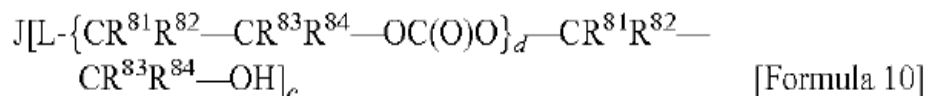
The '979 patent describes several examples of epoxide compounds that may be used according to the claimed method, including "ethylene oxide" and "propylene oxide." *Id.* at 9:31–33. The '979 patent also teaches that the claimed method can be carried out using a compound having an alcohol functional group as a chain transfer agent. *Id.* at 1:24–27.

In one embodiment, the '979 patent describes the preparation of a poly(alkylene carbonate) polymer in accordance with the claimed subject matter via "Carbon Dioxide/Propylene Oxide Copolymerization Using Diethyleneglycol as Chain Transfer Agent." *Id.* at 22:20–51, Example 6.

E. Challenged Claim

Petitioner challenges independent claim 2 of the '979 patent, which is reproduced below.

2. A poly(alkylene carbonate) represented by Formula 10 below:



wherein L is –O–; c is 2; J is –CH₂CH₂N(R)CH₂CH₂– (R is C₁-C₂₀ hydrocarbyl) or –[CH₂CH(R)O]_nCH₂CH(R)– (n is an integer from 0 to 10; R is hydrogen or methyl); R⁸¹ to R⁸⁴ are each independently hydrogen; (C₁-C₁₀)alkyl substituted or unsubstituted with halogen or (C₁-C₂₀)alkoxy; or (C₆-C₁₂)aryl substituted or unsubstituted with halogen or (C₁-C₂₀)alkoxy, R⁸¹ to R⁸⁴ being able to be linked with each other to form a ring; and a value obtained by multiplying d by c is a natural number of 1000 or less.

Ex. 1001, 25:3–19.

F. References and Other Evidence

Petitioner relies on the following prior art references:

Reference	Description	Date	Exhibit No.
Allen ("Novomer 2")	International PCT App. Pub. No. WO 2010/028362 A1	Mar. 11, 2010 ²	1005
Allen ("Novomer 1")	International PCT App. Pub. No. WO 2010/062703 A1	June 3, 2010 ³	1004
Asahi ⁴	Japanese Patent App. Pub. No. P2008-81518A	Apr. 10, 2008 ⁵	1006, 1007 (English translation)

In addition, both parties rely on expert declaration testimony. Petitioner relies on the Declaration of Donald J. Darensbourg, Ph.D. (Ex. 1002, "Darensbourg Declaration") and the Declaration of Geoffrey W. Coates, Ph.D. (Ex. 1003, "Coates Declaration") in support of its contentions. In support of the Motion to Amend, Patent Owner relies on the Declaration of Christopher M. Kozak, Ph.D. (Ex. 2001, "Kozak Declaration").

² "Novomer 2" was filed on September 8, 2009, and published on March 11, 2010. Ex. 1005; Pet. 29. According to Petitioner, Novomer 2 was cited in an Information Disclosure Statement during the prosecution of the '979 patent (Ex. 1004, p. 25), but the reference was not cited by the Examiner in any rejection. Pet. 29.

³ "Novomer 1" was filed on October 30, 2009, and published on June 3, 2010. Ex. 1004; Pet. 28. According to Petitioner, Novomer 1 was not of record during the prosecution of the '979 patent. Pet. 28.

⁴ We refer to "Asahi" as the English translation of the original reference (Ex. 1007). Petitioner provides an affidavit attesting to the accuracy of the translation. Ex. 1007, 1; *see* 37 C.F.R. § 42.63(b). The cited page numbers in Ex. 1007 refer to the page numbers added by Petitioner in the bottom center of the page.

⁵ "Asahi" was published on April 10, 2008. Ex. 1007; Pet. 30. According to Petitioner, Asahi was not of record during prosecution of the '979 patent. Pet. 30–31.

G. The Instituted Grounds

We instituted trial on the following grounds of unpatentability
(Institution Dec. 2, 6, 14–26):

Reference	Basis ⁶	Challenged Claim
Novomer 1	§ 102(e)	Claim 2
Novomer 1	§ 103(a)	Claim 2
Novomer 2	§§ 102(a), (e)	Claim 2
Novomer 2	§ 103(a)	Claim 2
Asahi	§ 103(a)	Claim 2

II. ANALYSIS

A. Level of Ordinary Skill in the Art

We begin our analysis by addressing the level of ordinary skill in the art. In determining the level of skill in the art, various factors may be considered, including the types of problems encountered in the art, prior art solutions to those problems, the sophistication of the technology, rapidity with which innovations are made, and educational level of active workers in the field. *In re GPAC Inc.*, 57 F.3d 1573, 1579 (Fed. Cir. 1995). In addition, we may be guided by the level of skill in the art reflected in the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d. 1350, 1355 (Fed. Cir. 2001).

Petitioner contends that a person of ordinary skill in the art (“POSA”) for purposes of the ’979 patent in 2010 would have been an individual with at least a Master’s Degree in the field

⁶ Because the application resulting in the ’979 patent is a divisional of an application filed before March 16, 2013, the effective date of the amendments to 35 U.S.C. §§ 102 and 103 enacted in the Leahy–Smith America Invents Act (AIA), Pub. L. No. 112–29, § 4(c), (e), 125 Stat. 284, 296, 297 (2011), the pre-AIA versions of § 102 and § 103 apply here.

of organic chemistry, inorganic chemistry, or polymer chemistry, and i) a Ph.D. in the field of organic chemistry, inorganic chemistry, or polymer chemistry, and/or ii) at least two years of experience conducting or supervising research in the field of polymer chemistry, either in an industrial or research setting.

Pet. 14. Petitioner further contends that the “more education one has, for example a Ph.D., the less industry or research experience is needed to attain a level of ordinary skill.” *Id.*

Patent Owner agrees with Petitioner’s assessment regarding the level of ordinary skill in the art. Mot. Amend 7. We determine the level of ordinary skill proposed by Petitioner is consistent with the ’979 patent and the asserted prior art, and we adopt that level in construing and deciding the patentability of claim 2.

B. Claim Construction

We interpret claims of an unexpired patent using the broadest reasonable construction in light of the specification of the patent in which the claims appear. 37 C.F.R. § 42.100(b) (2017)⁷; *see Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2144–46 (2016). Under that standard, and absent any special definitions, we give claim terms their ordinary and customary meaning, as would be understood by one of ordinary skill in the art at the time of the invention. *In re Translogic Tech., Inc.*, 504 F.3d 1249, 1257 (Fed. Cir. 2007). Additionally, any special definitions for claim terms

⁷ A recent amendment to this rule changing the claim construction standard does not apply here because the Petition was filed before November 13, 2018. *See* Changes to the Claim Construction Standard for Interpreting Claims in Trial Proceedings Before the Patent Trial and Appeal Board, 83 Fed. Reg. 51,340 (Oct. 11, 2018) (amending 37 C.F.R. § 42.100(b) effective November 13, 2018).

must be set forth with reasonable clarity, deliberateness, and precision. *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994).

Petitioner proposes constructions for the following phrases recited in claim 2: (1) “A poly(alkylene carbonate) represented by Formula 10” and (2) “each independently.” Pet. 14–15.

1. “A poly(alkylene carbonate) represented by Formula 10”

Petitioner proposes that the broadest reasonable construction of the phrase “A poly(alkylene carbonate) represented by Formula 10” is one or more polymer molecules (or polymers, used interchangeably herein) having a structure as defined by Formula 10. Pet. 15.

In the Institution Decision, we determined that the phrase “A poly(alkylene carbonate) represented by Formula 10” did not require construction at that stage. Institution Dec. 9; *see also id.* at 7 (citing *Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (holding that only terms which are in controversy need be construed and only to the extent necessary to resolve the controversy)). Neither party has argued post-institution that this phrase of claim 2 needs be construed. *See* PO Resp. 2; Pet. Reply 1–3. We conclude that no further construction of this phrase is necessary.

2. “each independently”

Petitioner proposes that the broadest reasonable construction of the phrase “each independently” means that each variable R^{81} , R^{82} , R^{83} , and R^{84} is independent from one instance to another throughout the polymer. Pet. 17–18. For example, under that proposed construction, which Petitioner refers to as the “variable construction,” one repeating unit of $-CR^{81}R^{82}-CR^{83}R^{84}-$ could be $-CH_2CH(CH_3)-$ (i.e., R^{81} to R^{83} are hydrogen

and R⁸⁴ is methyl), while another repeating unit of –CR⁸¹R⁸²–CR⁸³R⁸⁴– in the same polymer is –CH(CH₃)CH₂– (i.e., R⁸¹ is methyl and R⁸² to R⁸⁴ are hydrogen). *Id.* at 18.

In the Institution Decision, we agreed with Petitioner that the variable construction of the phrase “each independently” is the broadest reasonable interpretation in light of the specification, and construed the phrase to mean that “each variable R⁸¹, R⁸², R⁸³, and R⁸⁴ is independent from one instance to another throughout the polymer.” Institution Dec. 13–14.

Based on that construction, we also determined in the Institution Decision that claim 2 encompasses the following genera: (1) “Genus A,” which includes a poly(ethylene glycol) chain transfer agent flanked by poly(ethylene carbonate) chains (Pet. 24); (2) “Genus B,” which includes a poly(propylene glycol) chain transfer agent flanked by poly(propylene carbonate) chains (*id.* at 25–26); (3) “Genus C,” which includes a poly(propylene glycol) chain transfer agent flanked by poly(ethylene carbonate) chains (*id.* at 26); and (4) “Genus D,” which includes a poly(ethylene glycol) chain transfer agent flanked by poly(propylene carbonate) chains (*id.* at 27). Institution Dec. 12–13.

Neither party opposes adopting the variable construction of the phrase “each independently” and the determination that, under the variable construction, claim 2 encompasses Genus A, Genus B, Genus C, and Genus D. PO Resp. 2; Pet. Reply 1–3. We maintain the variable construction of the phrase “each independently” on the complete record.

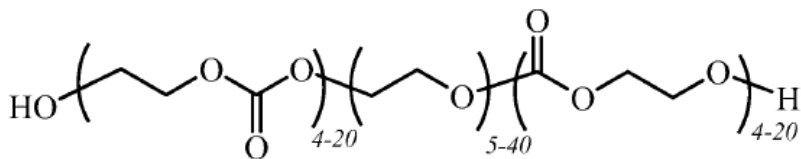
C. Scope and Content of the Prior Art

1. Overview of Novomer 1

Novomer 1 relates to block copolymers having the formula “A-L-B, where A- is a polycarbonate or polyethercarbonate chain having from about 3 to about 500 repeating units, L is a linker moiety and -B is a hydrophilic oligomer having from about 4 to about 200 repeating units.” Ex. 1004, Abstract. Novomer 1 discusses the reaction of propylene epoxide with carbon dioxide using a catalyst to form “poly(propylene carbonate)” (*id.* at 15:4–9), and discloses that the “polycarbonate chain A-” may be a copolymer of an optionally substituted epoxide and carbon dioxide selected from a group consisting of, for example, poly(ethylene carbonate) and poly(propylene carbonate), and including about 3 to about 500 repeating units (*id.* at 17:4–7, 17:11–12, 17:23–24). Novomer 1 further discloses that “L is a polyfunctional moiety,” which includes “diols.” *Id.* at 19:26–20:5.

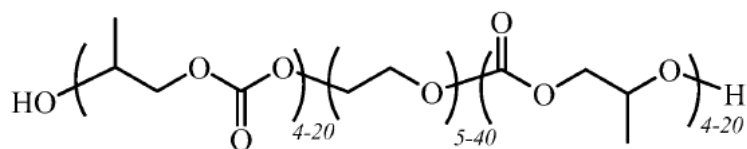
Novomer 1 also discloses “triblock copolymers” where the central portion is a polyether diol chain transfer agent (e.g., polyethylene glycol), with epoxide/CO₂ polycarbonate chains (e.g., poly(propylene carbonate) (“PPC”)) on either side. *Id.* at 51:12–13, 55:17–19. For example, Novomer 1 specifically describes “PPC/PPG/PPC triblock copolymers” having a central poly(propylene glycol) portion flanked by two poly(propylene carbonate) portions, “where each block in the copolymer comprises between 3 and 12 repeat units.” *Id.* at 16:13–14.

Novomer 1 discloses triblock copolymers of poly(ethylene glycol) and poly(ethylene carbonate) (“PEC”) having the formula (which Petitioner refers to as “Polymer A”) reproduced below:



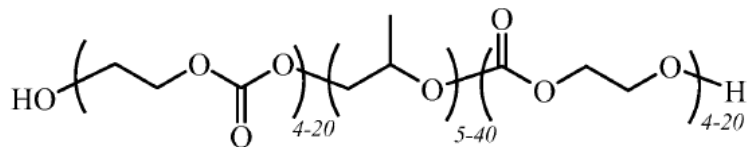
The above formula depicts the chemical structure of Polymer A. *Id.* at 56:7–57:1.

Novomer 1 further discloses triblock copolymers of poly(ethylene glycol) and poly(propylene carbonate) having the formula (which Petitioner refers to as “Polymer B”) reproduced below:



The above formula depicts the chemical structure of Polymer B. *Id.* at 55:17–56:1.

Novomer 1 also discloses triblock copolymers of poly(propylene glycol) and poly(ethylene carbonate) having the formula (which Petitioner refers to as “Polymer C”) reproduced below:



The above formula depicts the chemical structure of Polymer C. *Id.* at 59:9–60:1.

Novomer 1 discloses triblock copolymers of poly(propylene glycol) and poly(propylene carbonate) having the formula (which Petitioner refers to as “Polymer D”) reproduced below:

4:10–11, 4:16–17. Example 4 of Novomer 2 describes the preparation of propylene oxide/CO₂ polycarbonate using poly(ethylene glycol) as the chain transfer agent. *Id.* at 99:1–3; *see id.* at 98:2–9.

3. Overview of Asahi

Asahi relates to a “method for producing a copolymer of an alkylene oxide^[8] and carbon dioxide in which an alkylene oxide and carbon dioxide are copolymerized in the presence of a metal complex . . . and a chain transfer agent which has an active hydrogen is used.” Ex. 1007, 3, Abstract.

Asahi discloses “a copolymer of an alkylene oxide and carbon dioxide which is characterized in that the copolymer is produced by using a chain transfer agent which has two or more active hydrogens in one molecule.” *Id.* at 3. According to Asahi, the method for producing the described copolymer “can control the molecular weight” and “provide a copolymer of an alkylene oxide and carbon dioxide in which the molecular weight has been controlled.” *Id.*

Asahi teaches that a variety of epoxides may be used to prepare the copolymers, including ethylene oxide and propylene oxide. *Id.* ¶ 113. Asahi also describes exemplary diol chain transfer agents, including “glycol-type compound[s]” such as “ethyleneglycol, diethyleneglycol, triethyleneglycol, propyleneglycol, dipropyleneglycol, tripropyleneglycol.” *Id.* ¶ 73.

Asahi’s Example 7 describes a copolymerization of propylene oxide and carbon dioxide in the presence of ethylene glycol as the chain transfer agent. Ex. 1007 ¶ 156. Asahi teaches that the chain transfer agent used in

⁸ Petitioner contends that the term “alkylene oxide” as used in Asahi is a synonym for “epoxide.” Pet. 20.

Example 7 is a single unit of ethylene glycol having a molecular weight of 44 g/mol. *Id.* ¶ 161, Table 4.

Asahi's Example 8 describes a copolymerization of propylene oxide and carbon dioxide in the presence of poly(propylene glycol) as the chain transfer agent and teaches that the chain transfer agent in Example 8 is a poly(propylene glycol) having a molecular weight of 1,000 g/mol. *Id.* ¶ 158. Asahi also describes a reaction scheme using a diol "HO-R-OH" as a chain transfer agent, where the diol chain transfer agent is located in the center of the final polymer product (*id.* ¶¶ 82–83, Scheme 2) and further discloses using "triethyleneglycol" or "tripropyleneglycol" as chain transfer agents, which each have 3 ether units (*id.* ¶ 73).

D. Anticipation by Novomer 1

Petitioner contends that claim 2 is unpatentable under 35 U.S.C. § 102(e) as anticipated by Novomer 1. Pet. 28–29, 32–52. Petitioner relies on the Darensbourg Declaration in support of its contentions. *Id.*

"A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference." *Verdegaal Bros., Inc. v. Union Oil Co. of Cal.*, 814 F.2d 628, 631 (Fed. Cir. 1987). When evaluating a single prior art reference in the context of anticipation, the reference must be "considered together with the knowledge of one of ordinary skill in the pertinent art." *Paulsen*, 30 F.3d at 1480 (citing *In re Samour*, 571 F.2d 559, 562 (CCPA 1978)).

At pages 32–52 of the Petition, Petitioner identifies persuasive evidence and provides a detailed analysis of how claim 2 is anticipated by Novomer 1. In particular, Petitioner persuasively demonstrates that Novomer 1 anticipates claim 2 because Novomer 1 discloses polymers

corresponding to Genus A, Genus B, Genus C, and Genus D (as described at pages 24–27 of the Petition), which fall within the scope of the claim.

Pet. 27, 33.

For example, Petitioner points out that Novomer 1 discloses “PPC/PPG/PPC triblock copolymers” having a central poly(propylene glycol) portion flanked by two poly(propylene carbonate) portions, “where each block in the copolymer comprises between 3 and 12 repeat units.” Pet. 33; Ex. 1004, 51:12–13, 55:17–19, 16:13–14. Petitioner persuasively demonstrates that Novomer 1’s PPC/PPG/PPC triblock copolymer structure falls entirely within the scope of Genus B, thereby anticipating claim 2. Pet. 34–36.

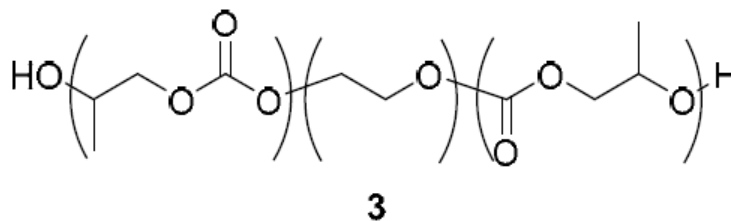
Petitioner establishes that Polymer A of Novomer 1 (Ex. 1004, 57, first structure) anticipates claim 2 because Polymer A contains a poly(ethylene glycol) chain transfer agent flanked by ethylene oxide/CO₂ polycarbonate chains, and depicts nine polymer structures that fall within the scope of Genus A. Pet. 36–40. Petitioner also establishes that a similar analysis applies to other polymers disclosed by Novomer 1. *Id.* at 40. In particular, Petitioner persuasively demonstrates that Polymer B of Novomer 1 (Ex. 1004, 56, first structure) is a poly(propylene carbonate) containing a poly(ethylene glycol) chain transfer agent, and depicts nine polymer structures that fall within the scope of Genus D. Pet. 41–42.

Petitioner further demonstrates that Novomer 1’s Polymer C (Ex. 1004, 60, first structure) is a poly(ethylene carbonate) containing a poly(propylene glycol) chain transfer agent, and that Novomer 1’s Polymer D (*id.* at 59, first structure) is a poly(propylene carbonate) containing a poly(propylene glycol) chain transfer agent. Pet. 44–45.

Petitioner establishes that because Polymer C and Polymer D each depicts polymers that fall within the scope of Genus C and Genus B, respectively, the disclosed polymers anticipate the claim. *Id.* at 45–46.

In addition, Petitioner identifies Example 3 of Novomer 1, which describes the synthesis of poly(propylene carbonate)-block-poly(ethylene glycol)-block-poly(propylene carbonate) (Ex. 1004, 94:8–9, 95:1–7).

Pet. 47. Petitioner establishes that Novomer 1 discloses the structure of the product of Example 3 (“Polymer 3”) as reproduced below:



The above formula depicts the chemical structure of Polymer 3. Ex. 1004, 94:9–12.

Petitioner establishes that, although Novomer 1 does not specify the number of repeating units of the bracketed portion of Polymer 3, based on calculations performed by Dr. Darensbourg (Ex. 1002 ¶¶ 93, 95–107), the Polymer 3 product necessarily includes polymers that fall within the scope of Genus D and thus, anticipates claim 2. Pet 48–50.

Patent Owner (PO Resp. 2) does not contest or rebut Petitioner’s analysis and evidence regarding Novomer 1’s disclosures, including that the reference discloses polymers that fall within the scope of the genera of claim 2, which we find is supported by a preponderance of the evidence cited by the Petitioner.

Accordingly, after reviewing the entire record, and for the foregoing reasons and those in Petitioner’s analysis (Pet. 32–52), including the cited

portions of the Darensbourg Declaration, we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 2 is anticipated by Novomer 1.

E. Obviousness over Novomer 1

Petitioner contends that claim 2 is unpatentable under 35 U.S.C. § 103(a) as obvious over Novomer 1. Pet. 52–58. Petitioner relies on the Darensbourg Declaration in support of its contentions. *Id.* Petitioner presents this challenge as an alternative to its anticipation challenge based on Novomer 1. Pet. 53 (stating that “to the extent the Board disagrees that Claim 2 is anticipated by Novomer 1, Claim 2 remains unpatentable as obvious in view of the teachings of Novomer 1”).

A 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) where in evidence, so-called secondary considerations, including commercial success, long-felt but unsolved needs, failure of others, and unexpected results. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).⁹

⁹ The parties have not presented evidence on the fourth *Graham* factor. We therefore do not consider that factor in this decision.

At pages 52–58 of the Petition, Petitioner identifies persuasive evidence and provides a detailed analysis of how claim 2 would have been obvious over Novomer 1. In particular, as previously discussed above in support of its anticipation challenge based on Novomer 1, Petitioner identifies specific polymers Novomer 1 discloses that correspond to genera falling within the scope of claim 2. Pet. 54–55. For example, Petitioner identifies Polymer A (Ex. 1004, 57, first structure) and Polymer B (*id.* at 56, first structure) of Novomer 1 and persuasively demonstrates that each polymer depicts structures that fall within the scope of Genus A and Genus D, respectively. Pet. 54–55 (explaining that “the polycarbonate portions of Polymers A and B are fully encompassed by those of Genera A and D” and “the polyether CTA portions of Polymers A and B overlap significantly with those of Genera A and D”) (citing *In re Petersen*, 315 F.3d 1325, 1329 (Fed. Cir. 2003)).

Petitioner also identifies Novomer 1’s Polymer 3 product and establishes it includes polymers that fall within the scope of and correspond to Genus D. Pet. 55–58. In particular, relying on the Darensbourg Declaration (Ex. 1002 ¶¶ 93, 101–102, 107–108), Petitioner demonstrates that a POSA would have reasonably expected that the Polymer 3 product, synthesized according to Example 3 of Novomer 1, would include polymers having a structure falling within Genus D. Pet. 56 (explaining that “a POSA would have interpreted the ranges of repeating units in Genus D to be a subset of the possible repeating units represented by prior art Polymer 3”); *see also id.* at 57 (explaining that “a POSA would have also expected that polymers at earlier time points would include fewer than 10 carbonate units in each branch, and polymers at later time points would include greater than

10 carbonate units in each branch” and “[t]hese shorter and longer polymers would also fall within Genus D”).

Petitioner further demonstrates that the teachings of Novomer 1 would have predictably led a POSA to the subject matter of claim 2 because Novomer 1 discloses and utilizes substantially similar methodologies to those used in the '979 patent. Pet. 54. In particular, Petitioner demonstrates that, like the '979 patent (Ex. 1001, Abstract, 1:24–33, 4:32–41), Novomer 1 describes a method for producing a polymer composition from the following four components: (1) a chain transfer agent composed of a compound having an alcohol or carboxylic acid functional group; (2) an epoxide compound; (3) carbon dioxide; and (4) a catalyst composed of a Salen type ligand. Ex. 1004, 84, 94; Pet. 54.

Petitioner also demonstrates (Pet. 53–54) that, like the polymers described in the '979 patent, Novomer 1's resulting polymers have a molecular weight and polymer chain structure that are precisely controlled. Ex. 1004, 55, 95, 78–79. Petitioner persuasively establishes (Pet. 54) that Novomer 1 also discloses “triblock copolymers” having a central portion (e.g., poly(ethylene glycol)), with epoxide/CO₂ polycarbonate chains (e.g., PPC) on either side similar to those disclosed in the '979 patent. *Compare* Ex. 1004, 55:17–19 *with*, Ex. 1001, 22:20–51, Example 6.

Patent Owner (PO Resp. 2) does not contest or rebut Petitioner's analysis and evidence regarding Novomer 1's disclosures or reasoning as to why a person of ordinary skill would have been led to the subject matter of claim 2 based on Novomer 1's teachings, which we find are supported by a preponderance of the evidence cited by the Petitioner.

Accordingly, after reviewing the entire record, and for the foregoing reasons and those in Petitioner's analysis (Pet. 52–58), including the cited portions of the Darensbourg Declaration, we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 2 would have been obvious over Novomer 1.

F. Anticipation by Novomer 2

Petitioner contends that claim 2 is unpatentable under 35 U.S.C. §§ 102(a) and (e) as anticipated by Novomer 2. Pet. 58–66. Petitioner relies on both the Darensbourg Declaration and the Coates Declaration in support of its contentions. *Id.*

At pages 58–66 of the Petition, Petitioner identifies persuasive evidence and provides a detailed analysis of how claim 2 is anticipated by Novomer 2. Petitioner maintains that Novomer 2 anticipates claim 2 because Novomer 2 discloses polymers corresponding to Genus D (as described at pages 26–27 of the Petition), which fall within the scope of the claim. Pet. 64–66.

In particular, Petitioner identifies Example 4 of Novomer 2, which describes the preparation of propylene oxide/CO₂ polycarbonate using poly(ethylene glycol) as a chain transfer agent (Ex. 1005, 99:1–3). Pet. 58. Petitioner maintains that the polymer composition produced by Example 4 necessarily falls within the scope of claim 2. *Id.* at 58; *see also SmithKline Beecham Corp. v. Apotex Corp.*, 403 F.3d 1331, 1343–44 (Fed. Cir. 2005) (holding that an expressly disclosed prior art method that necessarily results in the creation of a claimed product inherently anticipates the claimed product).

Petitioner demonstrates that Example 4 sets forth experimental details for polymerizing carbon dioxide and propylene oxide in the presence of a metal catalyst and poly(ethylene glycol) having a number average molecular weight of 400 g/mol (Ex. 1005, 97:12–99:3), and that based on the starting materials of (a) a poly(ethylene glycol) chain transfer agent, (b) propylene oxide, and (c) carbon dioxide, would have produced a polymer that includes a poly(ethylene glycol) chain transfer agent flanked by two propylene oxide/CO₂ polycarbonate chains. Pet. 59. In particular, Petitioner persuasively demonstrates that the experimental method of Novomer 2's Example 4, as performed by Dr. Coates, necessarily results in polymers that fall within the scope of Genus D, thereby anticipating claim 2. *Id.* at 59, 64–66.

Patent Owner does not contest or rebut Petitioner's analysis and evidence regarding Novomer 2's disclosures, including that the product of the method described in Example 4 of Novomer 2 necessarily contains polymers that fall within the scope of Genus D of claim 2. PO Resp. 2.

Accordingly, after reviewing the entire record, and for the foregoing reasons and those in Petitioner's analysis (Pet. 58–66), including the cited portions of the Darensbourg and Coates Declarations, we find that Novomer 2 discloses polymers that meet all of the elements of claim 2. We therefore determine that Petitioner has demonstrated by a preponderance of the evidence that claim 2 is anticipated by Novomer 2.

G. Obviousness over Novomer 2

Petitioner contends that claim 2 is unpatentable under 35 U.S.C. § 103(a) as obvious over of Novomer 2. Pet. 66–71. Petitioner relies on the Darensbourg Declaration in support of its contentions. *Id.* Petitioner

presents this challenge as an alternative to its anticipation challenge based on Novomer 2. *Id.* at 66 (stating that “to the extent the Board disagrees that Claim 2 is anticipated by Novomer 2, Claim 2 remains unpatentable as obvious in view of the teachings of Novomer 2”).

At pages 66–71 of the Petition, Petitioner identifies persuasive evidence and provides a detailed analysis of how claim 2 would have been obvious over Novomer 2. In particular, Petitioner identifies disclosures in Novomer 2, including specific polymers and methods, and persuasively demonstrates and explains why those disclosures would have led a POSA to polymers that correspond to Genus D and thus, fall within the scope of claim 2. Pet. 66, 70–71. For example, Petitioner demonstrates that Novomer 2 describes epoxide/CO₂ polycarbonates made with a diol CTA and having a certain structural formula (Ex. 1005, 67–69), which Petitioner refers to as “the Novomer 2 Formula.” Pet. 67–68.

Petitioner establishes that, because Novomer 2 expressly teaches that propylene oxide is a suitable epoxide (Ex. 1005, 67:4–5), a person of ordinary skill in the art would have been guided to a resulting polymer having a structure where the central CTA portion corresponds to a diol flanked by poly(propylene carbonate) chains. Pet. 68.

Petitioner further establishes that, based on Novomer 2’s disclosures with respect to using poly(propylene glycol) or poly(ethylene glycol) to make polycarbonate polymers (Ex. 1005, 70:23–25), and that suitable CTAs also include triethylene glycol (*id.* at 75:8–12), a POSA would have been led to select triethylene glycol as a CTA and would have had a reasonable expectation of success in doing so. Pet. 69.

Petitioner also establishes that, as evidenced by the Darensbourg Declaration (Ex. 1002 ¶¶ 174–179), utilizing triethylene glycol as a CTA and propylene oxide to prepare a polymer of the Novomer 2 Formula results in a polymer having a structure that corresponds to Genus D, and, thus, falls within the scope of claim 2. Pet. 69–71. In particular, Petitioner demonstrates that “the number of repeating units of the polyether CTA portion (i.e., 3 ether units) falls squarely within the range of 3-13 repeating units in Genus D while the range of 5-10,000 polycarbonate repeating units overlaps with substantially all of the claimed range of 1-500 repeating units in Genus D.” *Id.* at 70.

As previously discussed above regarding its obviousness challenge based on the Novomer 1 reference, Petitioner persuasively demonstrates (Pet. 64) that the teachings of Novomer 2 would have predictably led a POSA to the subject matter of claim 2 because Novomer 2 discloses and utilizes substantially similar methodologies to those used in the '979 patent, including, for example, a method for producing a polymer that utilizes the same four components as the method described in the '979 patent. *Compare* Ex. 1005, Abstract, 22:12–23:2, 36:1–2, *with* Ex. 1001, Abstract, 1:24–33, 4:32–41.

Patent Owner (PO Resp. 2) does not contest or rebut Petitioner’s analysis and evidence regarding Novomer 2’s disclosures or Petitioner’s explanation as to why a person of ordinary skill would have been led to the subject matter of claim 2 based on Novomer 2’s teachings, which we find are supported by a preponderance of the evidence cited by the Petitioner.

Accordingly, after reviewing the entire record, and for the foregoing reasons and those in Petitioner’s analysis (Pet. 66–71), including the cited

portions of the Darensbourg Declaration, we determine that Petitioner has demonstrated by a preponderance of the evidence that claim 2 would have been obvious over Novomer 2.

H. Obviousness over Asahi

Petitioner contends that claim 2 is unpatentable under 35 U.S.C. § 103(a) as obvious over Asahi (Ex. 1007). Pet. 71–79. Petitioner relies on the Darensbourg Declaration in support of its contentions. *Id.*

Petitioner argues that, although the particular lengths of the chain transfer agents used in Examples 7 and 8 of Asahi fall outside the scope of claim 2, it would have been obvious to a person of ordinary skill in the art to modify these examples and use other chain transfer agents explicitly taught by Asahi that would lead to polymers falling within the scope of claim 2. Pet. 72–73 (citing Ex. 1007, Abstract, ¶¶ 35, 73, 113, 143–144, 149–165).

Petitioner further argues that the polymer product of Example 7 includes polymers comprising an ethylene glycol chain transfer agent flanked by polycarbonate chains that contain, on average, 13.5 units of propylene carbonate (i.e., a mixture of poly(propylene carbonate) chains that have 13, 14, etc. propylene carbonate units) and that an exemplary polymer based upon the average repeating units in the Example 7 polymer product would include a polymer having an ethylene glycol chain transfer agent flanked by poly(propylene carbonate) chains having 14 propylene carbonate units. *Id.* at 73–74.

Petitioner also argues that based upon Asahi’s disclosure regarding the starting materials and the resulting polymer product of Example 8, a POSA could have determined that the polymer product of Example 8 includes polymers comprising a poly(propylene glycol) chain transfer agent

that contains, on average, 17.8 units of propylene glycol (i.e., a mixture of poly(propylene glycol) polymers having 17, 18, 19, etc., propylene glycol units), flanked by polycarbonate chains that contain, on average, 9.8 propylene carbonate units (i.e., a mixture of poly(propylene carbonate) polymers having 9, 10, 11, etc. propylene carbonate units). *Id.* at 75–76. According to Petitioner, an exemplary polymer based upon the average repeating units in the Example 8 polymer product would include a polymer having a poly(propylene glycol) chain transfer agent having 18 units flanked by poly(propylene carbonate) chains each having 10 propylene carbonate units. *Id.* at 76.

Petitioner contends that the only difference between Examples 7 and 8 of Asahi and claim 2 is the length of the central polyether portion which corresponds to the chain transfer agent used to prepare the polymer, i.e., claim 2 requires a length of 3 to 13 ether units, while Examples 7 and 8 disclose polymers having 1 and 18 ether units, respectively. *Id.* at 77. Petitioner further contends that because Examples 7 and 8 utilize propylene oxide, they produce polycarbonate chains like those of Genus B or Genus D. *Id.* at 79.

Petitioner argues that a POSA would have substituted chain transfer agents such as triethylene glycol or tripropylene glycol for the chain transfer agents in Examples 7 and 8 with a reasonable expectation of success, thus arriving at polymers falling within the scope of claim 2. *Id.* at 78. Petitioner also argues that a POSA would have had reason to make such substitution because “it is well established that the simple substitution of one known element for another to achieve predictable results supports a conclusion of *prima facie* obviousness.” *Id.* at 78.

Petitioner has not provided any additional argument or evidence post-institution in support of its obviousness challenge based on Asahi. Pet. Reply. 1–3. Patent Owner also does not provide any additional argument in response to Petitioner’s analysis and contentions in this regard. PO Resp. 2.

On this record, however, we are not persuaded that Petitioner sufficiently explains why a person of ordinary skill in the art would have substituted triethylene glycol or tripropylene glycol for the chain transfer agents in Examples 7 and 8 of Asahi. We find unavailing Petitioner’s argument that a POSA would have made the substitution because “it is well established that the simple substitution of one known element for another to achieve predictable results supports a conclusion of *prima facie* obviousness.” Pet. 78. This statement is conclusory and fails to provide adequate evidentiary support that triethylene glycol or tripropylene glycol are known substitutes, and one of ordinary skill in the art would have had a reasonable expectation of success in substituting them for the chain transfer agents in Examples 7 and 8. Consequently, it is not clear whether the improvement is more than the predictable use of prior art elements according to their established functions, which is a basic test identified by the Supreme Court for determining whether an invention would have been obvious. *See KSR*, 550 U.S. at 417.

Accordingly, after reviewing the entire record, we determine that Petitioner fails to demonstrate by a preponderance of the evidence that claim 2 would have been obvious over Asahi.

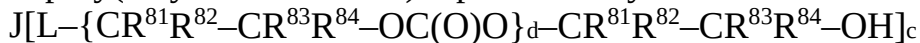
III. MOTION TO AMEND

A. Patent Owner's Motion to Amend

Pursuant to 35 U.S.C. § 316(d)(1) and 37 C.F.R. § 42.121(a), Patent Owner moves to replace claim 2 of the '979 patent with substitute claim 5. Mot. Amend 1. The motion is contingent on the outcome of the IPR as to the original claim and our determination as to whether a preponderance of the evidence establishes that claim 2 is unpatentable. *Id.* In support of the Motion to Amend, Patent Owner relies on the Kozak Declaration. *Id.*

A marked-up version of substitute claim 5 (proposed substitute for claim 2) is reproduced below:

A poly(alkylene carbonate) represented by Formula 10 below:



[Formula10]

wherein

L is -O-;

c is 2;

J is -CH₂CH₂N(R)CH₂CH₂- where [(*i*)]R is C₁-C₂₀ hydrocarbyl[*i*] or -[CH₂CH(R)O]_nCH₂CH(R)- where [(*i*)]n is ~~an integer from 0 to 10; 0 or 1 and~~ R is hydrogen ~~or methyl~~);;

among R⁸¹ to R⁸⁴, one is methyl while the others are hydrogen; are each independently hydrogen; (C₁-C₁₀)alkyl substituted or unsubstituted with halogen or (C₁-C₂₀)alkoxy; or (C₆-C₁₂)aryl substituted or unsubstituted with halogen or (C₁-C₂₀)alkoxy; R⁸¹ to R⁸⁴ being able to be linked with each other to form a ring; and

a value obtained by multiplying d by c is a natural number of 1000 or less; and

the poly(alkylene carbonate) is a complete alternating copolymer of propylene oxide and carbon dioxide.

Mot. Amend 3–4 (underlining indicating additions and strikethroughs and/or double brackets indicating deletions); *see also id.* at Appendix 1 (“Marked-Up Version”).

B. Analysis

In an *inter partes* review, an amended claim is not added to a patent as of right, but rather must be proposed as a part of a motion to amend. 35 U.S.C. § 316(d). The Board must assess the patentability of the proposed substitute claim “without placing the burden of persuasion on the patent owner.” *Aqua Prods., Inc. v. Matal*, 872 F.3d 1290, 1328 (Fed. Cir. 2017) (en banc). Patent Owner’s proposed substitute claim, however, must meet the statutory requirements of 35 U.S.C. § 316(d) and the procedural requirements of 37 C.F.R. § 42.121. *See* “Guidance on Motions to Amend in view of *Aqua Products*” (Nov. 21, 2017) (https://www.uspto.gov/sites/default/files/documents/guidance_on_motions_to_amend_11_2017.pdf) (“Guidance”).

Accordingly, Patent Owner must demonstrate (1) the amendment proposes a reasonable number of substitute claims; (2) the amendment does not seek to enlarge the scope of the claims of the patent or introduce new subject matter; (3) the proposed claim is supported in the original disclosure; and (4) the amendment responds to a ground of unpatentability involved in the trial. *See* 35 U.S.C. § 316(d); 37 C.F.R. § 42.121.

Patent Owner contends that its Motion to Amend and proposed substitute claim 5 meet all of the requirements of 35 U.S.C. § 316(d) and 37 C.F.R. § 42.121. Mot. Amend 2. Petitioner does not dispute that Patent Owner’s proposed substitute claim 5 meets the statutory requirements or that the substitute claim is patentable. Opp. Mot. Amend 2.

1. A Reasonable Number of Substitute Claims

Patent Owner contends that because only one substitute claim (substitute claim 5) is proposed to replace the only challenged claim (original claim 2), the motion presents a presumptively reasonable number of substitute claims in accordance with 37 C.F.R. § 42.121(a)(3) and Section 3 of the Guidance. *Id.* at 2. We agree with Patent Owner and find that one substitute claim is, indeed, a reasonable number of claims for purposes of the statutory requirements and the related Guidance.

2. The Scope of the Original Claims

Patent Owner contends that substitute claim 5 does not enlarge the scope of claim 2. Mot. Amend 2, 4. Rather, Patent Owner argues that the proposed amendments actually narrow and limit the scope of the original claim. *Id.* at 4. In particular, in identifying the differences between substitute claim 5 and claim 2, Patent Owner explains that when J is $-\text{[CH}_2\text{CH(R)O]}_n\text{CH}_2\text{CH(R)}-$, the integer n is amended from “an integer from 0 to 10” to “0 or 1,” and R is amended from “hydrogen or methyl” to “hydrogen.” *Id.* at 4. Patent Owner also explains that substitute claim 5 is further limited by defining one of R⁸¹ to R⁸⁴ as methyl while the others are hydrogen (R⁸¹ to R⁸⁴ are originally defined as “each independently hydrogen; (C₁-C₁₀)alkyl substituted or unsubstituted with halogen or (C₁-C₂₀)alkoxy; or (C₆-C₁₂)aryl substituted or unsubstituted with halogen or (C₁-C₂₀)alkoxy, R⁸¹ to R⁸⁴ being able to be linked with each other to form a ring”). *Id.* at 4. In addition, Patent Owner explains that substitute claim 5 is limited by further reciting “the poly(alkylene carbonate) is a complete alternating copolymer of propylene oxide and carbon dioxide.” *Id.* at 4–5.

Petitioner does not dispute or challenge Patent Owner’s analysis or contentions in this regard. Opp. Mot. Amend. 2. Thus, based on the analysis and reasons provided by Patent Owner (Mot. Amend 4–5), we find that substitute claim 5 does not enlarge the scope of original claim 2.

3. New Subject Matter and Support in the Original Disclosure

Patent Owner contends that substitute claim 5 does not introduce new subject matter and is supported under 35 U.S.C. § 112 by the originally filed disclosure of the ’979 patent, i.e., U.S. Patent Application No. 13/927,485 (Ex. 2006, “the ’485 application”).¹⁰ Mot. Amend 2, 5.

To satisfy the written description requirement under 35 U.S.C. § 112,¹¹ first paragraph, the specification must “reasonably convey[] to those skilled in the art that the inventor had possession” of the claimed invention as of the filing date. *Ariad Pharms., Inc. v. Eli Lilly & Co.*, 598 F.3d 1336, 1351 (Fed. Cir. 2010) (en banc). An adequate description does not require any particular form of disclosure or that the specification recite the claimed invention *in haec verba*, but must do more than render the claimed invention obvious. *Id.* at 1352.

As set forth at pages 6–7 of the Motion to Amend and reproduced, in relevant part, in the table below, for each element of substitute claim 5,

¹⁰ The ’979 patent issued from U.S. Patent Application No. 13/927,485, filed June 26, 2013, which is a divisional application of U.S. Patent Application No. 12/952,642, filed November 23, 2010 (Ex. 2007, “the ’642 application,” Ex. 2007), now U.S. Patent No. 8,530,616. Mot. Amend 5.

¹¹ As indicated in footnote 10, the ’979 patent issued from the ’485 application, which is a divisional of the ’642 application. Because the application resulting in the ’979 patent is a divisional of an application filed before September 16, 2012, the effective date of the amendments to 35 U.S.C. § 112 enacted in the AIA, the pre-AIA version of § 112 applies here.

Patent Owner identifies specific portions of the '485 application that provide written-descriptive support for all of the limitations of the claim. Patent Owner also identifies those portions of Dr. Kozak's testimony where each element of substitute claim 5 and the corresponding written-descriptive support provided in the '485 application are discussed. *Id.* at 5.

Elements of substitute claim 5	Exemplary support in the '485 application (Ex. 2006)	Kozak Declaration (Ex. 2001)
A poly(alkylene carbonate) represented by Formula 10 below: $J[L-\{CR^{81}R^{82}-CR^{83}R^{84}-OC(O)O\}_d-CR^{81}R^{82}-CR^{83}R^{84}-OH]_c$ [Formula 10] wherein	25:3-7	¶ 32
L is -O-;	25:7; 28:3-8	¶ 33
c is 2;	25:7-8; 28:3-8	¶ 34
J is -CH ₂ CH ₂ N(R)CH ₂ CH ₂ - <u>where</u> [(I)R is C ₁ -C ₂₀ hydrocarbyl[(I)] or	28:8-11	¶ 35
-[CH ₂ CH(R)O] _n CH ₂ CH(R)- <u>where</u> [(I)n is ~~an integer from 0 to 10~~ ; 0 or 1 and R is hydrogen or methyl);;	28:11-12; 40:16-41:2; 41:4-26	¶ 36
<u>among R⁸¹ to R⁸⁴, one is methyl while the others are hydrogen;</u> ~~are each independently hydrogen; (C₄-C₁₀)alkyl substituted or unsubstituted with halogen or (C₄-C₂₀)alkoxy; or (C₆-C₁₂)aryl substituted or unsubstituted with halogen or (C₄-C₂₀)alkoxy; R⁸¹ to R⁸⁴~~	21:10; 25:12-13; 40:16-41:2; 41:4-26	¶ 37

Elements of substitute claim 5	Exemplary support in the '485 application (Ex. 2006)	Kozak Declaration (Ex. 2001)
~~being able to be linked with each other to form a ring; and~~		
a value obtained by multiplying d by c is a natural number of 1000 or less; <u>and</u>	25:17–18	¶ 38
<u>the poly(alkylene carbonate) is a complete alternating copolymer of propylene oxide and carbon dioxide.</u>	21:10; 26:8–11; 40:16–41:2; 41:4–26	¶ 39

Mot. Amend 6–7 (footnote omitted).

Petitioner does not dispute or challenge Patent Owner’s analysis or evidence in this regard. Opp. Mot. Amend. 2. On this record, we are persuaded that Patent Owner has put forth evidence sufficient to establish that the '485 application does provide adequate written description support for all of the elements of substitute claim 5.

For example, regarding the recitation “A poly(alkylene carbonate) represented by Formula 10,” the '485 application explicitly discloses:

According to a further embodiment of the present invention, there is provided poly(alkylene carbonate) represented by Formula 10 below.

5 [Formula 10]

$$J[L-\{CR^{81}R^{82}-CR^{83}R^{84}-OC(O)O\}_d-CR^{81}R^{82}-CR^{83}R^{84}-OH]_c$$

In Formula 10, L is -O- or -CO₂-;

c is an integer from 2 to 10, and L is identical or different;

Ex. 2006, 25:3–7.

Regarding the recitation “among R⁸¹ to R⁸⁴, one is methyl while the others are hydrogen,” the ’485 application discloses that:

R⁸¹ to R⁸⁴ are each independently hydrogen; (C₁-C₁₀)alkyl substituted or unsubstituted with halogen or (C₁-C₂₀)alkoxy; or (C₆-C₁₂)aryl substituted or unsubstituted with halogen or (C₁-C₂₀)alkoxy, R⁸¹ to R⁸⁴ being able to be linked with each other to form a ring;

Id. at 25:12–16. The ’485 application also provides adequate written-descriptive support for the recitation “a value obtained by multiplying d by c is a natural number of 1000 or less” of substitute claim 5. *See id.* at 25:17–18.

In addition, in support of the recitation “the poly(alkylene carbonate) is a complete alternating copolymer of propylene oxide and carbon dioxide,” the ’485 application discloses that the epoxide compound in the preparation method according to the present invention includes “propylene oxide.” Ex. 2006, 21:10. The ’485 application also discloses that “the present invention can accomplish complete alternating copolymerization of carbon dioxide and an epoxide, resulting in pure poly(alkylene carbonate).” *Id.* at 26:8–11.

Therefore, based on the analysis and evidence provided by Patent Owner (Mot. Amend 5–7), including the cited portions of the Kozak Declaration, we determine that substitute claim 5 does not introduce new matter, and is supported under 35 U.S.C. § 112, first paragraph by the originally filed disclosure of the ’979 patent.

4. Grounds of Unpatentability

“[T]he Board determines whether substitute claims are unpatentable by a preponderance of the evidence based on the entirety of the record,

including any opposition made by the petitioner.” *Lectrosonics, Inc. v. Zaxcom, Inc.*, Case IPR2018-01129, 01130, Paper 15, 4 (PTAB Feb. 25, 2019) (precedential).

Patent Owner contends that the proposed amendments to claim 2 (as set forth in substitute claim 5) respond to each of the grounds of unpatentability at issue in this IPR, and distinguish substitute claim 5 from the prior art discussed in the Institution Decision. Mot. Amend 2, 7–20.

Petitioner does not contest or substantively respond to Patent Owner’s contentions in this regard in its Opposition to Patent Owner’s Motion to Amend. See Opp. Mot. Amend 2 (stating that Petitioner “takes no position as to whether substitute Claim 5 (i) meets the requirements of 35 U.S.C. § 316(d) or 37 C.F.R. § 42.121, or (ii) is patentable” and “offers no additional arguments or evidence beyond what is already of record in this proceeding”).

a. Level of Ordinary Skill in the Art

Because, as previously discussed above, we determine that the level of ordinary skill proposed by Petitioner (Pet. 14) for claim 2 is consistent with the ’979 patent and the asserted prior art, and Patent Owner agrees (Mot. Amend 7) for purposes of deciding Patent Owner’s Motion to Amend, we adopt that level of ordinary skill in the art in construing substitute claim 5.

b. Claim Construction

In its Motion to Amend, Patent Owner proposes constructions for the following phrases of substitute claim 5: (1) “Formula 10” and (2) “a complete alternating copolymer.” Mot. Amend 7–11.

1. “Formula 10”

Patent Owner contends that because of the specific limitations/values recited in substitute claim 5 for variables J, L, c, and R, the phrase “A poly(alkylene carbonate) represented by Formula 10” of substitute claim 5 can only read “on a poly(alkylene carbonate) prepared from propylene oxide and carbon dioxide using ethylene glycol or diethylene glycol as a chain transfer agent” and, thus, should be construed as such. *Id.* at 8–10.

In particular, as support for the proposed construction, Patent Owner argues that because substitute claim 5 recites “J is $-\text{CH}_2\text{CH}_2\text{N}(\text{R})\text{CH}_2\text{CH}_2-$ where R is $\text{C}_1\text{--C}_{20}$ hydrocarbyl or $-\text{CH}_2\text{CH}(\text{R})\text{O}]_n\text{CH}_2\text{CH}(\text{R})-$ where n is 0 or 1 and R is hydrogen,” “L is $-\text{O}-$,” and “c is 2,” the chain transfer agent used to obtain the claimed poly(alkylene carbonate) is either ethylene glycol or diethylene glycol. *Id.* at 9. Patent Owner further argues that because substitute claim 5 recites “among R^{81} to R^{84} , one is methyl while the others are hydrogen,” the epoxide used to obtain the claimed poly(alkylene carbonate) is propylene oxide. *Id.* at 10.

Petitioner does not contest Patent Owner’s proposed construction or argue that this phrase of substitute claim 5 needs to be construed. *See* Opp. Mot. Amend 2. On the record before us, we determine that neither the term “Formula 10” nor the phrase “A poly(alkylene carbonate) represented by Formula 10” as recited in substitute claim 5 require explicit construction. *Nidec*, 868 F.3d at 1017.

2. “a complete alternating copolymer”

Substitute claim 5 recites “the poly(alkylene carbonate) is a complete alternating copolymer of propylene oxide and carbon dioxide.” Mot. Amend, Appendix 2. Patent Owner proposes that this limitation should be

construed to mean a complete alternating poly(alkylene carbonate) that “has a structure in which the monomer units are always paired throughout the whole polymer chain.” Mot. Amend 11. Patent Owner contends that the proposed construction is supported by the ’979 patent Specification (Ex. 1001, 18:26–29) and the testimony of both Dr. Kozak (Ex. 2001 ¶¶ 14, 48, 49) and Dr. Darensbourg (Ex. 2001 ¶¶ 12, 18).

Petitioner does not dispute Patent Owner’s proposed construction or argue that the phrase “a complete alternating copolymer” should not be construed. See Opp. Mot. Amend 2.

Based on the record before us, we agree that Patent Owner’s proposed construction is consistent with the broadest reasonable interpretation in light of the specification. Therefore, for purposes of deciding Patent Owner’s Motion to Amend, we adopt Patent Owner’s construction and interpret the phrase “a complete alternating copolymer” of substitute claim 5 to mean a poly(alkylene carbonate) structure in which the monomer units are always paired throughout the whole polymer chain.

c. Anticipation by or Obviousness over Novomer 1

Patent Owner contends that substitute claim 5 is not anticipated by and/or would not have been obvious over Novomer 1 because Novomer 1 does not teach or suggest a copolymer that has a structure as recited in the claim. Mot. Amend 13–14. Because substitute claim 5 recites, among other limitations, “where n is 0 or 1 and R is hydrogen,” “L is –O–,” “c is 2,” and “among R⁸¹ to R⁸⁴, one is methyl while the others are hydrogen,” we agree with Patent Owner’s explanation that the chain transfer agent used to obtain the claimed poly(alkylene carbonate) must be either ethylene glycol or diethylene glycol and the epoxide used propylene oxide. *Id.* at 9–10.

Patent Owner also contends that Novomer 1 does not anticipate and/or would not have rendered obvious substitute claim 5 because Novomer 1 does not teach or suggest a structure obtained using an ethylene glycol or diethylene glycol chain transfer agent as required by the claim. *Id.* at 13–14. In particular, Patent Owner contends (*id.* at 13) that, in contrast to substitute claim 5, the central block of the poly(alkylene carbonate) described in Novomer 1 is a polyethylene glycol block containing at least four ethylene glycol units and the A-B-A triblock copolymer of Novomer 1 is prepared from a chain transfer agent that is at least tetraethylene glycol. *See* Ex. 1004, 52:11–13, 22:14, 21:21, 25:9, 52:6–7; Ex. 2001 ¶ 55.

Patent Owner further contends that a person of ordinary skill would have read Novomer 1 to require the use of a polyethylene glycol having at least four ethylene glycol units as the chain transfer agent to achieve its desired effect for oil extraction. Mot. Amend 15. According to Patent Owner, “a POSA, in the absence of additional guidance, would not select ethylene glycol or diethylene glycol for use as a chain transfer agent to replace a polyethylene glycol having at least four ethylene glycol units as described in Novomer 1.” *Id.* (citing Ex. 2001 ¶ 58); *see* Ex. 1004, 1:7–2:16.

Petitioner does not contest or rebut Patent Owner’s analysis and contentions regarding the patentability of substitute claim 5 as being anticipated by or obvious over Novomer 1.

We find Patent Owner’s arguments to be supported by the evidence of record. For example, we credit Dr. Kozak’s testimony that “Novomer 1 explicitly requires the central hydrophilic block B to be an oligomer having ‘about 4 to about 200 repeating units,’” which “requires a polyethylene

glycol that contains at least four ethylene glycol units.” Ex. 2001 ¶ 58. We also credit Dr. Kozak’s testimony that a POSA “would see that the presence of multiple ether linkages within the chain transfer agent were introduced to impart in the polymer particular physical properties,” and “creating a completely alternating copolymer that uses a chain transfer agent that minimizes the presence of either linkages (for example, ethylene glycol, diethylene glycol, etc.) would be seen as different from what is taught in Novomer 1.” *Id.* ¶ 16; *see also id.* ¶ 17 (Dr. Kozak explaining that, for a POSA, “non-polyether diols, such as ethylene glycol and its derivatives . . . would be considered different to a polyethylene glycol taught” in Novomer 1.).

Accordingly, after reviewing the entire record, we determine that the preponderance of the evidence does not demonstrate that substitute claim 5 is either anticipated by or would have been obvious over Novomer 1.

d. Anticipation by or Obviousness over Novomer 2

Patent Owner contends that substitute claim 5 is not anticipated by and/or would not have been obvious over Novomer 2 because the poly(alkylene carbonate) polymers Novomer 2 describes have different structures than the poly(alkylene carbonate) polymer recited in the claim. Mot. Amend 16–18. For example, as Patent Owner explains, the product of Example 4 of Novomer 2, particularly the central block of Example 4, differs in structure from the claimed poly(alkylene carbonate), as recited in substitute claim 5. In contrast to substitute claim 5 and like Novomer 1, Example 4 of Novomer 2 describes the preparation of poly(alkylene carbonate) using poly(ethylene glycol) as a chain transfer agent. Ex. 1005, 99:1–3. As Patent Owner explains (Mot. Amend 16–17), the poly(alkylene

carbonate) Novomer 2 discloses at page 70 of the reference also appears to have a different structure, formula, and central block than the poly(alkylene carbonate) encompassed by substitute claim 5. *See* Ex. 1005, 70:17–22; Ex. 2001 ¶ 62.

Patent Owner also explains that, although Novomer 2 does mention diethylene glycol among numerous chain transfer agents (Ex. 1005, 50:3–10), the reference does not provide any teaching or suggestion that would have led a POSA to replace its high molecular weight polyethylene glycol chain transfer agent with a diethylene glycol. Mot. Amend 17–18. We agree with Patent Owner’s analysis, which is supported by the evidence of record. Thus, on the record before us, we are not persuaded one of ordinary skill would have had reason to select diethylene glycol to replace Novomer 2’s polyethylene glycol chain transfer agent, or that a POSA would have had a reasonable expectation of success in doing so. *See Pfizer, Inc. v. Apotex, Inc.*, 480 F.3d 1348, 1365 (Fed. Cir. 2007) (“[T]o have a reasonable expectation of success, one must be motivated to do more than merely to vary all parameters or try each of numerous possible choices until one possibly arrived at a successful result.”) (quoting *Medichem, S.A. v. Rolabo, S.L.*, 437 F.3d 1157, 1165 (Fed. Cir. 2006)).

Petitioner does not contest or rebut Patent Owner’s analysis and contentions regarding the patentability of substitute claim 5 as being anticipated by or obvious over Novomer 2.

Accordingly, after reviewing the entire record, we determine that the preponderance of the evidence does not demonstrate that substitute claim 5 is either anticipated by or would have been obvious over Novomer 2.

e. Obviousness over Asahi

Patent Owner contends that substitute claim 5 would not have been obvious over Asahi because the poly(alkylene carbonate) described in Asahi is not “a complete alternating copolymer” of propylene oxide and carbon dioxide as required by the claim. Mot. Amend 19. In particular, based on the calculations performed by Dr. Kozak (Ex. 2001 ¶¶ 68–74), Patent Owner contends (Mot. Amend 19) that the poly(alkylene carbonate) of Example 7 of Asahi (Ex. 1007 ¶ 157) would not have resulted in a poly(alkylene carbonate) “structure in which the monomer units are always paired throughout the whole polymer chain,” as required by substitute claim 5.

Patent Owner also contends that substitute claim 5 would not have been obvious over Asahi because it does not teach or suggest a structure obtained using an ethylene glycol or diethylene glycol chain transfer agent as required by the claim. Mot. Amend 20. In particular, Patent Owner contends (*id.*) that, in contrast to substitute claim 5, Example 8 of Asahi (Ex. 1007 ¶ 58) is not “a complete alternating copolymer” and uses poly(propylene glycol) as the chain transfer agent, instead of ethylene glycol or diethylene glycol as required by the claim.

Petitioner does not contest or rebut Patent Owner’s analysis and contentions regarding the patentability of substitute claim 5 as being anticipated by or obvious over Asahi.

We find Patent Owner’s arguments to be supported by the evidence of record. For example, we credit Dr. Kozak’s un rebutted testimony that Asahi’s Example 7 “is not a complete alternating polymer of propylene oxide and carbon dioxide” at least because “Asahi uses a metal complex in which a porphyrin-based compound is coordinated as a catalyst” and a

POSA would have known that “copolymerizing an epoxide and carbon dioxide using” such a metal complex “as the catalyst would not result in ‘a complete alternating copolymer.’” Ex. 2001 ¶ 70; *see also id.* ¶¶ 71–72 (setting forth and explaining the calculations that show that Asahi’s Example 7 is not a complete alternating copolymer). We also credit Dr. Kozak’s testimony that Asahi’s Example 8 “differs from the poly(alkylene carbonate) as claimed in substitute claim 5 not only because it is not a complete alternating copolymer, but also because it has a different ‘central’ block.” *Id.* ¶ 73.

Accordingly, after reviewing the entire record, we determine that the preponderance of the evidence does not demonstrate that substitute claim 5 would have been obvious over Asahi.

IV. CONCLUSION

Based on the information presented, we conclude that Petitioner has shown, by a preponderance of the evidence, that claim 2 of the ’979 patent is unpatentable. We also grant Patent Owner’s Motion to Amend to replace claim 2 with substitute claim 5.

V. ORDER

It is, therefore,

ORDERED that Petitioner has shown by a preponderance of the evidence that claim 2 is unpatentable;

FURTHER ORDERED that Patent Owner’s Motion to Amend to substitute claim 5 for claim 2 is granted; 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.

PETITIONER:

Charles E. Lyon
John P. Rearick
Eric J. Marandett
Stephanie L. Schonewald
Michael A. Shinall
CHOATE, HALL & STEWART LLP
clyon@choate.com
jrearick@choate.com
emarandette@choate.com
sschonewald@choate.com
mshinall@choate.com

PATENT OWNER:

W. Todd Baker
Jacob A. Doughty
Claire Hu
Grace Kim
OBLON, MCCLELLAND, MAIER & NEUSTADT, LLP
CPDocketBaker@oblon.com
CPDocketDoughty@oblon.com
CPDocketHu@oblon.com
CPDocketGKim@oblon.com