

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

IQE PLC,
Petitioner,

v.

CORNELL RESEARCH FOUNDATION INC.,
Patent Owner.

IPR2024-00609
Patent 7,250,360 B2

Before KIMBERLY MCGRAW, JULIA HEANEY, and
MICHAEL G. McMANUS, *Administrative Patent Judges*.

McGRAW, *Administrative Patent Judge*.

DECISION
Granting Institution of *Inter Partes* Review
35 U.S.C. § 314

I. INTRODUCTION

IQE PLC (“Petitioner”) filed a Petition (Paper 1, “Pet.”) requesting an *inter partes* review of claims 1–24 of U.S. Patent No. 7,250,360 B2 (Ex. 1001, “the ’360 patent”). Cornell Research Foundation Inc. (“Patent Owner”) filed a Preliminary Response to the Petition (Paper 6, “Prelim. Resp.”). With our authorization, Petitioner filed a Reply to the Preliminary Response (Paper 7, “Prelim. Reply”) and Patent Owner filed a Sur-reply (Paper 8, “Prelim. Sur-reply”).

To institute an *inter partes* review, we must determine that the information presented in the Petition shows “there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” 35 U.S.C. § 314(a). For the reasons discussed below, after considering the parties’ submissions and the evidence of record, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing with respect to at least one claim of the ’360 patent. Thus, we institute an *inter partes* review of all challenged claims of the ’360 patent on all grounds asserted in the Petition. *PGS Geophysical AS v. Iancu*, 891 F.3d 1354, 1360 (Fed. Cir. 2018) (stating that a decision to institute is “a simple yes-or-no institution choice respecting a petition, embracing all challenges included in the petition”).

A. *Related Proceedings*

The parties identify *Akoustis Technologies, Inc. et al. v. Qorvo, Inc.*, 2:23-cv-00180 (E.D. Tex.) (“the District Court Litigation”), as a related matter. Pet. 3, 70; Paper 4, 2.

B. *Real Parties-In-Interest*

The parties identify themselves as the real parties-in-interest. Pet. 70; Paper 4, 2. Patent Owner additionally “identifies Akoustis

Technologies, Inc. as the exclusive licensee” of the ’360 patent. Paper 4, 2.

C. The ’360 Patent

The ’360 patent, titled “Single Step, High Temperature Nucleation Process for a Lattice Mismatched Substrate,” relates to “a single step process for the nucleation and subsequent epitaxial growth on a lattice mismatched substrate.” Ex. 1001, 1:17–19. According to the ’360 patent, there are applications for a “lattice mismatched substrate having an epitaxial nitride based material, such as (Al)GaN” “in the areas of high power, high frequency electronics, short wavelength optoelectronics, biology, and micromachining technologies.” *Id.* at 3:43–47. But, the ’360 patent observes, “[h]eteroepitaxial growth of GaN and related alloys on severely mismatched substrates such as sapphire, SiC and silicon requires thin nucleation layers to provide nucleation sites to initiate crystal growth.” *Id.* at 1:21–24. The single step approach described in the ’360 patent “is a single flow, single pressure, high temperature process” that “involves a surface treatment prior to epitaxial growth that allows complete coalescence of the epitaxial film within the first 200 Å of growth.” *Id.* at 2:3–7. This “eliminates the large temperature ramps and complex flow requirements of the commonly used two-step nucleation technologies.” *Id.* at 2:7–9.

In one embodiment, a surface of a lattice mismatched substrate, such as silicon, sapphire, or SiC, is pre-treated with at least one group III reactant or group II reactant, prior to the introduction of a group V or group VI reactant, respectively. Ex. 1001, 2:25–33. Preferably, group III includes gallium, aluminum, boron, and indium reactants, while group II includes cadmium and zinc reactants. *Id.* at 2:36–38, 2:45–46. More specifically, at least one of the group III or group II reactants “is introduced into a growth

chamber at an elevated growth temperature to pre-treat the surface of the substrate prior to any actual crystal growth.” *Id.* at 2:47–50. “Once the pre-treatment is complete, the group V reactant or the group VI reactant is introduced to begin the growth of the nucleation layer.” *Id.* at 2:56–58. Preferably, group V includes nitrogen, arsenic, and phosphorus reactants, while group VI includes tellurium and sulfur reactants. *Id.* at 2:59–60, 2:65–67. “After the nucleation layer is formed, a buffer layer is formed on the nucleation layer,” which “provides a surface upon which the epitaxial layer is grown.” *Id.* at 2:67–3:1.

The ’360 patent describes that preferred III-V and II-VI compounds for the nucleation layer include “AlN, GaN, AlGa_N, BGaN, BInN, CdTe, and ZnS.” Ex. 1001, 3:4–6. Figure 1 of the ’360 patent, reproduced below, shows “a schematic representation of a single step process for nucleation and subsequent growth of a preferred GaN-based material,” with “[r]elative reactant fluxes and exposure cycles . . . depicted for the surface pre-treatment, the AlN/AlGa_N nucleation layer, and the transition to GaN epitaxial growth on both sapphire and SiC substrates.” *Id.* at 3:51–56.

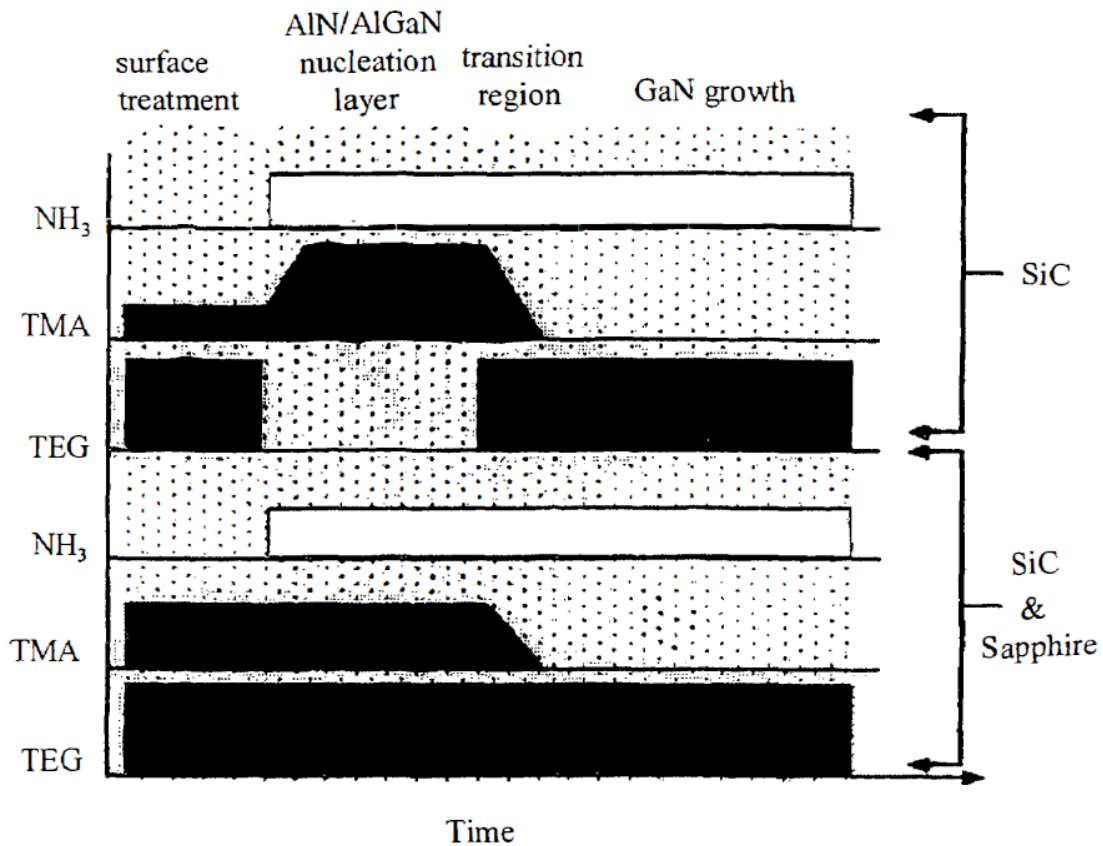


FIG. 1

In the process shown in Figure 1, after heating the substrates to 1100 °C in hydrogen for 10 minutes for cleaning, the temperature is decreased to 1040 °C. *Id.* at 3:59–64. Aluminum and gallium reactants, preferably TEG [triethylgallium] and TMA [trimethylaluminum], are introduced into the growth chamber for 100 seconds. *Id.* at 3:65–4:3. Next, ammonia is switched into the chamber to form Al_xGa_{1-x}N on the substrate. *Id.* at 4:4–7. If not already present, the gallium reactant is switched into the chamber, for example, if the nucleation layer is comprised of AlN. *Id.* at 4:8–10. The aluminum reactant is then ramped down and switched out of the chamber after 30 seconds, resulting “in GaN deposition, providing a buffer layer on

which other GaN-based epitaxial layers can subsequently be deposited without any change in growth chamber temperature.” *Id.* at 4:11–16.

D. Illustrative Claim

Of the challenged claims, claims 1 and 18 are independent. Claim 1 is reproduced below with bracketed annotations added to correspond to the annotations in the Petition. *See* Pet. 15–23.

1. [1.P] A process for growing an epitaxial layer on a lattice mismatched substrate comprising the steps of:

[1.a] a) providing a substrate;

[1.b] b) pre-treating a surface of the substrate with at least one group III reactant or at least one group II reactant at an elevated growth temperature prior to introducing a group V reactant or a group VI reactant;

[1.c] c) introducing a group V reactant or a group VI reactant to grow a nucleation layer on the surface of the substrate; and

[1.d] d) growing a buffer layer on said nucleation layer, said buffer layer providing a surface upon which said epitaxial layer is grown.

Ex. 1001, 5:2–14 (bracketed material added).

E. The Asserted Grounds of Unpatentability

Petitioner contends claims 1–24 of the ’360 patent are unpatentable on the following grounds. Pet. 5.

Ground	Reference(s)	35 U.S.C. §	Claims Challenged
1	Urashima ¹	103(a)	1–4, 6–14

¹ Urashima et al., U.S. Patent Appl. Pub. No. 2002/0155712 A1 (published Oct. 24, 2002) (Ex. 1004, “Urashima”).

Ground	Reference(s)	35 U.S.C. §	Claims Challenged
2	Urashima, Nagata ²	103(a) ³	5, 17
3	Urashima, Keiper ⁴	103(a)	15, 16
4	Urashima, Manabe ⁵	103(a)	18–24
5	Guo ⁶	103(a)	1–4, 6–9, 11–14
6	Guo, Ashby ⁷	103(a)	5, 10, 17

In support of its unpatentability arguments, Petitioner relies on the declaration of Dr. Stanley Shanfield (Ex. 1003 “Shanfield Declaration”).

II. ANALYSIS

A. *Discretionary Denial* – Fintiv

Patent Owner argues that we should exercise discretion to deny institution in view of *Akoustis Technologies, Inc. et al. v. Qorvo, Inc.*, 2:23-cv-00180 (E.D. Tex.), a proceeding in the Eastern District of Texas

² Nagata et al., Japanese Patent App. Pub. No. H5-63305 (published Mar. 12, 1993) (certified English translation, Ex. 1005 (“Nagata”)).

³ The Leahy-Smith America Invents Act, Pub. L. No. 112-29, 125 Stat. 284 (2011) (“AIA”), amended 35 U.S.C. § 103 effective March 16, 2013. Because the application giving rise to the ’360 patent was filed before that date, the pre-AIA version of §§ 102 and 103 applies. See Ex. 1001, code (22).

⁴ Keiper et al., *Metal organic vapour-phase epitaxy (MOVPE) growth of InP and InGaAs using tertiarybutylarsine (TBA) and tertiarybutylphosphine (TBP) in N₂ ambient*, J. of Crystal Growth 256–262, Vol. 204, No. 3 (1999) (Ex. 1006 “Keiper”).

⁵ Manabe et al., U.S. Patent No. 5,122,845 (issued June 16, 1992) (Ex. 1007 “Manabe”).

⁶ Guo et al., U.S. Patent App. Pub. No. 2004/0119063 A1 (published June 24, 2004) (Ex. 1008 “Guo”).

⁷ Ashby et al., U.S. Patent App. Pub. No. 2002/0090816 A1 (published July 11, 2002) (Ex. 1009 “Ashby”).

involving the '360 patent and Akoustis Technologies, Inc. (“Akoustis”) the exclusive licensee of Patent Owner and Qorvo, Inc. (“Qorvo”), a customer of Petitioner. *See* Prelim. Resp. 21–33; Prelim. Sur-reply 1–5.

The Board has held that the advanced state of a parallel district court action is a factor that may weigh in favor of denying a petition under § 314(a). *See NHK Spring Co. v. Intri-Plex Techs., Inc.*, IPR2018-00752, Paper 8 at 20 (PTAB Sept. 12, 2018) (precedential); Patent Trial and Appeal Board Consolidated Trial Practice Guide (Nov. 2019), 58 & n.2, *available at* <https://www.uspto.gov/TrialPracticeGuideConsolidated> (“Trial Practice Guide”). We consider the following factors to assess “whether efficiency, fairness, and the merits support the exercise of authority to deny institution in view of an earlier trial date in the parallel proceeding”:

1. whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted;
2. proximity of the court’s trial date to the Board’s projected statutory deadline for a final written decision;
3. investment in the parallel proceeding by the court and the parties;
4. overlap between issues raised in the petition and in the parallel proceeding;
5. whether the petitioner and the defendant in the parallel proceeding are the same party; and
6. other circumstances that impact the Board’s exercise of discretion, including the merits.

Apple Inc. v. Fintiv, Inc., IPR2020-00019, Paper 11 at 5–6 (PTAB Mar. 20, 2020) (precedential) (“*Fintiv*”). In evaluating these factors, we “take[] a holistic view of whether efficiency and integrity of the system are best served by denying or instituting review.” *Id.* at 6.

The Director has issued additional guidance on the application of *Fintiv*. See USPTO Memorandum, *Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation* (June 21, 2022), available at https://www.uspto.gov/sites/default/files/documents/interim_proc_discretionary_denials_aia_parallel_district_court_litigation_memo_20220621_.pdf (“*Fintiv* Memo”). The *Fintiv* Memo provides, *inter alia*, that “the PTAB will not discretionarily deny institution of an IPR . . . in view of parallel district court litigation where a petitioner stipulates not to pursue in a parallel district court proceeding the same grounds as in the petition or any grounds that could have reasonably been raised in the petition.” *Id.* at 7.

We agree with Petitioner that exercising discretion to deny institution under Section 314(a) is not warranted here. See Pet. 71–75; Prelim. Reply 1–5.

As for factor 1 (likelihood a stay will be been granted), no motion to stay has been filed and there is no indication that the district court would grant such a motion if one were to be filed. See Pet. 72. Accordingly, this factor should be neutral. See *Sand Revolution II LLC v. Cont'l Intermodal Grp. Trucking LLC*, IPR2019-01393, Paper 24 at 7 (PTAB June 16, 2020) (informative).

As for factor 2 (proximity of the district court’s trial date to the Board’s projected statutory deadline for a final written decision), the projected trial date is in January 2025, which is nearly eight months before the Final Written Decision would be due. See Prelim. Resp. 27 (citing Ex. 1017, 1). Petitioner notes that there are motions currently pending before the district court regarding joinder of Patent Owner in which Patent Owner (1) requests modification of the case schedule to allow for discovery

and (2) moves to dismiss, both of which would either end or effectively stay the District Court Litigation for an indeterminate length. Prelim. Reply 2–3. We decline to speculate as to how the district court might decide those motions or the impact on the case schedule.

Although Petitioner does not rely on time-to-trial statistics, discussed in the Director’s *Fintiv* Memo, Petitioner also asserts that the judge assigned to the *Akoustis-Qorvo* litigation has 676 active cases on his docket. Pet. 73 (citing Ex. 1018 (Lex Machina Statistics)); *see also* *Fintiv* Memo (stating that where “parties rely on time-to-trial statistics, the PTAB will also consider supporting factors such as the number of cases before the judge in the parallel litigation”). Petitioner, however, does not adequately explain whether the number of cases on the judge’s docket would necessarily result in a trial date that occurs after the Board’s deadline for filing a final written decision, particularly given the absence of evidence presented regarding the median time to trial.

Because the district court’s scheduled trial predates our projected final written decision deadline by nearly eight months, and for the reasons discussed above, factor 2 weighs in favor of denying institution. *See* Prelim. Resp. 26–27.

Factor 3 (investment in the parallel proceeding by the court and the parties prior to institution) does not weigh in favor of exercising discretion to deny institution. Although Patent Owner’s exclusive licensee, Akoustis, is the plaintiff in the District Court Litigation, Petitioner is not a party. Patent Owner asserts that Petitioner has been subpoenaed, and is fighting the subpoena, in the District Court Litigation and is thus “materially involved” and invested in the District Court Litigation. Prelim. Sur-reply 1–2. We disagree that Petitioner’s involvement in fighting a third party discovery

request in a district court proceeding results in material investment in the parallel proceeding that would support exercise of discretion to deny the Petition. We note that Petitioner has not been accused of infringement; nor has Petitioner filed any briefing on infringement, invalidity, or claim construction.

Additionally, although the district court issued a claim construction order, and the parties to the District Court Litigation have exchanged infringement and invalidity contentions, with fact discovery set to close in September 2024, the parties to the proceeding have yet to exchange dispositive motions, and expert discovery has not yet closed. *See* Pet. 73; Prelim. Resp. 7–8; Prelim. Sur-reply 3–4. Thus, significant effort by the parties to the parallel proceeding still remains to be expended.

Patent Owner also asserts that Petitioner “did not expeditiously file its Petition” as it waited ten months after the district court complaint was filed, more than five months after Petitioner’s customer was served invalidity contentions, and more than four months after Petitioner was served with a District Court Litigation subpoena, before filing its Petition. Prelim. Resp. 28 (citing Ex. 2004 (Subpoena); Ex. 2001 (Docket Sheet)). Petitioner, however, was not sued in, and is not a party to, the District Court Litigation. Thus, we disagree that Petitioner was not diligent in filing its Petition.

Therefore, although there has been some investment in the District Court Litigation, the facts that (a) Petitioner is not a party to the District Court Litigation, (b) there remains significant investment still to be expended by the parties to that litigation, and (c) Petitioner diligently filed the petition, together outweigh the investment to date by the parties to District Court Litigation such that this factor does not weigh in favor of exercising discretion to deny institution.

Factor 4 (issue overlap) weighs against denying institution.

The Petition challenges all 24 claims of the '360, whereas only 8 claims are challenged in the district court litigation. Pet. 74. Because a number of challenged claims will not be at issue in the district court, non-overlapping issues likely will remain even after the parallel litigation concludes.

Moreover, although there is overlap in asserted prior art references, Petitioner mitigates the potential for issue overlap by stipulating that if its Petition is instituted, it will not raise in any future litigation that might be brought by Patent Owner or Akoustis involving the '360 patent, any invalidity challenges based on the prior art asserted here. Pet. 74. Although Petitioner has not stipulated to forgo relying on any ground that was raised or could have been reasonably raised in the IPR (*see Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 at 18–19 (precedential as to § II.A.)), Petitioner's stipulation will likely help to streamline the issues. Therefore, the lack of overlap in the challenged claims and Petitioner's stipulation weigh against exercising discretion to deny institution.

With regard to factor 5 (whether the petitioner and the defendant in the parallel proceeding are the same party), Petitioner is not a party to the District Court Litigation.⁸ Patent Owner, however, argues that Petitioner is involved in the litigation because Petitioner's customer, Qorvo, is a party to the District Court Litigation, Qorvo may be joined as a petitioner to the present proceeding, and Petitioner's subsidiary (IQE KC, LLC) was subpoenaed in the litigation. Prelim. Resp. 31–32 (citing Ex. 2004

⁸ Although Patent Owner is not a party to the District Court Litigation, Patent Owner identifies Akoustis as the exclusive licensee of the '360 patent. *See* Paper 4, 1 (identifying "I. Real Party of Interest (37 C.F.R. § 42.8(b)(1))").

(Subpoena); Ex. 2003 (IQE Corporate Disclosure); Ex. 2021 (Mot. To Quash Response); Ex. 2002 (Misc. Docket Sheet)). Patent Owner further argues that Petitioner is “highly involved” in the District Court Litigation and “tightly coupled” with Qorvo, because Petitioner supplies materials to Qorvo; Petitioner filed its Petition after Petitioner’s subsidiary was subpoenaed in the litigation; Petitioner’s subsidiary filed a motion to quash the subpoena; Petitioner relies on a subset of references that are relied upon by Qorvo in the litigation; and Petitioner and Qorvo filed nearly identical Petitions and share an expert. Prelim. Resp. at 32–33.

Petitioner does not persuade us that it is “highly involved” in the District Court Litigation. Significantly, Petitioner is not a party to the litigation. The fact that Petitioner’s subsidiary was served with a discovery subpoena does not mean that Petitioner is a party to the litigation. Similarly, the fact that Petitioner relies on a subset of art that was publicly disclosed in the District Court Litigation, or that Qorvo filed a petition similar to a petition that was publicly available, does not show that Petitioner is “highly involved” in the litigation. As such, this factor weighs against denying institution.

Finally, under factor 6 (other circumstances, including the merits), for the reasons discussed below, on the current record, we determine Petitioner’s challenges have strong merit, which weighs against denying institution.

Weighing these factors in a holistic analysis, we conclude that the factors disfavoring denial (factors 3–6) outweigh those in favor (factor 2) and that the interests of efficiency and integrity of the system would be best served by declining to exercise our discretion to deny under 35 U.S.C. § 314(a).

B. Level of Ordinary Skill in the Art

We consider the grounds of unpatentability in view of the understanding of a person of ordinary skill in the art (sometimes abbreviated herein as “POSITA”). *Graham*, 383 U.S. at 17–18. Petitioner asserts that a person of ordinary skill in the art of the ’360 patent “would have a bachelor’s degree in electrical engineering, computer engineering, chemical engineering, or an equivalent field, or an advanced degree in those fields, as well as [at] least 3–5 years of academic or industry experience in nucleation and epitaxial growth processes, or comparable industry experience.” Pet. 9 (citing Ex. 1003 ¶ 56).

Patent Owner proposes a slightly different formulation of the level of skill in the art, namely, that a POSITA “would have a bachelor’s degree in electrical engineering, materials science, chemical engineering, or an equivalent field, and such a person would have at least 3 years of academic or industry experience in nucleation and epitaxial growth processes, or other comparable industry experience,” where “[t]his level of skill is approximate and more experience would compensate for less formal education, and vice versa.” Prelim. Resp. 7. Nevertheless, Patent Owner asserts that “the result here does not depend on which of the two articulations that the Board chooses.” *Id.* at 8.

For the purposes of this Decision, we adopt Patent Owner’s proposal because we find Patent Owner’s statement of the level of ordinary skill in the art adequate and supported on this record. The level of ordinary skill in the art also appears to be reflected by the prior art of record. *See Okajima v. Bourdeau*, 261 F.3d 1350, 1355 (Fed. Cir. 2001). We also note that the outcome of this Decision would be the same under Petitioner’s proposed definition.

C. Claim Construction

We interpret a claim “using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. [§] 282(b).” 37 C.F.R. § 42.100(b). Under this standard, we construe the claim “in accordance with the ordinary and customary meaning of such claim as understood by one of ordinary skill in the art and the prosecution history pertaining to the patent.” *Id.*

“[T]he ordinary and customary meaning of a claim term is the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention” and “after reading the entire patent” and its prosecution history. *Phillips v. AWH Corp.*, 415 F.3d 1303, 1313, 1321 (Fed. Cir. 2005) (en banc). A claim term, however, may not receive its plain and ordinary meaning if the patentee acted as his own lexicographer and clearly set forth a definition of disputed term in either the specification or the prosecution history. *CCS Fitness, Inc. v. Brunswick Corp.*, 288 F.3d 1359, 1366 (Fed. Cir. 2002). Only terms that are in controversy need to be construed, and then only to the extent necessary to resolve the controversy. *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999).

At this stage, “Petitioner submits that all claim terms should receive their plain and ordinary meaning in the context of the ’360 patent specification.” Pet. 9. “Patent Owner agrees that no express claim constructions are required and that all claim terms should be given their plain and ordinary meaning.” Prelim. Resp. 6.

Although both parties state that no express claim construction is required, the parties’ unpatentability arguments raise two claim construction issues that require discussion, namely (1) whether claim 1 requires that at

least one group II/III material is kept on after the pretreatment step [1b] and (2) whether the claims require pretreatment of the entire surface of the substrate as opposed to merely *a part* of a surface of the substrate. We address these issues below.

1. *Whether claim 1 requires that at least one group II/III material is kept on after pretreatment step [1b]*

Patent Owner argues that claim 1 “requires that at least one group II/III material is kept on [i.e., continues flowing] after (b) pretreatment when the group V/VI material is introduced for the (c)/(d) nucleation and buffer layers.” Prelim. Resp. 34; *see also id.* at 37–38 (stating the same). To support this argument, Patent Owner states that the “claim does not say that all group II/III materials are turned off, but says ‘introducing a group V reactant or a group VI reactant to grow a nucleation layer on the surface of the substrate’ and then ‘growing a buffer layer on said nucleation layer.’” *Id.* at 34–35 (quoting Ex. 1001, claim 1); *see also id.* at 35 (stating the “specification of the ’360 patent says the same”) (citing Ex. 1001, Abstract, 1:53–57, 2:25–30, 2:47–50, 2:56–58, 3:15–25, 3:65–4:7).

Patent Owner further asserts that Figure 1 of the ’360 patent shows that at least one group III reactant (i.e., the aluminum reactant (TMA)) continues to flow after pretreatment when NH₃ is turned on in the upper panel and that both the aluminum (TMA) and gallium (TEG) group III reactants continue to flow when NH₃ is turned on after pretreatment in the lower panel. Prelim. Resp. 36–37 (citing Ex. 1001, Fig. 1). Patent Owner also states that during prosecution, applicant “similarly pointed out that claim 1’s ‘pretreating step includes subjecting the surface of the substrate to at least one group III reactant or at least one group II reactant prior to

introducing a group V reactant or a group VI reactant.” Prelim. Resp. 37 (quoting Ex. 1002, 47⁹) (emphasis in original).

We disagree with Patent Owner’s arguments. The plain language of claim 1 does not recite any limitation regarding whether or not a group III/II reactant *must* continue to flow or must stop after the pretreatment step. Claim step [1b] simply recites “pre-treating a surface of the substrate with at least one group III reactant or at least one group II reactant at an elevated growth temperature prior to introducing a group V reactant or a group VI reactant.” Claim steps [1c] and [1d] simply recite “introducing a group V reactant or a group VI reactant to grow a nucleation layer on the surface of the substrate” ([1c]) and “growing a buffer layer on said nucleation layer, said buffer layer providing a surface upon which said epitaxial layer is grown” ([1d]). None of these steps contain any language either requiring or prohibiting the flow of the at least one group III/II reactant recited in step [1b]. Similarly, none of the cited portions of the Specification requires that at least one of the group III/II reactant must continue to flow after the pretreatment steps.

Patent Owner also points to Figure 1 of the ’360 patent, which depicts one (upper panel) or both (lower panel) of the two Group III reactants of the pretreatment step continue to flow after the pretreatment step, to support its claim construction argument. Prelim. Resp. 36–37. Figure 1, however, depicts examples of a preferred embodiment. See Ex. 1001, 3:49–53, 4:63–64. It is improper to read limitations from preferred embodiments described

⁹ Although Patent Owner refers to “Applicant’s December 8, 2006 office action” found at Ex. 1001, 47 (see Prelim. Resp. 37), we assume that Patent Owner intended to refer to Applicant’s December 8, 2006 *response* to the September 5, 2006 Office Action, found at Ex. 1002, 47.

in the specification into the claims absent a clear indication in the intrinsic record that the patentee intended the claims to be so limited. *See In re Van Geuns*, 988 F.2d 1184, 1184 (Fed. Cir. 1993); *see also Superguide Corp. v. DirecTV Enterprises, Inc.*, 358 F.3d 870, 875 (Fed. Cir. 2004) (stating “a particular embodiment appearing in the written description may not be read into a claim when the claim language is broader than the embodiment”).

Patent Owner also asserts that because claim 18 “shows that the applicant knew how to explain when a flow would be turned off,” that the “plain and ordinary meaning of claim 1 requires that at least one group II/III material is kept on after” pretreatment step [1b]. Prelim. Resp. 37–38.

We also disagree with this argument. Claims 1 and 18 recite different steps, including a different pretreatment step with different numbers of required pretreatment reactants. In particular, claim 1 step [1b] requires pretreatment with *at least one* reactant (i.e., “at least one group III reactant or at least one group II reactant”) while claim 18 step [18b] requires pretreatment with *at least two* reactants (i.e., “at least a first group III reactant and a second group III reactant”). Ex. 1001, 5:5–6, 6:16–18. While claim 18 step [18c] does require stopping the flow of one of its two required pretreatment reactants, claim 1 does not recite any limitation about stopping—or not stopping—the flow of its one required pretreatment reactant or the flow of any other unclaimed pretreatment reactants.

Thus, we do not see, nor does Patent Owner persuasively explain, how claim 18’s requirement to stop the flow of one of its two required pretreatment reactants means that claim 1 requires *not stopping* the flow of its one required pretreatment reactant or any other unclaimed pretreatment reactants. In other words, claim 18’s requirement that flow of one of the at

least two required pretreatment reactants must stop does not compel interpreting claim 1 to prohibit stopping the flow of a pretreatment reactant.

Thus, based on the present record, we do not construe claim 1 as requiring “that at least one group II/III material is kept on after (b) pretreatment when the group V/VI material is introduced for the (c)/(d) nucleation and buffer layers” as asserted by Patent Owner.

The parties are free to address this claim construction issue during trial if they so choose.

2. “a surface of the substrate”

Patent Owner also asserts that claim 1 requires “pretreatment of ‘a surface of the substrate’ and not merely *a part* of a ‘surface of the substrate.’” Prelim. Resp. 40; *see also id.* at 39–41 (asserting Urashima (Ex. 1004) only treats part of a surface of a substrate).

Patent Owner does not state how to distinguish between the surface of a substrate and part of a surface of a substrate. With respect to Urashima, Patent Owner does not clearly explain why Urashima only pretreats a part of a surface of a substrate as opposed to a surface of a substrate. Patent Owner cites to Petitioner’s annotated Figure 1(a) from Urashima, reproduced below, as showing “‘deposited particles’ on *a part* of ‘a surface of the substrate’” and states that “Petitioner thus alleges that Urashima discloses this pretreating through ‘depositing particles’ on *a part* of ‘a surface of a substrate.’” *Id.* at 40 (quoting Pet. 17–19).

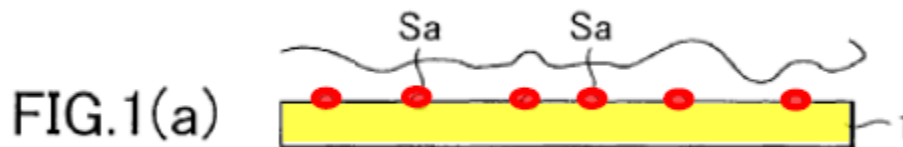


Figure 1(a), with Petitioner’s color coding of group III metal Sa highlighted in red and substrate 1 in yellow added, depicts a step in the process of

forming a semiconductor in which “a metal element, preferably metal nuclei (droplets) Sa of a group III metal element are adhered to a substrate 1.”

Ex. 1004 ¶¶ 106–107; Pet. 17–18.

Patent Owner also cites to the Specification of the ’360 patent as “mak[ing] clear that the patent wants (b) pretreatment that focuses on a reaction causing an ‘aluminum *saturated* surface’ and not merely ‘depositing particles.’” Prelim. Resp. 40 (quoting Ex. 1001, 1:65–2:2) (emphasis added). Thus, it appears that Patent Owner asserts that pretreating “a surface of the substrate” requires *saturating* the surface and not merely “depositing particles” and that Urashima’s pretreatment step does not saturate the surface, and, therefore, only pretreats a part of the surface. See Prelim. Resp. 40–41.

We disagree with Patent Owner’s argument. The portion of the Specification cited by Patent Owner relates to a preferred embodiment. See Ex. 1001, 1:65–2:2 (“In a preferred embodiment, *aluminum reacts with the surface of the substrate* providing the needed nucleation sites while gallium prepares the *aluminum saturated surface* for subsequent growth of the epitaxial layer”) (emphases added)). As noted above, it is improper to read limitations from preferred embodiments into the claim.

Patent Owner also cites to an office action response as “similarly focus[ing] on (b) pretreatment being of ‘a surface of the substrate’ and not merely *a part* of a ‘surface of the substrate.’”). Prelim. Resp. 40 (quoting Ex. 1002, 47). Contrary to Patent Owner’s assertion, however, the response, does not focus on, or even distinguish between, the surface of the substrate and *a part* of the substrate or whether or not the pretreatment step requires the saturation of the substrate. Rather, the response merely states that the claims are “directed to a process for growing an epitaxial layer on a lattice

mismatched substrate” including a pretreatment step, which “includes subjecting the surface of the substrate to at least one group III reactant or at least one group II reactant prior to introducing a group [V/VI] reactant.”

Ex. 1002, 47 (emphasis in original).

Patent Owner also states that its proposed claim construction is supported by the fact that Petitioner’s customer, Qorvo, “originally proposed (but now dropped) a construction of ‘a surface of a substrate’ that would read in the *a part* language: ‘an area on the substrate’s surface upon which a layer may be grown.’” Prelim. Resp. 40–41 (citing Ex. 2006 (Joint CC Statement)). Patent Owner asserts “that is not the construction Petitioner puts forth here, and Petitioner’s theory from Urashima therefore fails as to the claimed (b) pretreatment.” *Id.* at 41. We disagree with this argument. First, the mere fact that a third party proposed a claim construction in another venue does not compel adoption of that claim construction in the present proceeding. Moreover, the construction proposed in the District Court Litigation relates to the substrate’s surface area “upon which a layer may be grown.” It is unclear how this proposed construction relates to Patent Owner’s assertion that failure to saturate the substrate surface results in pretreatment of only a part of the substrate surface.

Thus, based on the present record, we disagree with Patent Owner’s argument that the plain and ordinary meaning of pretreating step [1b] requires pretreatment “of ‘a surface of the substrate’ and not merely *a part* of a ‘surface of the substrate’” such that the claim requires saturating the substrate’s surface and not merely depositing particles. *See id.* at 39–41.

The parties are free to address this claim construction issue during trial if they so choose.

No further construction of these terms, or other claim terms, is required for purposes of this Decision. *See Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (citing *Vivid Techs., Inc. v. Am. Sci. & Eng'g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999)) (holding that only claim terms in controversy need to be construed, and only to the extent necessary to resolve the controversy).

D. Principles of Law

“In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is unpatentable.” *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify “with particularity . . . the evidence that supports the grounds for the challenge to each claim”)). This burden of persuasion never shifts to Patent Owner. *See Dynamic Drinkware, LLC v. Nat’l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

A claim is unpatentable as obvious under § 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) when in evidence,¹⁰ objective indicia of non-obviousness (i.e., secondary considerations). *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966). “To satisfy its burden of proving obviousness, a petitioner cannot employ mere conclusory statements. The petitioner must instead articulate specific reasoning, based on evidence of record, to support the legal conclusion of obviousness.” *In re Magnum Oil Tools Int’l, Ltd.*, 829 F.3d 1364, 1380 (Fed. Cir. 2016).

We analyze the asserted grounds of unpatentability in accordance with these principles to determine whether Petitioner has met its burden to establish a reasonable likelihood of success at trial.

E. Urashima-Based Grounds (Grounds 1–4)

1. Urashima (Ex. 1004)

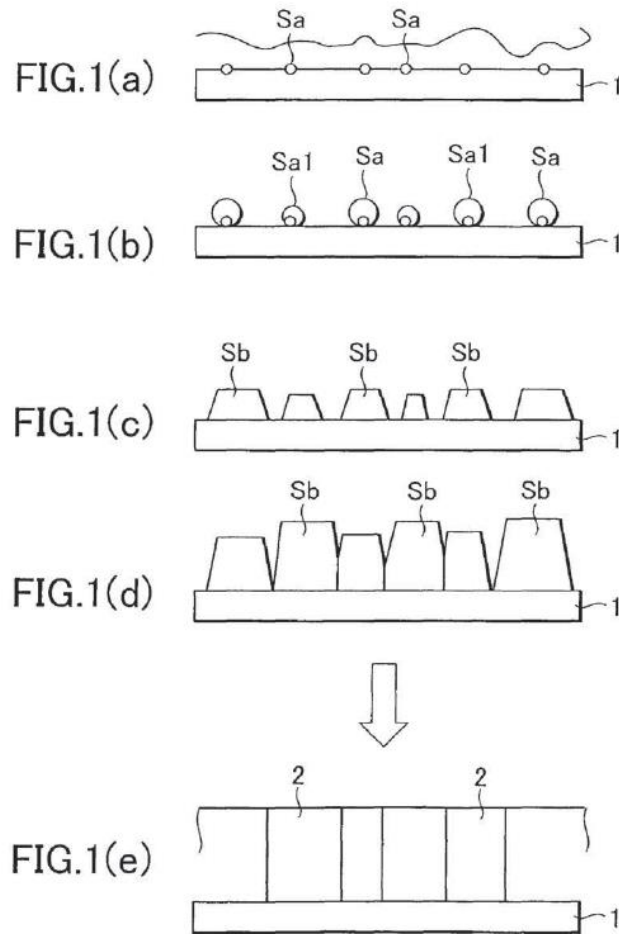
Urashima is a U.S. Patent Application Publication titled “Method of Fabricating Group-III Nitride Semiconductor Crystal, Method of Fabricating Gallium Nitride-Based Compound Semiconductor, Gallium Nitride-Based Compound Semiconductor, Gallium Nitride-Based Compound Semiconductor Light-Emitting Device, and Light Source Using the Semiconductor Light-Emitting Device.” Ex. 1004, code (54). Urashima discloses that group-III nitride semiconductors are useful for fabricating light-emitting diodes (LEDs) and laser diodes (LDs). *Id.* ¶¶ 1–2. In particular, Urashima describes that sapphire (Al₂O₃) and silicon carbide (SiC) substrates are employed for epitaxially grown group-III nitride compound semiconductor crystals, but that “[t]here is a large lattice mismatch between such a substrate and the” crystals. *Id.* ¶¶ 3–4. This

¹⁰ At this stage of the proceeding, neither party has provided any evidence or argument regarding objective indicia of non-obviousness.

“makes it difficult to epitaxially grow the crystal directly on the substrate, and even when such growth is achieved, the crystallinity is not good.” *Id.* ¶ 4.

Urashima proposes “a simplified method of fabricating a group-III nitride semiconductor crystal that enables formation of a high-quality group-III nitride semiconductor crystal,” as compared with the prior “method of using a low-temperature buffer layer that requires the optimization of many fabrication conditions.” *Id.* ¶ 12. Specifically, Urashima’s method comprises “depositing particles of a group III metal on a substrate surface,” “nitriding the particles in an atmosphere containing a nitrogen source,” and “using a vapor phase growth method to grow [a] group-III nitride semiconductor crystal.” *Id.* ¶ 16.

Figures 1(a)–1(e), reproduced below, show “the growth mechanisms in the steps of forming a layer of gallium nitride-based compound semiconductor.” *Id.* ¶ 106.



Urashima's Figure 1(a) shows a first step A within an epitaxial growth apparatus of adhering metal nuclei labeled "Sa" of a group III metal to substrate 1, which may be, for example, a sapphire substrate that has been thermally cleaned at a temperature between 1000 °C and 1200 °C. *Id.* ¶¶ 107, 109. After reducing the temperature in the growth apparatus, in the next step B, shown in Figure 1(b), metal nuclei Sa are annealed, and in a further step C, shown in Figure 1(c), annealed metal nuclei are nitrided to form growth nuclei, labeled "Sb." *Id.* In the step D shown in Figure 1(d), "a gallium nitride-based compound semiconductor layer is grown on the substrate 1 having the growth nuclei Sb." *Id.* ¶ 108. Urashima describes that "[a] different temperature can be used in each of the steps A, B and C,

or different temperatures can be used for steps A and B, and steps B and C,” and that “step D can be effected at a lower temperature than steps A to C, or at the same temperature.” *Id.* ¶ 110. The result of the steps illustrated by Figures 1(a) to 1(d) is “a flat, horizontal layer of gallium nitride-based compound semiconductor 2,” as shown in Figure 1(e).

2. *Nagata (Ex. 1005)*

Nagata is a Japanese Patent Application Publication titled “Method for Manufa[c]turing Semiconductor Quantum Well Box.” Ex. 1005, code (54). Nagata relates to “a method for manufacturing a semiconductor quantum well box with no crystal plane dependence and no damage to the crystal.” *Id.* at code (57). In particular, Nagata’s method “does not require an electron beam exposure process or an etching process, and cleverly utilizes only the initial process of epitaxial growth.” *Id.* ¶¶ 5–7. Nagata’s method includes producing “quantum well boxes comprising semiconductors made of group 3–5 compounds such as AlGaAs, InP, and InGaAsP and semiconductors comprising group 2–6 compounds such as CdSe, CdSSe, ZnSe, ZnSSe, and CdTe.” *Id.* ¶ 13.

3. *Keiper (Ex. 1006)*

Keiper is an article titled “Metal organic vapour-phase epitaxy (MOVPE) growth of InP and InGaAs using tertiarybutylarsine (TBA) and tertiarybutylphosphine (TBP) in N₂ ambient.” Ex. 1006, 256. In particular, Keiper discloses using “the combination of N₂ and TBA/TBP for the planar growth on unpatterned InP in a commercial MOVPE system,” which “provide[s] an inherently ‘safe process’ for MOVPE of III-V materials and in addition has the potential for increased wafer uniformity.” *Id.* at 257.

4. *Manabe (Ex. 1007)*

Manabe is a U.S. Patent titled “Substrate for Growing Gallium Nitride Compound-Semiconductor Device and Light Emitting Diode.” Ex. 1007, code (54). Manabe notes that “a high-quality gallium nitride compound-semiconductor crystal has not been obtained due to lattice mismatching between sapphire and gallium nitride compound-semiconductor as a light emitting layer and to the vast difference in vapor pressure between gallium and nitrogen.” *Id.* at 1:24–29. Accordingly, Manabe proposes a solution for “grow[ing] a high-quality single crystalline gallium nitride compound-semiconductor having fewer lattice defects on a sapphire substrate,” so as “to provide a light emitting diode in which blue light is a high-efficiency emitting light.” *Id.* at 1:38–47.

In an embodiment, a vapor phase growing system includes “a carrier gas-supplying system,” “a trimethylgallium (referred to as TMG)-supplying system,” “a trimethylaluminium (referred to as TMA)-supplying system,” and “a diethylzinc (referred to as DEZ)-supplying system” connected to a first manifold, and the carrier gas-supplying system and an NH₃-supplying system connected to a second manifold. Ex. 1007, 4:17–24. This system allows “a mixed gas comprising TMG, TMA, H₂ and DEZ-H₂” to be introduced through a first gas pipe, and an “NH₃ and H₂ mixed gas” to be introduced through a second gas pipe. *Id.* at 4:39–42. The mixed reaction gas is introduced to a sample loading compartment such that the flow on a sapphire substrate is constant and uniform, “so that high-quality crystal with less position-dependency may grow.” *Id.* at 4:43–51.

5. *Asserted Unpatentability of Claims 1–4 and 6–14
(Ground 1)*

Petitioner argues that claims 1–4 and 6–14 would have been obvious over Urashima. Pet. 15–30. Patent Owner opposes. Prelim. Resp. 33–44. Having considered the parties’ contentions and supporting evidence, we determine that Petitioner has established a reasonable likelihood of showing that claims 1–4 and 6–14 would have been obvious over the Urashima-based grounds.

a) *Claim 1 - Petitioner’s Contentions*

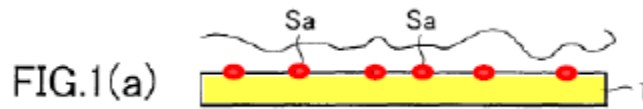
(1) *Preamble and Claim element 1[a] – A process for growing an epitaxial layer on a lattice matched substrate comprising the steps of providing a substrate*

Petitioner asserts that Urashima’s method of fabricating a group-III nitride semiconductor crystal on a sapphire substrate discloses the preamble and claim step 1[a] (i.e., “[a] process for growing an epitaxial layer on a lattice matched substrate comprising the steps of: providing a substrate;”). Pet. 15–17 (citing Ex. 1003 ¶¶ 67–72; Ex. 1004 ¶¶ 3–4, 12, 25, 35, 47, 67, 89–90, 107, 109, 133, 153, Figs. 1(a)–(e)); see also Pet. 15 (stating that Urashima’s layer of gallium nitride-based compound semiconductor crystal discloses the claimed “epitaxial layer”).

(2) *Claim element 1[b] – pre-treating a surface of the substrate with at least one group III reactant or at least one group II reactant at an elevated growth temperature prior to introducing a group V reactant or a group VI reactant*

Petitioner asserts that Urashima’s “step A (the first step)” discloses the pre-treating step recited in claim step [1b] (i.e., “pre-treating a surface of the substrate with at least one group III reactant or at least one group II reactant at an elevated growth temperature prior to introducing a group V

reactant or a group VI reactant”). Pet. 17–19 (citing Ex. 1004 ¶¶ 16, 89, 107, Fig. 1(a) (shown below)).



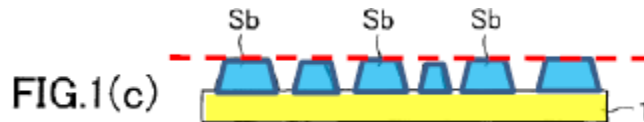
Urashima’s Figure 1(a), with Petitioner’s color annotations added, depicts step A of forming a semiconductor in which metal nuclei (droplets) Sa (shown in red) of a group III metal element are adhered to substrate 1 (yellow). Ex. 1004 ¶¶ 106, 107.

Petitioner explains that in Urashima’s “step A (the first step), a metal element, preferably metal nuclei (droplets) Sa of a group III metal element are adhered to a substrate 1.” Ex. 1004 ¶ 107; *see also* Pet. 18 (quoting Ex. 1004 ¶ 107); Pet 11 (citing Ex. 1004 ¶¶ 106–107). Petitioner further asserts that Urashima’s first step occurs at an elevated growth temperature between 900 and 1100 °C. Pet. 19 (citing Ex. 1003 ¶ 75; Ex. 1004 ¶¶ 25, 28, 109). Petitioner also asserts Urashima discloses that the group III metal, Sa, is introduced before introducing a nitrogen reactant (a group V reactant). *Id.* (citing Ex. 1004 ¶¶ 25, 83, 89, 119, Abstract; Ex. 1003 ¶ 76).

(3) Claim element 1[c] – introducing a group V reactant or a group VI reactant to grow a nucleation layer on the surface of the substrate

Petitioner asserts that Urashima discloses claim step [1c]. Pet. 20–23. Petitioner states that Urashima discloses nitriding the deposited group III metal particles in an atmosphere containing a nitrogen source. *See id.* at 20 (citing Ex. 1004 ¶¶ 16, 89, 113). Petitioner states a POSITA would have understood that “nitriding the particles in an atmosphere containing a nitrogen source,” such as ammonia, is an example of “introducing a group V reactant.” *Id.* (citing Ex. 1003 ¶ 78; Ex. 1004 ¶¶ 85, 123; Ex. 1001, 2:60–62,

3:22–25). Petitioner also states that Urashima discloses that nitriding the particles is carried out in order to grow a nucleation layer on the surface of the substrate. *Id.* (citing Ex. 1003 ¶¶ 79, 88, 107, 108). Petitioner asserts that Urashima’s Figure 1(c), shown below, depicts nitriding the annealed metal nuclei Sa1¹¹ “to form growth nuclei Sb.” *Id.* (citing Ex. 1004 ¶¶ 107, 108, 113).



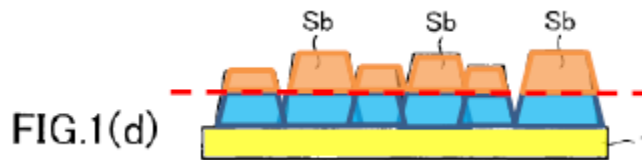
Urashima’s Figure 1(c), with Petitioner’s color annotations added, depicts step C of forming a semiconductor in which the annealed metal nuclei Sa1 are nitrided to form growth nuclei Sb. Ex. 1004 ¶¶ 106, 107; Pet. 21.

Petitioner asserts that Urashima’s growth nuclei Sb shown in Figure 1(c) collectively represent the claimed “nucleation layer.” Pet. 21–22. More particularly, Petitioner asserts that when Urashima’s growth nuclei Sb are formed by subjecting group metal III metal particles Sa or Sa1 to a nitrogen source (introducing a group V reactant), in some instances, the resulting grown nuclei Sb are composed of some combination of In, Ga, and/or Al and N (e.g., AlN, AlGa_xN, or GaN, which have a composition of Al_xGa_{1-x}N, where x varies from 0 to 1). *Id.* at 21–22 (citing Ex. 1003 ¶¶ 80–87; Ex. 1004 ¶¶ 16, 18, 25, 37, 81, 89, 107, 113, 117; Ex. 1001, 1:59–62 (stating that in a preferred embodiment the nucleation layer is Al_xGa_{1-x}N where x varies from 0 to 1)).

¹¹ Urashima states that in step B, metal nuclei Sa are annealed to form annealed metal nuclei Sa1. Ex. 1004 ¶ 107.

- (4) *Claim element 1[d] – growing a buffer layer on said nucleation layer, said buffer layer providing a surface upon which said epitaxial layer is grown*

Petitioner asserts that Urashima discloses growing a buffer layer as required by claim step [1d]. Pet. 23–26. Petitioner asserts that Urashima’s additional GaN-based compound semiconductor layer grown in step D—which is the layer depicted in orange above the red dashed line in Figure 1(d) of Urashima below—represents “growing a buffer layer on said nucleation layer” as recited in step [1d]. *Id.* at 24–25 (citing Ex. 1003 ¶¶ 91–92; Ex. 1004 ¶ 109).



Urashima Figure 1(d), with Petitioner’s color annotations added, depicts step D of forming a semiconductor in which a gallium nitride-based compound semiconductor is grown on substrate 1 having growth nuclei Sb. Ex. 1004 ¶¶ 106, 108.

Petitioner further states that Urashima states that after the layer is grown in step D, “it is therefore possible to form a layer of gallium nitride-based compound semiconductor 2 of a desired thickness and crystallinity” as shown in Urashima Figure 1(e). Pet. 25 (citing Ex. 1004 ¶¶ 114, 108, 140; Ex. 1003 ¶ 93). Petitioner further asserts that a POSITA would have understood that gallium nitride-based compound semiconductor 2 is an epitaxial layer, as recited in claim step [1.d]. *Id.* (citing Ex. 1003 ¶ 93).

Petitioner further states that to the extent that Urashima does not explicitly disclose growing an epitaxial layer on a buffer layer, that Urashima also discloses stacking multiple layers of GaN-based compound semiconductor 2 and that when such stacking is performed, a second layer of

GaN-based compound semiconductor 2 (i.e., an epitaxial layer) would necessarily be grown on the GaN-based compound semiconductor layer grown in step D (“*said buffer layer*”). *Id.* at 25–26 (citing Ex. 1003 ¶ 94; Ex. 1004 ¶¶ 46, 55, claim 77).

We have reviewed Petitioner’s arguments and evidence as stated above and determine that Petitioner has sufficiently shown a reasonable likelihood that claim 1 would have been obvious over Urashima, notwithstanding Patent Owner’s arguments to the contrary, which we address below.

b) Claim 1 - Patent Owner’s Arguments

Patent Owner does not dispute most of Petitioner’s contentions at this stage of the proceeding. Rather, Patent Owner presents two arguments as to why Urashima does not teach or suggest claim 1, both of which are based on Patent Owner’s proposed claim constructions, which we do not adopt. Prelim. Resp. 34–41; *see supra* Section II.C.

First, Patent Owner asserts that the “plain and ordinary meaning of claim 1 requires that at least one group II/III material is kept on after the step of (b) pretreatment when the group V/VI material is introduced for the (c)/(d) nucleation and buffer layers.” Prelim. Resp. 37–38; *see also id.* at 34–38 (providing arguments to support this claim construction). Patent Owner asserts that Urashima does not meet this limitation because it “is clear that [Urashima’s] group-V nitrogen material *should not* be introduced along with any metals (such as group-III gallium).” *Id.* at 38–39. We disagree with this argument because it is based on a claim construction that, at least at this stage of the proceeding, we do not adopt.

Second, Patent Owner asserts that claim 1 states that “the (b) pretreatment is of ‘a surface of the substrate’ and not merely *a part* of ‘a

surface of the substrate,’” Prelim. Resp. 40. Patent Owner asserts that Petitioner does not show Urashima meets this limitation because Petitioner “alleges that Urashima discloses this pretreating through ‘depositing particles’ on a part of ‘a surface of the substrate.’” *Id.* (citing Pet. 17–19). We disagree with this argument because it is based on a claim construction that, at least at this stage of the proceeding, we do not adopt.

Thus, for the foregoing reasons, we determine that Petitioner has established a reasonable likelihood of prevailing on its assertions that claim 1 would have been obvious over Urashima.

Because we determine that Petitioner has shown a reasonable likelihood of prevailing at trial in demonstrating that at least one claim is unpatentable on at least one of the stated Grounds, we institute *inter partes* review of all challenged claims of the ’360 patent based on the remaining grounds identified in the Petition. *See SAS Inst., Inc. v. Iancu*, 584 U.S. 357, 371 (2018); *PGS Geophysical*, 891 F.3d at 1360 (interpreting the statute to require “a simple yes-or-no institution choice respecting a petition, embracing all challenges included in the petition”). Nevertheless, we provide our preliminary views with respect to remaining challenges below, based upon the parties’ arguments and the evidence of record as presently developed.

c) Claims 2–4 and 6–14

Petitioner asserts that claims 2–4 and 6–14 would have been obvious over Urashima. Pet. 26–30. Other than the arguments set forth above with respect to claim 1, Patent Owner does not dispute Petitioner’s contentions.

We have reviewed Petitioner’s arguments and evidence and determine that Petitioner has sufficiently shown, at this stage of the proceeding, that Urashima teaches or suggest all of the limitations of claims these claims.

Accordingly, we determine that Petitioner has demonstrated a reasonable likelihood of showing that claims 2–4 and 6–14 would have been obvious over Urashima. *See* Pet. 26–30.

6. *Asserted Unpatentability of Claims 5 and 15–17 over Urashima in Combination with Nagata and Keiper (Grounds 2–3)*

Petitioner argues that claims 5 and 17 would have been obvious over Urashima and Nagata (Pet. 30–35) and that claims 15 and 16 would have been obvious over Urashima and Keiper (Pet. 35–40). Other than the arguments set forth above with respect to claim 1, Patent Owner does not dispute Petitioner’s contentions.

We have reviewed Petitioner’s arguments and evidence and determine that Petitioner has sufficiently shown, at this stage of the proceeding, that Urashima teaches or suggest all of the limitations of claims these claims. Accordingly, we determine that Petitioner has demonstrated a reasonable likelihood of showing that claims 5 and 17 would have been obvious over Urashima and Nagata (Pet. 30–35) and that claims 15 and 16 would have been obvious over Urashima and Keiper (Pet. 35–40).

7. *Asserted Unpatentability of Claims 18–24 over Urashima in Combination with Manabe (Ground 4)*

Petitioner argues that independent claim 18 and claims 19–24 which depend upon claim 18, would have been obvious over Urashima in combination with Manabe. Pet. 40–50. Petitioner sets forth where Urashima or Manabe discloses each limitation of claims 18–24 and sets forth reasons for combining the teachings of the two references to arrive at the challenged claims. *Id.*

For example, with respect to claim 18, Petitioner asserts that Urashima teaches a process for depositing particles of group III metal on a

substrate (step [18.a]), that involves pretreating a surface of the sapphire substrate with a metallo-organic materials containing gallium (a first group III reactant) or aluminum (a second group III reactant) (step [18.b]), stopping the flow of a first group III reactant (step [18.c]), introducing a nitrogen source (step [18.d]), and growing a buffer layer (step [18.e]). Pet. 40, 44–47, 50 (citing Ex. 1004 ¶¶ 16, 25, 28, 43, 46–47, 55, 81, 83, 89–90, 108–109, 114–115, 119, 128; Ex. 1003 ¶¶ 57, 160, 164, 173).

Petitioner relies on the combination of Urashima and Manabe for teaching resuming the flow of the first group III reactant and reducing a flow of a second group III reactant as required by step [18.e] and for stopping the flow of the second group II reactant, as required by step [18.f]. Pet. 47–49. Petitioner acknowledges that Urashima does not stop only the first group III reactant while allowing the second group III reactant to continue to flow. *Id.* Petitioner, however, asserts that Manabe discloses a process where at least one group III metal continues to be introduced during the introduction of the nitrogen source and that providing such a mixed atmosphere during the nitriding process results in high-quality crystal with less position-dependency. *Id.* at 41–42 (citing Ex. 1007, 1:38–42, 4:48–51, Abstract), 47–48 (citing Ex. 1007, 4:39–43, 5:5–8, 6:32–37, Fig. 1; Ex. 1003 ¶ 167). Petitioner asserts that a POSITA would have been motivated to modify Urashima to continue the flow of the second group III reactant (the metallo-organic material containing aluminum) during the introduction of the nitrogen source in the second step because, *inter alia*, a POSITA would have recognized that Manabe’s techniques are applicable to Urashima and that such a modification would produce high-quality crystal with less position-dependency, improved uniformity, and produce few lattice defects on a sapphire substrate. *Id.* at 42–43. Petitioner also asserts that a POSITA would

have had a reasonable expectation of success in implementing Manabe's mixed atmosphere during Urashima's nitriding process. *Id.* at 42–44 (citing, *inter alia*, Ex. 1003 ¶¶ 151–153; Ex. 1004 ¶ 137; Ex. 1007, 1:38–42, 4:48–51).

At this stage of the proceeding, Patent Owner does not dispute most of Petitioner's contentions. Patent Owner, however, asserts that "Petitioner's argument fails as to the (b) pretreatment followed by (c)(d)/(e)(f)(g) nucleation and buffer layers [of claim 18]," because as "discussed for claim 1, Urashima is clear that its group-V nitrogen material *should* not be introduced along with any metals (such as group-III gallium)." Prelim. Resp. 42. Patent Owner asserts that "Urashima fails to teach or render obvious the formation of (c)(d) nucleation and (e)(f)(g) buffer layers after the (b) pretreatment as claimed." *Id.* at 43. Patent Owner also asserts that "Petitioner's hindsight-based use of Manabe to use Urashima as Urashima expressly disavows is inappropriate." *Id.* at 42–43.

Patent Owner's arguments are not persuasive at this stage of the proceeding. Petitioner relies on the *combination* of Urashima and Manabe, not only Urashima for teaching the limitations of claim 1, and provides reasons why a POSITA would have combined the teachings of Urashima and Manabe that are sufficient at this stage of the proceeding. *See, e.g.*, Pet. 47–49. Patent Owner's arguments raise issues that are best resolved on a full record.

Patent Owner also asserts that, for the same reasons set forth with respect to claim 1, "Petitioner's theory as to Urashima 'depositing particles' on *a part* of 'a surface of the substrate' is insufficient" and that Manabe does not cure these deficiencies. Prelim. Resp. 43.

We disagree with this argument for the same reasons set forth above with respect to claim 1.

F. Guo-Based Grounds (Grounds 5 and 6)

Petitioner argues that claims 1–4, 6–9, and 11–14 would have been obvious over Guo (Pet. 50–65) and that claims 5, 10, and 17 would have been obvious over Guo and Ashby (*id.* at 65–71). Patent Owner opposes. Prelim. Resp. 44–65. Having considered the parties’ contentions and supporting evidence, we determine that Petitioner has established a reasonable likelihood of showing that claims 1–14 and 17 would have been obvious over the Guo-based grounds.

1. Guo (Ex. 1008)

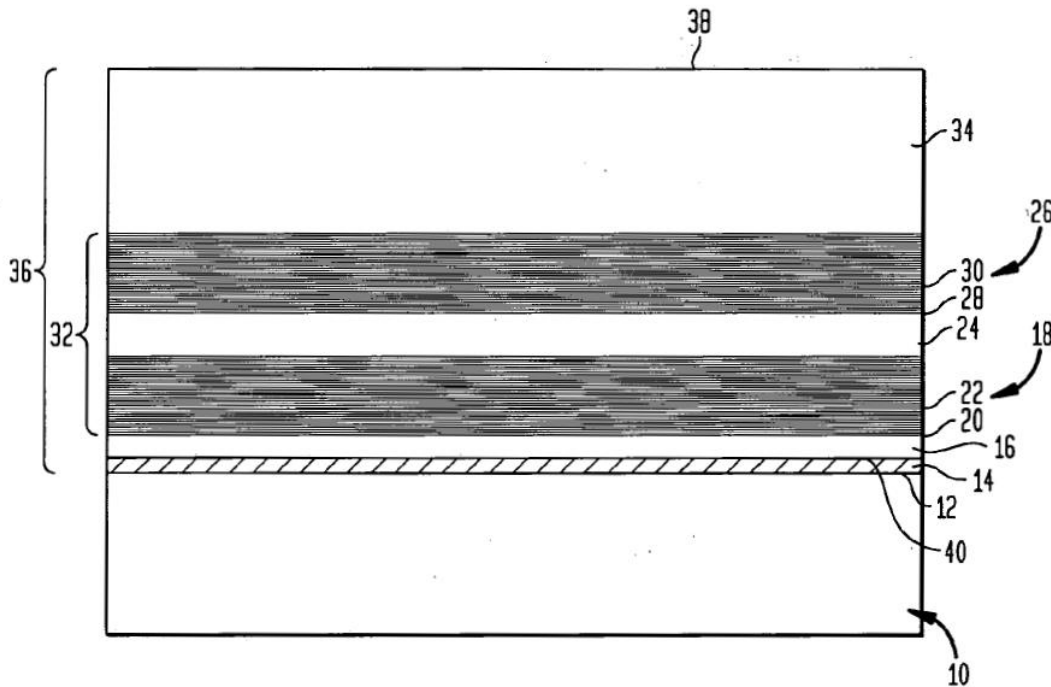
Guo is a U.S. Patent Application Publication titled “Gallium Nitride-Based Devices and Manufacturing Process.” Ex. 1008, code (54). Guo observes that “[n]itride semiconductors such as gallium nitride and related semiconductors are widely regarded as desirable bandgap compound semiconductors,” and “typically are formed by epitaxial growth on a substrate.” *Id.* ¶¶ 3–4. But, Guo notes, “[i]f the lattice spacing of the substrate is substantially different than that of the grown film, the grown film will have defects such as dislocations in the crystal lattice.” *Id.* ¶ 5. Guo discloses that “[h]igh quality silicon substrates are widely available at reasonable cost,” but that “the lattice spacing of silicon is not well matched to that of gallium nitride.” *Id.* ¶ 7.

Accordingly, Guo proposes “a method of making a semiconductor structure including the steps of depositing a small amount of aluminum directly on a silicon substrate to provide an aluminum protected substrate, and then depositing a nucleation layer of a nitride semiconductor on the aluminum protected substrate.” *Id.* ¶ 11. Guo’s method “further includes

the step of epitaxially growing a buffer structure including one or more superlattices of nitride semiconductor on the nucleation layer, and then epitaxially growing an operative structure including one or more gallium nitride-based semiconductors on the buffer structure.” *Id.*

Figure 1, reproduced below, shows “a fragmentary, diagrammatic sectional view on an enlarged scale of a semiconductor structure.” Ex. 1008 ¶ 23.

FIG. 1



The semiconductor structure in Guo’s Figure 1 begins with doped silicon substrate 10, which may be “a substantially mono-crystalline silicon wafer having a polished, flat top surface 12.” *Id.* ¶ 31. In a described method, after bringing the wafer to a temperature of about 600 to 900 °C in a conventional chemical vapor deposition apparatus, it is “exposed to an organo-aluminum compound, most preferably a lower alkyl aluminum

compound such as trimethyl aluminum ('TMA') in vapor form for a few seconds." *Id.* This compound decomposes, depositing thin aluminum layer 14 on surface 12. *Id.* The aluminum-protected substrate is then "exposed to a mixture of an organo-metallic compound, most preferably an organo-aluminum compound, and ammonia, together with a carrier gas, so as to deposit a thin layer 16 of a nitride semiconductor, most preferably AlN." *Id.* ¶ 32. First superlattice 18 is deposited on this nucleation layer 16, and includes "layers 20 and 22 of nitride semiconductors having differing compositions." *Id.* ¶ 34. Intermediate layer 24, comprised "of a gallium nitride based semiconductor," is deposited on first superlattice 18. *Id.* ¶ 35. Second superlattice 26 is formed on intermediate layer 24, and "is generally similar to the first superlattice 18." *Id.* ¶ 36. Together, first superlattice 18, intermediate layer 24, and second superlattice 26 comprise buffer structure 32. *Id.* ¶ 37. Finally, operative structure 34, including one or more gallium nitride based semiconductors, is deposited over buffer structure 32. *Id.*

Guo describes that "[t]he gallium nitride based semiconductors in the operative structure have excellent crystal quality," and that "the structure can be cooled to room temperature and then removed from the reactor, without appreciable cracking of the gallium nitride based semiconductors in the operative structure." *Id.* ¶ 38.

2. *Ashby (Ex. 1009)*

Ashby is a U.S. Patent Application Publication titled "Cantilever Epitaxial Process." Ex. 1009, code (54). Ashby relates to "[a] process of growing a material on a substrate, particularly growing a Group II-VI or Group III-V material, by a vapor-phase growth technique where the growth process eliminates the need for utilization of a mask or removal of the

substrate from the reactor at any time during the processing.” *Id.* at code (57).

3. *Asserted Unpatentability of Claims 1–4 and 6–9, and 11–14 over Guo (Ground 5)*

Petitioner contends that Guo discloses or suggests all of the limitations of claims 1–4, 6–9, and 11–14. Pet. 50–65.

At this stage of the proceeding, Patent Owner does not dispute that Guo discloses or suggests all of the limitations of these claims. Rather, Patent Owner asserts that Guo is not prior art under pre-AIA 35 U.S.C. § 102(a) to claims 1–4 and 6–14¹² because these claims were conceived of and reduced to practice years before Guo, which has a filing date of November 25, 2003 and a publication date of June 24, 2004. Prelim. Resp. 44.

In particular, Patent Owner asserts that inventors Drs. Shealy and Smart did “significant work relating to the ’360 Patent while at Cornell in the late 1990s that led to the conception and reduction to practice of their invention” years before the filing and publication dates of Guo. Prelim. Resp. 44; *see also id.* at 13–18, 45–61. To support this assertion, Patent Owner cites to a September 2000 invention disclosure (Ex. 2012); Dr. Smart’s binder of “run logs” reflected in his thesis (Ex. 2013); and Dr. Smart’s 2006 thesis (Ex. 2001), which Patent Owner asserts reflects work that was done in the 1997 to 2000 time period. *Id.* at 45–61.

¹² Petitioner asserts in ground 5 that claims 1–4, 6–9, and 11–14 would have been obvious over Guo alone and asserts in ground 6 that claims 5, 10, and 17 would have been obvious over Guo and Ashby. Pet. 50–71. Patent Owner asserts that “Guo is not prior art to challenged claims 1–4 and 6–14 (Grounds 5–6).” Prelim. Resp. 44.

We have reviewed Petitioner’s arguments and evidence set forth for ground 5 that claims 1–4 and 6–9, and 11–14 would have been obvious over Guo. Pet. 50–59. Based on the preliminary record before us, we find that Petitioner’s arguments and evidence are sufficient to show that Guo discloses or suggests the limitations of claims 1–4, 6–9, and 11–14.

We have also reviewed Patent Owner’s arguments that Guo is not prior art to any of the claims challenged under grounds 5 or 6 and determine that Patent Owner’s arguments raise disputed factual issues that are best resolved on a more fully developed record. See Ex. 3001 (email from Petitioner asserting that Patent Owner’s Preliminary Response contains “mischaracterizations and inconsistencies” including “when conception and reduction to practice allegedly occurred, and an omission of the inventors’ diligence between the various proffered dates”).

Based on the foregoing, Petitioner demonstrates a reasonable likelihood that claims 1–4 and 6–9, and 11–14 would have been obvious over Guo, notwithstanding Patent Owner’s arguments to the contrary which raise factual issues best resolved on a full record.

4. Asserted Unpatentability of Claims 5, 10, and 17 over Guo and Ashby (Ground 6)

a) Claims 5 and 17

Claim 5 depends upon claim 1 and requires that the group II reactant is a cadmium (Cd) reactant or a zinc (Zn) reactant. Claim 17, which also depends on claim 1, requires that the group VI reactant is a tellurium (Te) or sulfur (S) reactant.

Petitioner asserts that Ashby teaches the claimed reactants recited in the dependent claims 5 and 17 by disclosing “growing Group II materials including ‘at least one of the Group II elements Zn, Cd, and Hg’” (claim 5)

and “using “at least one of the Group VI elements O, S, Se, and Te” (claim 17). Pet. 69–71 (quoting Ex. 1009 ¶ 13). Petitioner asserts that a POSITA would have been motivated to use each of these reactants in Guo’s fabrication method for the reason set forth in Dr. Shanfield’s declaration. *Id.* at 69, 70–71 (citing Ex. 1003 ¶¶ 242–243, 247). Dr. Shanfield states, *inter alia*, a POSITA would have understood that at least CdSe, CdTe, ZnSe, and or other Cd-based compounds, like CdSSe, were known to be used in or for optimal emitters, detectors, quantum dots, and optical filters and were known to “provide significant economic value.” Ex. 1003 ¶¶ 242–243, 247; *see also* Ex. 1003 ¶¶ 242, 247 (stating a POSITA would have been motivated to use the Group II elements (Zn or Cd) or the Group VI reactants (S or Te) for the reasons discussed in Section XVII.A.2 (Ex. 1003 ¶¶ 234–241), ¶ 243 (stating that Zn and Cd compounds were used in or for optimal emitters, detectors, quantum dots, and optical filters and were known to “provide significant economic value”), ¶ 238 (asserting that CdS, CdTe, and ZnS materials were used for optical and infrared sensors and emitters” and that there would have been “certain economic motivations for substituting Ashby’s group II and VI reactants for Guo’s group III and V reactants”).

Petitioner further asserts that Guo discloses methods for forming group III-V semiconductors and expressly states that numerous variations and combinations of the features can be utilized. Pet. 68; Ex. 1003 ¶ 234. Petitioner states that although Guo does not disclose an exhaustive list of what or why variations and combinations of materials could be used, a POSITA would have looked to prior art, including Ashby, for guidance. Pet. 68; Ex. 1003 ¶¶ 234–235. Petitioner further states that a POSITA would have been motivated to modify Guo’s fabrication method to generate a Group II-VI material for reasons that mirror why a POSITA would have

been motivated to combine Urashima and Nagata as set forth in Section VIII.B.1 (Pet. 30–34). Pet. 69 (citing Ex. 1003 ¶¶ 237–241).

Patent Owner asserts that Petitioner has not shown a sufficient reason for combining Guo and Ashby and, thus, has not shown claims 5 or 17 would have been obvious over Guo and Ashby. Prelim. Resp. 61–65. Patent Owner asserts that Guo does not suggest using non-group III and non-group V materials instead of group III and V materials, but rather merely suggests using *other* group III and group V materials. *Id.* at 62. As such, Patent Owner asserts that Guo does not suggest substituting group II and group VI materials for its group III and group V materials. *Id.* Patent Owner also asserts that Petitioner fails to explain why a POSITA would have believed replacing Guo’s group III/V materials with Ashby’s group II/VI materials in the pretreatment step or the epitaxial or buffer layer growth steps would have worked, thus highlighting the conclusory nature of Petitioner’s improper use of hindsight. *Id.* at 64.

Guo, however, does state that “[n]umerous variations and combinations of the features set forth above can be utilized without departing from the present invention.” Ex. 1008 ¶ 48. Petitioner also provides argument and declaratory testimony that a POSITA would have had reason to combine Guo and Ashby. *See, e.g.*, Pet. 65–71; Ex. 1003 ¶¶ 242–247. Whether Petitioner’s assertions are sufficient to show a reason to combine Guo and Ashby to arrive at the challenged claims is best resolved upon a full record.

Patent Owner also argues that Ashby’s process involves “specially patterned substrates” that pretreats only *a part of* “a surface of a substrate,” and that Petitioner does not sufficiently explain how Ashby’s process is compatible with Guo. Prelim. Resp. 63–64. We disagree with this argument

at this stage of the proceeding as it is based upon a claim construction that we do not adopt.

b) Claim 10

Claim 10 further requires that the process of claim 1 further comprises preheating the substrate in hydrogen prior to pre-treating the surface with at least one group III or group II reactant.

Petitioner concedes that Guo does not disclose preheating the substrate in hydrogen prior to pretreating the surface as required by claim 10 but asserts that Guo does disclose purging metal from the preceding layer by flushing with a mixture of hydrogen or nitrogen carrier gas and ammonia and that a POSITA would have understood that an effective contaminant purging operation prior to pretreating substrate and depositing aluminum layer would be important to producing high quality epitaxy. Pet. 65–67 (citing Ex. 1003 ¶¶ 39, 227). Petitioner asserts that a POSITA would have looked to the prior art, such as Ashby, on how to implement an initial purging step. *Id.* at 66. Petitioner further asserts that a POSITA would have understood that Ashby’s cleaning step, teaches preheating the substrate in hydrogen (*i.e.*, ambient H₂) prior to pre-treating the surface of the substrate. *Id.* at 69–70. Petitioner further asserts that a POSITA would have been motivated to use Ashby’s cleaning step in Guo’s fabrication method for “the reasons discussed in Section VIII.F.1.a [(Pet. 65– 68)].” *Id.* at 70 (citing Ex. 1003 ¶ 246).

Patent Owner asserts that Guo is not prior art to claim 10. Prelim. Resp. 44–50, 56–57. As noted above, Patent Owner’s argument raises issues that are best resolved on a full record.

III. CONCLUSION

For the reasons set forth above, we determine that Petitioner has demonstrated a reasonable likelihood of prevailing with respect to at least one challenged claim of the '360 patent. Thus, we institute an *inter partes* review on all challenged claims and on all grounds presented.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that an *inter partes* review is instituted on each of the grounds asserted in the Petition; and

FURTHER ORDERED that, pursuant to 35 U.S.C. § 314(c) and 37 C.F.R. § 42.4, notice is hereby given of the institution of a trial, which shall commence on the entry date of this decision.

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