

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

10X GENOMINCS, INC.,
Petitioner,

v.

BIO-RAD LABORATORIES, INC.,
Patent Owner.

IPR2020-00087
Patent 9,562,837 B2

Before CHRISTOPHER M. KAISER, KIMBERLY McGRAW, and
ELIZABETH M. ROESEL, *Administrative Patent Judges*.

McGRAW, *Administrative Patent Judge*.

JUDGMENT
Final Written Decision
Determining Some Challenged Claims Unpatentable
35 U.S.C. § 318(a)

I. INTRODUCTION

In this *inter partes* review, instituted pursuant to 35 U.S.C. § 314, 10X Genomics, Inc. (“Petitioner”) challenges claims 1–4, 7–13, and 19 of U.S. Patent No. Patent 9,562,837 B2 (Ex. 1001, “the ’837 patent”), owned by Bio-Rad Laboratories, Inc. (“Patent Owner”). This Final Written Decision is entered pursuant to 35 U.S.C. § 318(a) and 37 C.F.R. § 42.73. For the reasons discussed below, we determine that Petitioner has shown by a preponderance of the evidence that claims 1–4, 7, 9–13, and 19 of the ’837 patent are unpatentable but has not shown by a preponderance of the evidence that claim 8 is unpatentable.

A. *Procedural History*

Petitioner filed a Petition for *inter partes* review of claims 1–4, 7–13, and 19 of the ’837 patent. Paper 2 (“Pet.”). Patent Owner filed a Preliminary Response. Paper 8. 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 instituted an *inter partes* review of all challenged claims on all asserted grounds. Paper 9 (“Inst. Dec.”).

Following institution, Patent Owner filed a Patent Owner Response (Paper 27, “PO Resp.”), Petitioner filed a Reply (Paper 30, “Pet. Reply”), and Patent Owner filed a Sur-reply (Paper 32, “PO Sur-reply”). An oral hearing was held on January 27, 2021, and a copy of the hearing transcript has been entered into the record. Paper 39 (“Tr.”).

B. *Real Parties-in-Interest*

Petitioner identifies 10X Genomics, Inc. as the real party-in-interest. Pet. 71. Patent Owner identifies Bio-Rad Laboratories, Inc. as the real

party-in-interest. Paper 25, 1 (Bio-Rad Laboratories, Inc.’s Updated Mandatory Notices, “Mandatory Notices”).

C. Related Matters

There are three related proceedings before the Board involving the parties. IPR2020-00086 also involves the ’837 patent, and IPR2020-00088 and IPR2020-00089 involve related U.S. Patent No. 9,896,722 B2 (“the ’722 patent”), which claims priority to the ’837 patent claims as a continuation-in-part application. The January 27, 2021, oral hearing transcript pertains to all four cases. Final written decisions are issued in the three related proceedings concurrently with this Decision.

The parties also identify *Bio-Rad Laboratories, Inc. v. 10X Genomics, Inc.*, Case No. 1:18-cv-01679-RGA (D. Del. Oct. 25, 2018) as a related matter. Pet. 71; Paper 25 (Updated Mandatory Notices), 1.

D. The ’837 Patent

The ’837 patent was issued on an application filed April 2, 2013, and lists a number of provisional and non-provisional priority applications, the earliest of which was filed May 11, 2006. Pet. 3; Ex. 1001, codes (22), (60), (63).¹

The ’837 Patent is titled “Systems for Handling Microfluidic Droplets.” Ex. 1001, code (54). The ’837 patent discloses an assembly that

¹ Petitioner argues that the America Invents Act (“AIA”) applies to the ’837 patent because the application that led to the ’837 patent contained new matter and claims to that new matter with an effective filing date of April 2, 2013. Pet. 5. We do not need to determine whether or not the AIA applies because on this record, as discussed below, Petitioner’s asserted references are prior art to the ’837 patent under either the AIA or pre-AIA version of 35 U.S.C § 102.

includes a droplet formation module and a chamber. *Id.* at code (57); 3:11–12, 3:36–37, 52:38–39, 53:21–22. The droplet formation module is configured to form droplets surrounded by an immiscible fluid. *Id.* at code (57); 3:12–20, 52:38–48. The chamber is configured to receive droplets and immiscible fluid and has an outlet configured to receive substantially only droplets. *Id.* at code (57), 3:37–48, 53:22–25. According to the '837 patent, the assembly is “particularly useful for reducing potential contamination associated with sample handling.” *Id.* at 52:27–29.

Figure 38 of the '837 patent is reproduced below:

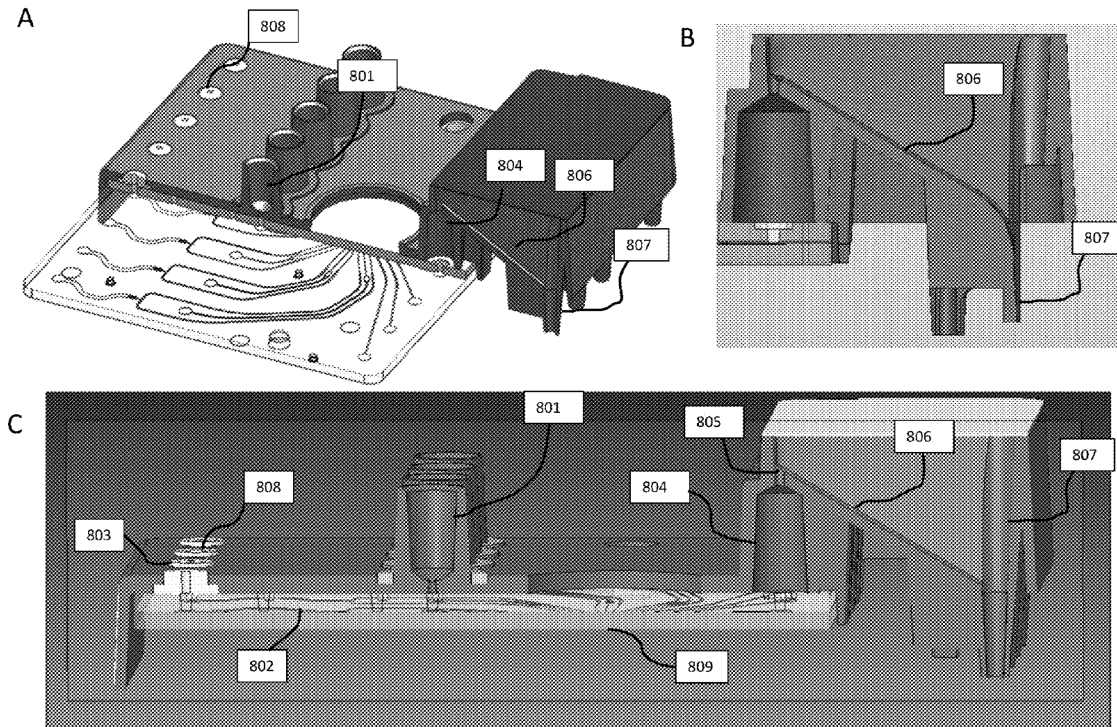


FIG. 38

Figure 38 shows a microfluidic assembly that includes a droplet formation module and a chamber. Ex. 1001, 8:22–23, 53:47–48, 53:62–65, 54:34–41. The droplet formation module includes sample input 801, channel 802, and oil input 803. *Id.* at 53:62–65. The assembly includes chamber 804 equipped with outlet 805, which is connected to slide 806, which is in turn

connected to output nozzle or exit port 807. *Id.* at 54:34–41, 54:47–57, 54:61–63. The assembly also includes reagent input 808 and coalescence module 809. *Id.* at 54:4–6, 54:19–22.

An aqueous sample solution is introduced through sample input 801, and oil is introduced through oil input 803. Ex. 1001, 53:48–50, 53:59–60. The oil and aqueous solution meet at a junction in channel 802 such that the aqueous solution is segmented by the oil, thereby forming droplets. *Id.* at 53:60–62. “As the oil containing the droplets moves along the assembly through the channel 802, the oil and droplets begin to enter the chamber 804.” *Id.* at 54:37–39. “Due to the difference in their respective densities, the oil and droplets separate from each other in the chamber 804.” *Id.* at 54:39–41. Droplets exit chamber 804 into outlet 805 “leaving a large part of the oil behind.” *Id.* at 54:41–44. Droplets exiting chamber 804 through outlet 805 enter slide 806 and travel through the slide and nozzle 807, which leads to a vessel or container for collecting the droplets. *Id.* at 54:51–59.

E. Illustrative Claims

The '837 patent includes 20 claims. Claim 1 is the sole independent claim and is reproduced below, with paragraph breaks adjusted and bracketed numbers added to correspond with Petitioner's identification of claim elements:

1. [1.0] An assembly, the assembly comprising:
 - [1.1] a microchannel in a horizontal plane;
 - [1.2] at least one droplet formation module comprising a sample inlet, an immiscible fluid inlet, and a junction, wherein the junction is located between the sample inlet and the microchannel and the droplet formation module is configured to

produce droplets comprising the sample surrounded by the immiscible fluid; and

[1.3] at least one downstream separation chamber comprising a droplet receiving chamber inlet and at least one droplet receiving outlet,

[1.4] wherein the separation chamber is upright to the microchannel and out of the horizontal plane;

[1.5] wherein the droplet formation module and the separation chamber are in fluid communication with each other via the microchannel;

[1.6] and wherein the separation chamber has a wider cross-section than the microchannel cross-section to accumulate a plurality of droplets comprising the sample and

[1.7] is of a volume sufficient to separate the plurality of droplets comprising the sample from the immiscible fluid within the separation chamber.

Ex. 1001, 88:2–23.

F. Testimonial Evidence

In support of its unpatentability contentions, Petitioner relies on a Declaration of Richard B. Fair, Ph.D. (Ex. 1008) and a Responsive Declaration of Richard B. Fair, Ph.D. (Ex. 1072) filed with the Reply. Patent Owner cross-examined Dr. Fair twice and filed a transcript of the first deposition as Exhibit 2017 and the second deposition as Ex. 2041.

Patent Owner relies on a declaration of Shelly Anna, Ph.D. Ex. 2016. Petitioner cross-examined Dr. Anna and filed a transcript of the deposition as Exhibit 1075.

G. Prior Art and Asserted Grounds

Petitioner asserts that claims 1–4, 7–13, and 19 would have been unpatentable on the following grounds (Pet. 19–20):

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–4, 10–13, 19	102	Thorsen ²
1–4, 7, ³ 9–13, 19	103	Thorsen
1–2, 4, 7–13, 19	103	Thorsen, Ismagilov 119 ⁴
1–2, 4, 7–13, 19	103	Thorsen, Ismagilov 119, Ismagilov 091 ⁵

II. ANALYSIS

A. Legal Standards

“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”)); *see also* 37 C.F.R. § 42.104(b) (2019) (requiring a petition for *inter partes* review to identify how the challenged claim is to be construed and where each element of the claim is found in the prior art patents or printed publications relied upon).

A claim is anticipated under 35 U.S.C. § 102 only if “each and every element as set forth in the claim is found, either expressly or inherently

² Ex. 1003, T. Thorsen, *Microfluidic Technologies for High-Throughput Screening Applications* (2003) (“Thorsen”).

³ Although Petitioner’s table identifying its asserted grounds states that it is challenging claim 8 as unpatentable over Thorsen, Petitioner does not present any argument supporting this challenge. Thus, we do not include claim 8 in the listing of claims challenged under Thorsen.

⁴ Ex.1005, Ismagilov et al., US 2006/0094119 A1, pub. May 4, 2006 (“Ismagilov 119”).

⁵ Ex. 1004, Ismagilov et al., US 7,129,091 B2, issued Oct. 31, 2006 (“Ismagilov 091”).

described, in a single prior art reference.” *Verdegaal Bros. v. Union Oil Co.*, 814 F.2d 628, 631 (Fed. Cir. 1987). A claim is unpatentable under 35 U.S.C. § 103 if “the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious 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 when in evidence (4) objective evidence of nonobviousness, i.e., secondary considerations. *See Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

Additionally, the obviousness inquiry typically requires an analysis of “whether there was an apparent reason to combine the known elements in the fashion claimed by the patent at issue.” *KSR*, 550 U.S. at 418 (*citing In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2016) (requiring “articulated reasoning with some rational underpinning to support the legal conclusion of obviousness”)). Furthermore, Petitioner does not satisfy its burden of proving obviousness by employing “mere conclusory statements,” but “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).

B. Level of Ordinary Skill in the Art

Relying on Dr. Fair’s testimony, Petitioner asserts that a person of ordinary skill in the art (“POSA”) would have had “a PhD in chemistry, biochemistry, mechanical or electrical engineering, or a related discipline

with one year of experience related to systems for handling microfluidic droplets,” “a Bachelor of Science in such fields with four years of such experience,” or an equivalent level of education and practical experience. Pet. 3; Ex. 1008 ¶ 40. Petitioner and Dr. Fair assert that a “POSA would have knowledge of scientific literature concerning droplets (including emulsions), and systems and methods for handling them (including both their formation and handling downstream of formation), their applications, and chemistry, components, and reactions that occur within them.” Pet. 3; Ex. 1008 ¶ 40. In addition, Petitioner and Dr. Fair assert that a “POSA may have worked on a multidisciplinary team and drawn on his or her own skills along with certain specialized skills of others; and a chemist, engineer, and biologist may have been part of the team.” Pet. 3; Ex. 1008 ¶ 40.

Relying on Dr. Anna’s testimony, Patent Owner asserts that a POSA “would have had at least the equivalent of a Bachelor’s degree in engineering, physics, or chemistry and two years of academic, research, or industry experience related to fluid mechanics, fluid dynamics, or microfluidics.” PO Resp. 16; Ex. 2016 ¶¶ 72–74. In addition, Patent Owner asserts that “[a]dditional training or study could substitute for work experience and additional work experience or training could substitute for formal education.” PO Resp. 16; Ex. 2016 ¶ 72.

Both sides’ declarants represent that their opinions would not change based on their opponent’s articulation of the level of ordinary skill in the art. Ex. 1072 ¶ 13; Ex. 2016 ¶ 74.

We find that Patent Owner’s definition of a POSA is consistent with the scope and content of the ’722 Patent and the asserted prior art. In addition, we find that Patent Owner’s definition of a POSA is consistent

with the legal standard for obviousness, which is to be determined from the viewpoint of a person of ordinary, not extraordinary, skill. *Stewart-Warner Corp. v. City of Pontiac, Mich.*, 767 F.2d 1563, 1570 (Fed. Cir. 1985) (section 103 is not concerned with the actual skill of the inventors—whose skill may be extraordinary—but rather with the level of ordinary skill in the art).

In contrast, Dr. Fair’s opinion about the level of ordinary skill in the art is based on his own experience working in the field and “working with others in this field who consistently had that level of education and/or experience and worked with a multidisciplinary team.” Ex. 1072 ¶ 10. Dr. Fair considers himself “an expert in the art of biomedical microfluidics and related applications, including handling microfluidic droplets.” Ex. 1008 ¶ 42. We find that Petitioner and Dr. Fair have defined a POSA based on the level of skill possessed by Dr. Fair and others like him who are experts in the field. Ex. 1008 ¶¶ 40–42; Ex. 1072 ¶¶ 9, 10. In our view, the level of skill in the art proposed by Petitioner and Dr. Fair is more akin to extraordinary, rather than ordinary skill in the art.

For these reasons, we apply Patent Owner’s definition of a POSA. We also apply a portion of Petitioner’s definition, namely that a POSA “would have knowledge of scientific literature concerning droplets (including emulsions), and systems and methods for handling them (including both their formation and handling downstream of formation), their applications, and chemistry, components, and reactions that occur within them.” Pet. 3; Ex. 1008 ¶ 40. This portion is undisputed by Patent Owner and is consistent with the ’837 patent and the asserted prior art, as summarized below.

In any event, our determinations regarding Petitioner’s challenges do not turn on the differences between Petitioner’s and Patent Owner’s definitions of a POSA, and our conclusion would be the same under either party’s definition.

C. Claim Construction

For petitions for *inter partes* review filed on or after November 13, 2018, such as here, we apply the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. § 282(b), following the standard articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). 37 C.F.R. § 42.100(b); 83 Fed. Reg. 51,340, 51,340–41, 51,343 (Oct. 11, 2018). In applying this standard, we generally give claim terms their ordinary and customary meaning, as would be understood by a person of ordinary skill in the art, at the time of the invention and in the context of the entire patent disclosure. *Phillips*, 415 F.3d at 1312–13.

Petitioner proposes constructions for the phrases: (1) “sample” (claim 1); (2) “separation chamber” (claim 1); (3) “droplet receiving outlet” (claim 1), (4) “coupled” (claims 7, 8); and (5) “polymerase chain reaction” (claim 13) that are based on Patent Owner’s expected claim constructions in view of Patent Owner’s infringement contentions in the related district court action. *See* Pet. 18–19 (citing Ex. 1026, 9–15, 21–22, 27–29; Ex. 1052, 12–15).

In the Institution Decision, we addressed three claim terms, namely “sample,” “separation chamber,” and “droplet receiving outlet,” and we applied the constructions proposed by Petitioner and relied upon by Patent Owner in its district court infringement contentions. Inst. Dec. 10–14. In

the Response, Patent Owner proposes its own constructions for these terms, as well as the additional terms “coupled” and “polymerase chain reaction (PCR).” PO Resp. 16–25. In the Reply, Petitioner disputes Patent Owner’s proposed construction of the term “sample” (Pet. Reply 3–4) and asserts that the cited art reads on the challenged claims under Patent Owner’s proposed construction of the remaining terms. *See* Pet. Reply 2–4 (discussing Patent Owner’s constructions).

Below we address the terms “sample,” “separation chamber,” and “droplet receiving outlet.” We determine that no other claim term requires express construction for purposes of resolving the controversy. *See Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“only those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy”); *see also Nidec Motor Corp. v. Zhongshan Broad Ocean Motor Co.*, 868 F.3d 1013, 1017 (Fed. Cir. 2017) (applying *Vivid Techs.* in the context of *inter partes* review).

I. “sample”

Claim 1 recites a “sample inlet,” a droplet formation module configured to produce “droplets comprising the sample,” and a separation chamber . . . to accumulate “a plurality of droplets comprising the sample” and to separate the “plurality of droplets comprising the sample.” Ex. 1001, 88:4–9, 88:18–23.

Petitioner’s declarant Dr. Fair states that the term “sample” should be construed to cover “a compound, composition, and/or mixture of interest, from any suitable source(s).” Ex. 1008 ¶ 73; *see also* Pet. 18 (citing Ex. 1008 ¶¶ 72–75).

Patent Owner responds that a sample is a “fluid containing molecules, cells, small molecules (organic or inorganic) or particles.” PO Resp. 16; *see also* Ex. 1001, 26:48–50 (describing a fluid “containing a sample such as molecules, cells, small molecules (organic or inorganic) or particles”).

We need not construe the term “sample” as Petitioner has sufficiently shown that the cited art teaches a “sample” under either party’s proposed construction and any further construction of this term is not necessary to resolve any issues in dispute.

2. *“separation chamber”*

Claim 1 requires the assembly to comprise a “downstream separation chamber comprising a droplet receiving chamber inlet and at least one droplet receiving outlet, wherein the separation chamber is upright to the microchannel and out of the horizontal plane.” Ex. 1001, 88:10–14.

In its Petition, Petitioner contends that “separation chamber” should be construed as “[b]road enough to encompass an open well.” Pet. 18 (citing Ex. 1026, 9–12; Ex. 1052, 12–15).

Patent Owner responds “separation chamber” should be construed as a “chamber sized to accommodate multiple droplets and an immiscible fluid in separated form.” PO Resp. 18.

Petitioner does not dispute Patent Owner’s construction. *See* Pet. Reply 2 (stating Patent Owner’s construction of “separation chamber” is broad enough to include Thorsen’s incubation chamber and outlet wells).

We find that the Specification supports Patent Owner’s construction for “separation chamber.” The Specification discloses that partitioned portions, i.e. droplets, and immiscible fluid flow into a chamber, where the partitioned portions sink, float, or are displaced from the chamber as a result

of a difference in density between the partitioned portions and the immiscible fluid. Ex. 1001, 2:45–50, 3:37–46. Patent Owner’s construction is further supported by the Specification’s description of a “chamber . . . configured to receive droplets and an immiscible fluid from the droplet formation module,” where “the immiscible fluid displaces the droplet from the chamber into the outlet due to the difference in density.” *Id.* at 53:31–37. Patent Owner’s construction is also consistent with the Specification’s disclosure that “the chamber can include any vessel suitable for holding droplets, for example, test tubes, vials, beakers, jars, and PCR tubes.” *Id.* at 53:44–47.

Accordingly, we adopt Patent Owner’s proposed construction of “separation chamber” as a “chamber sized to accommodate multiple droplets and an immiscible fluid in separated form.”

3. “*droplet receiving outlet*”

Claim 1 recites that the separation chamber comprises “a droplet receiving chamber inlet and at least one droplet receiving outlet.” Ex. 1001, 88:10–12.

Petitioner and Dr. Fair assert the term “droplet receiving outlet” is broad enough to “include the opening at the top of an open well.” Pet. 19; Ex. 1008 ¶ 77 (stating that “[b]ased on Bio-Rad’s infringement contentions, I understand that Bio-Rad’s interpretation of this term must be broad enough to include an open well” and citing Ex. 1026, 9–13; Ex. 1052, 12–15).

Patent Owner disagrees that any and all openings at the top of any and all open wells is a droplet receiving outlet. PO Resp. 22. Instead, Patent Owner contends that “droplet receiving outlet” should be construed as the “portion of the separation chamber where droplets are collected.” *Id.* at 21.

Petitioner does not dispute Patent Owner's proposed construction, stating that Patent Owner's proposed construction is broad enough to encompass the asserted art. Pet. Reply 2–3.

We disagree with Petitioner that a droplet receiving outlet encompasses any opening of at the top of any open well. Petitioner proposes this construction based on Patent Owner's "infringement contentions (and its Complaint) showing [Patent Owner's] expected claim interpretation. Pet. 17–18 (citing Ex. 1026; Ex. 1052). Patent Owner's infringement contentions and complaint, however, are based on a particular structure as satisfying the "droplet receiving outlet" limitation and do not purport that a "droplet receiving outlet" is satisfied by any opening at the top of any open well. *See, e.g.*, Ex. 1026, 11. Petitioner does not provide any other support for its proposed construction.

We agree with Patent Owner that a "droplet receiving outlet" should be construed as the "portion of the separation chamber where droplets are collected." The Specification of the '837 patent discloses that "[t]he chamber includes an outlet that is positioned to receive substantially only the partitioned portions of sample." Ex. 1001, 3:46-48. In addition, the Specification discloses that the outlet may positioned be "at the top, middle, or bottom of the chamber" depending on the densities of the partitioned portions and the immiscible fluid. *Id.* at 3:48–52. For example, the Specification states that the outlet is positioned in a top portion of the chamber if the immiscible fluid is of a greater density than the partitioned portions, such that the partitioned portions rise in the chamber while the immiscible fluid sinks and the partitioned portions flow into the outlet. *Id.* at

3:52–58. These portions of the Specification show that a “droplet receiving outlet” can be a portion of the separation chamber.

We find that the Specification also supports Patent Owner’s interpretation that a “droplet receiving outlet” can include “where droplets are collected.” For example, the Specification discloses that aqueous droplets tend to rise when placed in a chamber of fluorinated oil, and accordingly, “an outlet for collecting the displaced droplets can be positioned at the top of the chamber.” Ex. 1001, 4:8–12. In another example, the Specification discloses that aqueous droplets tend to sink when placed in a chamber of certain mineral oils, and accordingly, “an outlet for collecting the displaced droplets can be positioned at the bottom of the chamber.” *Id.* at 4:12–16. Both of these examples illustrate the role of an outlet as a structure for collecting droplets.

We find that Patent Owner’s claim construction is supported by the Specification’s description of Figure 38. The Specification states that “a chamber 804 equipped with an outlet 805” and “the outlet 805 can be positioned at an upper portion of the chamber 804 where the rising droplet will exit the chamber 804 into the outlet 805” or “the outlet 805 [can be] positioned at a lower portion of the chamber 804.” Ex. 1001, 54:34–35, 54:41–46. When describing the Figure 38 embodiment, the Specification states that outlet 805 is positioned at the top of chamber 804 to collect droplets that are displaced by oil flowing into the chamber and that rise to the top of the chamber. *Id.* at 59:55–63. These descriptions are consistent with Patent Owner’s proposed construction for “droplet receiving outlet.”

For these reasons, we adopt Patent Owner’s proposed construction that a “droplet receiving outlet” is the “portion of the separation chamber where droplets are collected.”

D. Overview of the Asserted References

We summarize the relevant disclosures of Petitioner’s asserted references below.

1. Thorsen (Ex. 1003)

Thorsen is a Ph.D. dissertation. Ex. 1003, 6.⁶ Petitioner asserts that Thorsen is prior art to the ’837 patent under § 102(a)(1) and pre-AIA § 102(a) and (b) “because it is a printed publication that was available to the public more than one year before the earliest date of application for the 837 Patent.” Pet. 12–13. Patent Owner does not contest the prior art status of Thorsen.

Thorsen relates to the design and development of microfluidic devices for high-throughput screening applications. Ex. 1003, 6, 10. Thorsen describes the “development of a two-phase microfluidic device,” including “crossflow-based dynamic formation of picoliter-sized water droplets in a continuously flowing oil-surfactant stream.” *Id.* at 10.

In one design described in Chapter 4 (i.e., Thorsen’s “serpentine channel device”), Thorsen uses a serpentine outlet channel to slow down droplets in the microfluidic device. *Id.* at 115 (stating the length and width of the serpentine outlet channels were varied to create a long outlet path that served as an incubation chamber for the encapsulated enzyme and substrate). In another design described in Chapter 3 (i.e., Thorsen’s “incubation

⁶ We cite to Exhibit 1003 using the page numbers added by Petitioner in the lower right corner of each page.

chamber device”), Thorsen replaces the serpentine output channel with a large, high cavity (i.e., an “incubation chamber”) to slow down droplets in its microfluidic device. *Id.* at 99.

a) Chapter 3

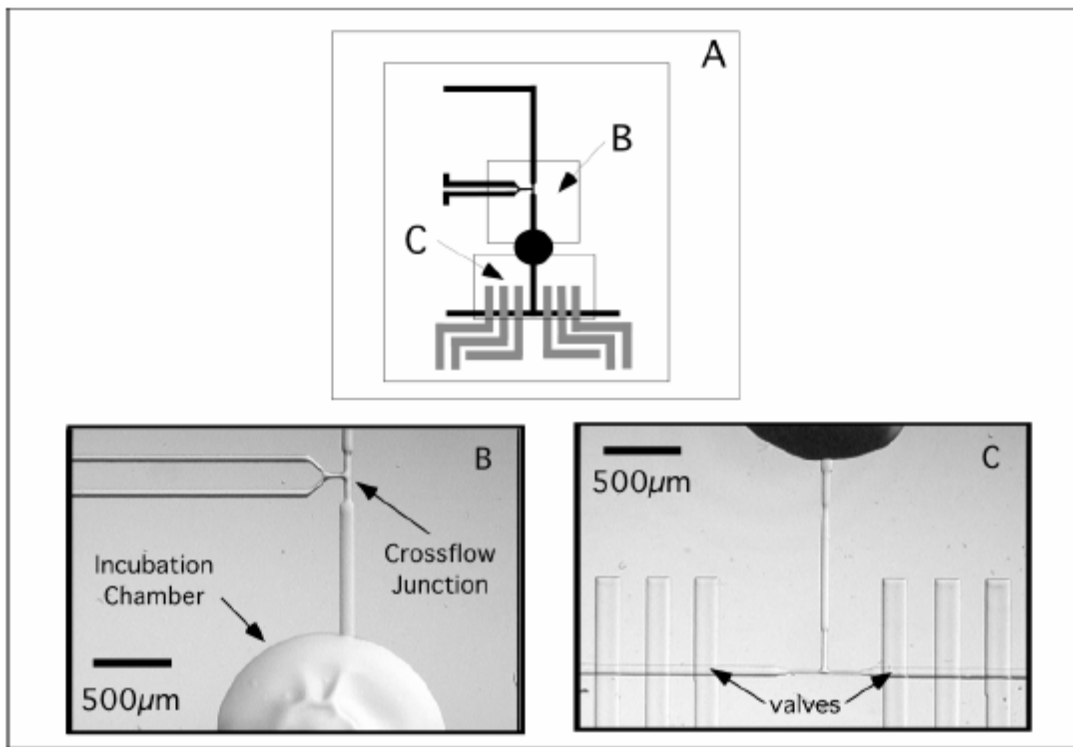
Thorsen Chapter 3 discusses microfluidic crossflow as a droplet formation technology. Ex. 1003, 52. Thorsen reviews the channel architecture and theory of existing microfluidic crossflow devices, including those having a serpentine channel to incubate the contents of the droplets. *Id.* at 62–89. Thorsen reports that he developed “integrated elastomeric valves” for gating microfluidic flow and sorting droplets. *Id.* at 53, 89, 97, 104 (“we successfully demonstrated droplet sorting via elastomeric valves in the silicone microfluidic devices”).

Thorsen Chapter 3 describes the design and fabrication of microfluidic device prototypes including a large cavity “incubation chamber” as follows:

Multilayer soft lithography techniques were used to fabricate a two-layer Dow Corning Sylgard 184 crossflow device with integrated valves for droplet sorting. . . . A significant design modification was added to the device to accommodate chemical screening reactions where incubations of several minutes to a few hours are optimal (Figure 3.28A). The serpentine output channel at the crossflow junction was replaced with a large (~500 μm) high cavity to slow down the droplets and create an on-chip incubation chamber (Figure 3.28B). . . . A control layer of valves was added for sorting droplets at the T-junction intersection at the end of the chip (Figure 3.28C).

Ex. 1003, 99, 101.

Figure 3.28 of Thorsen is reproduced below:



Ex. 1003, 101. Thorsen Figure 3.28 shows a microfluidic chip design, including: (A) a schematic of a silicone crossflow device with an incubation cavity, where black represents the flow layer and grey represents the control layer; (B) a high resolution image of an actual chip showing a crossflow junction and an incubation chamber; and (C) a high resolution of a sorting junction in a chip showing valve structures. *Id.*

Thorsen describes the steps for fabricating the Sylgard 184 crossflow devices, stating that after “the two-layer crossflow devices were cured, they were released from the mold, processed, and sealed channel side down on the coated coverslips.” *Id.*

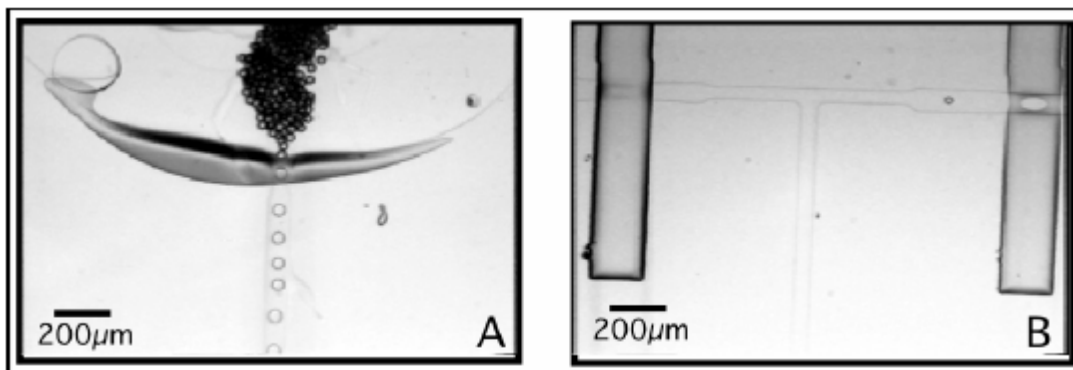
Thorsen describes testing the crossflow devices having an incubation chamber as follows:

Droplets were generated in the Sylgard 184 crossflow devices using mineral oil/1% Span 80 for the continuous phase and dH₂O for the disperse phase. Water and oil streams were balanced at the crossflow junction at ~12/15 psi water/oil-surfactant (w/o-s). Water droplet formation was initiated by increasing the water pressure to 12.5–13.0 psi. Generated water droplets entered the “incubation” cavity, where they encountered a sharp drop in flow velocity (Figure 3.29A). After ~1 hour, the droplets had passed entirely through the cavity and re-entered the narrow (~60 μm wide) outlet channel, where they flowed toward the T-junction for valve-based sorting.

Initial sorting was performed by manually switching the valves while observing the droplets under 20x magnification. The elastomeric valves were actuated using pressurized air controlled by an external solenoid valve. When ~13–15 psi of air pressure was applied to the selected control channel, the interfacial membrane between the two channel layers (Figure 3.28C) was deflected down, closing the underlying flow channel. Manual valve switching rates of several Hz were carried out without any observable mechanical breakdown. The valves efficiently sorted the droplets at the T-junction (Figure 3.29B).

Id. at 102–103.

Figure 3.29 of Thorsen is reproduced below:



Id. at 103. Thorsen Figure 3.29 shows: (A) water droplets entering the incubation cavity of a Sylgard 184 device; and (B) sorting of droplets using elastomeric valves. *Id.*

Thorsen also describes the development of a fluorescence-activated droplet sorter using his Sylgard 184 microfluidic chip having a microcavity and elastomeric valves. Ex. 1003, 104–111. Thorsen discloses that, “[a]s a functional demonstration of the device, the fluorescence-activated droplet sorter was used to sort 2–3 μm diameter droplets filled with either green . . . or red . . . fluorescent dyes.” *Id.* at 109. Thorsen describes using the microcavity crossflow device to generate red and green droplets. *Id.* at 109–110. Thorsen states: “The formed droplets entered the microcavity, where they slowed down and formed a mixed cluster of droplets.” *Id.* at 110. Thorsen discloses that, to sort the droplets, a detection region was set up downstream of the microcavity and upstream of a T-junction near the device outlets. *Id.* at 110–111. Responsive to fluorescence emission detection, the valves were actuated to sort the red and green droplets toward the respective outlet channels. *Id.* at 110.

Thorsen describes the results of his sorting experiment as follows:

Sorting efficiency was measured both by looking at the PMT [photomultiplier tube] output values of the output material in the collection wells. As droplets formed a large aggregate in the output wells, PMT readings were not especially useful as neighbor droplets washed out the signal from improperly sorted droplets. Visual inspection of the output wells was carried under a 40x objective . . . on an inverted microscope . . . equipped with a mercury lamp. The wells were rapidly scanned using both green . . . and red . . . filter sets to look for improperly sorted droplets. Of the thousands of sorted droplets in each well, only a small fraction (~1–2%) were of the wrong dye type.

Id. at 111.

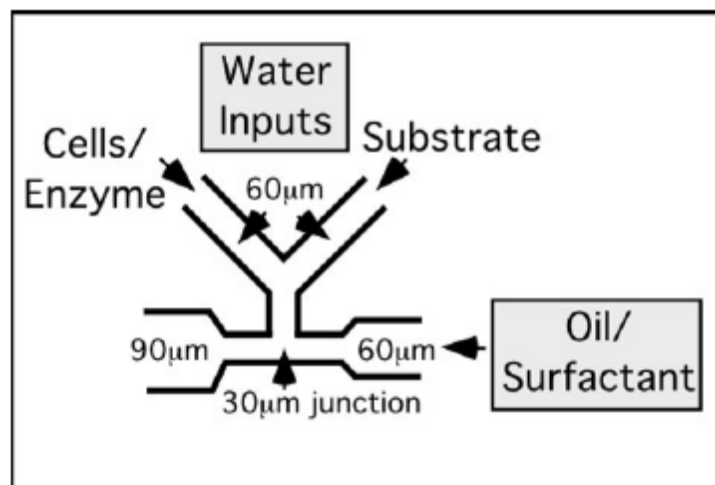
b) Chapter 4

Thorsen Chapter 4 discusses biochemical screening applications for microfluidic crossflow devices. Ex. 1003, 113. In particular, Thorsen Chapter 4 describes the development and characterization of a model enzyme system in reverse vesicles generated by microfluidic crossflow using a serpentine channel design to act as an incubation chamber for encapsulated enzyme and substrate. *Id.* at 114. Thorsen describes the microfluidic crossflow device for measuring enzyme activity at the single cell level as follows:

Cells [i.e., *Escherichia coli* (“*E. coli*”)] expressing a recombinant enzyme [i.e., p-nitrobenzyl (pNB) esterase (“pNB esterase”)] and the appropriate substrate are injected into separate water channels that meet at the crossflow junction (Figure 4.1). As soon as the two water streams merge, they are immediately encapsulated into a droplet in the oil-surfactant stream. As the droplets flow down the channel toward the outlet, the substrate is converted to a detectable fluorescent product.

Id. at 114.

Figure 4.1 of Thorsen is reproduced below:



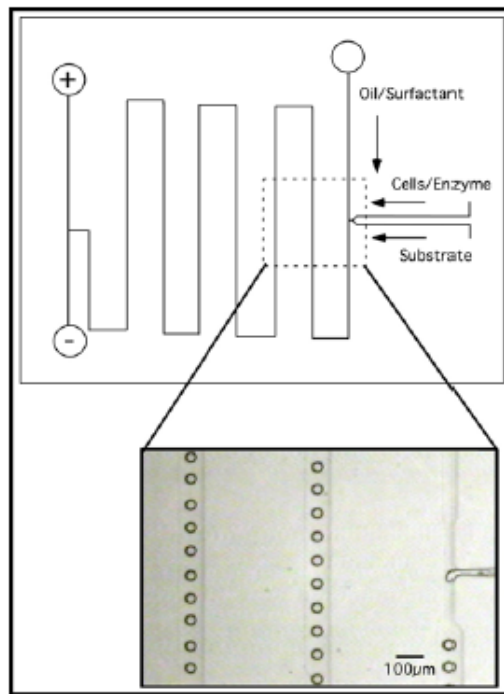
Id. at 115. Thorsen Figure 4.1 shows a microfluidic channel layout in a microfluidic crossflow device for single cell catalysis measurements. *Id.*

Thorsen Chapter 4 describes the preparation and testing of microfluidic crossflow devices using a serpentine output channel as follows:

Several crossflow patterns were designed with serpentine outlet channels. The length and width of the channel where the droplets emerge from the crossflow junction were varied to create a long outlet path that served as an incubation chamber for the encapsulated enzyme and substrate. Single-layer devices were fabricated in Sylgard 184 from the photoresist molds of the patterns. With a 90 μm wide x 10 μm high output channel ~8 cm in length, formed droplets required ~20 minutes to reach the output well. Given adequate spacing between the monodisperse droplets at the crossflow junction, water droplets in mineral oil/2% Span 80 (13.0/15.0 psi w/o-s) traveled as a perfectly coherent stream from the crossflow junction to the outlet well (Figure 4.2). At higher relative water pressures, the generated droplets collided in the output channels, forming aggregates.

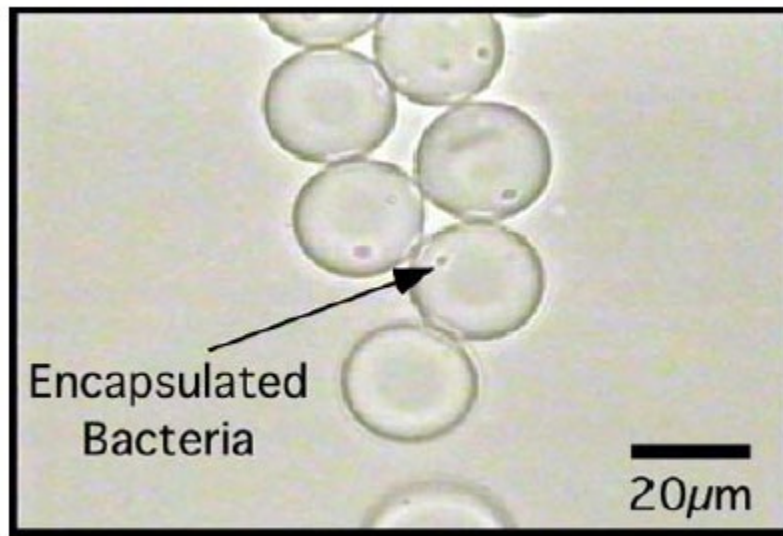
Ex. 1003, 115.

Figure 4.2 of Thorsen is reproduced below:



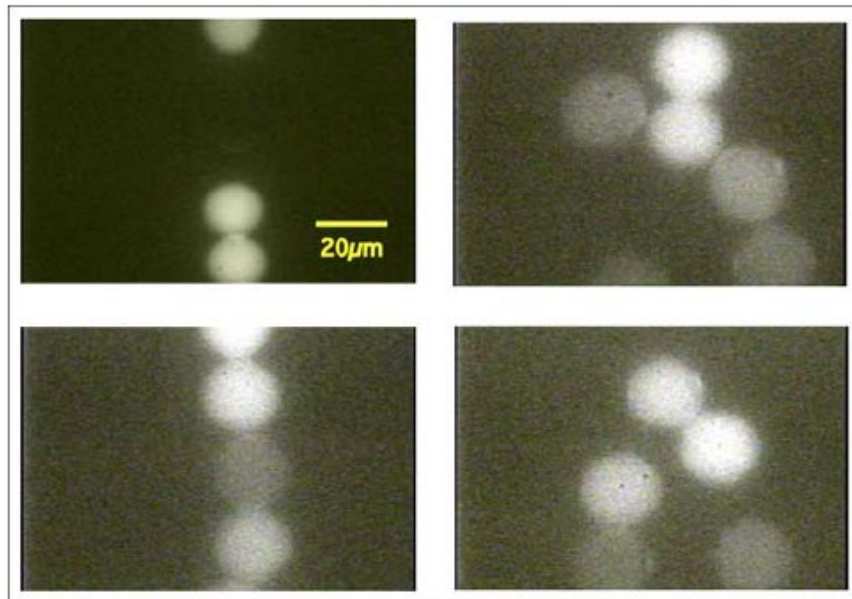
Ex. 1003, 116. Thorsen Figure 4.2 shows a serpentine channel design for a biochemical screening chip. *Id.* According to Thorsen, “[m]onodisperse water droplets in mineral oil/2% Span 80 retain a coherent pattern as they flow towards the device outlet.” *Id.*

Thorsen describes cross flow experiments using devices fabricated from Sylgard 184. *Id.* at 118. An oil stream was balanced against two separate aqueous inputs (containing washed *E. coli* cells and substrate respectively) as previously described for the two-color droplet sorting experiment described in Chapter 3. *Id.* Figure 4.4 of Thorsen is reproduced below.



Ex. 1003, 119. Thorsen Figure 4.4 shows *E. coli* bacteria cells encapsulated in droplets generated by microfluidic crossflow. *Id.* Thorsen states that although the crossflow assay was unreliable, “a few good examples of catalysis inside the formed droplets were still acquired” as shown in Figure 4.5. *Id.* Thorsen further states that droplets were visualized for fluorescent product approximately 10 minutes after encapsulation, after they had flowed through 4–5 loops of the wide serpentine outlet channel. *Id.*

Figure 4.5 of Thorsen is reproduced below.



Ex. 1003, 120. Thorsen Figure 4.5 depicts monodisperse droplets containing *E. coli* expressing recombinant pNB esterase and fluorescein diacetate substrate. *Id.* at 120. The active *E. coli* cells took on a bright fluorescent green coloration as they accumulated fluorescein product during catalysis, making it easy to visually confirm their presence in droplets. *Id.* at 119.

2. *Ismagilov 091 (Ex. 1004)*

Ismagilov 091 is asserted as prior art to the '837 patent under 35 U.S.C. § 102(a)(2) and pre-AIA § 102(e) as of its May 9, 2003 filing date and under § 102(a)(1) and pre-AIA § 102(a) as of its December 8, 2005 publication date. Pet. 15–16. Petitioner contends that Ismagilov 091 is prior art under pre-AIA § 102(b), if the challenged claims are not entitled to their earliest asserted priority date. *Id.* at 16.

Patent Owner does not contest the prior art status of Ismagilov 091. We do not need to address Petitioner's contention under pre-AIA § 102(b)

because Patent Owner does not attempt to show a date of invention earlier than Ismagilov's 091's filing date or publication date. We find that Ismagilov 091 is prior art to the '837 patent regardless of whether the AIA applies to the patent.

Ismagilov 091 discloses microfabricated substrates and methods of conducting reactions in droplets ("plugs") in a flow of carrier fluid in a substrate. Ex. 1004, code (57).

Ismagilov 091 discloses that "[p]lugs" . . . are formed in a substrate when a stream of at least one plug-fluid is introduced into the flow of a carrier-fluid in which it is substantially immiscible." Ex. 1004, 9:20–23. According to Ismagilov 091, the "plugs" may be in the form of "an aqueous plug-fluid . . . surrounded by a non-polar or hydrophobic fluid such as an oil." *Id.* at 9:39–44. Ismagilov 091 discloses that an "inlet port" is "an area of a substrate that receives plug-fluids," and "[t]he inlet port can be in fluid communication with a channel." *Id.* at 8:41–42, 8:46–47. According to Ismagilov 091, a "channel" includes "microchannels." *Id.* at 7:46–48. Ismagilov 091 discloses that an "outlet port" is "an area of a substrate that collects or dispenses the plug-fluid, carrier-fluid, plugs or reaction product." *Id.* at 9:5–8.

In a section headed, "Channels and Devices," Ismagilov 091 discloses a device that "includes one or more substrates comprising a first channel comprising an inlet separated from an outlet." Ex. 1004, 14:20–23.

According to Ismagilov 091,

The device may have one or more outlet ports or inlet ports. Each of the outlet and inlet ports may also communicate with a well or reservoir. The inlet and outlet ports may be in fluid

communication with the channels or reservoirs that they are connecting or may contain one or more valves.

Id. at 14:36–40. In this section, Ismagilov 091 also discloses that “a plug-forming region generally comprises a junction between a plug-fluid inlet and a channel containing the carrier-fluid such that plugs form.” *Id.* at 14:44–45.

In a section headed, “Fabrication of Channels, Substrates, and Devices,” Ismagilov 091 discusses methods for fabricating microfluidic devices, including a polymer casting method. Ex. 1004, 16:1–7, 16:23–41. According to this method, a negative image of the channels is etched into a crystalline silicon wafer, and the wafer is used as a mold for casting the channels from polydimethylsiloxane (PDMS). *Id.* at 16:23–28. In this method, the silicon wafer mold is placed in the bottom of a Petri dish, uncured PDMS is poured onto the mold, and the PDMS then cured and removed from the mold. *Id.* at 16:30–35. Ismagilov 091 discloses that “[h]oles may be cut into the PDMS using, for example, a tool such as a cork borer or a syringe needle.” *Id.* at 16:35–36. According to Ismagilov 091, the PDMS channels are treated with hydrochloric acid to render the surface hydrophilic. *Id.* at 16:37–38. Ismagilov 091 discloses that the PDMS channels can be “placed onto a microscope cover slip (or any other suitable flat surface), which can be used to form the base/floor or top of the channels.” *Id.* at 16:38–41.

Ismagilov 091 also discloses that “[a] substrate containing the fabricated flow channels and other components is preferably covered and sealed, preferably with a transparent cover, e.g., thin glass or quartz, although other clear or opaque cover materials may be used.” Ex. 1004, 16:60–64. According to Ismagilov 091, the substrate can include “[a]

variety of channels for sample flow” as well as “manifolds (a region consisting of several channels that lead to or from a common channel).” *Id.* at 17:10–11, 17:18–20. Such manifolds can “route[] the flow of solution to an outlet.” *Id.* at 17:23–27. Ismagilov 091 discloses that “[t]he outlet can be adapted for receiving, for example, a segment of tubing or a sample tube, such as a standard 1.5 ml centrifuge tube. Collection can also be done using micropipettes.” *Id.* at 17:27–30.

Figure 3A of Ismagilov 091 is reproduced below.

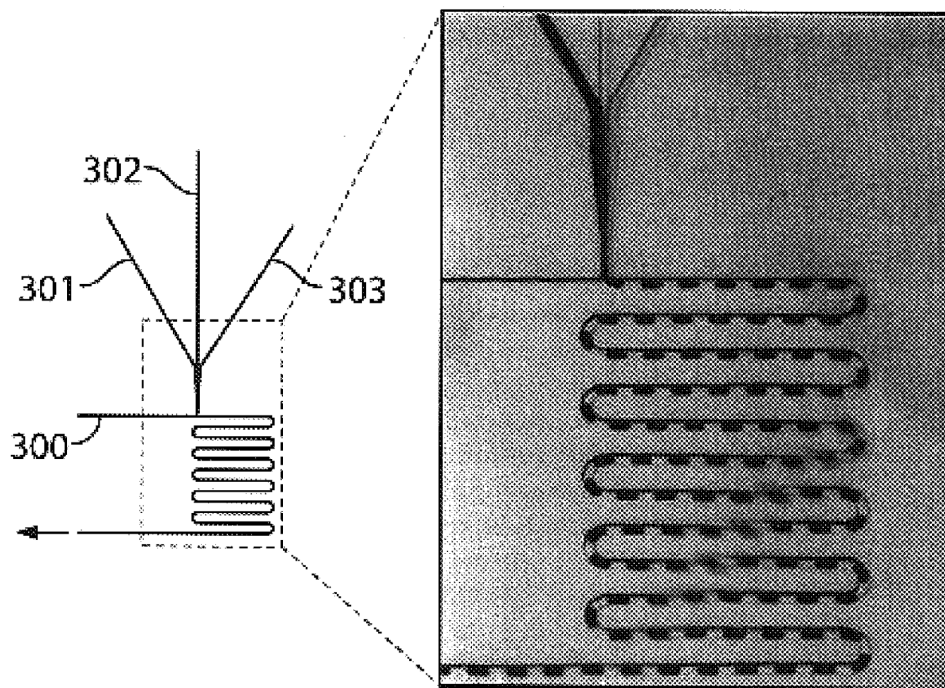


FIG. 3A

Ismagilov 091 Figure 3A shows a photograph (right side) and a schematic diagram (left side) depicting a stream of plugs formed from an aqueous plug-fluid and an oil (carrier-fluid) in curved serpentine channels. Ex. 1004, 4:6–10, 18:24–26, Fig. 3A. According to Ismagilov 091, the carrier-fluid is

introduced into inlet port 300 of a substrate, and three aqueous plug-fluids are introduced in separate inlet ports 301, 302, and 303. *Id.* at 18:31–33.

Ismagilov 091 discloses that “[p]lug-fluids may comprise a solvent and optionally, a reactant” and that “[s]uitable carrier-fluids include oils, preferably fluorinated oils.” Ex. 1004, 20:10–11, 20:37–38. According to Ismagilov 091, “[t]he carrier-fluid or plug-fluid, or both may contain additives, such as agents that reduce surface tensions (e.g., surfactants).” *Id.* at 20:45–47.

3. *Ismagilov 119 (Ex. 1005)*

Ismagilov 119 is asserted as prior art to the ’837 patent under 35 U.S.C. § 102(a)(2) and pre-AIA § 102(e) as of its March 16, 2005 filing date and under § 102(a)(1) and pre-AIA § 102(a) as of its May 4, 2006 publication date. Pet. 16–17. Patent Owner does not contest the prior art status of Ismagilov 119. We find that Ismagilov 119 is prior art to the ’837 patent regardless of whether the AIA applies to the patent.

Ismagilov 119 incorporates Ismagilov 091 by reference. Ex. 1005, ¶ 30. Like Ismagilov 091, Ismagilov 119 also discloses a microfluidic system and refers to droplets as “plugs.” *Id.* ¶ 22, Fig. 13b (showing “aqueous droplets, or plugs” being formed at the junction between “channel a” through which an aqueous stream is pumped and “channel b” through which a carrier fluid is pumped).

Ismagilov 119 discloses that “the use of fluorinated carrier fluid can provide protection of plugs and control of the surface chemistry.” Ex. 1005 ¶ 9. Ismagilov 119 discloses that, if centrifugation is used as a force for bringing two plugs into contact, then “preferably the carrier fluids and the

plug fluids have different densities, as is the case when aqueous plug fluids and fluorinated carrier fluids are used.” *Id.* ¶ 14.

Ismagilov 119 discloses that “it is desirable add a surfactant into the carrier fluid . . . to control the surface tension and the wetting properties of the carrier fluid.” Ex. 1005 ¶ 94. For example, Ismagilov 119 discloses “perfluorooctanol as the surfactant when fluorinated fluids were used as carrier fluids.” *Id.* According to Ismagilov 119, “fluorous-soluble surfactants can be used to control non-specific protein adsorption at a fluorinated carrier-aqueous interface.” *Id.* Ismagilov 119 provides an example of a fluorous-soluble surfactant that “arranges itself at the fluorinated carrier-aqueous interface during plug formation and presents a monolayer of oligoethylene glycol groups.” *Id.*

E. Asserted Anticipation of Claims 1–4, 10–13, and 19 by Thorsen

Petitioner contends that Thorsen anticipates claim 1 in three ways: (1) the disclosure in Chapter 3 of a microfluidic incubation chamber device (Thorsen’s “incubation chamber system”); (2) the disclosure in Chapter 4 of a microfluidic serpentine channel outlet device (Thorsen’s “serpentine channel system”); and (3) the teachings of Chapter 4 applied to the system of Chapter 3. *See, e.g.*, Pet. 19–21, 27–28. Regarding the third way, Petitioner contends a POSA would have understood that Chapter 4’s teaching of a cell screening assay applies to the incubation chamber system described in Chapter 3 system and “read the teachings in both chapters as describing a single system and operation.” *Id.* at 20.

For the reasons discussed below, we find Petitioner has shown that claims 1–3, 10–13, and 19 are anticipated by Thorsen’s incubation chamber system disclosed in Chapter 3, alone or in combination with the teachings of

Thorsen Chapter 4 pertaining to a sample, and we find Petitioner has shown that the subject matter of dependent claim 4 would have been obvious in view of Thorsen's disclosure of outlet wells having an open top. In view of these findings, we do not reach Petitioner's contention that claims 1–4, 10–13, and 19 are anticipated by Thorsen's serpentine channel system in Chapter 4 alone.

1. Claim 1

a) [1.0] An assembly, the assembly comprising:

Petitioner contends, and Patent Owner does not dispute, that Thorsen's incubation chamber system, as described in Chapter 3 and shown in Figures 3.28 and 3.29, constitutes an assembly as recited in the preamble. Pet. 27–28 (citing Ex. 1003, 10, 99, 101–103, 109–111, 115; Ex. 1008 ¶ 95).

We are persuaded by Petitioner's undisputed contentions and find that Thorsen's microfluidic incubation chamber device is an assembly and discloses the preamble of claim 1.⁷

b) [1.1] a microchannel in a horizontal plane;

Petitioner contends, and Patent Owner does not dispute, that Thorsen's incubation chamber system has a microchannel in a horizontal plane as required by claim element 1.1. Pet. 28–30 (citing, *inter alia*, Ex. 1003, Fig. 3.28). We have reviewed and agree with Petitioner's undisputed contentions. For example, we find that Thorsen's incubation chamber system, as shown in Figure 3.28, includes a microchannel located between

⁷ Because we find that Thorsen discloses the subject matter recited in the preamble of claim 1, we need not, and do not, determine if the preamble should be construed as limiting.

the crossflow junction and the incubation chamber. Ex. 1003, Fig. 3.28; Pet. 28.

We also agree with Petitioner's undisputed contention that Thorsen's microchannel is in a horizontal plane. For example, Petitioner persuasively shows that a coverslip is used to close the channels. Pet. 29–30. We are persuaded by Petitioner's contention that because the glass coverslip is placed horizontally, Thorsen's microchannels, which are closed by and parallel to the glass coverslip, are similarly horizontal and in a horizontal plane. *Id.* (citing Ex. 1003, 96–97, 103, Figs. 3.28, 3.29, 4.2, 4.4, 4.5; Ex. 1006 ¶¶ 31, 100).

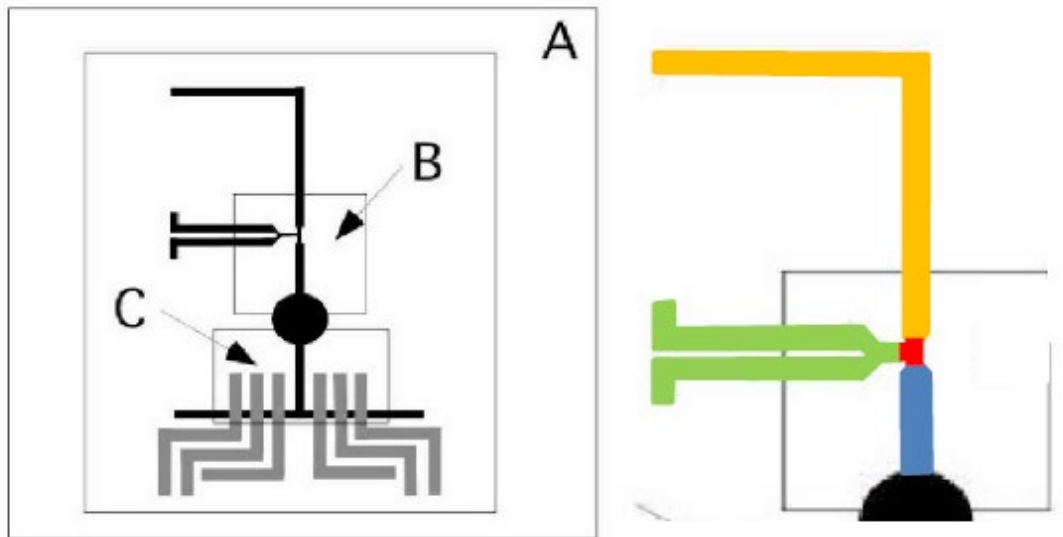
Therefore, we determine Petitioner has persuasively shown that Thorsen's description of its incubation chamber system discloses a microchannel as required by claim element 1.1.

c) [1.2] at least one droplet formation module comprising a sample inlet, an immiscible fluid inlet, and a junction, wherein the junction is located between the sample inlet and the microchannel and the droplet formation module is configured to produce droplets comprising the sample surrounded by the immiscible fluid;

Petitioner contends that Thorsen discloses the limitations of claim element 1.2, relying on the combined disclosures of Chapters 3 and 4. Pet. 30–37.

Addressing the structural limitations of claim element 1.2, Petitioner contends Thorsen's crossflow junction—which is used in Thorsen's microfluidic devices having an either incubation chamber system as disclosed in Chapter 3 or the serpentine channel system disclosed in Chapter 4—is a droplet formation module as required by claim element 1.2. *See,*

e.g., Pet. 31–32. Petitioner states Thorsen’s Figure 3.28A shown below left, with an annotated excerpt shown below right, depicts the cross flow junction used in an incubation chamber system. Pet. 31–32.



Thorsen’s Figure 3.28A illustrating Thorsen’s cross flow junction is depicted above left and an annotated excerpt of the cross flow junction shown in Figure 3.28A is depicted above right. Pet. 31–32.

Petitioner states, and we find, that Thorsen’s crossflow junction depicted in Figure 3.28A is a “droplet formation module” comprising a “sample inlet” (the channels annotated in green), an “immiscible fluid inlet” (the channel annotated in orange containing an immiscible oil), and a “junction” (the red cross flow junction where the orange and green channels intersect), wherein the “junction” is located between the “sample inlet” (the channels annotated in green) and the “microchannel” (the microchannel annotated in blue) that leads to the incubation chamber (black dot). Pet. 31–32; Ex. 1003, Fig. 3.28.

Turning to the recitation of a “sample” in claim element 1.2, Petitioner states that Thorsen discloses using the cross flow junction in both

the incubation chamber system and the serpentine outlet channel system, and that the incubation chamber system is a modification of the serpentine channel system designed for chemical screening reactions that require additional time beyond the time provided by the serpentine output channel system. Pet. 32, 35 (citing Ex. 1003, 3.28, 3.29, 4.1, 4.2, 99–103, 109–111, 114–116). Petitioner points to Thorsen’s description of the incubation chamber device as a modification of its serpentine channel device wherein the “serpentine output channel at the crossflow junction was replaced with a large (~500 μm) high cavity to slow down the droplets and create an on-chip incubation chamber (Figure 3.28B).” Pet. 35; Ex. 1003, 99.

Petitioner also asserts that Thorsen discloses that its devices are intended for “chemical screening” that includes screening of a sample, such as compound, composition, and/or mixture of interest from any suitable source. Pet. 34 (citing Ex. 1003, 10, 21, 26; Ex. 1008 ¶¶ 106–109).

Petitioner asserts that Chapter 3 of Thorsen discloses using the cross flow junction incubation chamber system to form aqueous droplets surrounded by immiscible oil fluid at the junction (Pet. 33 (citing Ex. 1003, 62, 73–74)) as well as to sort aqueous droplets containing either “green (fluorescein) or red (R-phycoerythrin) fluorescent dyes” (Pet. 36–37 (citing Ex. 1003, 109–12)).

Petitioner further asserts that Thorsen Chapter 4 describes using the same cross flow junction in connection with the serpentine output channel system to produce aqueous droplets comprising a sample (e.g., cells/enzymes of interest and a reagent (substrate)) for a chemical screening assay to measure enzyme activity at the single cell level. Pet. 35–36 (citing Ex. 1003, 114–120, Figs. 4.1, 4.2, 4.4, 4.5).

Patent Owner responds that Thorsen does not disclose the subject matter of claim element 1.2, asserting that Thorsen does not disclose using a “sample” under either party’s construction of the term, and therefore the “sample” limitations are missing from Thorsen’s disclosure. PO Resp. 26. Patent Owner asserts that, although the red or green dyes may be used to indicate the presence of certain bacteria or antibodies, they are not “samples” themselves, within the meaning of the ’837 claims. *Id.* at 27 (citing Ex. 2016 ¶ 121). Patent Owner further contends Thorsen does not disclose using cells or enzymes as samples because the experiments disclosed in Chapter 4 using cells/enzymes reported problems with the adhesion of cells to the channel walls. *Id.* at 26. Patent Owner points to Thorsen’s statement of problems with “flow balance,” “cell adhesions to PDMS” and “substrate autohydrolysis [sic].” *Id.* at 10 (citing Ex. 1003, 120–127; Ex. 2016 ¶¶ 36–40). Patent Owner also points to Thorsen’s statements that “[w]orking on the development of a microfluidic crossflow assay emphasized the difficult dynamic integration process between biochemical and micromechanical systems” and “that the problems he experienced ultimately ‘plagued the assays’ and that ‘further research in this area’ was needed.” *Id.* at 10–11 (quoting Ex. 1003, 127).

Patent Owner similarly contends that a POSA would not understand Thorsen to disclose use of the incubation chamber disclosed in Chapter 3 to perform chemical screening because the channel walls of Thorsen’s incubation chamber system were made from the same material as the serpentine channel system and “Thorsen reported problems with the adhesion of cells to the channel walls in his only attempt to use an actual sample, i.e., his use of pNB esterase in the serpentine channel system of

Chapter 4).” PO Resp. 26 (citing Ex. 2016 ¶ 120); *see also id.* at 47–48 (asserting Thorsen’s Chapters 3 and 4 do not describe a single system and that even they do describe a single system, the system is not enabled).

We have reviewed the parties’ evidence and arguments and determine Petitioner has shown persuasively that Thorsen discloses the subject matter recited in claim limitation 1.2, notwithstanding Patent Owner’s arguments to the contrary.

We disagree with Patent Owner’s argument that because Thorsen does not disclose the successful use of a sample in Thorsen’s incubation chamber system, that Thorsen does not disclose a sample inlet, for two reasons.

First, claim 1 is directed to an “assembly” comprising a “droplet formation module [that] is configured to produce droplets comprising the sample.” Ex. 1001, 88:2–9. Thus, although claim 1 recites a “sample,” the “sample” is not an element of the claimed assembly, but rather is merely a material “worked upon” by the assembly. *See In re Otto*, 312 F.2d 937, 939 (CCPA 1963) (“inclusion of the material or article worked upon by a structure being claimed does not impart patentability to the claims”). The recitation of a “sample” in the context of claim 1 is analogous to the recitation of “hair” in the context of Otto’s claimed hair curlers and does not impart patentability to the claim. *See id.* at 937–38, 939.

Second, even if claim 1 requires a sample, we find that Thorsen discloses using a sample in its incubation chamber system. For example, we determine that Petitioner has shown persuasively that the green (fluorescein) and red (R-phycoerythrin) fluorescent dyes disclosed in Thorsen Chapter 3 are “samples” under either party’s definition of the term sample. Patent Owner contends that although “fluorescein and R-phycoerythrin complexes

may be used to indicate the presence of certain bacteria or antibodies, they are not ‘samples’ themselves within the meaning of the ’837 claims.” PO Resp. 27 (citing Ex. 2016 ¶ 121). We disagree with Patent Owner. The green and red fluorescent dyes are each compounds of interest and thus satisfy Petitioner’s definition of “sample” (i.e., “a sample, such as a compound, composition, and/or mixture of interest, from any suitable source”). The droplets containing the dyes are also a fluid containing molecules and thus satisfy Patent Owner’s definition of “sample” (i.e., fluid containing “molecules, cells, small molecules (organic or inorganic) or particles”).

We also agree with Petitioner that Thorsen’s microfluidic devices, including Thorsen’s incubation chamber system disclosed in Chapter 3, were intended as a general platform that could be used with samples (e.g., molecules, DNA, enzymes or other proteins, or cells). Pet. 40–41 (citing Ex. 1003, 21, 104); *see also* Ex. 1003, 104 (stating “given the small volume of individual droplets” that are can be sorted using the elastomeric valves in its microfluidic device, that to fluorescence was proposed as a system for “applications such as single-cell assays of enzymatic activity or protein/protein interactions”).

We further agree that a POSA would understand that Thorsen’s incubation chamber system is not limited to using only the materials used in the disclosed experiments (i.e., water and oil or the red and green fluorescent dyes). Thorsen’s Chapter 3 states that the incubation chamber is a design modification “to accommodate chemical screening reactions where incubation of several minutes to a few hours are optimal (Figure 3.28A)” (Ex. 1003, 99), thus indicating that the incubation chamber is intended for

use with chemical screening reactions and samples besides that used in the disclosed experiments. We agree with Petitioner that a POSA would understand this statement to expressly disclose use of samples in screening reactions where incubation intended to be used with this system is not limited to water droplets in oil or to only samples having green and red fluorescent dyes. Pet. 33–34.

We also agree with Petitioner that Thorsen discloses use of samples comprising *E. coli* cells and pNB esterase enzymes in the experiments disclosed in Chapter 4. We disagree with Patent Owner’s argument that the *E. coli* cells and pNB esterase enzyme are not disclosed as “samples” because Thorsen reported problems “with the adhesion of cells to the channel walls” in the experiments involving “use of pNB esterase in the serpentine channel system of Chapter 4.” PO Resp. 26–27; *see also id.* at 48–50 (Patent Owner’s non-enablement argument).

Although Thorsen identifies problems with the crossflow assay described in Chapter 4 and states the assay was unreliable due to the problems that “quickly made the fabricated devices non-functional” (*see* Ex. 1003, 119), Thorsen also states that, in spite of the problems, a “few good examples of catalysis inside the formed droplets were still acquired” (Ex. 1003, 120). As such, even though Thorsen identifies issues with cell adhesion in the crossflow assay of Chapter 4, Thorsen also discloses successful results using the assay. *See Celeritas Techs. v. Rockwell Int’l Corp.*, 150 F.3d 1354, 1361 (Fed. Cir. 1998) (stating a “reference is no less anticipatory if, after disclosing the invention, the reference then disparages it”).

In particular, Thorsen describes an experiment in which it was possible to visualize droplets containing *E. coli* bacterial cells for fluorescent product for approximately 10 minutes after encapsulation after they had flowed through 4–5 loops of the wide serpentine output channel. Ex. 1003, 119. Thorsen further explains that the “active cells took on a bright fluorescent green coloration as they accumulated fluorescein product during catalysis, making it easy to visually confirm their presence in droplets under a 60x/1.4 NA oil immersion objective.” *Id.* Additionally, Thorsen provides photographs of *E. coli* bacterial cells successfully encapsulated in droplets that were generated by microfluidic crossflow (Ex. 1003, Fig. 4.4) as well as images of monodisperse droplets containing *E. coli* expressing recombinant pNB esterase and fluorescein diacetate substrate, thus illustrating “a few good examples of catalysis inside the formed droplets” (Ex. 1003, 119, Fig. 4.5). As such, Thorsen discloses the successful use of its serpentine channel system using *E. coli* cells and pNB esterase enzymes as samples, and we disagree with Patent Owner that Thorsen does not enable the use of cells (i.e., *E. coli*) and enzymes (i.e., pNB esterase) as samples.

Therefore, we determine that Petitioner has sufficiently shown that Thorsen discloses the subject matter recited in claim element 1.2.

d) [1.3] at least one downstream separation chamber comprising a droplet receiving chamber inlet and at least one droplet receiving outlet

Petitioner contends that Thorsen’s incubation chamber device satisfies the limitations of claim element 1.3. Pet. 45–48. Petitioner asserts the incubation chamber of Thorsen’s microfluidic incubation chamber device disclosed in Chapter 3 is a separation chamber as required by claim element 1.3. Pet. 46–47. Petitioner asserts that the incubation chamber is a

“separation chamber” that has both a “droplet receiving chamber inlet” and a “droplet receiving outlet.” Pet. 45–46. In particular, Petitioner asserts that the microchannel that delivers the droplets formed at the Crossflow Junction to the incubation chamber, and which is shown in Figures 3.28A, 3.28B and 3.29A, is a “droplet receiving chamber inlet.” Pet. 46–47 (citing Ex. 1003, 101, Figs. 3.28A, 3.28B). Petitioner further asserts that the microchannel shown in Figure 3.28C through which droplets exit the incubation chamber is a “droplet receiving outlet” as required by claim element 1.3. Pet. 47 (citing Ex. 1003, 101, Fig. 3.28C).

Patent Owner opposes, asserting that Thorsen’s incubation chamber is not a separation chamber and that Thorsen’s incubation chamber does not have a droplet receiving outlet.

We have reviewed the parties’ arguments and evidence and determine Petitioner has shown persuasively that Thorsen’s microfluidic incubation chamber device discloses the subject matter recited in claim element 1.3.

As noted above, we adopt Patent Owner’s proposed construction of “separation chamber” as a “chamber sized to accommodate multiple droplets and an immiscible fluid in separated form.” Petitioner’s evidence shows persuasively that Thorsen’s incubation chamber accommodates multiple droplets and an immiscible fluid in separated form and, therefore, that Thorsen’s incubation chamber is a separation chamber under our construction of the term. For example, Petitioner points to Figure 3.29A of Thorsen, which depicts multiple droplets in mineral oil entering and accumulating in Thorsen’s incubation chamber. Pet. 46–47; Ex. 1003, Fig. 3.29A; *see also* Ex. 1003, 99 (stating that Thorsen’s incubation chamber has a “large (~500 μm) high cavity”), 110 (stating “thousands” of red and

green droplets were formed and that the formed droplets entered the microcavity, where they slowed down and formed a mixed cluster of droplets).

Patent Owner presents a number of arguments as to why Thorsen's incubation chamber is not a separation chamber. PO Resp. 29–31. In particular, Patent Owner argues that (1) Thorsen “does not expressly discuss separating droplets from the immiscible fluid inside the incubation chamber” (*id.* at 29); (2) Thorsen's incubation chamber is designed to slow the movement of droplets and oil and is not designed to separate droplets for collection (*id.* at 30); (3) the flow of droplets and oil into the chamber is the same as the flow out of the chamber (*id.*); (4) the purpose of a “separation chamber” of the '837 patent is to separate droplets so they can be collected at a “droplet receiving outlet” and such collection cannot occur in Thorsen's incubation chamber (*id.* at 31); (5) Figure 3.29 depicts droplets in multiple layers, not all of which are resting on the bottom of the incubation chamber (*id.*); (6) if an oil was used that had the same density as water, the aqueous droplets would stay dispersed in the oil and not sink to the bottom. (*id.*).

We disagree with these arguments because they do not refute that Thorsen's incubation chamber is “sufficiently sized to accommodate multiple droplets and an immiscible fluid in separated form.” Whether Thorsen's incubation chamber was designed to separate droplets for collection, or whether droplets would not settle in the chamber if a different oil were used, is not the correct test. Patent Owner's construction for separation chamber, which we adopt here, does not require actual separation or collection in the chamber. Moreover, even if separation were required, Petitioner shows persuasively that Thorsen discloses separation because

Figure 3.29 depicts multiple droplets accumulating on the floor of Thorsen's incubation chamber. Patent Owner's argument that Figure 3.29 depicts droplets in multiple layers, not all of which are resting on the bottom of the incubation chamber supports, rather than refutes, Petitioner's position because it admits that at least some of the droplets did rest (settle) on the bottom of the chamber.

Therefore, we agree with Petitioner that Thorsen's incubation chamber is a separation chamber as recited in claim 1.

We also agree with Petitioner that Thorsen's incubation chamber has both a droplet receiving inlet and a droplet receiving outlet. Petitioner shows that Thorsen's incubation chamber has a microchannel that deposits droplets into the chamber (a droplet receiving inlet) and a microchannel through which droplets leave the incubation chamber (a droplet receiving outlet). *See, e.g.*, Ex. 1003, Fig. 3.28A (illustrating microchannels entering and leaving the incubation chamber).

We disagree with Patent Owner's argument that Thorsen does not disclose an incubation chamber having a droplet receiving outlet. Patent Owner first argues Thorsen does not disclose a droplet receiving outlet because there is "no evidence in the record as to whether droplets approach and exit the incubation chamber one at a time, collect as a group and exit the incubation chamber multiple droplets at a time or something in between." PO Resp. 37–38 (citing Ex. 2016 ¶¶ 143–150). We disagree with this argument because Thorsen discloses droplets leaving the incubation chamber through the microchannel. For example, in describing use of the incubation chamber system to sort droplets containing red or green dyes, Thorsen states that the droplets containing the red or green fluorescent dyes

“entered the microcavity, where they slowed down and formed a mixed cluster of droplets,” then describes “a single droplet or small cluster of droplets leaving the microcavity” and then states that the droplets collect in the output wells. Ex. 1003, 110–111. As such, Thorsen discloses droplets leaving the incubation chamber.

Patent Owner also argues that it is impossible for a POSA to collect droplets before they exit the incubation chamber because it would be impossible to collect droplets without also collecting oil. PO Resp. 38–39. We disagree with this argument because there is no restriction in claim 1 that prevents the collection of oil at the droplet receiving outlet. Indeed, the ’837 patent describes outlet 805, which is shown in Figure 38, as positioned where the rising droplets will exit chamber 804 into outlet 805 and “leav[e] a large part of the oil behind.” Ex. 1001, 54:41–44. Because the Specification states that a “large part of the oil” is left behind, it can be presumed that at least part of the oil exits chamber 804 into outlet 805 with the droplets. *Id.*

Third, Patent Owner contends that it would be impossible to collect droplets at all in Thorsen’s incubation chamber if the system used an oil that was more dense than water because only oil would leave chamber and the water droplets would rise to the top of the incubation chamber. PO Resp. 39 (citing Ex. 2017, 86:15–87:15; Ex. 2016 ¶ 146). We disagree with this argument because it ignores Thorsen’s disclosure of using mineral oil, which is less dense than water droplets. *See, e.g.*, Ex. 1003, 102, 109; Ex. 1008 ¶ 51.

Fourth, Patent Owner contends that Thorsen does not disclose a droplet receiving outlet because Dr. Fair testified during his deposition that his opinion regarding the “droplet receiving outlet” is based on a

misunderstanding of Figure 3.29A. PO Resp. 39–41 (citing Ex. 2016 ¶¶ 147–148; Ex. 2017, 132:21–133:16).

We disagree with this argument. Although Dr. Fair did mistakenly state during his deposition that Figure 3.29A depicted a droplet receiving *outlet*, as opposed to droplet receiving *inlet*, Dr. Fair corrected later his misstatement. *See* Ex. 2017, 167:9–169:1. Dr. Fair’s misstatement during a deposition, which was later corrected, does not negate his declaration testimony in which he correctly identifies the microchannel shown in Figure 3.29A as the channel through which droplets enter the incubation chamber (i.e., a droplet receiving inlet) and identifies the microchannel through which droplets leave the incubation chamber as a droplet receiving outlet. *See* Ex. 1008 ¶¶ 125–128.

Thus, for the foregoing reasons, Petitioner has sufficiently shown that Thorsen’s disclosure of its microfluidic incubation chamber device discloses the limitations of claim element 1.3.

e) [1.4] wherein the separation chamber is upright to the microchannel and out of the horizontal plane;

Petitioner contends, and Patent Owner does not dispute, that Thorsen’s incubation chamber is a separation chamber that is upright to the microchannel and out of the horizontal plane. Pet. 51–52 (citing Ex. 1003, 35, 63, 99, 102–103, Fig. 3.29, Fig. 4.1); *see also* PO Resp. 44–46 (asserting that Thorsen’s outlet wells do not satisfy the limitations of claim element 1.4, but not making a corresponding argument regarding Thorsen’s incubation chamber).

We agree with Petitioner’s undisputed contentions. For example, we agree that because Thorsen’s incubation cavity is approximately 500 μm high

(Ex. 1003, 99), which is taller than any of the microchannel dimensions disclosed in Thorsen (*see, e.g.*, Ex. 1003, 35, 63, 103 (disclosing microchannel dimensions 100 μm or smaller)), that Thorsen's incubation chamber necessarily extends out of the horizontal plane of the microchannels.

Therefore, we find Petitioner has persuasively shown that Thorsen discloses the subject matter of claim element 1.4.

f) [1.5] wherein the droplet formation module and the separation chamber are in fluid communication with each other via the microchannel;

Petitioner asserts that Thorsen discloses the subject matter recited in claim element 1.5 because Thorsen discloses a microchannel providing fluid communication between the Crossflow Junction (droplet formation module) and the Incubation Chamber (separation chamber). Pet. 55. Other than its arguments regarding "separation chamber," which we address above, Patent Owner does not dispute Petitioner's contentions.

We have reviewed the parties contentions and agree with Petitioner that Thorsen discloses the subject matter recited in claim element 1.5. For example, we find that Thorsen's Figure 3.28 discloses a cross flow junction (droplet formation module) that is in fluid communication with the incubation chamber (separation chamber) via the channel that runs from the junction to the incubation chamber (a microchannel) and thus discloses the subject matter recited in claim element 1.5. Ex. 1003, Fig. 3.28, 98–103.

g) [1.6] and wherein the separation chamber has a wider cross-section than the microchannel cross-section to accumulate a plurality of droplets comprising the sample and

Petitioner contends that Thorsen's microfluidic incubation chamber device discloses the limitations of claim element 1.6. Pet. 55–56 (citing Ex. 1003, 99, 103, 109–111, Figs. 3.28, 3.29). Other than its arguments regarding “separation chamber,” which we address above, Patent Owner does not dispute Petitioner's contention.

We agree with Petitioner's contention and find that Thorsen discloses the subject matter recited in claim element 1.6. For example, we find that the high resolution images of an actual chip in Figures 3.28 and 3.29 of Thorsen each show an incubation chamber (“separation chamber”) having a wider cross section than the microchannel cross section. Ex. 1003, Figs. 3.28, 3.29. We also find that Figure 3.29 of Thorsen depicts a plurality of droplets accumulating in the separation chamber. Ex. 1003, Fig. 3.29. We also find that Thorsen discloses that “thousands” of droplets containing red or green fluorescent dyes entered the incubation cavity where they slowed down and formed a mixed cluster of droplets. Ex. 1003, 109–111.

Thus, Petitioner has persuasively shown that Thorsen discloses the subject matter of claim element 1.6

h) [1.7] is of a volume sufficient to separate the plurality of droplets comprising the sample from the immiscible fluid within the separation chamber.

Petitioner asserts Thorsen discloses the limitations of claim element 1.7 by disclosing an incubation chamber of sufficient volume that the droplets can move and sink relative to the less dense mineral oil phase.

Pet. 57 (citing Ex. 1003, 76, 80–84, 100–103, 119, Figs. 3.28, 3.29; Ex. 1008 ¶ 154).

Other than asserting Thorsen does not disclose a separation chamber, which we address above, Patent Owner does not dispute Petitioner’s contention. PO Resp. 46.

We agree with Petitioner’s contentions and find that Thorsen discloses the subject matter recited in claim element 1.7. For example, we find that Thorsen discloses that the incubation chamber has a volume of 1 μm , while the droplets have a volume of only $\sim 30\text{pL}$. Ex. 1003, 76, 100–103, 119, Fig. 3.29. We are persuaded by Dr. Fair’s testimony that a POSA would understand that, given these volumes, Thorsen’s incubation chamber is of a sufficient volume to allow the droplets to separate. Ex. 1008 ¶ 154.

i) Conclusion

For the foregoing reasons, we Petitioner has sufficiently shown that Thorsen discloses all of the limitations of claim 1. Accordingly, we conclude that Petitioner has shown by a preponderance of the evidence that claim 1 is anticipated by Thorsen.

2. Claim 2

Claim 2 recites the “assembly of claim 1, wherein an aqueous fluid from the sample inlet is segmented with an immiscible fluid from the immiscible fluid inlet at the junction.” Ex. 1001, 88:24–26.

Petitioner contends that Thorsen’s crossflow junction, which is used in both Thorsen’s incubation chamber system and serpentine channel system, discloses the limitations of claim 2. Pet. 60 (citing Ex. 1003, 70–76, 102, 103, 109–111, 114–120, Figs. 3.5–3.9, 3.11, 3.12, 3.14, 3.15, 3.28,

3.29, 4.1, 4.2). Patent Owner does not separately argue the patentability of claim 2.

We have reviewed, and are persuaded by, Petitioner’s contentions and find that Thorsen’s cross flow junction as depicted in Thorsen Figure 3.28, which is used in both Thorsen’s incubation chamber system and serpentine channel system, produces droplets, as shown in Figure 3.29, by segmenting aqueous fluid from the sample inlet with an immiscible fluid from the immiscible fluid inlet. *See, e.g.*, Ex. 1003, 102 (describing production of aqueous droplets in mineral oil depicted in Figure 3.29), Fig. 3.28; *see also id.* at 114–116 (describing the production of droplets using the cross flow junction in the serpentine chamber device described in Chapter 4); Figs. 4.1, 4.2 (depicting Thorsen’s cross flow junction in connection with the serpentine channel system).

3. Claim 3

Claim 3 recites the “assembly of claim 1, wherein the at least one droplet receiving outlet is located on the lower portion of the separation chamber.”

Petitioner contends that Thorsen’s incubation chamber device disclosed in Chapter 3 satisfies the limitations of claim 3. Pet. 60 (citing Pet. 45–48).

Other than contending the microchannel through which droplets leave the incubation chamber is not a droplet receiving outlet, which we address above, Patent Owner does not dispute Petitioner’s contentions. *See generally* PO Resp.

We agree with Petitioner’s contentions and determine Thorsen discloses the subject matter recited in claim 3. For example, we agree that

Thorsen discloses a microchannel that receives droplets out of the separation chamber and that this microchannel is a droplet receiving outlet. We also agree with Petitioner's contention that this microchannel is located on the lower portion of the incubation chamber (separation chamber). Thorsen states that after the cross flow device (i.e., the microchannel incubation chamber device) was released from a mold, that it was "sealed channel side down on the coated coverslips" (Ex. 1003, 102), thus demonstrating that the microchannel is located on the lower portion of the incubation chamber. *See also* Ex. 1003, Fig. 3.29A (depicting a photograph of the incubation chamber and microchannel viewed through an inverted microscope).

Therefore, we find that Thorsen's incubation chamber system discloses the limitations recited in claim 3 and therefore Petitioner has shown by a preponderance of the evidence that Thorsen anticipates claim 3.

4. *Claim 4*

Claim 4 recites the "assembly of claim 1, wherein the at least one droplet receiving outlet is located on the upper portion of the separation chamber."

Petitioner contends that claim 4 is anticipated by Thorsen's disclosure of an outlet well having an opening at the top of the well. Pet. 61. Petitioner makes no argument that Thorsen's incubation chamber has a droplet receiving outlet located on its upper portion. For purposes of Petitioner's anticipation ground, we do not reach Petitioner's contention that Thorsen's outlet wells have a "droplet receiving outlet," as recited in claims 1 and 4. Instead, we address this aspect of claims 1 and 4 below in the context of Petitioner's obviousness ground. *See, e.g., Boston Sci. Scimed, Inc. v. Cook Grp. Inc.*, Nos. 2019-1594, -1604, -1605, 2020 WL 2071962, at *4

(Fed. Cir. Apr. 30, 2020) (non-precedential) (recognizing that the “Board need not address issues that are not necessary to the resolution of the proceeding” and, thus, agreeing that the Board has “discretion to decline to decide additional instituted grounds once the petitioner has prevailed on all its challenged claims”).

5. *Claim 10*

Claim 10 recites the “assembly of claim 1, wherein the droplet receiving outlet receives substantially one or more droplets.”

Petitioner asserts, *inter alia*, that Thorsen discloses that the incubation chamber receives thousands of droplets and has a droplet receiving outlet that receives substantially one or more droplets. Pet. 66 (citing Ex. 1003, 102–103, 109–111, Figs. 3.29). Patent Owner does not separately argue the patentability of claim 10. *See generally* PO Resp.

We agree with Petitioner’s contentions and determine Thorsen discloses the subject matter recited in claim 10. For example, we agree that Thorsen discloses a droplet receiving outlet that receives substantially one or more droplets by describing the use of Thorsen’s incubation chamber system to sort droplets containing red or green dyes. Ex. 1003, 110–111. Thorsen states that droplets containing the red or green fluorescent dyes “entered the microcavity, where they slowed down and formed a mixed cluster of droplets,” then describes “a single droplet or small cluster of droplets leaving the microcavity” where they later collect in the output wells. Ex. 1003, 110–111.

Therefore, we find that Thorsen’s incubation chamber system discloses the limitations recited in claim 10 and therefore Petitioner has shown by a preponderance of the evidence that Thorsen anticipates claim 10.

6. *Claim 11*

Claim 11 recites the “assembly of claim 1 further comprising a reagent inlet, wherein the reagent inlet is in fluid communication with the junction or the microchannel.”

Petitioner asserts that Thorsen’s cross flow junction discloses a reagent inlet that is in fluid communication with the junction or the microchannel. Pet. 67 (citing Pet. 30–37; Ex. 1003, 99–103, 114–118, Figs. 3.28–3.29, 4.1, 4.2). Patent Owner does not separately argue the patentability of claim 11. *See generally* PO Resp.

We agree with Petitioner’s contentions. For example, Figures 3.8 and 4.1 each depict a cross flow junction having two inlets for adding sample and reagents. *See, e.g.*, Ex. 1003, Fig. 4.1 (identifying one input for cells/enzymes (sample) and the other input for substrate (reagent)). These figures also show that the reagent inlet is in fluid communication with the junction or microchannel.

Therefore, we find that Thorsen’s incubation chamber system discloses the limitations recited in claim 11 and therefore Petitioner has shown by a preponderance of the evidence that Thorsen anticipates claim 11.

7. *Claims 12 and 13*

Claim 12 recites the “assembly of claim 11, wherein the reagent inlet introduces one or more amplification reagents to the junction or the microchannel.” Claim 13 recites the “assembly of claim 12, wherein the one or more amplification reagents are for a polymerase chain reaction.”

Petitioner asserts Thorsen discloses the subject matter recited in claims 12 and 13. Pet. 67–69 (citing Ex. 1003, 52, 130).

Patent Owner does not separately argue the patentability of claims 12 and 13. *See generally* PO Resp.

We have reviewed and agree with Petitioner's evidence and argument. For example, we agree that Thorsen describes use of microfluidic systems for biological applications including PCR reactions and describes microfluidic assay systems having a cross flow junction with a reagent inlet for use with those same applications. *See, e.g.*, Ex. 1003, 52, 103, Figs. 3.28, 4.1. We agree with Petitioner's contentions, supported by the persuasive un rebutted testimony of Dr. Fair, that a POSA would be familiar with amplification reagents for use in PCR. Pet. 67; Ex. 1008 ¶ 182.

Thus, we determine Petitioner has shown that Thorsen discloses the limitations recited in claims 12 and 13 and therefore has shown by a preponderance of the evidence that claims 12 and 13 are unpatentable under 35 U.S.C. § 102 as anticipated by Thorsen.

8. *Claim 19*

Claim 19 recites the "assembly of claim 1, further comprising a sorting module to direct the flow of droplets, wherein the sorting module is located between the droplet formation module and the separation chamber."

Petitioner asserts that the serpentine channel microfluidic device discloses this limitation because this device uses valves to sort droplets to direct the flow of droplets to a particular outlet well. Pet. 69–70 (citing Ex. 1003, 99–103, 106–112, Figs. 3.28–3.29, 4.2). Patent Owner does not present any particularized argument directed to this claim. *See generally* PO Resp.

We have reviewed and we agree with Petitioner's contentions. We agree that Thorsen shows a valve sorting module that is located between the

crossflow junction (the droplet formation module) and the outlet well. Ex. 1003, 99–103, 106–112, Figs. 3.28–3.29, 4.2. Thorsen further discloses using this droplet sorting module to sort “thousands” of red from green fluorescent droplets with 98–99% accuracy. *Id.* at 109–111.

Thus, we determine Petitioner has shown that Thorsen discloses the limitations recited in claim 19 and therefore has shown by a preponderance of the evidence that claim 19 is unpatentable under 35 U.S.C. § 102 as anticipated by Thorsen.

9. Conclusion

For the foregoing reasons, Petitioner has shown by a preponderance of the evidence that claims 1–3, 10–13, and 19 are unpatentable under 35 U.S.C. § 102 as anticipated by Thorsen. As discussed above, we do not reach Petitioner’s contention that claim 4 is anticipated by Thorsen.

F. Asserted Obviousness of Claims 1–4, 7, 9–13, and 19 over Thorsen

Petitioner contends that claims 1–4, 7, 9–13, and 19 would have been obvious under 35 U.S.C. § 103(a) over Thorsen.

Having already determined that Petitioner establishes by a preponderance of the evidence that claims 2, 3, 10–13, and 19 are anticipated by Thorsen, we do not address Petitioner’s additional grounds challenging these claims as obvious over Thorsen. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1359 (2018) (holding a petitioner “is entitled to a final written decision addressing all of the claims it has challenged”); *Boston Sci. Scimed*, 809 F. App’x at 990 (“We agree that the Board need not address [alternative grounds] that are not necessary to the resolution of the proceeding.”).

For the reasons stated below, we determine that Petitioner has shown by a preponderance of the evidence that claims 1, 4, 7, and 9 would have been obvious over Thorsen.

1. Claim 1

Petitioner contends that claim 1 would have been obvious in view of Thorsen's disclosure of an incubation chamber system and a serpentine channel system, both of which have outlet wells, where the outlet well corresponds to a "separation chamber" and the open top of the outlet well corresponds to a "droplet receiving outlet" under Patent Owner's claim constructions. Pet. 47–48; *see also id.* at 19, 27–59 (Petitioner's obviousness contentions for claim 1 based on Thorsen alone). Patent Owner opposes.

For the reasons below, we agree with Petitioner notwithstanding Patent Owner's arguments to the contrary.

Turning first to claim element 1.3, we agree with Petitioner that Thorsen's outlet wells are a separation chamber under Patent Owner's proposed construction of that term, i.e., "chamber sized to accommodate multiple droplets and an immiscible fluid in separated form," which we adopt. We are persuaded by Petitioner's arguments and evidence that Thorsen's outlet well are sized to accommodate multiple droplets and an immiscible fluid as Thorsen teaches collecting aqueous droplets surrounded by immiscible mineral oil in its outlet well. Pet. 48 (citing Ex. 1003, 110–111). For example, we find that Thorsen discloses collecting thousands of droplets comprising either red or green fluorescent dye in its outlet wells. *See, e.g.,* Ex. 1003, 110–111. We also agree with Petitioner's argument and evidence that, because Thorsen's aqueous water droplets are more dense

than the mineral oil, the droplets will sink to the bottom of the outlet well, and therefore Thorsen discloses that the droplets and immiscible fluid are in separated form. *See* Section II.E.1.d. above.

Patent Owner responds that the outlet wells are not separation chambers because Thorsen does not expressly disclose that the droplets may sink to the bottom of the outlet well and that if an oil was used that has the same density as water, the droplets would not sink to the bottom of the well. PO Resp. 33. We disagree with Patent Owner's argument because it ignores Thorsen's disclosure of using mineral oil, which is less dense than water, in its microfluidic devices, including the serpentine channel device. *See, e.g.,* Ex. 1003, 115; Ex. 1008 ¶ 51.

We also disagree with Patent Owner's argument that Petitioner's expert, Dr. Fair, testified that he did not assert that Thorsen's outlet wells were separation chambers. PO Resp. 32–33 (citing Ex. 2017, 80:19–81:22). We agree with Petitioner that Dr. Fair's testimony during this part of his deposition was directed to opinions of a separation chamber under a claim construction of separation chamber that is not asserted in the present proceeding. Pet. Reply 8 (citing Ex. 2017, 77:2–5, 77:11–14). Dr. Fair testifies in his declaration that Thorsen's outlet wells are separation chambers under the construction of this term asserted in the present proceeding. *See, e.g.,* Ex. 1008 ¶¶ 129–130.

Therefore, we find that Thorsen's outlet well is a separation chamber as recited in claim 1.

We also agree with Petitioner's evidence and argument that Thorsen's outlet wells teach or suggest the separation chamber limitations recited in claim elements 1.3–1.7.

More particularly, we agree with Petitioner's contention that Thorsen's outlet wells have a "droplet receiving chamber inlet" as required by claim element 1.3, which Patent Owner does not dispute, because Thorsen states that the droplets formed at Thorsen's crossflow junction will travel to the outlet well through a microchannel. Pet. 47–48 (citing Ex. 1003, 114–116, Figs. 4.1, 4.2). We agree with Petitioner and find Thorsen teaches a droplet receiving inlet (the end of the microchannel that enters the outlet well and delivers droplets from the crossflow junction) as required by claim element 1.3.

We also agree with Petitioner's assertions that the outlet wells are upright to the microchannels as required by claim element 1.4 and have a wider cross section to accumulate a plurality of droplets comprising the sample as required by claim element 1.6. Pet. 52–53, 56. We disagree with Patent Owner's arguments that Thorsen does not disclose the dimensions or designs of Thorsen's outlet wells and therefore do not disclose the subject matter recited in these limitations. PO Resp. 33–37.

For example, we are persuaded by Petitioner's argument that Thorsen's outlet wells were fabricated by punching through multiple layers of the microchip (i.e., the thick upper layer of PDMS and the thin lower layer of PDMS), whereas the main channel is only patterned only along the thin bottom layer. Pet. Reply 14–19; Ex. 1003, 98–102, Fig. 3.27. Patent Owner admits that Thorsen fabricated the openings (i.e., outlet wells) in the devices by punching holes in the microchip itself at the channel ends, as was standard practice at the time. PO Resp. 2. Patent Owner asserts that the punch used to fabricate the outlet wells is 585 μm , which is larger than the dimensions of the microchannels disclosed in Thorsen, each of which are

under 100 μm . PO Sur-reply 11; *see also* Ex. 1003, 31 (stating holes were punched with a 585 μm steel punch at channel ends), 115, Fig. 4.1 (identifying microchannel of 90 μm output channel connected to outlet well). Thus, according to Patent Owner's own contentions, the outlet well was formed by punching through the microfluidic device layers at the channel ends using a punch that is wider than the microchannels, we find the outlet wells are upright to the microchannel as required by claim element 1.4 and have a wider cross-section than the microchannel as required by claim element 1.6. Ex. 1003, 98–102, Figs. 3.27, 4.2; Pet. Reply 14–19.

We also agree with Petitioner's contentions that Thorsen teaches that its outlet wells are "of volume sufficient to separate the plurality of droplets comprising the sample from the immiscible fluid within the separation chamber" as required by claim element 1.7 for the same reasons we find Thorsen's outlet wells are a separation chamber (i.e., a "chamber sized to accommodate multiple droplets and an immiscible fluid in separated form").

We are also persuaded by Petitioner's argument, supported by Dr. Fair's testimony, that it would have been obvious to remove collected droplets from Thorsen's outlet wells using a micropipette. Pet. 48 (citing Ex. 1008, 130, 136).

For example, we also persuaded by Petitioner's argument, supported by Dr. Fair's testimony, that a POSA "would know that the purpose of screening is often to collect the positive results for further use (e.g., by collecting the positive droplets from the outlet well by micropipette and transferring them to a sample test tube for subsequent use)." Pet. 21–22; Ex. 1008 ¶¶ 83–84.

Patent Owner argues there is no evidence that a micropipette would be used with Thorsen's outlet well because there is no evidence that the opening in Thorsen's outlet well would be wide enough to accommodate a micropipette. *See, e.g.*, PO Resp. 41–44; *see also id.* at 46 (citing Ex. 2016 ¶¶ 154–157). In particular, Patent Owner contends Dr. Fair testifies that the smallest micropipette is 1 mm (1000 µm), which is much larger than the dimensions of the wells described in Thorsen. PO Resp. 43–44; *see also id.* at 46 (stating there is no evidence Thorsen's outlet well is large enough to insert a micropipette).

Petitioner responds that, to the extent Thorsen does not expressly disclose an outlet well large enough to accommodate a micropipette, it would have been well within the knowledge and skill of a POSA to produce an outlet well that would accommodate a micropipette tip, such as by using a commercially available 2 mm or 4 mm cork borer, or Thorsen's disclosed ~5 mm punch. Pet. Reply 24–25 (citing Ex. 2016 ¶¶ 30–31; Ex. 1004, 44; Ex. 1006 ¶ 196 (identifying 2mm diameter wells); Ex. 1076, 2, 4–5 (identifying 4mm reservoir holes); *see also* Ex. 2016 ¶ 69 (stating that Exhibit 2033 describes techniques “common at the time” to “punch a hole through the PDMS at the end of channels”)).

We agree with Petitioner that it would have been obvious to a POSA to transfer the droplets collected in Thorsen's outlet wells and move them into a vessel such as a PCR tube or test tube using a micropipette. *See, e.g.*, Pet. 58–59 (citing Ex. 1008 ¶¶ 130, 156); *see also* Ex. 1008 ¶¶ 129–130, 155–156 (stating using a pipette to remove droplets from an open well was routine and well known). Petitioner provides persuasive argument and evidence, supported by the persuasive testimony of Dr. Fair that, after

sorting droplets in a chemical screening reaction, a POSA would have collected the sorted droplets for further use or additional processing. Pet. 58; Ex. 1008 ¶ 156.

We are also persuaded by Petitioner's argument that Thorsen discloses that his fluorescence-based droplet sorter was only 98–99% accurate on a first pass, and that this disclosure would have provided additional motivation to a POSA to collect Thorsen's sorted droplets by micropipette for another round of additional sorting or other processing. Pet. 58–59 (citing Ex. 1003, 109–111; Ex. 1008 ¶ 156). We are persuaded by Dr. Fair's testimony that a POSA would have collected the sorted droplets for additional processing. Ex. 1008 ¶ 156.

Patent Owner does not direct us to persuasive evidence rebutting Dr. Fair's testimony that using a pipette to remove droplets from an open well, such as Thorsen's open wells, would have been routine and well-known to a person of ordinary skill in the art. Ex. 1008 ¶¶ 129, 130, 155, 156. Although Patent Owner directs us to paragraphs 151 and 152 of Dr. Anna's testimony (PO Resp. 42–44 (citing Ex. 2016 ¶¶ 151, 152)), neither paragraph (nor the related paragraph 153) refutes Dr. Fair's testimony regarding what was known in the art about the use of micropipettes to collect droplets from the open wells of a microfluidic device.

Therefore, to the extent Thorsen does not expressly disclose an outlet well (separation chamber) having an opening that large enough to accommodate a micropipette tip (droplet receiving outlet), we agree with Petitioner that it would have been obvious to a POSA to modify the outlet well of Thorsen to provide an outlet well large enough to accommodate a

micropipette tip in order to allow the collection of droplets that contain the desired (screened for) product for further use. Pet. Reply 22–25 (citing Pet. 48–54; Ex. 1008 ¶¶ 83, 108, 129–136). We are persuaded by Petitioner’s argument that Thorsen discloses sorting (physically separating) droplets and that it would have been obvious to use a micropipette to collect and transfer the sorted droplets, as a “standard industry way” of moving solutions containing multiple droplets from wells. Pet. 47–48, 57–58, 68–69; Ex. 1008 ¶¶ 85, 106, 162; Pet. Reply 22–25; *id.* at 23 n.5 (citing Ex. 2017, 42:21–43:4, 140:21–142:2).

We also find that Petitioner shows persuasively that Thorsen teaches the remaining limitations of claim 1 in connection with either the incubation chamber system or the serpentine channel system, both of which have outlet wells. Thorsen’s incubation chamber system teaches the limitations of 1.1 (“a microchannel in a horizontal plane) and 1.2 (“at least one drople formation module . . .”) for the same reasons as discussed in Section II.E.1.a–c above.

In addition, we agree with Petitioner’s undisputed contentions that Thorsen’s serpentine channel system has a microchannel (the serpentine outlet channel) in a horizontal plane. Pet. 29–30 (citing Ex. 1003, 114–116, Figs. 4.1, 4.2). We further agree that Thorsen uses a coverslip to cover the channels of Thorsen’s microfluidic devices, and that because the glass coverslip is placed horizontally, Thorsen’s microchannels, which are closed by and parallel to the glass coverslip, are similarly horizontal and in a horizontal plane. *Id.* (citing Ex. 1003, 96–97, 103, Figs. 3.28, 3.29, 4.2, 4.4, 4.5; Ex. 1006 ¶¶ 31, 100).

We also agree with Petitioner's contentions that the cross-flow junction of Thorsen's serpentine channel system satisfies the limitations of claim element 1.2 for the same reasons set forth above. As described above, we agree with Petitioner that Thorsen's cross-flow junction teaches the subject matter recited in claim elements 1.2 and that the cross-flow junction is used in both Thorsen's serpentine channel system and Thorsen's incubation chamber system.

Therefore, we find that Thorsen teaches or suggests all of the subject matter recited in claim 1.

2. Claim 4

Claim 4 recites the "assembly of claim 1, wherein the at least one droplet receiving outlet is located on the upper portion of the separation chamber." Petitioner asserts that Thorsen teaches the subject matter recited in claim 4 for the same reasons described in connection with claim limitations 1.3–1.7. Pet. 61.

We agree with Petitioner that Thorsen teaches the subject matter of claim 4. For example, we agree that the top of Thorsen's outlet wells, which as described above is a droplet receiving outlet, is located on the upper portion of the separation chamber (outlet well). Pet. 61. Thus, we find that Thorsen teaches the subject matter recited in claim 4.

3. Claims 7 and 9

Claim 7 recites the "assembly of claim 1, wherein the droplet receiving outlet is coupled to a vessel." Claim 9 recites the "assembly of claim 7, wherein the vessel is a PCR tube or a test tube."

Petitioner asserts that Thorsen renders obvious the additional limitations of these dependent claims. Pet. 62–66 (citing Ex. 1008 ¶¶ 108, 130, 167–171).

Petitioner asserts that Thorsen’s outlet well (droplet receiving outlet) is “coupled” to a vessel if the droplets can be moved from the outlet well to a test tube strip or other vessel. Pet. 62–63 (citing Ex. 1026, 21–22). Petitioner asserts that it would have been obvious to collect the sorted droplets from the outlet wells for further use or additional processing. *Id.* (citing Ex. 1008 ¶¶ 108, 169).

Patent Owner does not dispute that the transfer of droplets from the outlet to a vessel using a pipette may constitute “coupling.” *See, e.g.*, PO Resp. 55–57. Rather, Patent Owner contends that Thorsen does not teach the subject matter of claims 7 and 9 for the same reason a POSA would not have been motivated to collect droplets using a micropipette. PO Resp. 55.

As noted above in Section II.F.1., we agree with Petitioner that it would have been obvious to collect droplets from the top of Thorsen’s outlet wells using a micropipette and transfer the droplets to another vessel, such as a PCR or test tube. Thus, we agree that Petitioner has sufficiently shown that Thorsen teaches or suggests the subject matter recited in claims 7 and 9.

4. *Secondary Considerations*

Patent Owner contends that secondary considerations, including long-felt need, commercial success, praise, and acquiescence and licensing weigh in favor of a finding of nonobviousness of the ’837 patent claims. PO Resp. 57–63.

a) *Presumption of Nexus*

Patent Owner asserts that its “ddPCR™ platform . . . practices the ‘837 patent.” PO Resp. 57–58. As support for this assertion, Patent Owner relies on a statement that “[t]he Bio-Rad Digital PCR Systems and/or their use is covered by claims of U.S. patents,” including the ‘837 patent and eight other patents. *Id.* at 57 (citing Ex. 2018 (Patent Owner’s standard terms and conditions of sale)). Patent Owner also asserts that “[t]he patented features from the ‘837 patent are repeatedly referenced in Bio-Rad’s instruction manuals and are critical to the Bio-Rad products’ workflows.” *Id.* (citing Exs. 2010, 2011). Dr. Anna directs us to portions of these manuals that instruct users how to transfer droplets out of the separation chamber of a cartridge. Ex. 2016 ¶ 204 (citing Ex. 2010, 18; Ex. 2011, 18). Based on these assertions, Patent Owner contends that “the secondary considerations . . . related to Bio-Rad’s products have a direct nexus to the claims of the ‘837 Patent.” PO Resp. 57.

“In order to accord substantial weight to secondary considerations in an obviousness analysis, the evidence of secondary considerations must have a nexus to the claims, i.e., there must be a legally and factually sufficient connection between the evidence and the patented invention.” *Fox Factory, Inc. v. SRAM, LLC*, 944 F.3d 1366, 1373 (Fed. Cir. 2019) (internal quotes omitted); *see also Lectrosonics, Inc. v. Zaxcom, Inc.*, Case IPR2018-01129, Paper 33 at 32 (PTAB Jan. 24, 2020) (precedential) (“For objective indicia of nonobviousness to be accorded substantial weight, its proponent must establish a nexus between the evidence and the merits of the claimed invention.”). There is a rebuttable presumption of nexus “when the patentee shows that the asserted objective evidence is tied to a specific product and

that product ‘embodies the claimed features, and is coextensive with them.’”
Fox Factory, 944 F.3d at 1373 (citations omitted); *Lectrosonics*, Paper 33
at 32.

Patent Owner does not present an analysis demonstrating that its products are coextensive (or nearly coextensive) with the challenged claims of the ’837 patent. At best, Dr. Anna directs us to instructions for transferring droplets from outlet wells to a PCR plate. Ex. 2016 ¶ 204 (citing Ex. 2010, 18; Ex. 2011, 18). Even if these instructions were sufficient to establish that Patent Owner’s products have a “separation chamber” and a “droplet receiving outlet,” there are numerous other claim limitations that are not addressed by Patent Owner’s evidence of nexus. Although Patent Owner relies on its standard terms and conditions listing the ’837 patent among eight other patents (PO Resp. 57 (citing Ex. 2018)), a simple patent listing is not enough to show coextensiveness or nexus.

Accordingly, Patent Owner has not shown that its products are entitled to a presumption of nexus.

b) Patent Owner’s Acquisition of ’837 Patent

Patent Owner asserts that “Bio-Rad acquired RainDance and all of its intellectual property in January 2017, including the ’837 patent, demonstrating the value that has been placed on the protected features of the ’837 patent.” PO Resp. 57 (citing Ex. 2014 (press report titled, “Bio-Rad to Acquire RainDance Technologies”)). Patent Owner does not present arguments or evidence as to the value that was ascribed to the ’837 patent or the technology covered by the challenged claims in the context of Patent Owner’s acquisition of RainDance. Accordingly, we are not persuaded that

Patent Owner has shown a nexus for this asserted secondary considerations evidence.

c) Long-Felt Need

Patent Owner asserts that “RainDance’s patented droplet system, which included features embodied in the ‘837 patent, fundamentally enhances the way researchers and scientists study cell-based and cell-free biomarkers in cancer, infectious disease, and inherited disorders.” PO Resp. 58 (citing Ex. 2016 ¶ 205).

According to Patent Owner, its ddPCR™ platform was heralded as a breakthrough that greatly advanced the capabilities of PCR and was rapidly adopted in the industry and led to an explosion of research. PO Resp. 59 (citing Exs. 2001–2004). Based on this evidence, Patent Owner contends that “[t]he inventions of the ‘837 patent fulfilled a long-term need for a means of isolating sample from the surrounding environment for further analysis using microfluidic droplets by means of the claimed separation chamber.” *Id.* at 60.

“A finding that a presumption of nexus is inappropriate does not end the inquiry into secondary considerations.” *Fox Factory*, 944 F.3d at 1375; *Lectrosonics*, Paper 33 at 33. “To the contrary, the patent owner is still afforded an opportunity to prove nexus by showing that the evidence of secondary considerations is the ‘direct result of the unique characteristics of the claimed invention.’” *Fox Factory*, 944 F.3d at 1373–74 (quoting *In re Huang*, 100 F.3d 135, 140 (Fed. Cir. 1996)); *Lectrosonics*, Paper 33 at 33. Patentee must show a “nexus to the merits of the claimed invention,” meaning “some aspect of the claim not already in the prior art.”

Lectrosonics, Paper 33 at 33 (quoting *In re Kao*, 639 F.3d 1057, 1068–69 (Fed. Cir. 2011)).

We determine that Patent Owner has not demonstrated a nexus between the evidence relied upon to show long-felt need and the merits of the claimed invention. Patent Owner asserts that the evidence touts its ddPCR™ platform as “an easy-to-use alternative to the existing technology” that enabled researchers to publish numerous studies and “to detect rare targets with a level of precision that was just not possible with previous technologies.” PO Resp. 55–56 (citing Exs. 2001–2004). Patent Owner makes no attempt to show a nexus between the technology discussed in Exhibits 2001 to 2004 and the features recited in the challenged claims of the ’837 patent.

d) Commercial Success

Patent Owner contends that its products that embody the ’837 patent have been a commercial success, with the inventions disclosed in the ’837 patent contributing to this success and representing “a significant improvement on the prior art that greatly advanced the capability of PCR and NGS [Next Generation Sequencing].” PO Resp. 60 (citing Exs. 2006–2009; Ex. 2016 ¶ 210).

Patent Owner also contends that Petitioner’s “products embodying the invention have been a commercial success.” PO Resp. 631 (citing and quoting Ex. 2012 (discussing number of instruments sold in total and to “top research institutions” and “global pharmaceutical companies” and associated revenue increases as of December 31, 2018 and June 30, 2019)).

For the reasons discussed above, Patent Owner has not shown that its products are entitled to a presumption of nexus. Nor has Patent Owner

shown a nexus between the merits of the claimed invention and the evidence relied upon to show commercial success of its products or Petitioner's products. Although Patent Owner relies on Exhibits 2005 to 2009 and 2012, it does not show a nexus between this evidence and the unique features of the challenged claims.

e) Praise by Others

Patent Owner asserts that its ddPCR™ products have received “repeated accolades for their contributions to the field” and that its “ddSEQ™ system has also received wide acclaim.” PO Resp. 62–63 (citing Exs. 2005–2009). According to Patent Owner, “prior to its acquisition by Bio-Rad, Raindance received praise from the industry for its own systems that incorporated the patented features of the ‘837 patent.” *Id.* at 62 (citing Ex. 2016 ¶ 216). Petitioner asserts that both Patent Owner's and Petitioner's products “have received praise because of their turn-key, easy-to-use workflows.” *Id.* at 63 (citing Ex. 2013).

For the reasons discussed above, Patent Owner has not shown that its products are entitled to a presumption of nexus. Nor has Patent Owner shown a nexus between the merits of the claimed invention and the evidence relied upon to show industry praise of Patent Owner's products, RainDance's products, or Petitioner's products. Although Patent Owner relies on Exhibits 2005–2009, 2013, and 2023–2026, it does not show a nexus between this evidence and the unique features of the challenged claims. Furthermore, although Patent Owner discusses advantages of the patented inventions (PO Resp. 62–63), Patent Owner does not show that these advantages are the reasons Patent Owner's and Petitioner's products have received praise. Nor does Patent Owner show that the evidence of

industry praise or other asserted secondary considerations is tied to the novel features of the claimed invention or the claimed combination as a whole.

WBIP, LLC v. Kohler Co., 829 F.3d 1317, 1331 (Fed. Cir. 2016);

Lectrosonics, Paper 33 at 33.

5. Conclusion

As discussed above, we find that Thorsen teaches or suggests the subject matter of claims 1, 4, 7, and 9. We have considered all of Patent Owner's evidence of nonobviousness and find it unpersuasive. Accordingly, we balance Petitioner's strong evidence of obviousness against Patent Owner's alleged objective evidence of nonobviousness, we determine that a preponderance of the evidence supports Petitioner's position that claims 1, 4, 7, and 9 are unpatentable under 35 U.S.C. § 103 over Thorsen.

G. Asserted Obviousness of Claims 1, 2, 4, 7–13, 19 over Thorsen and the Ismagilov References.

Petitioner contends claims 1, 2, 4, 7–13, 19 would have been obvious over the combined teachings of (1) Thorsen 092 and Ismagilov 119 alone, which incorporates Ismagilov 091 by reference, or over the combined teachings of (2) Thorsen, Ismagilov 119 and Ismagilov 091. *See, e.g.*, Pet. 19–20.

Having already determined that Petitioner establishes by a preponderance of the evidence that claims 1, 2, 4, 7, 9–13, 19 are unpatentable, we do not address Petitioner's additional grounds challenging these claims over the combined teachings of Thorsen, Ismagilov 119 or over Thorsen, Ismaagilov 119, and Ismagilov 091.

For the reasons below, we find that Petitioner has not established by a preponderance of the evidence that claim 8 would have been obvious over

combined teachings of (1) Thorsen 092 and Ismagilov 119 alone, which incorporates Ismagilov 091 by reference, or over the combined teachings of (2) Thorsen, Ismagilov 119 and Ismagilov 091.

1. Claim 8

Claim 8 recites the “assembly of claim 7, wherein the droplet receiving outlet is sealably coupled to a vessel.” Petitioner asserts claim 8 is unpatentable over either Thorsen and Ismagilov 119 over Thorsen, Ismagilov 119 and Ismagilov 091. Pet. 65–66. In particular, Petitioner asserts that it would have been obvious to modify Thorsen’s outlet wells so that they are adapted for receiving a standard 1.5 ml centrifuge tube in view of the teachings of Ismagilov 091. Pet. 66 (citing Ex. 1004, 17:27–29). Petitioner also asserts that it would have been obvious that a vessel, such as centrifuge tube, could be substituted in place of an outlet well and thus such substitution is nothing more than combining known element according to known methods to yield predictable results. Pet. 63 (citing Ex. 1008 ¶ 170). Petitioner further asserts that an outlet that has been adapted to receive a centrifuge tube would seal the tube, or that it would have been obvious to do so. Pet. 66 (citing Ex. 1008 ¶¶ 174–175; Ex. 1005 ¶¶ 32–34, 191–195).

We determine that Petitioner’s contentions are insufficient to show that claim 8 would have been obvious over Thorsen in combination with the Ismagilov references. Petitioner relies upon Thorsen’s outlet well for teaching the separation chamber having a droplet receiving outlet. Petitioner does not provide any evidence or argument, however, as to how the modified devices, in which a centrifuge tube replaces the outlet well, or the outlet well is adapted to receive a centrifuge tube, would satisfy the separation chamber or droplet receiving outlet limitations of claim 1.

Therefore, Petitioner has not sufficiently shown that the combination of Thorsen and the Ismagilov references would have rendered obvious the subject matter of claim 8 and, thus, has not shown by a preponderance of the evidence that claim 8 is unpatentable over either Thorsen and Ismagilov 119 or over Thorsen, Ismagilov 119 and Ismagilov 091.

III. CONCLUSION⁸

For the foregoing reasons, we determine that Petitioner has shown by a preponderance of the evidence that claims 1–2, 4, 7, 9–13, and 19 are unpatentable but has not shown that claim 8 is unpatentable.

IV. ORDER

In consideration of the foregoing, it is hereby:

ORDERED that claims 1–2, 4, 7, 9–13, and 19 of U.S. Patent No. 9,562,837 B2 have been shown to be unpatentable;

ORDERED that claim 8 of U.S. Patent No. 9,562,837 B2 has not been shown to be unpatentable; and

FURTHER ORDERED that, because this is a final written decision, parties to this proceeding seeking judicial review of the decision must comply with the notice and service requirements of 37 C.F.R. § 90.2.

⁸ Should Patent Owner wish to pursue amendment of the challenged claims in a reissue or reexamination proceeding subsequent to the issuance of this decision, we draw Patent Owner's attention to the April 2019 *Notice Regarding Options for Amendments by Patent Owner Through Reissue or Reexamination During a Pending AIA Trial Proceeding*. See 84 Fed. Reg. 16,654 (Apr. 22, 2019). If Patent Owner chooses to file a reissue application or a request for reexamination of the challenged patent, we remind Patent Owner of its continuing obligation to notify the Board of any such related matters in updated mandatory notices. See 37 C.F.R. § 42.8(a)(3), (b)(2).

In summary:

Claims	35 U.S. C. §	Reference(s)/Basis	Claims Shown Unpatent able	Claims Not shown Unpatentable
1–4, 10–13, 19	102	Thorsen ⁹	1–3, 10– 13, 19	
1–4, 7, 9–13, 19	103	Thorsen ¹⁰	1, 4, 7, 9	
1–2, 4, 7–13, 19	103	Thorsen, Ismagilov 119 ¹¹		8
1–2, 4, 7–13, 19	103	Thorsen, Ismagilov 119, Ismagilov 091 ¹²		8
Overall Outcome			1–2, 4, 7, 9–13, 19	8

⁹ As noted above, we do not reach Petitioner’s challenge of claim 4 as anticipated under § 102 by Thorsen.

¹⁰ As noted above, we do not reach Petitioner’s challenge of claims 2, 3, 10–13, and 19 as unpatentable under § 103 over Thorsen.

¹¹ As noted above, we do not reach Petitioner’s challenge of claims 1–2, 4, 7, 9–13, 19 as unpatentable over the combined teachings of Thorsen and Ismagilov 119.

¹² As noted above, we do not reach Petitioner’s challenge of claims 1–2, 4, 7, 9–13, 19 as unpatentable over Thorsen, Ismagilov 119, and Ismagilov 091.

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