

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

TAIWAN SEMICONDUCTOR MANUFACTURING COMPANY
LIMITED,

Petitioner,

v.

ALIDDOUBLE, INC.

Patent Owner.

Case No.

IPR2023-00372 (U.S. Patent No. 6,169,319)

PATENT OWNER'S PRELIMINARY RESPONSE

UNDER 37 C.F.R. § 42.107

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TABLE OF EXHIBITS

Exhibit	Description
2001	Backside illuminated (BSI) complementary metal-oxidesemiconductor (CMOS) image sensors (2020)
2002	Microelectronics Packaging Handbook, 2nd edition (1997)
2003	WARPAGE AND MECHANICAL STRENGTH STUDIES OF ULTRA THIN 150MM WAFERS (1996)
2004	<i>Alidouble Inc., v. Taiwan Semiconductor Manufacturing Company Limited.</i> , Case No. 2:22-cv 00298-JRG (E.D. Tex), Docket Control Order.
2005	Die level thinning after bonding on the substrate in 3D packaging (2023)
2006	U.S. Patent No. 6,153,495
2007	U.S. Patent No. 6,239,033
2008	U.S. Patent No. 6,300,148
2009	Ultrahigh sensitivity single - photon detector using a Si avalanche photodiode for the measurement of ultraweak biochemiluminescence (April 1, 1995)
2010	A New MOS Imager Using Photodiode as Current Source (August 1991).
2011	MOS Area Sensor: Part n-Low-Noise MOS Area Sensor with Antiblooming Photodiodes (1980)
2012	A Dielectrically Isolated Photodiode Array by Silicon-Wafer Direct Bonding (1987)
2013	Ceramic and Glass-Ceramic Packaging in the 1990s (1991)

Alidouble, Inc. (“Patent Owner” or “Alidouble”) submits this Preliminary Response to the Petition of Taiwan Semiconductor Manufacturing Company Limited (“Petitioner” or “TSMC”) seeking *inter partes* review (“IPR”) of claims 1 - 6 (“the Challenged Claims”) of U.S. Patent No. 6,168,319 (“the ’319 patent”). For purposes of this Preliminary Statement, Alidouble addresses some but not all of Petitioner’s arguments. Alidouble does not concede any of Petitioner’s arguments that are not addressed in this Preliminary Response.

I. INTRODUCTION

First, the Board should deny institution under *Apple, Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (P.T.A.B. Mar. 20, 2020) (designated precedential May 5, 2020) and related guidance from the Director. The ongoing parallel district court litigation will likely be completed at least three months before any Final Decision. Petitioner has not moved for a stay nor argued that it will move for a stay should institution be granted. Institution should be denied because an IPR “would not ... provide an effective and efficient alternative to the district court litigation.” *NHK Spring Co. v. Intri-Plex Techs., Inc.*, IPR2018-00752, 2018 WL 4373643, at *7 (P.T.A.B. Sep. 12, 2018) (precedential) (citations omitted).

Further, the Petition should be denied on the merits. For example, Petitioner proposes the limitations [1pre], [1b], [1c], [1d], [1e], and [1f] of the sole independent claim 1 are disclosed by the cited references. Petitioner’s assertions are wrong

because at least four critical material limitations “backside illuminated image sensor,” “photodiode diffusion region,” “protective substrate,” and “effectively exposed” are not disclosed by the cited references.

As Petitioner admits, Badihi’s disclosures are not specific to image sensors. Petitioner also provides no evidence indicating that a POSA would have understood that the packaging method taught by Badihi could be used for BSI image sensors. Indeed, no BSI image sensors are even mentioned in Badihi. Thus, Badihi fails to disclose BSI image sensors.

Petitioner asserts that it would have been a matter of routine, design choice to incorporate photodiode diffusion regions. The assertion is incorrect. The specification of the ’319 patent describes that a photodiode is formed by a diffusion region extending into substrate from the first surface of the substrate and several metal lines connected between the diffusion region and a polysilicon gate structure. In contrast, neither Nixon nor Badihi discloses how a photodiode diffusion region extends into the semiconductor substrate from the first surface or whether metal lines are formed between the diffusion region and a polysilicon gate structure or not.

The material limitation “protective substrate” in the ’319 patent should provide structural support to the claimed BSI image sensor and be non-transparent, but the cited references fail to disclose a protective substrate with such features.

The material limitation “effectively exposed” is clearly defined in the

specification to mean that the light-sensitive pixel regions of the image sensor circuit would generate electron flow in response to light (photons) passing therethrough. However, neither Nixon nor Badihi discloses that electron flow is generated. Indeed, electron flow would not necessarily generate when the light-sensitive pixel regions of the image sensor circuit are illuminated as there may be an illumination threshold that has to be reached before any electron flow is generated.

Because the Petition has not demonstrated that there is a “reasonable likelihood” that Petitioner would prevail as to at least one of the claims challenged, institution must be denied.

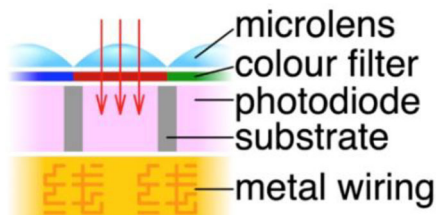
II. BACKGROUND

A. Related Technology

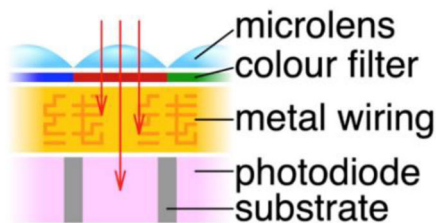
As described in the Petition, CMOS Image Sensors (CIS) can be either frontside illuminated (FSI) or backside illuminated (BSI). Pet. at 1. The difference between a BSI image sensor and an FSI image sensor is the arrangement of imaging elements in the sensor with respect to incident light to the pixel. Pet. at 1-2. In FSI, the photons pass through the metal wiring layer before they reach the image sensors (e.g., photo diodes). Ex. 2001 at 95 (“[i]n a frontside illuminated (FSI) sensor (see Fig. 4.1A), the light reaches the PD active region through the passivation, metallization, and inter-dielectric layers. Several are the loss mechanisms associated with the coupling of light from the frontside of the sensor. ... the reflection of light

from the metal control lines which surround the PD [photodiode].”) In contrast, in a BSI image sensor, the photons reach image sensors directly from the backside without passing through the metal wiring layer on the front side. *Id.* at 96 (“[a] BSI sensor contains the same components as a FSI sensor but the sensor's metals are located behind the PD [photodiode].”). See figure reproduced below for the arrangement of metal wiring layer in relation to the direction of the light. BSI image sensors are preferred over FSI image sensors because they allow the image sensors to achieve higher quantum efficiency by letting the photon reach the image sensors directly without passing through the metal wiring layer. *Pet.* at 2. Thus, BSI image sensors are different from FSI image sensors because BSI image sensors only receive illumination from the backside. Petitioner’s technical expert agrees, repeating the same argument in his supporting declaration. *Ex.* 1003, ¶¶43-45.

1. Back-side illumination



2. Front-side illumination



Pet. at 2.

As shown in the above figure, in BSI image sensors, the photons reach photodiodes directly without passing through metal wiring layer, meaning the sensors *only* receive light from the backside. There is no such thing as BSI image sensors can receive light from both frontside and backside because allowing the light to pass through metal layer before reaching photodiodes destroy the purpose of BSI image sensors. Ex. 2001at 96.

Although BSI image sensors contain the same components as FSI image sensors, the BSI image sensors' metal wiring layers are located behind the photodiode with respect to the direction of photons. The main technological challenge associated with producing BSI image sensors is the bonding of the original wafer containing photodiodes to a protective substrate to provide structural support while the original wafer is being grinded down to a thickness of a few microns. *See e.g., id*; Ex. 2002 at 476 (discussing the challenges that backside grinding increases chip failures because of die cracks by stating “[h]owever, die cracks still originate from flaws on the back side due to backgrinding operations used to manufacture thin packages.”); Ex. 2003 at 1 (discussing backside grinding induces damage in the wafer that leads to crack propagation by stating “[g]rind processes will induce damage in the wafer backsurface that can lead to crack propagation, growth, and fracture).

B. The '319 patent

The '319 patent, titled "Backside illuminated image sensor," was filed on November 17, 1999 and claims priority to a divisional of application No. 09/372,863, which was filed on August 12, 1999, and resulted in U.S. Patent No. 6,168,965 ("the '965 patent"). Ex. 1001. The '319 patent was issued to inventors Yacov Malinovich and Ephie Koltin on January 2, 2001. *Id.* Like the '965 patent, the '319 patent realized that conventional backside illuminated image (BSI) image sensors are expensive because (1) they are made using nonstandard complementary metal-oxide-semiconductor (CMOS) processes and (2) packaging the BSI image sensors is complex. *Id.*, 4:14-31. To address these problems, the '319 patent discloses a BSI image sensor that can be manufactured using standard wafer processing techniques and equipment. *Id.*, 8:52-55.

The USPTO's publicly accessible patent assignment records indicate that inventors Yacov Malinovich and Ephie Koltin assigned the entire right, title, and interest in the '319 patent to Tower Semiconductor Ltd. (reel 010171; frame 0466), which assigned its entire right, title and interest to Keystone Intellectual Property Management Limited (reel 057109; frame 0965), which then assigned the '319 patent to Alidouble (reel 058130; frame 0548). As a result, Alidouble owns the entire right, title, and interest in the '319 patent.

C. The '319 patent claims

The challenged '319 patent claims are directed to BSI image sensors. The patent contains 6 claims, with claim 1 being independent. Independent claim 1 is reproduced below. The limitations for claim 1 are identified below consistent with the Petition for ease of reference.

U.S. Patent No. 6,169,319	
Claim 1	
1pre	A backside illuminated image sensor comprising:
1a	a semiconductor substrate having a first surface and a second surface;
1b	a plurality of light-sensitive pixel regions formed on the first surface of the semiconductor substrate and including a photodiode diffusion region extending into the semiconductor substrate from the first surface;
1c	a metal line formed adjacent the first surface of the semiconductor substrate;
1d	a protective substrate secured to the semiconductor substrate such that the metal line is located between the protective substrate and the semiconductor substrate; and
1e	a transparent substrate secured to the second surface of the semiconductor substrate such that the semiconductor substrate is sandwiched between the transparent substrate and the protective substrate;
1f	wherein the semiconductor substrate has a thickness defined such that the light-sensitive pixel region is effectively exposed through the second surface.

Thus, the claimed BSI image sensor includes a wafer having image sensor circuits formed on the wafer's frontside, with the frontside of the wafer being secured to a non-transparent protective substrate. Then the backside of the wafer has a thickness defined such that the image sensor circuits are effectively exposed to generate electron flow. Further, a transparent substrate is secured to the backside of the wafer to form a waferwise sandwich. The waferwise sandwich is sliced to produce individually packaged BSI image sensors.

D. Parallel District Court Proceedings

The '319 patent is presently at issue in the following district court litigation brought by Patent Owner against Petitioner for infringement of several patents, including the '319 patent: *Alidouble Inc., v. Taiwan Semiconductor Manufacturing Company Limited.*, United States District Court for the Eastern District of Texas, Case No. 2:22-cv 00298-JRG. Patent Owner filed the lawsuit against Petitioner in August 2022 for infringement of several patents, including the '319 patent, for its use of and sale of products incorporating accused image sensors made by Petitioner. The Court has entered docket control and discovery orders (Dkt. 39). Ex. 2004. Invalidity and infringement contentions have been exchanged, written discovery has been served and responded to, and the parties are now fully engaged in remaining fact discovery and claim construction. Jury selection is set for May 6, 2024. *Id.* at 1.

E. Petitioner's Arguments

Petitioner asserts that the Challenged Claims of the '319 Patent are obvious in light of four references on seven different grounds:

- U.S. Patent No. 6,429,036 (“Nixon”) [Ex. 1004], which purportedly claims priority to the U.S. Provisional Patent Application No. 60/116144 (“Nixon Prov.”) [Ex. 1005]
- Badihi, A., ShellCase Ultrathin Chip Size Package, in PROCS. INT’L SYMPOSIUM ON ADV. PACKING MATERIALS, PROCESSES, PROPERTIES AND INTERFACES (IEEE CAT. NO. 99TH8405), IEEE, pp. 236-40 (Mar. 1999) (“Badihi”), attached as Exhibit 1101 to Declaration of Dr. Sylvia Hall-Ellis [Ex. 1101]
- U.S. Patent No. 5,789,774 (“Merrill”) [Ex. 1049]
- Certified translation of JP H06-268183 (“Watanabe”) [Ex. 1007]

Petitioner asserts the following Grounds:

Ground	Claims	Statutory Basis	References
1	1, 2, 5, and 6	§103	Nixon
2	3	§103	Nixon and Merrill
3	4	§103	Nixon and Watanabe
4	1, 2, 5, and 6	§103	Badihi
5	4	§103	Badihi and Watanabe
6	1, 2, 3, 5, and 6	§103	Merrill and Badihi
7	4	§103	Merrill, Badihi, and Watanabe

III. PERSON OF ORDINARY SKILL IN THE ART (“POSA”)

Petitioner asserts that a POSA “would have been a person having a Master’s degree in electrical engineering, computer engineering, or physics with at least two years of industry experience in integrated circuit design, layout, packaging or fabrication.,” and further asserts that “[a] greater level of experience may compensate for less education, and vice versa.” Pet. at 9. Patent Owner reserves the right to dispute Petitioner’s definition of a POSA if an IPR is instituted. For present purposes, this Response establishes that Petitioner’s arguments fail even under its proffered definition of a POSA.

IV. CLAIM CONSTRUCTION

Petitioner states that “Petitioner does not believe the claim terms need to be construed to resolve the prior art issues presented in this Petition.” Pet. at 9. Patent Owner presently submits that certain claim construction as discussed below is necessary to deny institution. Patent Owner reserves the right to advance its own construction for any claim term should an IPR be instituted.

A. “effectively exposed”

The Challenged Claims recite “effectively exposed.” The ’319 patent specification defines this term to mean “the pixel of each light-sensitive pixel region generates electron flow in response to light (photons) passing through second surface.” Ex. 1001, 6:48-51 (“The term ‘effectively exposed’ herein is used to indicate ...”); *In re Paulsen*, 30 F.3d 1475, 1480 (Fed. Cir. 1994) (holding that an

inventor may define specific terms used to describe invention); the Manual for Patent Examining Practice (“MPEP”) 2111.01.IV.A (stating that an applicant [to a patent] is entitled to be their own lexicographer; where an explicit definition is provided by the applicant for a term, that definition will control interpretation of the term as it is used in the claim.). For purposes of this Response, this claim term “effectively exposed” should be construed as it is defined in the specification of the ’319 patent.

V. THE BOARD SHOULD EXERCISE ITS DISCRETION TO DENY INSTITUTION

Whether to institute an IPR is “a matter committed to the Patent Office’s discretion.” *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2140 (2016). The Board should exercise its discretion and deny this petition under 35 U.S.C. § 314(a) because it would be a waste of the Board’s resources and fundamentally unfair to Patent Owner to institute trial when a final written decision would issue after the conclusion of the same validity challenge in overlapping district court litigation. In *Apple Inc.*, the Board stated that the following factors are relevant to a determination of whether the Board should exercise discretion not to institute a petition in view of parallel district court proceedings on the same patent:

1. whether the court granted a stay or evidence exists that one may be granted if a proceeding is instituted;
2. proximity of the court's trial date to the Board's projected statutory deadline for a final written decision;
3. investment in the parallel proceeding by the court and the parties;

4. overlap between issues raised in the petition and in the parallel proceeding;
5. whether the petitioner and the defendant in the parallel proceeding are the same party; and
6. other circumstances that impact the Board's exercise of discretion, including the merits.

On June 1, 2022, the Director issued a Guidance, which stated that the PTAB will not rely on the *Fintiv* factors where a petition presents compelling evidence of unpatentability. *See* Memorandum from USPTO on Interim Procedure for Discretionary Denials in AIA Post-Grant Proceedings with Parallel District Court Litigation (June 21, 2022), at 2.. For the reasons set forth below, the Petition in this case does not present compelling evidence.

In this case, Patent Owner first sued Petitioner for infringement of the patent-at-issue on December 14, 2021. That suit was voluntarily dismissed on May 14, 2022. Petitioner did not file an petition against the patent-at-issue while the first lawsuit was pending. Patent Owner again sued Petitioner for infringement on August 4, 2022. Petitioner waited until December 16, 2022 to file the Petition in this case, just narrowly beating the deadline for filing a Petition.

According to the Second Amended Docket Control Order, the jury selection would be on May 6, 2024. Ex. 2004 at 1. The Final Decision by the Board would be due on or about July 20, 2024, about three months after the jury is scheduled to be impaneled in the district court case. In this case, Petitioner's long delay in filing

a Petition, coupled with the likelihood that the jury will render its verdict substantially before the Board issues its final written decision, compels the conclusion that the Board should exercise its discretion to deny institution.

Although Petitioner contends that it has provided a “*Sotera*-type stipulation,” it has not done so. In *Sotera Wireless, Inc. v. Masimo Corp.*, IPR2020-01019, Paper 12 (PTAB December 1, 2020) (designated precedential as of Dec. 17, 2020), the Petitioner filed a stipulation in the district court, stating that Petitioner “will not pursue in [the District Court] the specific grounds [asserted in the inter partes review], or on any other ground . . . that was raised or could have been reasonably raised in an IPR (i.e., any ground that could be raised under §§ 102 or 103 on the basis of prior art patent or printed publications).” *Id.* at 13-14. Here, in contrast, the Petitioner has not filed a stipulation in district court. Further, the alleged “stipulation” offered on page 25 of the Petition falls short of the stipulation that was filed in the district court in *Sotera*. Here, the Petitioner states only that it “will not pursue in the district court litigation any ground raised or that could have been reasonably raised in the instituted IPR with respect to the patent claim subject to the instituted IPR.” This is significantly narrower than the petition filed in the district court that was considered by the Board in *Sotera*. There the stipulation precluded Petitioner from litigating in the district court “*any other ground . . . that was raised or could have been reasonably raised in an IPR*” which the Petitioner there

characterized as “any ground that could be raised under §§ 102 or 103 on the basis of prior art or printed publications.” *Sotera*, at 13-14. Thus, Petitioner’s argument regarding its so-called “stipulation” falls far short of that considered by the Board in *Sotera*. This is not the type of “stipulation” that should preclude discretionary denial.

VI. THE BOARD SHOULD DENY INSTITUTION

Petitioner must establish a reasonable likelihood of prevailing on unpatentability to support institution of an IPR. *See* 35 U.S.C. § 314(a) (prohibiting the institution of IPR absent “a reasonable likelihood that Petitioner would prevail”); 37 C.F.R. § 42.108(c). Petitioner has not shown a reasonable likelihood of success that Challenged Claims are rendered obvious.

A. Applicable Legal Standard

“[A] patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 418 (2007). “This is so because inventions in most, if not all, instances rely upon building blocks long since uncovered, and claimed discoveries almost of necessity will be combinations of what, in some sense, is already known.” *Id.* at 418-419. For this reason, “it can be important to identify a reason that would have prompted a person of ordinary skill in the relevant field to combine the elements in the way the claimed new invention

does.” *Id.* at 418. “One cannot use hindsight reconstruction to pick and choose among isolated disclosures in the prior art.” *In re Fine*, 837 F.2d 1071, 1075 (Fed. Cir. 1988).

A proper petition must both “clearly point out the differences between the claimed invention and [the prior art]” and “explain why a person of ordinary skill in the art would have found the claimed subject matter obvious in spite of those differences.” *Synopsys, Inc. v. Mentor Graphics Corp.*, IPR2012-00041, 2013 WL 3355865 at *8 (P.T.A.B. Feb. 22, 2013). A Petitioner must specifically recite where the challenged limitation is found in the secondary reference(s), and explain why a POSA would have modified the primary reference with the recited limitation from the secondary reference(s). *See Microsoft Corp. v. Secure Web Conf. Corp.*, IPR2014-00745, 2014 WL 4925718, at *6-7 (P.T.A.B. Sept. 29, 2014). “[M]ere conclusory statements” are not sufficient. *Wowza Media Sys., LLC v. Adobe Sys. Inc.*, IPR2013-00054, 2013 WL 5653113, at *8 (P.T.A.B. April 8, 2013).

B. The References Relied Upon by Petitioner

1. Nixon

Nixon is a U.S. patent claiming priority to the Nixon Prov., which includes two documents: (1) an Invention Disclosure Technical Description (“IDTD”); and (2) an article entitled “A CSP Optoelectronic Package for Imaging and Light Detection Applications” by Shweky et al. (“Shweky”). The IDTD has very limited

information with only one and half pages written description and two hand-sketched figures. *See* Ex. 1005, 4-6. Also, there is nothing in the IDTD indicating that Shweky is incorporated as a prior art reference, and the IDTD discloses the exact same method as discussed in Shweky. *Id.*

2. Badihi

Badihi is a printed publication published in the *Proceedings International Symposium of Advanced Packaging Materials, Processes, Properties and Interfaces*. Ex. 1101. The paper is titled “ShellCase Ultrathin Chip Size Package,” which is clearly not regarding BSI image sensors. *Id.* Thus, as discussed in detail below, it is not obvious for a POSA to apply the Badihi’s disclosures for BSI image sensors.

3. Merrill

Merrill is a U.S. patent titled “Active pixel sensor cell that minimizes leakage current,” which does not describe BSI image sensors. Merrill discloses a CMOS APS cell including a “conventional photodiode ... typically combined with a number of active transistors”. Ex. 1049, 1:31-45, 6:13-18.

C. Institution Should Be Denied As To Ground 1 Because Claims 1, 2, 5, and 6 Are Not Obvious Over Nixon

1. Nixon does not disclose or render obvious the “photodiode diffusion region” limitation

Claim [1b] recites “a photodiode diffusion region extending into the semiconductor substrate from the first surface”. Although Petitioner argues with reference to Nixon’s Fig. 2 that “pixels 145 extend[] into silicon substrate 105 from

top surface 148”, Pet. at 25, that is not how the Nixon reference describes Fig. 2. Describing Fig. 1, Nixon states that “[p]ixels 145 are positioned at the top surface 148 of the silicon substrate 105.” Ex. 1004, 2:8-9. With respect to Fig. 2, Nixon states that “[f]ig. 2 illustrates the image sensor 100 of Fig. 1 modified to include a color filter array (CFA) 205.” *Id.*, 2:15-16. Thus, Nixon does not describe the photodiode diffusion region as “extending into the semiconductor substrate.” Rather, it sits on top of it.

Nor does Nixon render this limitation obvious. The conclusory statement of Petitioner’s expert does not establish otherwise. In this case, Petitioner’s expert merely parrots the petition. This is not evidence. *See, e.g., Xerox Corp. et al. v. Bytemark, Inc.*, IPR2022-00624, Paper 12 at 4-5 (P.T.A.B. Feb. 10, 2023) (expert declaration that offered conclusory assertions without underlying factual support and repeated, *verbatim*, Petitioner’s conclusory arguments given little weight); *Unirac, Inc. v. Ecofasten Solar, LLC*, IPR2021-00532, 2021 WL 3116853, at *7 (P.T.A.B. July 22, 2021) (denying institution where “Petitioner’s witness merely parrots the conclusory statements of Petitioner”); *Unified Patents Inc. v. GE Video Compression, LLC*, IPR2019-00726, 2019 WL 3714386, at *11 (P.T.A.B. Aug. 6, 2019) (giving little weight to expert testimony that “simply parrots the Petition without providing any basis for his opinion” and denying institution); *TQ Delta, LLC v. Cisco Sys., Inc.*, 942 F.3d 1352, 1359 (Fed. Cir. 2019) (“conclusory expert

testimony is inadequate to support an obviousness determination”); *Elbit Sys. of Am., LLC v. Thales Visionix, Inc.*, 881 F.3d 1354, 1359 (Fed. Cir. 2018) (“Attorney argument is not evidence.”) (quoting *Icon Health & Fitness, Inc. v. Strava, Inc.*, 849 F.3d 1034, 1043 (Fed. Cir. 2017)); *Free-Flow Packaging Int’l, Inc. v. Automated Packaging Sys., Inc.*, IPR2016-00447, Paper 7, at 10 (P.T.A.B. June 22, 2016) (denying institution where the petitioner’s expert did “nothing more than parrot the language of the Petition word for word”).

2. Nixon does not disclose or render obvious the “protective substrate” limitation

Claim 1 recites “a protective substrate secured to the semiconductor substrate such that the metal line is located between the protective substrate and the semiconductor substrate.” Ex. 1001, 11:20-41. It also recites “a transparent substrate secured to the second surface of the semiconductor substrate such that the semiconductor substrate is sandwiched between the transparent substrate and the protective substrate.” *Id.* Neither of those limitations is rendered obvious by Nixon.

a. The alleged glass layer in Nixon corresponding to “protective substrate” of claim 1 does not provide any structural support

The abstract of the ’319 patent clearly discloses that “the protective substrate provid[es] **structural support**...” See Ex. 1001 at Abstract (emphasis added). The specification further explains that “because the method utilizes **a protective substrate to support the semiconductor substrate**, the thinning process is less

expensive to perform.” *See id.*, 4:48-50 (emphasis added). The intrinsic disclosure is consistent with the plain and ordinary meaning as understood by a POSA that the protective substrate in the ’319 patent is configured to provide structural support to the BSI image sensor. *See. e.g.*, Ex. 2001 at 2 (disclosing that the main technological challenge associated with producing BSI is the bonding of the original wafer containing photodiodes to a protective substrate to provide structural support while the original wafer is being grinded down to a thickness of a few microns); Ex. 2002 at 476 (discussing the challenges that backside grinding increases chip failures because of die cracks by stating “[h]owever, die cracks still originate from flaws on the back side due to backgrinding operations used to manufacture thin packages.”); Ex. 2003 at 1 (discussing backside grinding induces damage in the wafer that leads to crack propagation by stating “[g]rind processes will induce damage in the wafer backsurface that can lead to crack propagation, growth, and fracture).

Contrary to Petitioner’s arguments, Nixon does not disclose a “protective substrate.” In Nixon, the supposed “protective substrate” asserted by Petitioner is just a thin layer of glass permitting light to go through. *See Pet.* at 29. Petitioner has presented no evidence that the identified thin layer of glass in Nixon provides any structural support. In contrast, the protective substrate in the ’319 patent would have been designed to be thick enough to fulfill the purpose of providing structural support.

b. The alleged glass layer in Nixon corresponding to “protective substrate” of claim 1 is a transparent substrate, not the required non-transparent protective substrate

Claim 1 of the '319 patent recites both “protective substrate” and “transparent substrate.” Ex. 1001, 11:20-41. Different terms in the same claim usually have different meanings. *See e.g., Neville v. Aldridge Constr., Inc.*, 825 Fed. Appx. 808 (2020) (affirming non-infringement, where claimed protrusion extends outwardly from an end plate, rejecting argument that “end plate” can be indistinguishable part of the “protrusion”: “While the ‘protrusion’ and ‘end plate’ structures must be connected in some fashion, the use of these ‘two terms in a claim requires that they connote different meanings.’”); *Firstface Co., LTD. v. Apple Inc.*, 859 Fed. Appx. 579 (2021) (affirming PTAB non-obviousness; that one claim uses both “perform” and “initiate” reinforces that “performing” (without additional user input) means full performance of the function (without additional user input) not just initiating it). Thus, “protective substrate” and “transparent substrate” in claim 1 should have different meanings, concluding that the protective substrate is a non-transparent substrate. This is confirmed by the intrinsic record describing an embodiment consistent with the claims as the protective substrate in the '319 patent has metal leads formed thereon, making it non-transparent. *See* Ex.1001, 8:8-12.

By contrast, the protective substrate asserted by Petitioner in Nixon is transparent. Nixon Prov. discloses an image sensor with lights coming from both

sides of the sensor as described in the IDTD and as shown in Figure 2 of Nixon Prov.. Regarding Nixon, the Petition identifies that “Nixon’s first glass plate 410 corresponds to the claimed protective substrate.” Pet. at 29. Because Nixon claims priority to Nixon Prov., which has only transparent protective glass substrate, Nixon’s protective glass substrates are transparent as well. Otherwise, Nixon cannot claim priority to Nixon Prov., which would disqualify Nixon as prior art.

Based on the above, regarding the “protective substrate” limitation, Nixon does not teach a non-transparent protective substrate that provides structural support, as claimed by the ’319 patent. A POSA would readily know that a thin glass layer disclosed by Nixon is not a non-transparent protective substrate providing structural support as claimed by the ’319 patent. Accordingly, this material limitation “protective substrate” would not be rendered obvious by Nixon.

3. Nixon does not disclose or render obvious the “effectively exposed” limitation

Claim limitation [1f] recites: “wherein the semiconductor substrate has a thickness defined such that the light-sensitive pixel region is effectively exposed through the second surface.” As explained above, the inventors define the “effectively exposed” limitation in the ’319 patent to require “the pixel of each light-sensitive pixel region generates electron flow in response to light (photons) passing through second surface.” *Supra.* §IV.A.

Petitioner asserts that this limitation is disclosed because Nixon discloses removing material from the second surface of the wafer to “a predetermined thickness that allows for the light sensitive area of the die 430 to be illuminated from . . . the back side.” Pet. at 32. However, Petitioner has presented no evidence that Nixon discloses that electron flow is generated with the light sensitive pixel regions (*i.e.*, the image sensor) being exposed to light (photons) after the grinding/thinning process. A POSA would have known that the grinding/thinning process is not inclusively for exposing light-sensitive pixel regions to generate electron flow. *See e.g.*, Ex. 2002 at 20, 66, 71, 74 (discussing flip-chip, *i.e.*, back-side processed chips, have general advantages in decreasing electromagnetic effects, increasing interconnection capability, and their applications in high performing I/O packaging, all of which have nothing to do with effectively exposing CMOS photodiodes whatsoever); Ex. 2005 (in its Abstract: “[t]his paper aims to realize heterogeneous integrated packaging technology for high integration by applying a thinning process technology for controlling the thickness of chipsets used in packaging, *i.e.*, A technology for processing silicon dies with a thickness of 100 um or less and a technology for handling thinning ultrasmall dies.”); Ex. 2006. 2007, 2008 (where the grinding/thinning process is performed in general semiconductor packaging rather than image sensors); Ex. 2003 at 1 (discussing dies with back-grinding are routinely used for its advantage of better heat dissipation, which is important for

high-power RF chips. Thus back-grinding process is routinely used in packaging technology that has nothing to do with effectively exposing CMOS photodiodes). Thus, the grinding/thinning process is not just/inclusively for image sensors, i.e., for exposing light-sensitive pixel regions to generate electron flow.

Indeed, electron flow would not necessarily be generated when the light-sensitive pixel regions of each image sensor circuit are illuminated because, for example, there may be an illumination threshold that has to be reached before electron flow is generated. *See e.g.*, Ex. 2009 (discussing how the threshold of silicon photodiodes should be designed to reduce noise interference and yet preserve high sensitivity); Ex. 2010 (discussing how to improve threshold uniformity among photodiodes in an array to increase the quality of imaging); Ex. 2011 (discussing how to tune thresholds of photodiodes to reduce current contamination to neighboring photodiodes, e.g., antiblooming photodiodes); Ex. 2012 (indicating the threshold of the photodiodes used in the research is lower than 5V).

Accordingly, this material limitation “effectively exposed” would not be rendered obvious by Nixon.

Because Nixon fails to render claim 1 obvious, it follows that claims 2, 5, and 6, which depend on claim 1, are not obvious.

D. Institution Should Be Denied As To Ground 2 Because Claim 3 Is Not Obvious Over Nixon In View Of Merrill

As is demonstrated above, Nixon fails to render claim 1 obvious. Petitioner did not cite Merrill against claim 1. Thus, claim 1 is patentable over Nixon in view of Merrill. Because claim 1 is patentable, claim 3 is also patentable. *See Rembrandt Wireless Techs., LP v. Samsung Elecs. Co.*, 853 F.3d 1370, 1380 (Fed. Cir. 2017), citing, *In re Fine*, 837 F.2d at 1076 (“Dependent claims are nonobvious under section 103 if the independent claims from which they depend are nonobvious.”).

E. Institution Should Be Denied As To Ground 3 Because Claim 4 Is Not Obvious Over Nixon In View Of Watanabe

As is demonstrated above, Nixon fails to render claim 1 obvious. Petitioner did not cite Watanabe against claim 1. Thus, claim 1 is patentable over Nixon in view of Watanabe. Because claim 1 is patentable, claim 4 is also patentable. *See Rembrandt Wireless Techs., supra.*

F. Institution Should be Denied As To Ground 4 Because Claims 1, 2, 5, and 6 Are Not Obvious Over Badihi

1. Badihi does not disclose or render obvious the “backside illuminated image sensor” limitation

Petitioner admits that Badihi’s disclosures are not specific to image sensors. Pet. at 52, 70. Badihi is directed to general back-side grinding and packaging of wafer that may not have any implication to BSI image sensors. *See e.g.*, Ex. 2002 at 20, 66, 71, 74 (discussing flip-chip, i.e., back-side processed chips, have general advantages in decreasing electromagnetic effects, increasing interconnection

capability, and their applications in high performing I/O packaging, all of which have nothing to do with BSI image sensors)); Ex. 2005 (in its Abstract: “[t]his paper aims to realize heterogeneous integrated packaging technology for high integration by applying a thinning process technology for controlling the thickness of chipsets used in packaging, i.e., A technology for processing silicon dies with a thickness of 100 um or less and a technology for handling thinning ultrasmall dies.”); Ex. 2006, 2007, 2008 (where the grinding/thinning process is performed in general semiconductor packaging rather than image sensors); Ex. 2003 at 1 (discussing dies with back-grinding are routinely used for its advantage of better heat dissipation, which is important for high-power RF chips. Thus back-grinding process is routinely used in packaging technology that has nothing to do with BSI image sensors).

Petitioner asserts that POSA would understand “Badihi could be used for BSI CMOS image sensors,” citing Petitioner’s parroting conclusory statement as support. Pet. at 70. The conclusory statement of Petitioner’s expert cannot establish that a POSA would understand that the general packaging process taught by Badihi could be used for BSI image sensors. *Compare, e.g.,* Pet. at 52-54 with Ex. 1003 ¶¶ 145-149 (parroting same argument with the use of same annotated Figures). *See, e.g., Xerox Corp. et al., IPR2022-00624, Paper 12 at 4-5* (expert declaration that offered conclusory assertions without underlying factual support and repeated, *verbatim*, Petitioner’s conclusory arguments given little weight); *Unirac, Inc.,*

IPR2021-00532, 2021 WL 3116853, at *7 (denying institution where “Petitioner’s witness merely parrots the conclusory statements of Petitioner”); *Unified Patents Inc.*, IPR2019-00726, 2019 WL 3714386, at *11 (giving little weight to expert testimony that “simply parrots the Petition without providing any basis for his opinion” and denying institution); *TQ Delta, LLC*, 942 F.3d at 1359 (“conclusory expert testimony is inadequate to support an obviousness determination”); *Elbit Sys. of Am., LLC.*, 881 F.3d at 1359 (“Attorney argument is not evidence.”) (quoting *Icon Health & Fitness, Inc.*, 849 F.3d at 1043); *Free-Flow Packaging Int’l, Inc.*, IPR2016-00447, Paper 7 at 10 (denying institution where the petitioner’s expert did “nothing more than parrot the language of the Petition word for word”).

Moreover, Badihi does not disclose or suggest that its packaging process could be applied to BSI image sensors. Although Badihi discloses that its packaging process can be readily applied to silicon light detectors, CMOS image sensors, and CCD devices. Pet. at 52, 70; Ex. 1101 at 239, “a claimed species or subgenus is encompassed by a prior art genus is not sufficient by itself to establish a prima facie case of obviousness.” *In re Baird*, 16 F.3d 380, 382, 29 USPQ2d 1550, 1552 (Fed. Cir. 1994); MPEP 2144.08 – Obviousness of Species When Prior Art Teaches Genus. Because a claimed species (*e.g.*, BSI image sensors) may be encompassed by a disclosed genus (*e.g.*, CMOS image sensors) does not render that species

obvious, Petitioner has presented no evidence that a POSA would be motivated to apply the packaging method disclosed in Badihi for BSI image sensors.

In this regard, Badihi does not disclose how its packaging process should be applied to BSI image sensors, and there is nothing in the prior art that even suggests how to do it. Thus, Petitioner has presented no evidence that a POSA would be motivated to apply the packaging method disclosed in Badihi for BSI image sensors.

2. Badihi does not disclose or render obvious the “protective substrate” limitation

Claim 1 recites “a protective substrate secured to the semiconductor substrate such that the metal line is located between the protective substrate and the semiconductor substrate.” Ex. 1001, 11:20-41. It also recites “a transparent substrate secured to the second surface of the semiconductor substrate such that the semiconductor substrate is sandwiched between the transparent substrate and the protective substrate.” *Id.* Neither of those limitations is rendered obvious by Badihi.

a. The alleged glass layer in Badihi corresponding to “protective substrate” of claim 1 does not provide any structural support

The abstract of the '319 patent clearly discloses that “the protective substrate provid[es] **structural support**...” See Ex. 1001 at Abstract (emphasis added). The specification further explains that “because the method utilizes **a protective substrate to support the semiconductor substrate**, the thinning process is less expensive to perform.” See *id.* at 4:48-50 (emphasis added). The intrinsic disclosure

is consistent with the plain and ordinary meaning as understood by a POSA that the protective substrate in the '319 patent is configured to provide structural support to the BSI image sensor.

Contrary to Petitioner's arguments, Badihi does not disclose a "protective substrate." In Badihi, the supposed "protective substrate" asserted by Petitioner is just a thin layer of glass permitting light to go through. *See* Pet. at 58, 75. Petitioner has presented no evidence that the identified thin layer of glass in Badihi provides any structural support. In contrast, the protective substrate in the '319 patent would have been designed to be thick enough to fulfill the purpose of providing structural support.

b. The alleged glass layer in Badihi corresponding to "protective substrate" of claim 1 is a transparent substrate, not the required non-transparent protective substrate

Claim 1 of the '319 patent recites both "protective substrate" and "transparent substrate." Ex. 1001, 11:20-41. Different terms in the same claim usually have different meanings. *See e.g., Neville.*, 825 Fed. Appx. 808 (2020); *Firstface Co., LTD.*, 859 Fed. Appx. 579 (2021). Thus, "protective substrate" and "transparent substrate" in claim 1 should have different meanings, concluding that the protective substrate is a non-transparent substrate. This is confirmed by the intrinsic record as the protective substrate in the '319 patent has metal leads formed thereon, making it non-transparent. *See* Ex.1001, 8:8-12.

Petitioner asserts that “Badihi’s protective glass layer (first glass cover) corresponds to the claimed protective substrate.” Pet. at 58, 75. But Badihi discusses semiconductor packaging in the 1990s, and a POSA would have known that a glass layer would be transparent in such packaging process back then due to the cost and technical constraints. Ex. 2013 at 2 (showing, in the state of the art of glass in semiconductor packaging in the 1990s, silicon dioxide SiO_2 and borosilicate B_2O_3 are considered to be used in the applications to transfer light, e.g., optical fiber. Both silicon dioxide and borosilicate are transparent). Thus, the glass layer in Badihi cannot be both the transparent substrate and the protective substrate.

Based on the above, regarding the “protective substrate” limitation, Badihi does not teach a non-transparent protective substrate that provides structural support, as claimed by the ’319 patent. A POSA would readily know that a thin glass layer disclosed by Badihi is not a non-transparent protective substrate providing structural support as claimed by the ’319 patent. Accordingly, this material limitation “protective substrate” would not be rendered obvious by Badihi.

3. Badihi does not disclose or render obvious the “effectively exposed” limitation

Claim limitation [1f] recites: “wherein the semiconductor substrate has a thickness defined such that the light-sensitive pixel region is effectively exposed through the second surface.” As explained above, the inventors define the “effectively exposed” limitation in the ’319 patent to require “the pixel of each light-

sensitive pixel region generates electron flow in response to light (photons) passing through second surface.” *See Supra.* §IV.A.

Petitioner asserts that Badihi discloses that “the thickness of the semiconductor substrate is defined such that the light-sensitive pixel region is effectively exposed through the second surface. . . . A POSITA would readily understand that the purpose of grinding the silicon wafer from its backside before enclosing it in a glass transparent package is so that the photons absorbed by the remaining semiconductor substrate are closer to the photodiode for a better response.” Pet. at. 60-61. This is a conclusory statement that should be ignored because it is without any support.

First, as previously discussed, Badihi is directed to general back-side grinding and packaging of wafer. *See Supra.* §VI.F.1. Back-side grinding was routinely done in the semiconductor packaging industry for advantages that have nothing to do with image sensing. *See e.g.*, Ex. 2002 at 20, 66, 71, 74 (discussing flip-chip, i.e., back-side processed chips, have general advantages in decreasing electromagnetic effects, increasing interconnection capability, and their applications in high performing I/O packaging, all of which have nothing to do with effectively exposing CMOS photodiodes whatsoever); Ex. 2005 (in its Abstract: “[t]his paper aims to realize heterogeneous integrated packaging technology for high integration by applying a thinning process technology for controlling the thickness of chipsets used in

packaging, i.e., A technology for processing silicon dies with a thickness of 100 um or less and a technology for handling thinning ultrasmall dies.”); Ex. 2006. 2007, 2008 (where the grinding/thinning process is performed in general semiconductor packaging rather than image sensors); Ex. 2003 at 1 (discussing dies with back-grinding are routinely used for its advantage of better heat dissipation, which is important for high-power RF chips. Thus, back-grinding process is routinely used in packaging technology that has nothing to do with effectively exposing CMOS photodiodes). Second, Badihi mentioned nothing whatsoever about CMOS photodiodes and/or BSI sensors. *See Supra.* §VI.F.1. Thus, no POSA reading Badihi would understand the general back-side grinding disclosed in Badihi is to “effectively expose” the BSI image sensors such that electron flow is generated with the light sensitive pixel regions (*i.e.*, the image sensor) being exposed to light (photons).

Indeed, electron flow would not be necessarily generated when the light-sensitive pixel regions of each image sensor circuit are illuminated because, for example, there may be an illumination threshold that has to be reached before electron flow is generated. *See e.g.*, Ex. 2009 (discussing how the threshold of silicon photodiodes should be designed to reduce noise interference and yet preserve high sensitivity); Ex. 2010 (discussing how to improve threshold uniformity among photodiodes in an array to increase the quality of imaging); Ex. 2011 (discussing

how to tune thresholds of photodiodes to reduce current contamination to neighboring photodiodes, e.g., antiblooming photodiodes); Ex. 2012 (indicating the threshold of the photodiodes used in the research is lower than 5V).

Further for Badihi, the disclosed step of thinning/grinding is just for reducing the thickness of the silicon substrate for achieving a chip size packaging instead of illuminating the image sensor, which further eliminate the possibility of generating electron flow. Ex. 1101, 237. In summary, the thinning/grinding process in the cited references is totally different from that of the '319 patent.

Thus, Badihi does not disclose or suggest the invention of claim 1 of the '319 patent. As stated above, Petitioner's expert report, which simply parrots the Petition, is insufficient to establish that the limitations not disclosed in Badihi would be obvious to a POSA.

Because independent claims 1 is patentable, so are dependent claims 2, 5, and 6. *Rembrandt Wireless Techs., supra.*

G. Institution Should Be Denied As To Ground 5 Because Claim 4 Is Not Obvious Over Badihi In View Of Watanabe

As is demonstrated above, Badihi fails to render claim 1 obvious. Petitioner did not cite Watanabe against claim 1. Thus, claim 1 is patentable over Badihi in view of Watanabe. Because claim 1 is patentable, claim 4 is also patentable. *See Rembrandt Wireless Techs., supra.*

H. Institution Should Be Denied As To Ground 6 Because Claims 1, 2, 3, 5, and 6 Are Not Obvious Over Merrill In View Of Badihi

Patent Owner has explained above that Merrill is a U.S. patent titled “Active pixel sensor cell that minimizes leakage current,” which does not describe BSI image sensors. Merrill discloses a CMOS APS cell including a “conventional photodiode ... typically combined with a number of active transistors”. Ex. 1049, 1:31-45, 6:13-18.

Petitioner’s expert, who parrots the arguments in the Petition, provides no evidence in support for Petitioner’s assertion that a POSA would have been motivated to modify Merrill’s CMOS APS cells to include the semiconductor packaging taught by Badihi. Pet. at 67. But even if a POSA were to do that, neither prior art reference, either alone or in combination, suggests the claimed invention.

Because neither Badihi nor Merrill even mentions a BSI sensor, Petitioner’s argument that a combination of those references teaches a BSI sensor should be rejected. Pet. at 68-70. In fact, the only way one could conceivably envision a combination of Badihi and Merrill to even remotely suggest BSI sensors is through hindsight, using the ’319 patent and its claims as a guide. This, however, is not a proper way to combine references. “Obviousness cannot be based on the hindsight combination of components selectively culled from the prior art to fit

the parameters of the patented invention.” *Univ. of Strathclyde v. Clear-Vu Lighting LLC*, 17 F.4th 155, 162 (Fed. Cir. 2021).

Further, as mentioned above, Badihi does not disclose the “protective substrate.” Instead, Badihi discloses a transparent substrate, which is a different limitation in the claim. *See Supra.* §VI.F.2. Thus, claim limitations [1d] and [1e] are entirely missing from the combination of references, because Petitioner does not argue that Merrill discloses those limitations. Pet. at 75-77. Further, Badihi does not disclose claim limitation [1f] for the reasons set forth in section VI.F.3. above, and Petitioner does not argue that Merrill discloses it. *Id.* at 77.

Because the combination of Merrill and Badihi does not disclose or render obvious independent claim 1, those references do not disclose or render obvious dependent claims 2, 3, 5, and 6. *See Rembrandt Wireless Techs., supra.*

I. Institution Should Be Denied As To Ground 7 Because Claim 4 Is Not Obvious Over Merrill In View of Badihi and Watanabe

As is demonstrated above, the combination of Merrill and Badihi fail to render claim 1 obvious. Petitioner did not cite Watanabe against claim 1. Thus, claim 1 is patentable over Merrill in view of Badihi and Watanabe. Because claim 1 is patentable, claim 4 is also patentable. *See Rembrandt Wireless Techs., supra.*

VII. CONCLUSION

For the reasons set forth above, Patent Owner respectfully requests that the

Board deny the Petition for *inter partes* review in its entirety.

Dated: April 20, 2023

Respectfully submitted,

By: /s/ Eric Cohen
Eric Cohen
Registration No. 27,429

Counsel for Patent Owner
Alidouble Inc.

CERTIFICATION OF WORD COUNT UNDER 37 CFR § 42.24(d)

Pursuant to 37 C.F.R. §§ 42.24(d) and 42.24(a)(1), I hereby certify that the number of words in this Response is no more than 7,712 excluding the parts of the petition exempted by 37 C.F.R. § 42.24(a), as determined using the word count provided by Microsoft Word, which was used to prepare this Petition.

DATE: April 20, 2023

Respectfully Submitted,

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Eric Cohen
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*Counsel for Patent Owner
Alidouble Inc.*

CERTIFICATE OF SERVICE

Pursuant to 37 CFR § 42.6(e), the undersigned hereby certifies that a copy of the Patent Owner's Preliminary Response Under 37 C.F.R. §42.107 by P-TACS electronic notification and electronic mail to each of the following individuals on the date indicated below:

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