

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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SAMSUNG ELECTRONICS CO., LTD.,  
Petitioner

v.

ACORN SEMI, LLC,  
Patent Owner

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Case No. IPR2020-01264  
Patent No. 8,766,336

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PATENT OWNER'S PRELIMINARY RESPONSE  
TO PETITION FOR *INTER PARTES* REVIEW

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## **I. INTRODUCTION AND SUMMARY OF ARGUMENTS**

This IPR petition is one of ten filed by the petitioner, Samsung, against six Acorn Semi, LLC (“Acorn”) patents that are the subject of infringement litigation between Acorn and the petitioner in the U.S. District Court for the Eastern District of Texas. That litigation, which started in October 2019, is far advanced, with a firm trial date set less than three months after a decision on institution is due in this case and less than two months after decisions on institution are due for the last of the ten IPR petitions. By the time this institution decision is due, the parties will have completed all discovery (fact and expert), completed claim construction, and filed summary judgment and *Daubert* motions in the district court. Only final pretrial preparations will remain to be done. By the time the Board were to render a final written decision in this case – if trial were instituted – the district court trial will have completed nearly nine months prior, and the district court will have fully resolved the parties’ validity (and other) disputes. In similar circumstances, the Board has recognized that it would be wasteful, inefficient, and unfair to conduct an IPR trial. So it is here, and the Board should exercise its discretion to deny this petition.

This petition is also one of two petitions filed by the petitioner against the ’336 Patent. The other is IPR2020-01204 filed nine days earlier. While this petition should not be instituted at all, it certainly should not be instituted as a second parallel

petition against the '336 Patent, as explained in Acorn's contemporaneously filed Paper 8.

On the merits, the petition's challenges fail to have a reasonable likelihood of prevailing. The petition presents four challenge grounds based on various combinations of three references: Jammy (Ex. 1116), Kim (Ex. 1117), and Chang (Ex. 1119). Jammy teaches a metal-semiconductor interface different from what the '336 Patent claims, so the petition turns to Kim to modify Jammy's interface. But the proposed modification is not a slight adjustment; it is, instead, a complete scrap-and-replace. A person of ordinary skill in the art (POSITA) would not have done so as the petition proposes. Also, neither Kim alone nor the proposed combination of Jammy and Kim would yield the "metal oxide" recited in all claims. The petition's assertions to the contrary are based on an incomplete and incorrect understanding of Kim. Moreover, neither Jammy nor Kim teaches or suggests key features recited in every independent challenged claim, such as reducing the Schottky barrier height, Fermi-level depinning, and MIGS reduction.

Finally, the petition fails to address prominent known instances, among many, of objective indicia of non-obviousness by failing to acknowledge the petitioner's own writings recognizing the Acorn inventors' inventions.

## **II. BACKGROUND**

### **A. The '336 Patent**

#### **1. Technology overview**

The '336 Patent describes an improved metal-semiconductor junction and devices comprising such junctions. The '336 Patent teaches a particular interface layer placed between the metal and semiconductor. While metal-interface-layer-semiconductor structures were known in the prior art, the '336 Patent teaches an improved interface layer that can yield junctions with far superior electrical properties.

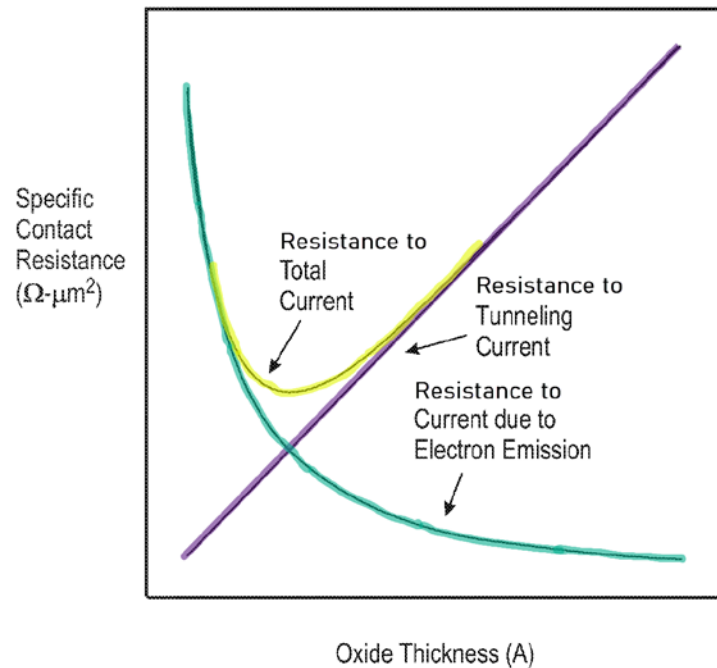
The patent's improved interface layer is a result of groundbreaking insights made by the Acorn inventors, Daniel Grupp and Daniel Connelly, who discovered that multiple interacting phenomena can be controlled by an appropriate interface layer. The result is that junctions can be engineered to have desirable properties that had not been possible in the prior art.

The basic science of metal-semiconductor junctions begins with the fact that there is an energy barrier (named after physicist Walter Schottky) when a metal is brought into contact with, or close proximity to, a semiconductor. This Schottky barrier resists the flow of electrical current across the metal-semiconductor junction. *See* '336 Patent at 1:30-62. According to the earliest theory, the magnitude or “height” of the Schottky barrier in an ideal metal-semiconductor junction depends

directly on the work function of the metal (a measure of the metal's propensity to give up an electron to an adjacent material or vacuum). *Id.* at 1:60. However, that ideal relationship is not observed in practice, and various theories were developed to try to explain this variation from the ideal behavior. *Id.* at 1:63–2:2. All of those theories contemplated that the reason for the disconnect from the ideal relationship between the Schottky barrier height and the metal's work function was that the Fermi level of the semiconductor was somehow being “pinned” in a position that Schottky's theory did not account for. The earliest theory (advanced by Bardeen) supposed that atoms with incomplete valences, or “dangling bonds,” on the surface of the semiconductor pinned the Fermi level. *Id.* at 2:3-24. Bardeen's theory, while an improvement, did not fully explain what was observed in experiments. *Id.* at 2:18-29. Another theory that attempted to explain Fermi level pinning was advanced by Tersoff, who postulated that an effect called metal-induced gap states (MIGS) pins the Fermi level of a semiconductor. *Id.* at 2:33-58. Other theories were advanced as well. *Id.* at 2:58-67.

The Acorn inventors realized that satisfactorily depinning the Fermi level involves both satisfying dangling bonds on the surface of the semiconductor (a process called passivation) and reducing the effects of MIGS. *See, e.g., id.* at 3:26-32. The Acorn inventors further realized that an appropriate interface layer between the semiconductor and the metal could depin the Fermi level without adversely

affecting the resistance of the junction. In particular, the Acorn inventors found that the thickness of an appropriate interface layer could be optimized to result in minimum overall resistivity/resistance, as illustrated in Figure 8 of the Acorn patents.



*Id.* at Fig. 8 (“Resistance to” and color highlights added).

Figure 8 illustrates three curves of resistance across a metal-interface-layer-semiconductor junction as a function of the interface layer thickness, two component curves and one sum total curve. *See id.* at 14:9-31. The first component is the straight line going up to the right (highlighted purple); it represents the phenomenon that quantum tunneling resistance increases as the thickness of the interface layer increases. *See id.* The second component is the curve sweeping down to the right (highlighted green); it represents the effect of MIGS, as a thicker interface layer

further separates the metal from the semiconductor, further decreasing the effect of MIGS and further reducing the Schottky barrier height. *See id.* The third curve (a section of which is highlighted yellow) is the sum of the other two curves, representing the resistance to total current. *See id.* As can be seen, there is a minimum point on the total curve, which represents the ideal interface layer thickness. *See id.*

The Acorn inventors understood that a thinner interface layer is better for tunneling, but a thicker interface layer that further separates the metal from the semiconductor could better reduce the effects of MIGS and thus better depin the Fermi level. Armed with that deeper appreciation of the various effects at play and an understanding of the tradeoffs involved, the Acorn inventors achieved an insight that there is a Goldilocks zone of interface layer thickness – not too thin such that MIGS unduly pins the Fermi level and not too thick such that tunneling is hampered. Figure 8 of the '336 Patent illustrates this insight.

The '336 Patent goes on to teach that the interface layer may be made of a single material or multiple materials. In the latter case, there may be a passivating layer on the semiconductor side and a “separation” or “spacer” layer on the metal side. *Id.* at 3:44-47, 9:34-47. The '336 Patent teaches different materials for those layers, including oxides and nitrides of the semiconductor for the passivating layer and oxides of the metal for the separation layer. *Id.* at 9:48-63, 10:35-39. The '336

Patent also teaches different thicknesses for the interface layer and different specific contact resistances. *Id.* at 9:64–10:9, 14:9-31. The '336 Patent also teaches that its improved junction can be incorporated into electrical devices, such as transistors, particularly at the source and drain contacts of a MOSFET transistor. *See id.* at 12:25 *et seq.*, 16:57 *et seq.*

## **2. Disclaimer of select claims**

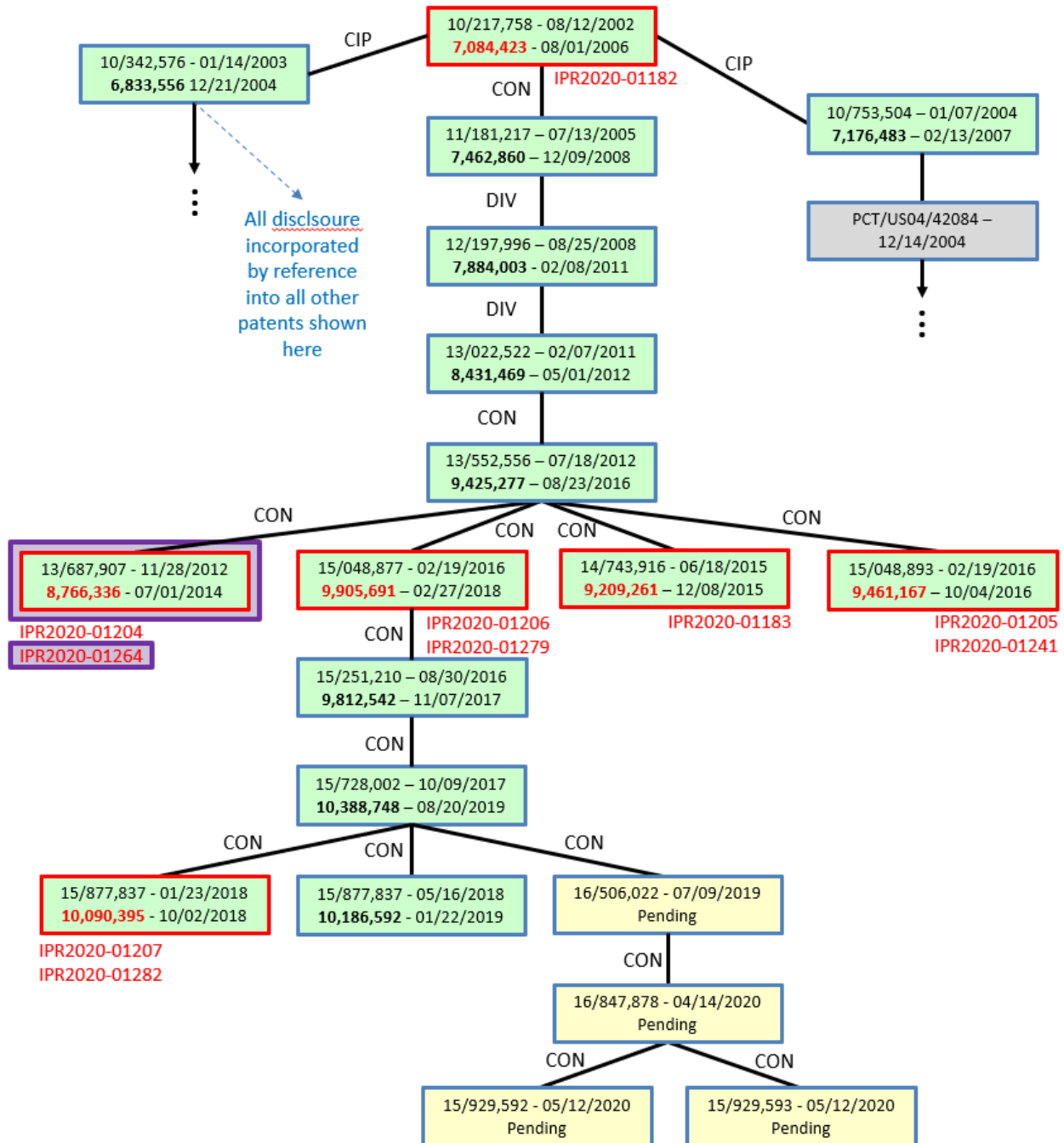
On October 14, 2020, Acorn disclaimed claims 9-12 and 65-76 of the '336 Patent, leaving only claims 1-8, 13-16, and 77-80 subject to challenge by the petition. *See* Ex. 2001. Acorn did so to simplify the IPRs of the '336 Patent and to reduce the number of issues to a more manageable number and does not request adverse judgment in any respect. Acorn does not concede that those or similar claims are unpatentable for any reason. *See* 37 C.F.R. § 42.107(e) (“The patent owner may file a statutory disclaimer under 35 U.S.C. 253(a) in compliance with § 1.321(a), disclaiming one or more claims in the patent. No inter partes review will be instituted based on disclaimed claims.”); PTAB Consol. Trial Prac. Guide (“Consol. TPG”) at 52 (Nov. 2019) (same); *SFC Co. v. LG Chem, Ltd.*, IPR2020-00182, Paper 16 at 2, 7-8 (June 2, 2020) (denying institution for lack of reasonable likelihood of prevailing against remaining claims after patent owner disclaimed some claims); *Cisco Sys., Inc. v. Straight Path IP Group, Inc.*, IPR2015-01962, Paper 16 at 3, 6-7 (Apr. 6, 2016) (same).



## B. Related Proceedings

### 1. Related Acorn patents and IPR petitions

The '336 Patent is one of a large family of patents, as shown below in the following family-tree diagram, which is a partial view of this family:



The '336 Patent is one of six patents Acorn has asserted against the petitioner in related litigation. The six asserted patents are illustrated in the diagram above in boxes outlined in red. The '336 Patent is shown on the left side of the diagram with an additional purple border.

The petitioner has filed a total of ten IPR petitions against the six asserted patents. Those IPR case numbers are noted in red near the subject patents. Those ten IPR petitions include eight parallel petitions, two each against four of the asserted patents, including the '336 Patent, which is the subject of this IPR petition as well as IPR2020-01204.

In the pending continuations, Acorn has filed information disclosure statements disclosing all of the IPR petitions, the art cited therein, and the petitioner's expert declarations (as well as the petitioner's invalidity contentions and art cited therein from the related litigation). After considering that information, the examiner has allowed similar claims. *See* Ex. 2005 at 262-265, 300-07; Ex. 2006 at 233-35, 267-74.

## **2. Related litigation**

The parties will have been engaged in litigation in the United States District Court for the Eastern District of Texas for about 15 months by the time a decision on institution is due in this IPR. Acorn filed its complaint in October 2019, *see* Ex. 1147, and served infringement contentions in March 2020, *see* Exs. 1050-51. The

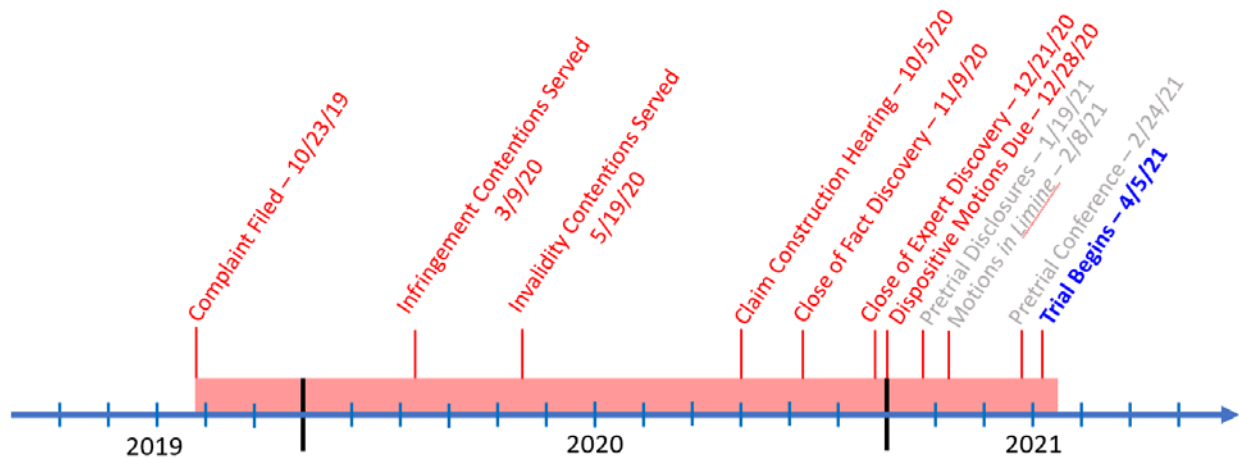
petitioner served invalidity contentions in May 2020 and filed its ten IPR petitions, including this one, in June and July 2020. The claims of the '336 Patent originally asserted in the district court are claims 1-16 and 65-80 – exactly the same claims as challenged in this IPR petition (and IPR2020-01204). The petitioner's invalidity contentions included contentions based on Jammy and Kim. *See* Ex. 2017; Ex. 2020 (claim chart based primarily on Jammy but referencing Kim at 10); Ex. 2021 (claim chart based primarily on Kim but referencing Jammy at 7). The invalidity contentions also reference Chang. *See* Ex. 2017 at 31-32; Ex. 2020 at 16-17; Ex. 2021 at 10-12, 14-15.

The petitioner filed a motion for a stay in the district court in August 2020, and the court denied that motion in September 2020. *Acorn Semi, LLC v. Samsung Elecs. Co.*, No. 2:19-cv-003347-JRG, Dkt. # 72 (E.D. Tex. Sept. 14, 2020) (copy provided as Ex. 2010). The Court stated that the petitioner could re-file its stay motion only “following the PTAB’s institution decision regarding the *last* of the patents-in-suit to be acted upon by the PTAB.” *Id.* at 3 (emphasis added).

Claim construction briefing has been completed, and an in-person *Markman* hearing took place in October 2020. By the time a decision on institution is due in this case (January 16, 2021), the court very likely will have made claim construction rulings, fact discovery will have closed in November 2020, expert discovery will have closed in December 2020, and the deadline for dispositive motions and *Daubert*

motions will have passed in December 2020. The litigation will then be in the home stretch, with trial scheduled to begin in less than three months, on April 5, 2021. By the time decisions on institution are due in all ten IPRs (February 11, 2021), the court case will be less than two months from trial.<sup>1</sup>

The following timeline illustrates the key milestones of the litigation. Milestones that will have been completed by the (non)-institution due date in this IPR are colored red, subsequent events are gray, and the trial date is bold blue.



*See Acorn Semi, LLC v. Samsung Elecs. Co.*, No. 2:19-cv-003347-JRG, Dkt. # 57 (E.D. Tex. July 21, 2020) (“3d Am. Docket Control Order”) (copy provided as Ex.

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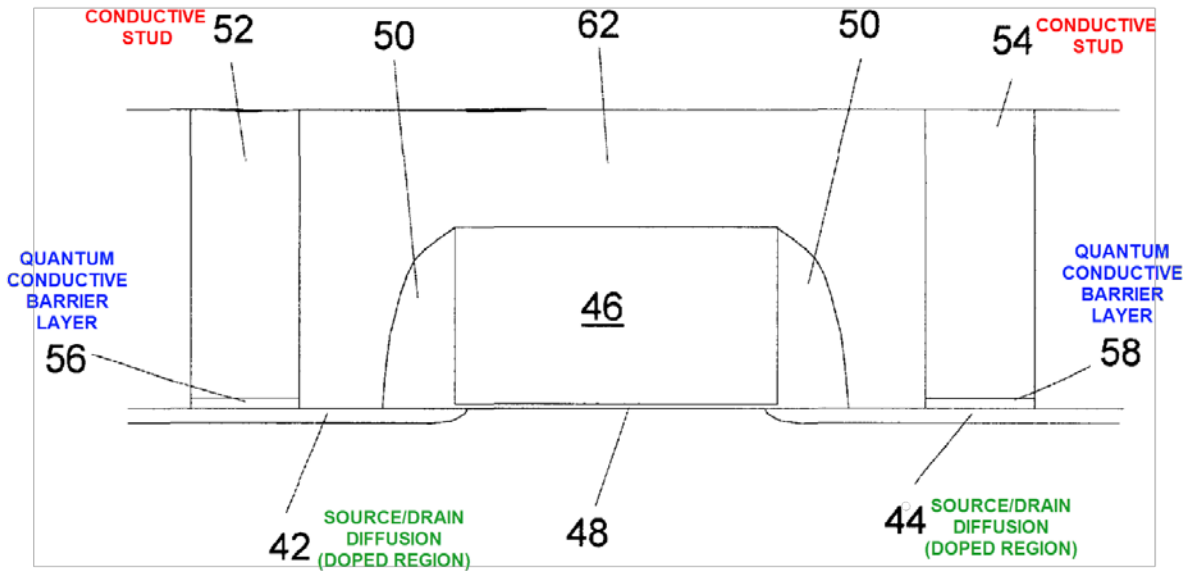
<sup>1</sup> Decisions on institution are due for three of the six patents on January 16, 2021, and for the other three patents on February 11, 2021.

2008). The court's schedule has been slightly amended three times, but the major deadlines, including the trial date, have not changed and are not expected to change.

### **C. The IPR Petition**

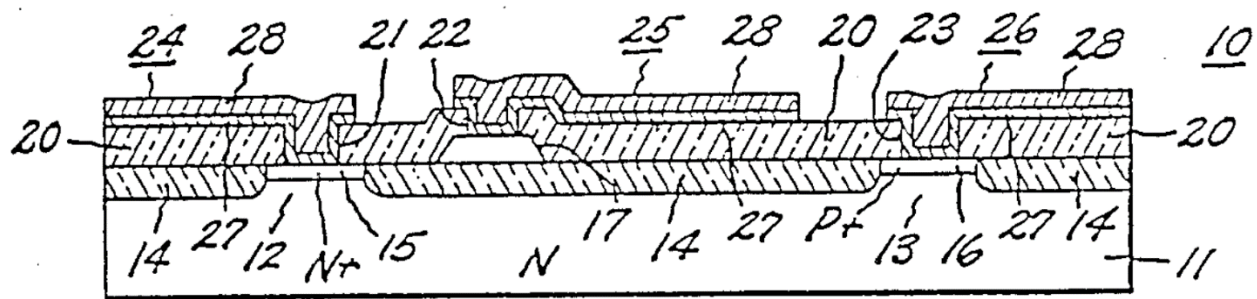
The petition's challenges are directed at independent claims 1, 5, 13, and 77 and each of their three dependent claims – in total, 16 claims remaining after disclaimer. All challenges are based on 35 U.S.C. § 103. Independent claims 1, 5, and 13 are challenged based on Jammy in view of Kim (challenge 1), while independent claim 77 is challenged based on Kim alone (challenge 3). The challenges to certain dependent claims reciting a narrower, lower range of specific contact resistance additionally relies on Chang to augment either Jammy and Kim or Kim alone.

Jammy discloses a MOSFET transistor in which a quantum conductive barrier layer 56/58 is placed between source and drain terminals 42/44 and conductive studs 52/54, as illustrated in Jammy's sole drawing:



Jammy at Fig. 1 (annotated).

Kim discloses a direct-contact interface between doped silicon regions 15/16 and a tungsten-titanium alloy 27, on which molybdenum 28 is placed. Those interfaces are in apertures 21/23 formed by removing a layer of silicon dioxide 20, as illustrated in Kim's Figure 2:



Kim at Fig. 2.

Chang discloses that contact resistance of a metal-semiconductor junction is dependent on several parameters including doping of the semiconductor. Chang at 545-50.

The petition alleges as part of challenge 1 (and 2) that a POSITA would have replaced Jammy's conductive studs 52/54 and quantum conductive barrier layers 56/58 with Kim's stack of molybdenum on a titanium-tungsten alloy. *See* Pet. at 19-22. The petition argues that this would result in a layer of titanium oxide. *Id.* This combination is illustrated in a modified, colorized version of Jammy's Figure 1 on page 22 of the petition. For some claims, the petition further alleges that a POSITA would have additionally modified that combination by initially adding a layer of silicon dioxide over the source/drain diffusion areas 42/44 before addition of Kim's stack of titanium-tungsten alloy and molybdenum.

Challenge 3 asserts that Kim's interface structure alone renders obvious certain claims.

Challenges 2 and 4 assert that a POSITA would have (1) replaced Kim's titanium-tungsten alloy with pure titanium and (2) doped the semiconductor regions to decrease specific contact resistance, as allegedly taught by Chang.

### III. THE BOARD SHOULD DENY THE PETITION BECAUSE OF THE ADVANCED STAGE OF THE RELATED LITIGATION.

Institution of *inter partes* review is **discretionary**. See *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1367 (Fed. Cir. 2016) (“[T]he PTO is permitted, but never compelled, to institute an IPR proceeding”); see also *Cuozzo Speed Techs., LLC v. Lee*, 136 S. Ct. 2131, 2140 (2016) (“[T]he agency’s decision to deny a petition is a matter committed to the Patent Office’s discretion.” (citations omitted)). That discretion derives in part from the wording of 35 U.S.C. § 314(a) (“Director may not authorize an inter partes review to be instituted unless . . .”).

The petition asserts that Congress made a “deliberate decision to provide *inter partes* review petitioners with a full year to file a petition after service of an infringement complaint.” Pet. at 68 (citing 35 U.S.C. § 315(b)). Not so. Congress made no guarantees that a petition filed within the one-year limit of 35 U.S.C. § 315(b) would be timely. The one-year bar of 35 U.S.C. § 315(b) is just one outer limit Congress put on *inter partes* review petitions.

More fundamentally, Congress intended IPRs to be an **alternative** to litigation. See H.R. Rep. No. 112–98, pt. 1 at 40 (2011), 2011 USCCAN 67, 69 (IPRs were meant to be “quick and cost effective **alternatives** to litigation” (emphasis added)); see also S. Rep. No. 110–259 at 20 (2008). The Board has recognized this important principle. See Consol. TPG at 56 (citing legislative



history); *Gen. Plastic Indus. Co. v. Canon Kabushiki Kaisha*, IPR2016-01357, Paper 19 at 16-17 (Sept. 6, 2017) (precedential in relevant part) (“[A]n objective of the AIA is to provide an effective and efficient **alternative** to district court litigation.” (emphasis added)); *NHK Spring Co. v. Intri-Plex Techs., Inc.*, IPR2018-00752, Paper 8 at 20 (Sept. 12, 2018) (precedential) (same); *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 11 (“*Fintiv I*”) at 9 (Mar. 20, 2020) (precedential) (“As a matter of petition timing, notwithstanding that a defendant has one year to file a petition, it may impose unfair costs to a patent owner if the petitioner, faced with the prospect of a looming trial date, waits until the district court trial has progressed significantly before filing a petition at the Office.”); *Apple Inc. v. Fintiv, Inc.*, IPR2020-00019, Paper 15 (“*Fintiv II*”) at 11 (May 13, 2020) (informative) (“To Petitioner’s point regarding the time-bar of 35 U.S.C. § 315(b), we recognize that, under certain circumstances, considerations of the state of a parallel proceeding may require petitioners to act more quickly than the maximum amount of time permitted by Congress.”).

Accordingly, the Board regularly denies petitions in its discretion when there is related litigation and an IPR would not be “an effective and efficient **alternative** to district court litigation.” *Gen. Plastic* at 16–17 (emphasis added). When deciding to exercise such discretion, the Board considers six factors: (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.” *Fintiv I* at 5-6. The *Fintiv* factors compel denial of the petition in this case, as explained below.

#### **A. *Fintiv* Factor 1**

Factor 1 strongly favors denial in this case, as the court has already denied the petitioner’s motion for a stay and is highly unlikely to enter a stay after the decisions on institution. The petitioner filed a motion for a stay in the district court on August 8, 2020. *Acorn Semi, LLC v. Samsung Elecs. Co.*, No. 2:19-cv-003347-JRG, Dkt. # 60 (E.D. Tex. Aug. 8, 2020). However, the court denied that motion on September 14, 2020. *Id.*, Dkt. # 72. And, the court made clear that it would not entertain a renewed motion to stay until after decisions on institution had been rendered in *all ten* of the IPRs. *Id.* at 3 (requiring any renewed motion to be filed “within fourteen (14) days following the PTAB’s institution decision regarding the last of the patents-in-suit to be acted upon by the PTAB”). The last such decision on institution is not due until February 11, 2021 – after all discovery has closed, after dispositive motions have been fully briefed, after the parties and the court have spent approximately a

year and a half steeped in the case, and less than two months from the trial date. While the Board has expressed an unwillingness to predict whether a district court will enter a stay, *see, e.g., Fintiv II* at 12, it does not take a crystal ball to see that this particular court would be extremely unlikely to enter a stay at that point in this case.

The case cited in the petition, *see* Pet. at 69, *Image Processing Technologies LLC v. Samsung Electronics. Co.*, No. 2:16-cv-505-JRG, 2017 WL 7051628 (E.D. Tex. Feb. 17, 2017) (copy provided as Ex. 2012) is an outlier – the *only* case in which United States District Judge Rodney Gilstrap, the judge presiding over the related litigation, has granted a renewed motion for stay after Board institution decisions. Judge Gilstrap has denied four other such motions, and three of those cases (all subsequent to *Image Processing*) are telling.

First, in *Intellectual Ventures I LLC v. T Mobile USA, Inc.*, No. 2:17-CV-00577-JRG (E.D. Tex. Dec. 13, 2018) (copy provided as Ex. 2013), Judge Gilstrap denied a renewed motion for a stay, even though IPR trials had been instituted against all asserted claims, because the “advanced stage” of the litigation “weighs strongly against a stay.” *Id.*, slip op. at 6. The pretrial conference was scheduled to begin about one month after the institution date. *Id.* at 2, 6. In this case, the pretrial conference is scheduled February 24, 2021, less than two weeks following the final

institution decision's due date. By comparison, this case will be even more advanced than *Intellectual Ventures*, and denial of a renewed stay motion is even more likely.

Second, in *Oyster Optics, LLC v. Infinera Corp.*, No. 2:19-CV-00257-JRG (E.D. Tex. July 17, 2020) (Ex. 2014), Judge Gilstrap denied a renewed, post-institution stay motion, even though IPR trials were instituted on all but one asserted claim because of, again, the advanced stage of the litigation. *Id.*, slip op. at 1. According to the court, “[T]he case is clearly at an advanced stage. Fact discovery is closing in about a month and trial is only six months away. Further, the claim construction briefing and argument is completed. As such, the Court finds that the late stage of this case weighs against granting a stay.” *Id.* at 5. Here, the litigation will be at an even more advanced stage than was *Oyster Optics*, with fact discovery closed, claim construction concluded, and trial less than two months away from any renewed motion filing. This case will thus be even less likely to be stayed than *Oyster Optics*.

Third, in *Solas OLED Ltd. v. Samsung Display Co.*, No. 2:19-CV-00152-JRG (E.D. Tex. July 17, 2020) (Ex. 2015), Judge Gilstrap again denied a renewed, post-institution stay motion, even though IPR trials were instituted on all asserted claims because of, yet again, the advanced stage of the litigation. *Id.*, slip op. at 1-2. In fact, the court said that the case was at an “extremely advanced stage” where discovery had closed, the court had issued a claim construction order, and dispositive

and *Daubert* motions had been filed. *Id.* at 5. The same will be true in this case, and a renewed post-institution motion for a stay, even if IPRs are instituted against all Acorn patents, will likewise be denied by the court.

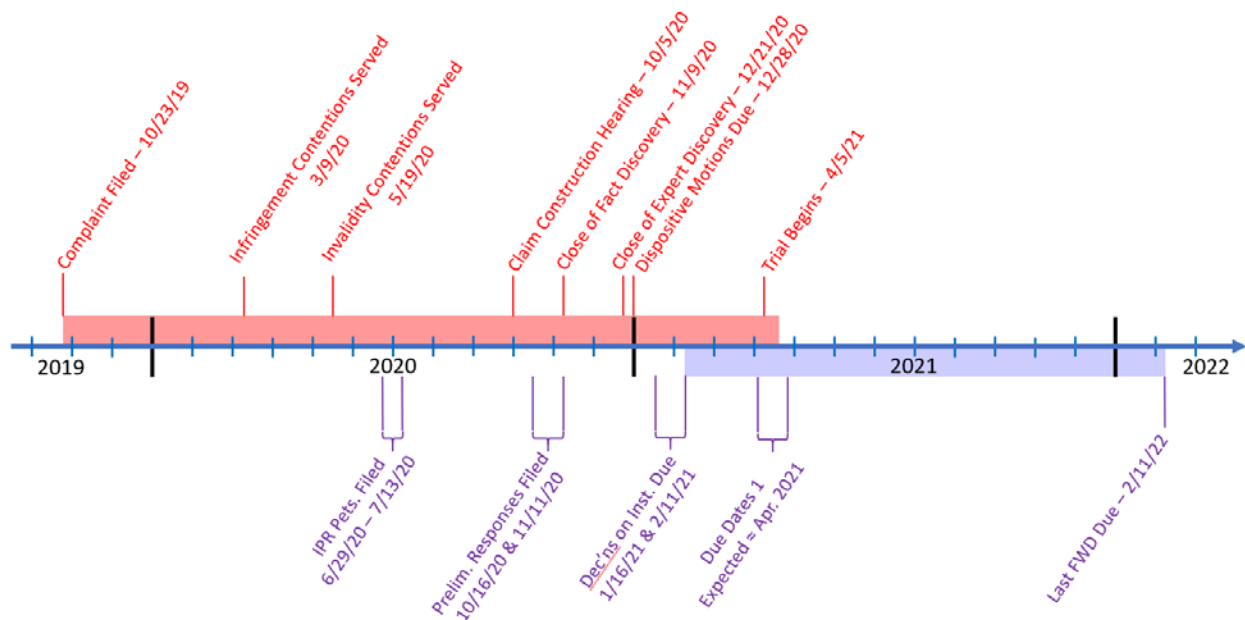
In each of *Intellectual Ventures I*, *Oyster Optics*, and *Solas OLED*, the opinions denying the renewed motion are much more recent, fulsome, and thoroughly reasoned than the relative terse and conclusory opinion in *Image Processing*. These three subsequent cases better reflect the evolution of Judge Gilstrap's thinking of renewed, post-institution stays. Overall, a complete review of the court's stay jurisprudence in similar circumstances shows that it would be shocking for the court to grant a stay even if IPR trials are instituted against all six Acorn patents.

Moreover, if trial is instituted against only a subset of the six Acorn patents, then the likelihood of a stay is extremely low. *See Oyster Optics* at 6 ("The fact that one claim in the '500 Patent was not instituted means that no matter the outcome of the IPR, the '500 Patent will remain in this case, and this will remain on this Court's active docket. Accordingly, the parties will be forced to litigate the same issues and put forward the same evidence regardless of the outcome of the IPR. While the IPR may eliminate some of the claims, it will not eliminate the patent infringement cause of action. As such, the Court finds that a stay will not adequately simplify the issues in this case to warrant a stay.").

For these reasons, *Fintiv* factor 1 strongly favors discretionary denial.

## B. *Fintiv* Factor 2

In this case, factor 2 strongly supports denial, as the court trial is scheduled to begin over *nine months before the final written decision* would be due in this case and over *ten months before the last final written decision* would be due in this set of IPRs. That is, the court trial will begin just 2-3 months after the IPRs would be instituted, if instituted, as shown in the following timeline, in which events in the court are shown in red on the top and events in the IPRs are shown in violet on the bottom. As can be seen, the IPRs lag behind the litigation significantly.



The petition asserts, “*NHK Spring* does not suggest, much less hold, that *inter partes* review should be denied under § 314(a) solely because a district court is scheduled to consider the same validity issues before the *inter partes* review would

be complete.” Pet. at 72 (quoting *Intuitive Surgical, Inc. v. Ethicon LLC*, IPR2018-01703, Paper 7 at 13 (Feb. 19, 2019)). However, *Intuitive Surgical* is a pre-*Fintiv* case that has been overruled on that very point by the precedential *Fintiv I* decision: “If the court’s trial date is earlier than the projected statutory deadline, the Board generally has weighed this fact[or 2] in favor of exercising authority to deny institution under *NHK*.” *Fintiv I* at 9.

In comparable cases of such a far-advanced related litigation, the Board has routinely found that this factor favors discretionary denial. See *Supercell Oy v. GREE, Inc.*, PGR2020-00034, Paper 13 at 12-13 (Sept. 3, 2020) (denying institution and finding that this factor weighs “**strongly** toward denying institution” where trial in E.D. Tex. was scheduled to occur nine months before final written decision (FWD) and commenting, “In keeping with precedent, a jury trial set to begin seven months before our statutory deadline would weigh in favor of denying institution”); *Supercell Oy v. GREE, Inc.*, PGR2020-00039, Paper 14 at 12 (Sept. 14, 2020) (same); *Supercell Oy v. GREE, Inc.*, IPR2020-00215, Paper 10 at 10-12 (June 10, 2020) (denying institution where trial in E.D. Tex. was scheduled to occur ten months before FWD); *Ethicon Inc. v. Bd. of Regents, Univ. of Tx. Sys.*, IPR2019-00406, Paper 27 at 9-10 (June 10, 2020) (denying institution where court trial was scheduled shortly after institution); *Kranos Corp. v. Apalone, Inc.*, IPR2020-00501, Paper 13 at 9-10 (July 16, 2020) (denying institution where trial is scheduled to begin

approximately two months after decision on institution); *Cisco Sys., Inc. v. Ramot at Tel Aviv Univ. Ltd.*, IPR2020-00484, Paper 10 at 7-8 (Aug. 18, 2020) (denying institution where trial will begin eight months before FWD); *Intel Corp. v. VLSI Tech. LLC*, IPR2020-00158, Paper 16 at 7-9 (May 20, 2020) (denying institution where FWD would occur seven months after court trial); *Samsung Elecs. Am., Inc. v. Uniloc 2017 LLC*, IPR2020-00117, Paper 11 at 8 (May 28, 2020) (denying institution where trial was scheduled approximately six months before FWD); *Fintiv II* at 12-13 (finding factor 2 weighs somewhat in favor of denial where court trial will begin approximately only two months before FWD).

The petition asserts that trial dates are subject to change. *See* Pet. at 69-70. However, there is no evidence to suggest that the U.S. District Court for the Eastern District of Texas changes its trial dates in general, let alone in this case. Rather, the court has a standing order “to keep cases moving” despite the COVID-19 pandemic, characterizing trial dates as “firm” notwithstanding the pandemic. Ex. 2016 at 3. In fact, that court has conducted jury trials during the pandemic, as the Board has noted:

[W]e decline to speculate whether that date will change due to COVID-19 disruptions . . . . We are cognizant of the impact of COVID-19 on any proceeding, before the Board, in district courts, or otherwise. We are also cognizant, however, that *the District Court for the Eastern District of Texas has recently completed a jury*



*trial.* . . . As it stands, on this record, the jury trial in this case in the District Court for the Eastern District of Texas is set . . . approximately ten months before the statutory deadline for final written decision, should we institute trial. Generalized speculation as to trial dates universally (e.g., due to impacts of COVID-19), are outweighed by the fact that the jury trial in this case is scheduled to occur approximately ten months before the Board’s statutory deadline and the fact that the record lacks specific evidence showing that the jury trial is in doubt at this time. Accordingly, on this record, we determine that the facts underlying this factor weigh in favor of exercise of our discretion to deny institution.

*Google LLC v. Personalized Media Commc’ns, LLC*, IPR2020-00719, Paper 16 at 11-12 (Aug. 31, 2020) (emphasis added) (citing *Optis Wireless Tech., LLC v. Apple, Inc.*, 2:19-cv-00066 (E.D. Tex. jury trial Aug. 3-11, 2020); *see also Supercell*, PGR2020-00034, Paper 13 at 11 (“We recognize that some uncertainty exists, in theory, due to the COVID-19 pandemic. However, the record lacks specific, non-speculative evidence suggesting that further delay of the trial date is likely in the parallel proceeding at issue here [in the Eastern District of Texas].”).

Overall, factor 2 weighs heavily in favor of denial in this case.

### C. *Fintiv* Factor 3

Factor 3, investment in the litigation to date, also strongly supports denial in this case. By the time the decision on institution is due in this case, the parties and the court will have invested significant time and energy in the case to ***complete***, for example, the following key events:

- Exchange of infringement and invalidity contentions
- Claim construction discovery, briefing, and hearing (conducted in-person on Oct. 5, 2020) (and very likely a ruling)
- Fact discovery (including, *inter alia*, all document discovery and all depositions of fact witnesses)
- Expert reports
- Expert discovery
- Dispositive (summary judgment) motions and responses thereto
- *Daubert* motions and responses thereto

*See* 3d Am. Docket Control Order (Ex. 2008). When the court has completed or nearly completed similar major milestones, the Board has found that factor 3 strongly favors denial. *See Intel*, IPR2020-00158, Paper 16 at 9-10 (finding factor 3 weighs in favor of denial where final infringement and invalidity contentions had been served, claim construction was complete, and fact discovery was about to close); *Supercell*, IPR2020-00215, Paper 10 at 12-14 (finding factor 3 favors denial

where court had issued claim construction order and “substantial discovery has been conducted”); *Kranos* at 10-12 (finding factor 3 favors denial even though the court has not done claim constructions but discovery and summary judgment briefing was complete); *Cisco v. Ramot* at 9-10 (finding factor 3 favors denial where court has issued claim construction order, expert discovery is about to close, and trial is scheduled to begin in less than four months.). *Cf. Fintiv II* at 13-14 (finding factor 3 weighed somewhat in favor of denial where claim construction had completed, fact discovery was in its early stages, expert reports had not yet been produced, and dispositive motions were yet to come).

Moreover, by the time when a decision on institution will be due, the parties will be days away from serving pre-trial disclosures (due Jan. 19, 2021). Soon thereafter, motions *in limine* will be due (Feb. 8, 2021) and the pretrial conference will take place (Feb. 24, 2021). 3d Am. Docket Control Order at 1-2. With less pressing upcoming similar events in court, the Board has found that factor 3 strongly favors discretionary denial. *See Bentley Motors Ltd. v. Jaguar Land Rover Ltd.*, IPR2019-01539, Paper 16 at 10 (Oct. 2, 2020) (pretrial disclosures due over seven weeks after institution decision, pretrial conference scheduled 4 months after institution decision, and trial scheduled over four and a half months after institution “weigh strongly in favor of denying institution”).

The petitioner argues that its delay in filing the IPR petition after service of Acorn's infringement contentions was reasonable. *See* Pet. at 70. However, that does not swing this factor in the petitioner's favor. *See Supercell*, IPR2020-00215, Paper 10 at 11-12 (“[T]o date, substantial resources have been expended by both the district court and the parties. The date on which Petitioner was served with amended infringement contentions is certainly a fact that weighs in favor of Petitioner. It does not alone, however, change the fact that these significant resources have already been expended.”). Besides, the petitioner waited over eight months after filing of the complaint to file its IPR petitions.

In sum, the parties and the court have and will have expended significant resources and will have completed almost all pretrial activities before the (non-)institution decision is due. That weighs heavily in favor of denial.

**D. *Fintiv* Factor 4**

Factor 4, the overlap between the issues raised in the IPR and the court, also supports discretionary denial in this case.

First, the same claims are at issue in both proceedings. Acorn asserted claims 1-16 and 65-80 of the '336 Patent in the litigation. *See* Ex. 1034 at 2. The petition challenges exactly those claims in this IPR, no more, no less. *See* Pet. at 6.

Second, there is overlap in the invalidity contentions. Essentially the same challenges presented in this IPR petition are included in the petitioner's invalidity contentions in the court. *See* Exs. 2020, 2021. Although the court invalidity contentions are presented in two separate claim charts, they rely on Jammy and Kim (and Chang) for the same teachings as does this IPR petition. The Board has found such an overlap points factor 4 in the direction of denial. *See Fintiv II* at 14-15. The fact that the petitioner asserts in court that the same claims are invalid for additional reasons does not change that conclusion. *Id.*

The petitioner's conditional representation that it will drop from the district court its invalidity contention matching the challenge in the petition, if this IPR trial is instituted, *see* Pet. at 71, should not swing this factor towards institution. That is so for several reasons.

First, the petitioner's conditional representation is a ruse. The petitioner made a similar representation in its parallel petition against the '336 Patent. *See* IPR2020-01204, Paper 2 at 64. The petitioner is attempting to ensure that it will get at least two bites at the apple between the Board and the district court. Because the Board is unlikely to institute both petitions, *see* Paper 8, and because the petitioner is unlikely to be able to try two invalidity theories in court given the practical constraints of a court trial, the petitioner's representation is not a concession at all. Thus, the petitioner's representation notwithstanding, the petitioner hopes to burden

each of the Board and the court with one of its two alternative arguments to reach the same goal. That is not consistent with the AIA's goal of providing an efficient alternative to litigation. Rather than promoting efficiency and fairness, the petitioner's representation is just a ploy to get two chances to invalidate the '336 Patent and to have two different tribunals separately consider the validity/patentability of the exact same patent claims.

Second, the petitioner's conditional representation is too narrow to be of much value, as the Board has twice explained:

Notably, Petitioner stipulates only that it will not pursue, in district court, the "same grounds" presented in the Petition in this case. . . . Petitioner could have stipulated that it would not pursue any ground raised or that 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 patents or printed publications. *A broader stipulation of that nature, not at issue here, might better address concerns regarding duplicative efforts and potentially conflicting decisions in a much more substantial way. Likewise, such a stipulation might help ensure that an IPR functions as a true alternative to litigation in relation to grounds that could be at issue in an IPR.* Further still, Petitioner could have expressly waived in the district court any overlapping

patentability/invalidity defenses. Doing so might have tipped this factor more conclusively in its favor.

*Sand Revolution II, LLC v. Cont'l Intermodal Grp. – Trucking LLC*, IPR2019-01393, Paper 24 at 12 n. 5 (June 16, 2020) (informative) (emphasis added); *see also Apple Inc. v. Seven Networks, LLC*, IPR2020-00506, Paper 11 at 23 (Sept. 1, 2020) (same). Thus, the petitioner's narrow conditional representation that it "will promptly cease asserting Jammy, Kim, and Chang as prior art references to the challenged claims in the Acorn Litigation" – even if it were more than an empty promise in the unique circumstances of this case – would be simply too narrow to swing this factor more than "marginally" against denial. Pet. at 71; *Sand Revolution II* at 12.

Finally, the petition also argues that, if Acorn does not include all challenged '336 Patent claims in the court trial, then the Board will be the only tribunal that can adjudicate their validity. *See* Pet. at 71. However, in that case, the petitioner should not worry about, and the Board should not waste its time with, those claims. *See Intel Corp. v. VLSI Tech. LLC*, IPR2020-00526, Paper 18 at 14 (Aug. 18, 2020) (rejecting petitioner's argument as "too speculative"); *Supercell*, PGR2020-00034, Paper 13 at 19 (same).

#### **E. *Fintiv* Factor 5**

Factor 5 also supports denial in this case, as the parties in this IPR and the related litigation are exactly the same. *See, e.g., Intel*, IPR2020-00158, Paper 16 at

12-13; *Supercell*, PGR2020-00039, Paper 14 at 16. The petition argues that this factor only concerns avoiding rework. *See* Pet. at 71 (citing *Fintiv I* at 13-14). However, *Fintiv I* simply notes that even *if the petitioner is unrelated* to a court defendant, there may still be a concern about the Board needlessly repeating the court’s work. Here, the parties are exactly the same, and this factor firmly supports denial, as *Fintiv I* and the cases cited immediately above hold.

**F. *Fintiv* Factor 6**

The petition asserts that factor 6 supports institution because of a “well-supported obviousness grounds.” Pet. at 71. The petition’s challenges are, however, far from well supported. As explained in detail in §§ V-VII *infra*, there are serious flaws in the challenges. The Board has recognized that this factor favors denial even when the petition presents “a close call” on the merits. *U.S. Venture, Inc. v. Sunoco Partners Mktg. & Terminals L.P.*, IPR2020-00728, Paper 10 at 13-14 (Oct. 1, 2020). Here, the substantive weaknesses in the petition are more serious, and this factor definitely points toward denial.

Even assuming *arguendo* that the challenges had strong merits, that would be insufficient to outweigh the other factors in this case. *See Apple*, IPR2020-00506, Paper 11 at 16-17 (“[E]ven if the merits of the Petition are strong . . . , that factor is insufficient to overcome the other factors in this case that weigh in favor of denying



institution” where “Petitioner likely will have litigated validity nearly a full year prior to our being able to reach a final decision on the merits”).

Moreover, additional circumstances counsel in favor of denial under *Fintiv* factor 6. First, the fact that the petitioner has filed parallel petitions against the ’336 Patent is another reason to deny institution. *See Fintiv I* at 16.

Second, the relative size and stature of the parties also weighs in favor of denial. To be sure, this is a dispute between a David and a Goliath. The petitioner is one of the largest companies in the world, whereas Acorn, at most, is a ten-employee research company.<sup>2</sup> The petitioner’s strategy of multiplying the proceedings by filing ten IPR petitions against the asserted Acorn patents certainly works in the petitioner’s favor, as the petitioner has the resources to outspend Acorn and to spread Acorn thin across multiple proceedings. That is certainly true given the timing here, as Acorn would be forced to prepare and file up to ten IPR responses in the critical weeks before and during the trial in the district court. This timing is suspicious and suggests that the petitioner may have timed the petitions to gain an

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<sup>2</sup> Acorn and its related companies have less than ten full-time-equivalent employees.

unfair advantage in the trial. That is not justice, that is leverage, and the Board should not countenance it.

Third, the limited term remaining on the '336 Patent further favors denial. The '336 Patent will expire in August 2022 – about six months after a final written decision would be due – and there are no other pending lawsuits involving the '336 Patent. Thus, beyond the parties, there is limited public interest in the validity of the few remaining challenged claims of the '336 Patent, and the Board's resources are better spent on patents having a longer lifespan and broader public impact.

In total, each of the *Fintiv* factors, properly considered, points toward denial. At worst, some of the minor factors are neutral or might be considered from an anti-*Fintiv*-biased perspective to favor institution very slightly. But, the factors that should be given the most weight here – factors 2 and 3 – weigh strongly in favor of denial. The Board should therefore exercise its discretion to deny the petition.

#### **IV. STANDARD FOR INSTITUTION OF TRIAL ON THE MERITS**

“The Director may not authorize an inter partes review [trial] to be instituted unless the Director determines that the information presented in the petition . . . shows that there is a reasonable likelihood that the petitioner would prevail.” 35 U.S.C. § 314(a). At a minimum, the reasonable-likelihood-of-prevailing standard “effectively requires the petitioner to present a prima facie case justifying a rejection of the claims in a patent.” 112 Cong. Rec. S1375 (daily ed. Mar. 8, 2011) (quoting

Sen. Kyl). Indeed, if a challenge fails to set forth at least a *prima facie* case of unpatentability, then it would be pointless to institute trial on that challenge, as the petitioner cannot cure defects in a petition during trial. As explained by the Federal Circuit:

It is of the utmost importance that petitioners in the IPR proceedings adhere to the requirement that ***the initial petition*** identify “with particularity” the “evidence that supports the grounds for the challenge to each claim.” 35 U.S.C. § 312(a)(3). . . . Unlike district court litigation — where parties have greater freedom to revise and develop their arguments over time and in response to newly discovered material — the expedited nature of IPRs bring[s] with it an obligation for petitioners to make their case ***in their petition to institute***.

*Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1369 (Fed. Cir. 2016) (emphases added).

Moreover, the petition must be judged as it is written. The Board may not overlook flaws in the petition or reformulate its challenges to enhance their suitability. *See SAS Inst. Inc. v. Iancu*, 138 S. Ct. 1348, 1355 (2018) (“[I]t’s the petitioner, not the Director, who gets to define the contours of the proceeding.”); *see also id.* (“[T]he petitioner is master of its complaint . . .”); *see also id.* at 1353 (forbidding the Board from “curat[ing]” the petition).

The burden to show unpatentability is on the petitioner. 35 U.S.C. § 316(e). For an obviousness challenge, that “requires a suggestion of *all* limitations in a claim.” *CFMT Inc. v. Yieldup Int’l Corp.*, 349 F.3d 1333, 1342 (Fed. Cir., 2003) (citing *In re Royka*, 490 F.2d 981, 985 (CCPA 1974) (emphasis added)). Furthermore, the analysis must include “some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.” *KSR Int’l v. Teleflex Inc.*, 550 U.S. 398, 418 (2007) (quoting *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006)). The challenger must supply the factual basis for the challenge and “may not resort to speculation, unfounded assumptions or hindsight reconstruction to supply deficiencies in its factual basis.” *In re Warner*, 379 F.2d 1011, 1017 (CCPA 1967).

When an obviousness assertion involves a modification or combination of prior-art teachings, then the petitioner must also establish that a POSITA would have had a reasonable expectation of success to make the modification or combination. *Intelligent Bio-Sys.*, 821 F.3d at 1367-68. The modification or combination must not “require a substantial reconstruction and redesign of the elements” in a reference or “a change in the basic principles under which [a reference] was designed to operate.” *In re Ratti*, 270 F.2d 810, 813 (CCPA 1959). Nor can the modification or combination render a reference unsatisfactory or “inoperable for its intended purpose.” *In re Gordon*, 733 F.2d 900, 902 (Fed. Cir. 1984).

Also, the prior art must be considered for all that it teaches, and a *prima facie* case of obviousness may be rebutted “by showing that prior art teaches away from claimed invention in any material respect.” *In re Peterson*, 315 F.3d 1325, 1331 (Fed. Cir. 2003).

Critically, obviousness cannot be established by hindsight combination to produce the claimed invention, as the Supreme Court has emphasized:

A factfinder should be aware, of course, of the distortion caused by hindsight bias and must be cautious of arguments reliant upon *ex post* reasoning. *See Graham [v. John Deere Co.]*, 383 U.S. [1,] 36, 86 S. Ct. 684, 15 L. Ed. 2d 545 [(1966)] (warning against a “temptation to read into the prior art the teachings of the invention in issue” and instructing courts to “guard against slipping into use of hindsight”) (quoting *Monroe Auto Equip. Co. v. Heckethorn Mfg. & Supply Co.*, 332 F.2d 406, 412 (6th Cir. 1964))).

*KSR*, 550 U.S. at 421. “[I]mpermissible hindsight must be avoided and the legal conclusion must be reached on the basis of the facts gleaned from the prior art.” MPEP § 2142.

As explained below, the petition’s challenges are not reasonably likely to prevail with respect to any claim. Moreover, even assuming *arguendo* that the challenge were reasonably likely to prevail with respect to some claims, the Board

should still deny the petition in its discretion. *See Chevron Oronite Co. v. Infieum USA LP*, IPR2018-00923, Paper 9 at 9-11 (Nov. 7, 2018) (informative) (denying institution on all claims where petition's case was deficient with respect to subset of claims); *see also Deeper, UAB v. Vexilar, Inc.*, IPR2018-01310, Paper 7 at 41-43 (Jan. 24, 2019) (informative) (same).

## **V. CHALLENGE 1 IS NOT REASONABLY LIKELY TO PREVAIL.**

Challenge 1 is a § 103 challenge based on Jammy in view of Kim. Challenge 1 is directed at claims 1, 2, 5, 6, 13, and 14, of which claims 1, 5, and 13 are independent. Claim 1 reads as follows (with line breaks and labels<sup>3</sup> added):

1. An electrical junction comprising
  - [a] an interface layer disposed between
  - [b] a contact metal and
  - [c] a group IV semiconductor,
  - [d] the semiconductor comprising a source or drain of a transistor,
  - [e] the interface layer comprising a metal oxide and

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<sup>3</sup> The labels are for ease of reference only and not to imply any order or arrangement.

[f] configured to reduce a height of a Schottky barrier between the contact metal and the semiconductor from that which would exist at a contact junction between the contact metal and the semiconductor without the interface layer disposed therebetween, and

[g] wherein the electrical junction has a specific contact resistance of less than or equal to approximately  $10\ \Omega\text{-}\mu\text{m}^2$ .

Independent claims 5 and 13 are similar with respect to limitations [a], [b], [d], [e], and [g]. Claims 5 and 13 replace limitation [f] with “sufficiently thick to depin a Fermi level of the semiconductor.”

As explained below, a POSITA would not have combined Jammy and Kim as the petition proposes, the proposed combination fails to satisfy limitation [e], and Jammy and Kim fail to suggest limitation [f] in any of its various forms.

**A. A POSITA Would Not Have Combined Jammy and Kim as the Petition Proposes.**

The petition proposes a particular combination of Jammy and Kim. First, the petition proposes that a POSITA would have replaced Jammy’s conductive studs 52/54 and quantum conductive barrier layers 42/44 with Kim’s stack of molybdenum on a titanium-tungsten alloy. *See* Pet. at 20-22. The petition argues that this would result in a layer of titanium oxide. *Id.* This combination is illustrated in a modified, colored version of Jammy’s Figure 1 on page 22 of the petition.

Second, to reach claims that require passivation (claims 5 and 13), the petition alleges that a POSITA would have further modified that combination by initially adding and then retaining a layer of silicon dioxide over the source/drain diffusion areas 42/44 before addition of Kim's stack of molybdenum on a titanium-tungsten alloy, thereby resulting in silicon dioxide below titanium dioxide, as illustrated in another annotated version of Jammy's Figure 1. *See* Pet. at 41. Both proposals are problematic.

First, a POSITA would not have undertaken such a radical re-engineering of the base reference Jammy. The center point of Jammy's design is the quantum conductive barrier layer 56/58. That fact is reflected in Jammy's title, abstract, specification section entitled "SUMMARY OF THE INVENTION" at 2:34–3:6, the sole drawing, and throughout the rest of the specification. A POSITA acting reasonably, objectively, and unguided by hindsight would not scrap that key feature of the primary reference and replace it with a different contact structure, like Kim's, employing a different approach for semiconductor-metal contacts. Practically nothing would be left of Jammy. The law recognizes that such fundamental modifications would not have been obvious. *See Ratti*, 270 F.2d at 813; *Gordon*, 733 F.2d at 902. That is especially true where, as here, (1) Kim does not mention quantum conduction; (2) Jammy does not mention or contemplate titanium dioxide, *see* Jammy at 3:51-58; and (3) Kim's alleged teaching of a titanium dioxide layer is



at best cryptic and ambiguous and certainly not what the petition presents it to be. For example, as explained in § V-B *infra*, Kim does not disclose or suggest that titanium dioxide would form in a horizontal layer, as needed to realize Jammy's quantum conductive barrier layers 56/58. In fact, there is insufficient evidence within the petition to support a finding that a POSITA would have had a reasonable expectation of success to make the proposed combination. *See Intelligent Bio-Sys.*, 821 F.3d at 1367-68.

A POSITA as defined by the petition – with just general experience in “semiconductor research and design” but without experience in interfacial layers specifically, Pet. at 12 – would be especially hesitant to combine Jammy and Kim in the radical manner that the petition proposes. *See Goodnick Decl.* (Ex. 2043) ¶ 18.

To elaborate, the teachings of Jammy and Kim are incongruous. Jammy's quantum conductive barrier “acts to ***prevent or inhibit diffusion*** of dopants from the studs to the diffusions and further into substrate 60.” Jammy at 4:21-23 (emphasis added). Kim, on the other hand, ***relies on diffusion*** of the titanium-tungsten stud into the silicon to form an interspersed mixture of silicon and titanium dioxide at the interface (not stratified layers), thereby providing an ohmic contact to the silicon. The presence of Jammy's quantum conductive barrier would inhibit such interaction (perhaps even prevent it entirely) and is the critical, essential component of the Jammy contact. A POSITA would not have found it obvious to eliminate that barrier

layer in favor of Kim's approach because doing so would have (1) been at cross-purposes to Jammy's teachings and (2) rendered the essential purpose of Jammy ineffective. Further, Jammy rejects the underlying principles of Kim (allowing a reaction between the titanium-tungsten stud and the silicon) by noting that "the contact metallurgy may interact with the monocrystalline semiconductor substrate altering the doping of the diffusion in an *undesirable* manner." *Id.* at 2:4-6 (emphasis added). Jammy recognizes that "[i]n the case of a tungsten stud, dopant may diffuse from the junction into the stud. This lowers the average doping concentration and increases the resistance of the diffusion. Increased diffusion resistance slows the switching speed of the MOSFET." *Id.* at 2:6-10. Yet the petition advocates the very sort of contact that Jammy cautions against when suggesting that a POSITA would have swapped Jammy's quantum conductive barrier for a quasi-conducting layer of silicon and titanium dioxide created through a diffusion of titanium into the underlying silicon. Such a marked departure from the teachings of Jammy is not one that a POSITA would have found obvious, especially since it is exactly the kind of result Jammy seeks to avoid. *See Peterson*, 315 F.3d at 1331

The proposed combination of Jammy and Kim is tainted by impermissible hindsight. *See KSR*, 550 U.S. at 421. Nothing in the references themselves suggests combining the two references, let alone in the particular way the petition proposes.

The petition's highly concocted combination of Jammy and Kim diverges far from what those references actually teach in a hindsight-fueled attempt to arrive at the claimed inventions.

The second proposed combination – leaving a layer of silicon dioxide on the semiconductors – is also problematic. A POSITA would not have done so. To be clear, the petition asserts that Kim's stack of molybdenum atop a tungsten-titanium alloy sintered on the semiconductor would create titanium dioxide. *See* Pet. at 20-22. However, as admitted by the petition, titanium dioxide “only moderately passivates silicon,” Pet. at 37, whereas the '336 Patent's definition of Fermi-level depinning requires “all, or substantially all, dangling bonds that may otherwise be present at the semiconductor surface have been terminated,” '336 Patent at 3:28-30; *see also* Goodnick Decl. ¶ 49. Recognizing that critical weakness in its case with respect to claims 5 and 13, the petition asserts that it would have been obvious to leave silicon dioxide on the interface:

To the extent that Patent Owner contends that the TiO<sub>2</sub> interface layer alone would not have depinned a Fermi level due to insufficient passivation, a POSITA would have found it obvious to modify the combination of Jammy and Kim described above to ensure that a layer of SiO<sub>2</sub> remained present on the surface of the silicon . . .

Pet. at 38.

However, leaving “a layer of SiO<sub>2</sub> . . . present on the surface of the silicon” is directly contrary to Kim’s overriding goal of eliminating all native oxides from the interface. *See* Kim at 1:12-18 (“A **major impediment** in the fabrication of low resistivity ohmic contacts to silicon **is the presence of a thin layer of native oxide** on the surface of the silicon. **Accordingly, it is advantageous** to use metals that are capable of reacting with the native oxide during the sintering or bonding step thereby **removing the native oxide from the metal-silicon interface.**”). Jammy too suggests eliminating the native oxide. *See* Jammy at 5:32-40. Those are strong teachings away from what the petition proposes for claims 5 and 13. *See Peterson*, 315 F.3d at 1331; *see also* MPEP § 2145(X)(D) (“A prior art reference that ‘teaches away’ from the claimed invention is a significant factor to be considered in determining obviousness . . . . It is improper to combine references where the references teach away from their combination.”). Kim does not merely express a preference for less native oxide. Rather, Kim unequivocally criticizes leaving any native oxide material whatsoever between the semiconductor and the metal, specifically teaches a contact without native oxide, and extols the advantages of his contact. *See Arctic Cat Inc. v. Bombardier Recreational Prods. Inc.*, 876 F.3d 1350, 1360 (Fed. Cir. 2017) (“Prior art teaches away when a person of ordinary skill, upon reading the reference, would be discouraged from following the path set out in the reference, or would be led in a direction divergent from the path that was taken by the applicant.” (citations

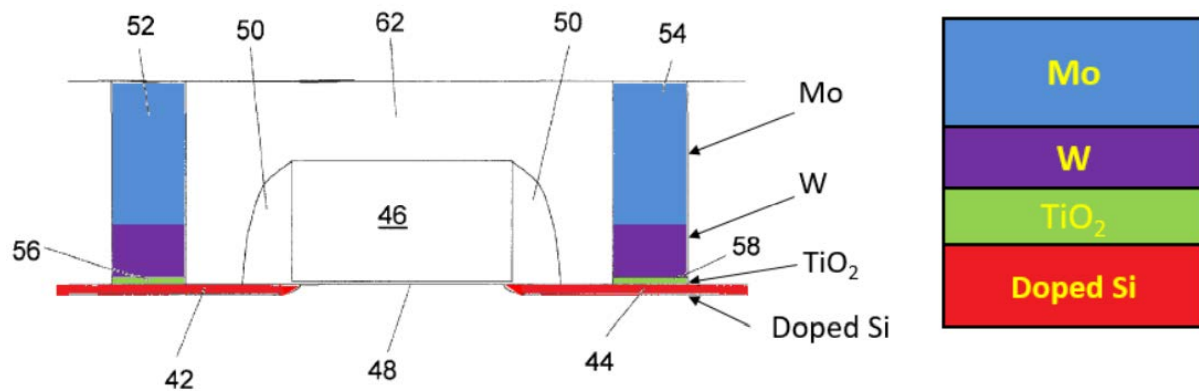
and quotation marks omitted)); *see also In re Fulton*, 391 F.3d 1195, 1201 (Fed. Cir. 2004) (prior art reference teaches away if it “criticize[s], discredit[s], or otherwise discourage[s] the solution claimed”).

For the foregoing reasons, challenges 1 and 2 fail to have a reasonable likelihood of prevailing against claims 5 and 13 for this reason.

**B. The Proposed Combination of Jammy and Kim Fails to Satisfy Limitation [e].**

Properly understood, Kim fails to teach a resulting “metal oxide,” as required by limitation [e] of all independent claims, let alone a horizontal layer of metal oxide as the petition depicts in its drawings. The petition’s reasoning to the contrary is based on a misunderstanding of Kim. To be clear, the petition does not rely on Jammy for the “metal oxide” recited in the claims. Instead, the petition relies on Kim’s alleged titanium dioxide to satisfy this limitation. *See* Pet. at 30. That is not correct in light of Kim’s full disclosure.

The petition asserts that Kim discloses a molybdenum-tungsten-titanium dioxide-silicon structure, as depicted on, for example, page 22 of the petition (reproduced below):

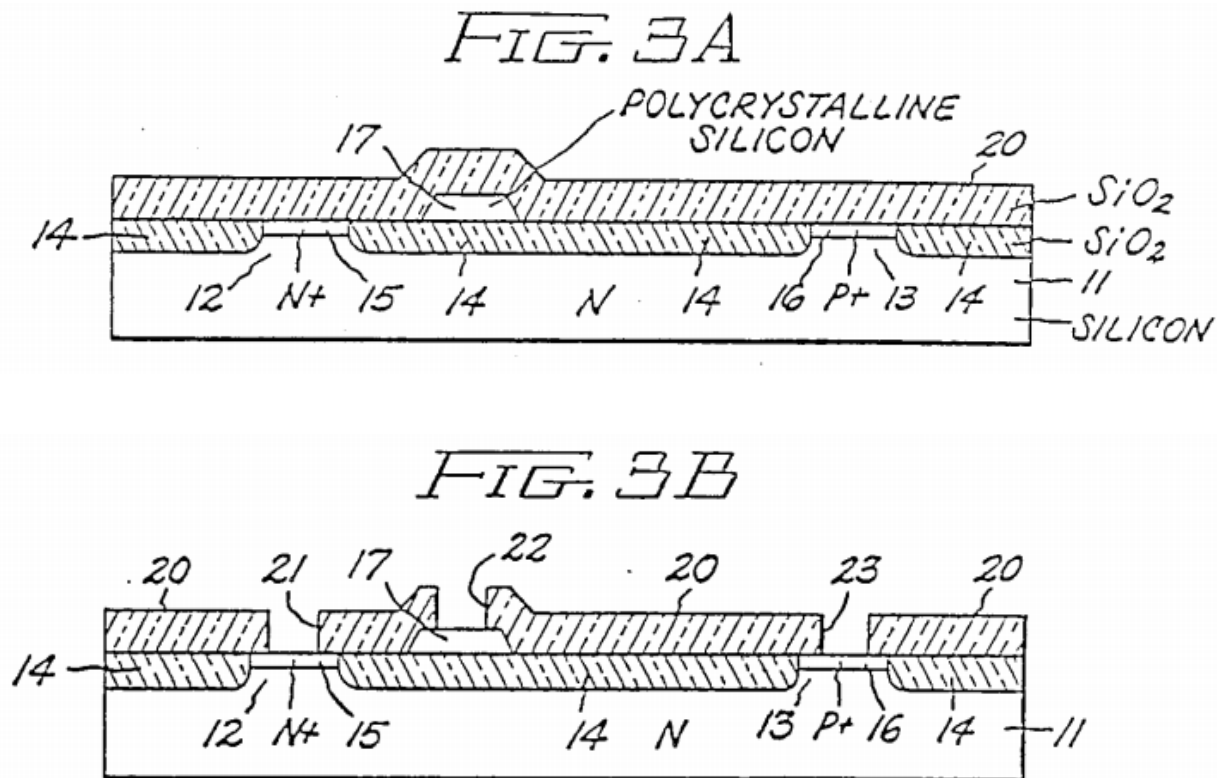


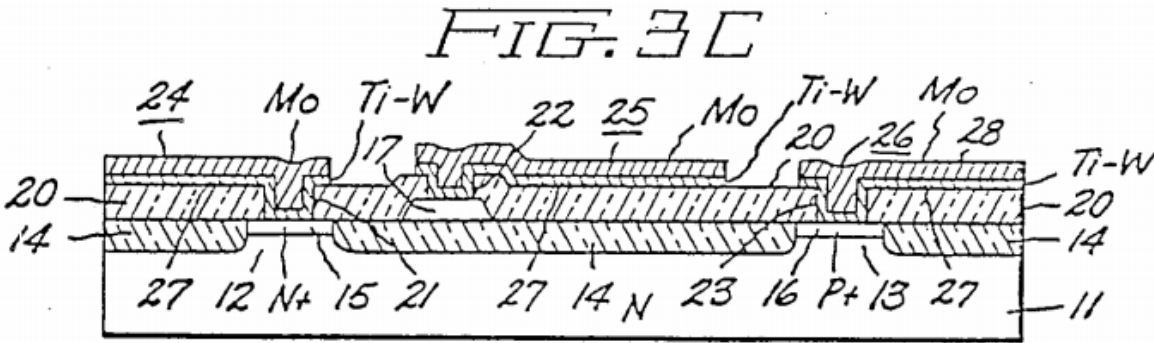
Pet. at 22 (showing colorized and modified version of Jammy’s Fig. 1 on left and petition’s depiction of Kim’s contact on right). The sole basis for this conclusion is the passage of Kim at 4:59 – 5:4, the most pertinent part of which says, “It is believed that during the sintering step titanium in the conductor 27 at the interface between the conductor 27 and the silicon conductive members 15, 17, and 16 reacts with native silicon dioxide present on the exposed portions of these conductors to form silicon and titanium dioxide, a semiconductor . . .”

The first flaw with the petition’s position is that, even if Kim’s supposition (“It is believed . . .”) is true – *i.e.*, even if that reaction takes place – Kim does not state that the result would be a separate metal oxide layer, as the petition’s drawings assume. Instead, Kim merely states that what is formed at the interface is a mix of two semiconductors, silicon and titanium dioxide (likely interspersed in the tungsten-titanium alloy matrix). Kim does not specify where those two products would be in relation to each other, and no evidence supports the assumption that they would form horizontal layers as the petition depicts.

The second flaw with the supposition that the reaction takes place at all is that it is inconsistent with other clear disclosure in Kim, including (1) the drawings, (2) the process Kim describes before this purported reaction would take place, and (3) Kim's goal of forming ohmic contacts.

Regarding (1), Kim's drawings do not depict any titanium dioxide or undoped silicon purportedly resulting from this reaction. *See, e.g., Kim at Figs 3A-3C:*





Regarding (2), Kim describes a process before sintering that leaves no native silicon dioxide on the exposed portions of the conductive (doped) silicon. In fact, Kim clearly says this processing is “to remove native silicon dioxide thereon” from the conductive silicon members 15-17. *Id.* 4:16-17. That processing includes “suitable cleaning of the surface portions of conductive members 15,17 and 16 of silicon by entirely conventional means such as rinsing in a solution of hot hydrogen peroxide and sulfuric acid followed by a water rinse and a dip in hydrofluoric acid buffered by ammonium fluoride to remove native silicon oxide thereon.” *Id.* at 11-17. Next, “the structure of FIG. 3B is placed in sputtering apparatus” to sputter deposit the titanium-tungsten alloy “over the layer 20 of silicon dioxide and into the apertures 21, 22 and 23 therein to cover the walls of the apertures and also the exposed portions of the conductive members 15, 17 and 16 of silicon semiconductor material.” *Id.* at 21-25. Importantly, that sputtering occurs in a vacuum, *i.e.*, without oxygen. Next, “[u]sing the same sputtering apparatus ***without breaking the vacuum*** therein molybdenum is sputter deposited over the layer of the alloy of titanium and



tungsten.” *Id.* at 25-28 (emphasis added). Although some oxygen at very low pressure is subsequently used when etching patterns in the sputter-deposited metal, *see id.* at 29-50, there is no indication in Kim or evidence external to Kim that such oxygen would penetrate through the sputter-deposited metal to the surfaces 15-17 of the semiconductor. Thus, the petition’s premise that the sentence starting at 4:63 presupposes silicon dioxide on the semiconductor before sintering is undercut by Kim’s clear disclosure to the contrary.

Regarding (3), Kim’s desire to form ohmic contacts, *see id.* at 1:1-11, also shows that there is no silicon dioxide at the interface when the titanium-tungsten alloy is sputtered on, as a POSITA would have believed that an oxide on the silicon would deleteriously affect the contact resistance, and variations in the amount of oxide would lead to different contact resistance across different batches of devices.

At best, Kim is ambiguous as to whether there would be silicon dioxide present before sintering. But that is insufficient to support unpatentability. “[I]t has long been understood that ambiguous references do not, as a matter of law, anticipate a claim.” *Wasica Fin. GmbH v. Cont’l Auto. Sys., Inc.*, 853 F.3d 1272, 1284 (Fed. Cir. 2017) (internal quotes and citations omitted); *see also W.L. Gore & Assocs., Inc. v. Garlock, Inc.*, 721 F.2d 1540, 1554 (Fed. Cir. 1983) (refusing to find claims unpatentable when the prior art references were “unacceptably vague”); *In re Brink*, 419 F.2d 914, 917–18 (CCPA 1970) (same); *In re Hughes*, 345 F.2d 184, 188

(CCPA 1965) (“[A]n ambiguous reference . . . will not support an anticipation rejection”). That principle applies with full force to any claim limitation that is asserted to be disclosed by a reference, even if part of an obviousness challenge, as here.

What is clear from Kim is that, at the time of sintering, there is silicon dioxide *on the side walls* of the apertures 21-23 in contact with the titanium-tungsten alloy. That, if anywhere, is where a POSITA would expect this purported reaction to take place. Yet, there is no reason to believe that titanium reacting with silicon dioxide on the side walls would form a *horizontal* layer of titanium dioxide as the petition depicts in its drawings, rather than in *vertical* films/layers along the side walls. In fact, regardless of where the alleged silicon dioxide is prior to the reaction, there is no evidence at all that the result of the reaction would be stratified horizontal layers of titanium dioxide above silicon, etc. Because the reaction is via sintering, these materials are solids, not liquids that might float to the top or sink to the bottom. Thus, there is a lack of evidence that the titanium dioxide would form in a horizontal layer as the petition assumes.

To the extent that other silicon dioxide might be present despite the rinse to remove native oxide from the exposed silicon and that this other silicon dioxide would interact with the sputtered Ti-W alloy during the sintering step – a supposition that the petition has not even advanced, let alone proven – Kim still fails to support

the petition's assertion that the result would be a separate layer of  $\text{TiO}_2$  – let alone a horizontal layer – rather than a mixed Si- $\text{TiO}_2$  layer. Moreover, there is no evidence in Kim or otherwise that a sufficient amount of other silicon dioxide would be present to form an appreciable layer of  $\text{TiO}_2$ , even if a layer did result.

Finally, published literature calls into question Kim's statement ("It is believed . . .") and other assumptions the petition makes. Although titanium reacts readily with silicon dioxide to form titanium oxides (unlikely to be titanium dioxide) via oxygen rebonding at room temperature, sintering at the temperatures disclosed by Kim would decompose the Ti-O species and change the titanium atom bonding to form TiSi species. Ex. 2042 at 771, 772, 774-75. That is, any titanium oxide species that might have formed at lower temperatures would be decomposed by sintering. That fact completely undermines Kim's statement that "[i]t is believed that [a reaction takes place] to form . . . titanium dioxide" and the petition's case.

To sum up, (1) it has not been proven that  $\text{SiO}_2$  would be present in advance for this reaction to take place at all, and (2) even assuming that the reaction did take place, it is unknown where the resulting titanium dioxide would be or in what arrangement.

Another troubling aspect of the petition's depictions of stratified layers is that it fails to account for the undoped silicon that is also a product of this alleged reaction. That matters because undoped silicon is not conductive. If the silicon

resulting from this reaction forms in a horizontal layer like the titanium dioxide depicted in the petition, it likely would interfere with the operation of the junction as a conductor.

Additional confusion arises from Kim's statement just before the "It is believed . . ." sentence that the titanium-tungsten alloy "forms a strong bond to the thick layer 20 of silicon dioxide." Does it form a strong bond or does it react with silicon dioxide?

Finally, the sentence speculating that titanium dioxide (and silicon) is formed during the sintering is clearly for the example in which the temperature was 400° C, whereas the petition relies on the case in which the temperature is 600-650° C, see Kim at 4:50-58, 5:27-34; Pet. at 51, yet the petition fails to carry its burden to establish that the same speculated reaction would take place at the higher temperature and would result in the same arrangement of materials.

For all these reasons, Kim does not support the petition's interpretation of that reference, and the petition fails to establish that challenge 1 is reasonably likely to prevail.

**C. Jammy and Kim do Not Suggest Limitation [f].**

As noted above, limitation [f] in independent claims 1, 5, and 13 recites that the interface layer is either "configured to reduce a height of a Schottky barrier between the contact metal and the semiconductor from that which would exist at a

contact junction between the contact metal and the semiconductor without the interface layer disposed therebetween,” “sufficiently thick to depin a Fermi level of the semiconductor,” or “sufficiently thick to approximately equal a penetration depth of metal induced gap states (MIGS) in the semiconductor which would be present [if] the interface layer were absent.” Jammy and Kim fail to teach or suggest an interface layer with such properties.

Jammy says nothing about Schottky barrier height, Fermi level, or MIGS. Nor does Kim. Perforce, no conceivable combination of the two references could possibly teach or suggest limitation [f] in any of its various forms. But “obviousness requires a suggestion of *all* limitations in a claim.” *CFMT*, 349 F.3d at 1342. As a result, Jammy and Kim fail to have a reasonable likelihood of rendering any claim obvious.

To the extent that the petition relies on expert testimony to attempt to cure the deficiencies in Jammy and Kim, that attempt fails. *See* Consol. TPG at 36 (“Expert testimony, however, cannot take the place of a disclosure in a prior art reference. . . . In other words, expert testimony may explain ‘patents and printed publications,’ but is not a substitute for disclosure in a prior art reference itself.”); *see also Scripps Clinic & Res. Found. v. Genentech, Inc.*, 927 F.2d 1565, 1576 (Fed. Cir. 1991) (“The role of extrinsic evidence is to educate the decision-maker to what the reference

meant to a person of ordinary skill in the field of the invention, not to fill gaps in the reference.”).

Moreover, to the extent that the petition contends that Jammy and Kim teach a POSITA “to depin the Fermi level,” as recited in claims 5 and 13, nothing in those references indicates that a POSITA without having seen the Acorn patents would have understood “depin[ning] the Fermi level” as the Acorn patents use that phrase. The Acorn inventors arrived at an understanding of Fermi level depinning beyond that of the prior art and explicitly defined the phrase to include both passivation of dangling bonds on the surface of the semiconductor and displacing the metal from the semiconductor far enough to reduce or overcome the effect of MIGS. *See, e.g.,* ’336 Patent at 3:26-32 (“By depinning the Fermi level, the present inventors mean a condition wherein all, or substantially all, dangling bonds that may otherwise be present at the semiconductor surface have been terminated, and the effect of MIGS has been overcome, or at least reduced, by displacing the semiconductor a sufficient distance from the metal.”); *accord* Pet. at 13-14. However, conventional thinking in the art prior to the Acorn inventions did not take into account MIGS when considering Fermi-level depinning. *See* Goodnick Decl. ¶¶ 43-54. Indeed, neither Jammy nor Kim mentions MIGS or contains anything that evinces in any way awareness of MIGS, appreciation of its influence on Fermi-level pinning, or consideration of MIGS as a factor in designing an interface layer, especially

considering that a POSITA as defined by the petition would have had no experience in interfacial layers specifically. *See* Pet. at 12 (defining POSITA as having just general experience in “semiconductor research and design”); *see also* Goodnick Decl. ¶ 18. The references’ failure to account for MIGS is fatal to challenges 2 and 3.

Furthermore, the proposed combination of Jammy and Kim would not even satisfy the passivation prong of the ’336 Patent’s definition of Fermi-level depinning without additional non-obvious modifications, as explained above.

## **VI. CHALLENGE 3 IS NOT REASONABLY LIKELY TO PREVAIL.**

Challenge 3 is a § 103 challenge based on Kim alone. Challenge 3 is directed at claims 65-79, of which only claims 77-79 remain after disclaimer. Challenge 3 fails to have a reasonable likelihood of prevailing for the same reasons discussed above in relation to challenge 2 in §§ V-B and V-C.

First, challenge 3 is based on the same misreading of Kim to conclude that (1) it discloses SiO<sub>2</sub> on the semiconductor prior to the sintering step and (2) the result, if any, would be a separate horizontal layer of TiO<sub>2</sub>. Without that silicon dioxide, no metal oxide results, as required by each of claims 65, 68, 71, 74, and 77. Even if a metal oxide results, it would not be in a separate layer as the petition assumes.

Second, claim 77 is like claims 5 and 13, requiring Fermi-level depinning. However, explained in § VI-C *supra*, Kim does not disclose Fermi-level depinning (*i.e.*, both passivation and MIGS reduction). As explained above, Kim does not even mention MIGS, and passivation requires an additional non-obvious modification to Kim. That flaw is fatal to challenge 3.

## **VII. CHALLENGES 2 AND 4 ARE NOT REASONABLY LIKELY TO PREVAIL.**

Challenges 2 and 4 are directed at certain dependent claims and build on challenges 1 and 3, respectively. As such, challenges 2 and 4 fail to have a reasonable likelihood of prevailing for the same reasons as challenges 1 and 3. *See In re Fine*, 837 F.3d 1071, 1076 (Fed. Cir. 1988) (claims that depend from and further limit patentable base claims are also patentable over the same prior art); *see also* MPEP § 2143.03 (same). In addition, Challenges 2 and 4 have other clear deficiencies, as explained below.

Challenge 2 is directed at claims 3, 4, 7, 8, 15, and 16. Claims 3, 7, and 15 depend, respectively, from independent claims 1, 5, and 13 and recite “wherein the electrical junction has a specific contact resistance of less than or equal to approximately  $1\ \Omega\text{-}\mu\text{m}^2$ .” Claims 4, 8, and 16 depend, respectively, from claims 3, 7, and 15. Challenge 4 is directed at claim 80, which depends from independent



claim 77 and also recites “wherein the electrical junction has a specific contact resistance of less than or equal to approximately  $1\ \Omega\text{-}\mu\text{m}^2$ .”

The petition acknowledges that Jammy and Kim do not disclose this narrower, lower range of specific contact resistance. *See* Pet. at 50-51. The petition therefore turns to Chang, adding it as another reference to each of challenges 1 and 3 (to form challenges 2 and 4, respectively). *Id.* at 49-55, 64-65. Chang is a journal article that shows that contact resistance is dependent on parameters including (1) ionized impurity concentration, (2) temperature, (3) barrier height, (4) effective Richardson constant, and (5) tunneling effective mass. Chang at 545-50.

The petition asserts that a POSITA would have found it obvious to increase doping (parameter (1) in the list above) to reduce the contact resistance to the claimed range of “less than or equal to approximately  $1\ \Omega\text{-}\mu\text{m}^2$ .” *See* Pet. at 52-54. However, nothing in any of these references would have guided a POSITA to the claimed resistance range. Chang, at best, might be considered to teach that a POSITA **could** adjust the doping or the other parameters to affect contact resistance, but nothing teaches toward the claimed range. *See, e.g., Belden Inc. v. Berk-Tek LLC*, 805 F.3d 1064, 1074 (Fed. Cir. 2015) (“[O]bviousness concerns whether a skilled artisan not only **could** have made but **would** have been motivated to make the combinations or modifications of prior art to arrive at the claimed invention” (emphasis in original)); *Personal Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 993-

94 (Fed. Cir. 2017) (same); *Polaris Indus., Inc. v. Arctic Cat, Inc.*, 882 F.3d 1056, 1068-69 (Fed. Cir. 2018) (finding error where “the Board focused on what a skilled artisan would have been *able* to do, rather than what a skilled artisan would have been *motivated* to do at the time of the invention.”).

To the extent that the motivation might be considered to be just reducing contact resistance generally (again, without the particular goal of specific contact resistance less than or equal to approximately  $1\ \Omega\cdot\mu\text{m}^2$ ), then Chang highlights a serious flaw in all of the petition’s challenges. If the goal is simply reduced contact resistance, Chang teaches the simplest, surest way to achieve that goal – just dope the semiconductor more. Why go through the machinations of re-engineering the entire interface structure to achieve that easily obtainable goal? The answer is that a POSITA would not, unless guided by a hindsight-fueled desire to concoct an interface resembling the claimed invention. *See TriVascular, Inc. v. Samuels*, 812 F.3d 1056, 1068–69 (Fed. Cir. 2016) (“[W]hile a skilled artisan might have had a reasonable expectation of success in [making one modification], there was an insufficient motivation to [make the modification proposed by the petitioner].”).

Yet another problem with challenges 2 and 4 is that they rely on another non-obvious modification of Kim. Whereas Kim discloses a titanium-tungsten alloy as the first (lower) layer of his metal stack, the petition proposes using pure titanium instead. *See* Pet. at 51 (“A POSITA would have been motivated to replace Kim’s

titanium-tungsten alloy with titanium in Jammy’s conductive stud . . .”); *compare id.* at 52 (showing Ti in the purple layer) with *id.* at 22 (showing W in the purple layer). However, none of the references teach making that substitution, and Kim teaches explicitly against doing so. According to Kim, “Pure titanium, however, is not suitable for contacts as direct contact between titanium and silicon has shown poor reproducibility due to the large difference in the linear thermal coefficient of expansions of titanium and silicon (the linear coefficient of expansion of titanium being three times the linear coefficient of expansion of silicon).” Kim at 1:24-30. Kim therefore uses alloys of tungsten and titanium. *See id.* at 1:31 *et seq.* This is another instance of Kim strongly teaching away from what the petition proposes.

In addition, titanium is known to have a significantly higher bulk resistivity than tungsten – by a factor of about 8. *See* Ex. 2052 at 5-6 (resistivity of tungsten and titanium are  $4.82 \times 10^{-8} \Omega \cdot \text{m}$  and  $39 \times 10^{-8} \Omega \cdot \text{m}$ , respectively, at 273° K). Thus, a POSITA would have known that pure titanium would be less conductive than Kim’s tungsten-titanium alloy. The petition fails to take into account the fact that no reasonable POSITA would have rationally sacrificed a significant advantage in bulk resistivity for a small alleged gain in contact resistance, as the petition proposes.

For all these reasons, challenges 2 and 4 are not reasonably likely to prevail.

### **VIII. THE PETITION FAILS TO MEANINGFULLY ADDRESS KNOWN OBJECTIVE INDICIA OF NONOBVIOUSNESS.**

All challenges are based on obviousness. As such, objective indicia of obviousness are relevant. The Federal Circuit “has consistently held that objective indicia may often be the most probative and cogent evidence of nonobviousness. Objective indicia are essential safe-guards that protect against hindsight bias. The objective indicia analysis is, therefore, a fundamental part of the overall § 103 obviousness inquiry. As a result, the Board must consider all such evidence of objective indicia and determine the weight to give it en route to a determination of obviousness.” *Liqwd, Inc. v. L’Oréal USA, Inc.*, 941 F.3d 1133, 1136-37 (Fed. Cir. 2019) (citations and quotation marks omitted).

Here, another reason to deny the petition is that it fails to address known evidence of objective indicia of nonobviousness.<sup>4</sup> While the petition mentions some objective indicia, it does not address certain telling indicia well known to the petitioner. *See Stryker Corp. v. KFx Med., LLC*, IPR2019-00817, Paper 10 at 29

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<sup>4</sup> There is much objective indicia supporting the nonobviousness of Acorn’s inventions, and Acorn reserves all rights to present that evidence, if necessary.

(Sept. 16, 2019) (“Petitioner’s failure to address the known evidence of secondary considerations further weighs in favor of denying institution.”).

In 2004 and 2006, the Acorn inventors published two papers (Exs. 2045 and 2046) describing their inventions. These seminal papers have been cited over 130 and 140 times, respectively, in the professional literature. In fact, technical personnel working for the petitioner have cited to the Acorn papers. For example, an abstract published by nine researchers at the petitioner in 2017 cites to the 2006 Acorn paper as a basis for their work, as follows:

In the rapid scaling of Si MOSFET, the channel resistance has been decreased continuously. On the other hand, the contact resistance ( $R_c$ ), one of the main source of the external resistance, has been kept relatively unchanged. As a result,  $R_c$  became one of the dominant factors limiting the performance of MOSFET.

One of the main cause of  $R_c$  is Schottky barrier between metal and Si in source and drain region. . . .

The current approach to lower  $R_c$  is to change the carrier flow mechanism to tunneling emission. To increase the tunneling current, heavily doped Si was used to reduce the tunneling barrier width. However, this method is approaching its limitation because of the dopant solubility in Si, short channel effect, and dopant profile control. *As an alternate option, metal-insulator-*

*semiconductor (MIS) structure was presented. The interface insulator is working as a tunnel barrier and depinning materials.*<sup>4</sup> However, this technique is lack [sic] of thermal stability and thickness controllability of insulator layer.

Here, we present a new approach to reduce the SBH and the Rc at the interface between metal and Si . . .

Ex. 2047 at 1 (emphasis added; footnotes 1-3 omitted). Here, footnote 4 is a citation to the 2006 Acorn paper.

Curiously, however, when this paper was published in full in 2018, the citation to the Acorn paper had been removed even though the 2018 paper (Ex. 2048) reads like an advertisement for Acorn's patented technology: "To modulate the SBH [Schottky barrier height], *a thin insulator film* such as SiN, TiO<sub>2</sub>, or ZnO can be inserted at the interface between a metal and Si [12–14]. The inserted insulator *alleviates Fermi-level pinning; thus, a low pc can be achieved* in a metal-insulator-semiconductor (MIS) structure by *tuning the SBH between the low-work-function metal and n-type Si.*" Ex. 2048 at 4879 (emphases added).

While direct citations to the 2006 Acorn paper have been removed, the references 12-14 are written by researchers who have credited the Acorn inventors. For example, authors of reference 12 have said, "FLP [Fermi-level pinning] has been attributed to metal-induced gap states that can be alleviated by insertion of a thin

interfacial layer (IL) between the metal and the semiconductor (MIS contacts) [Connelly, 2006].” Ex. 2049 at 1 (other citations omitted). The authors of reference 13 have said, “Unfortunately, Fermi level pinning at metal/III-V interfaces by bond polarization or metal induced gap states (MIGS) renders Schottky barrier heights roughly independent of the metal work functions. Recently, Connelly et al. [Connelly 2006] have alleviated metal/Si Fermi level pinning through the use of an ultrathin Si<sub>3</sub>N<sub>4</sub> to reduce the penetration of MIGS.” Ex. 2050 at 1 (other citations omitted). And, the authors of reference 14 have said, “Alternative contact architectures are now being sought to improve the interface contact resistance to n-Si (for silicon channel CMOS) and to n-SiGe or n-Ge (for germanium channel CMOS) by reducing the Schottky barrier height (SBH) between metal and n-type S/D semiconductors. *The MIS technology to mitigate Fermi level pinning and reduce the contact resistance by inserting interfacial layer between metal and semiconductor was first proposed for Si MOSFETs [Connelly 2006].*” Ex. 2051 at 1 (emphasis added).

In sum, even at this preliminary stage, it is evident that objective indicia put a heavy thumb on the non-obviousness side of the scale, further showing that the petition’s challenges are not reasonably likely to prevail. Plus, the fact that the petition has failed to address the objective indicia known to it is yet another reason to deny institution.

## IX. CONCLUSION

For at least the foregoing reasons, Acorn respectfully requests that the Board deny the petition and not institute trial.

Respectfully submitted,

Date: 2020 Oct. 16

By: / M.C. Phillips /

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Lead Counsel for Acorn



## WORD-COUNT CERTIFICATE

I certify that the foregoing document complies with the type-volume limitation of 37 C.F.R. § 42.24(a) and (b) and contains 13,921 words based on the word count indicated by Microsoft Word for Office 365 MSO®, excluding those portions exempted by the rule, including words in drawings created by the Patent Owner or as annotations added by the Patent Owner to images reproduced in this document.

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## CERTIFICATE OF SERVICE

I hereby certify that on October 16, 2020, copies of the foregoing PATENT OWNER'S PRELIMINARY RESPONSE TO PETITION FOR *INTER PARTES* REVIEW and all documents filed with it were served via electronic mail, as agreed to by counsel, upon the following counsel for the Petitioner:

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