UNITED STATES DISTRICT COURT
FOR THE EASTERN DISTRICT OF TEXAS
MARSHALL DIVISION

ACORN SEMI, LLC,

Plaintiff,

v.

SAMSUNG ELECTRONICS CO., et al,

Defendants.

Civil Action No. 2:19-cv-00347-JRG

ACORN'S OPPOSITION TO
SAMSUNG'S MOTION FOR JUDGMENT AS A MATTER OF LAW

TABLE OF CONTENTS

Page

TABLE OF AUTHORITIES

Page(s)

Cases

Rules

TABLE OF EXHIBITS

Exhibit Identifier[1]	Exhibit Description
Ex. A, or "Tr."	Excerpts of Trial Transcript, 5/13/2021 – 5/19/2021
Ex. B	Dr. Piner Direct Examination Demonstrative Slides
Ex. C	Dr. Piner Redirect Examination Demonstrative Slides
Ex. D	Dr. Bokor Cross Examination Demonstrative Slides
Ex. E	PTX106
Samsung Ex. 34, ECF No. 387-27	PTX201
Samsung Ex. 28, ECF No. 387-21	PTX202
Ex. F	PTX265
Ex. G	PTX282
Ex. H	PTX302
Ex. I	PTX373
Samsung Ex. 24, ECF No. 387-17	PTX404
Samsung Ex. 32, ECF No. 387-25	PTX510
Samsung Ex. 25, ECF No. 387-18	PTX650
Samsung Ex. 26, ECF No. 387-19	PTX702
Samsung Ex. 31, ECF No. 387-24	PTX733
Samsung Ex. 29, ECF No. 387-22	PTX737
Ex. J	PTX744-1
Ex. K	PTX870
Ex. L	PTX874
Samsung Ex. 35, ECF No. 387-28	PTX875
Samsung Ex. 30, ECF No. 387-23	PTX1285
Ex. M	DTX241
Ex. N	DTX242
Ex. O, or "Pretrial Tr."	Excerpts of Pretrial Conference Transcript, 4/27/2021

[1] Unless otherwise noted, exhibits are to the Declaration of Christina Rayburn ISO Acorn's Opposition to Samsung's Motion for Judgment as a Matter of Law, filed herewith.

I. INTRODUCTION

Substantial evidence supported the jury's verdict. There is no basis to disturb it.

II. LEGAL STANDARD

Samsung's burden under Fed. R. Civ. P. 50(b) is a high one. "The Fifth Circuit views all evidence in a light most favorable to the verdict and will reverse a jury's verdict only if the evidence points so overwhelmingly in favor of one party that reasonable jurors could not arrive at any contrary conclusion." *Core Wireless Licensing S.A.R.L. v. LG Elecs., Inc.*, 880 F.3d 1356, 1361 (Fed. Cir. 2018) (citing *Bagby Elevator Co. v. Schindler Elevator Corp.*, 609 F.3d 769, 773 (5th Cir. 2010)). A court should not second-guess the jury by re-weighing evidence or making credibility determinations. *Gomez v. St. Jude Med. Daig Div. Inc.*, 442 F.3d 919, 937-38 (5th Cir. 2006). "Although the court must review the record as a whole, it must disregard all evidence favorable to the moving party that the jury is not required to believe." *Papst Licensing GmbH & Co., KG v. Samsung Elecs. Co., Ltd*, 403 F. Supp. 3d 571, 581–82 (E.D. Tex. 2019) (citing *Ellis v. Weasler Eng'g Inc.*, 258 F.3d 326, 337 (5th Cir. 2001)).

III. INFRINGEMENT IS SUPPORTED BY SUBSTANTIAL EVIDENCE.

Defendants dispute only the claim limitations that require the accused interface layer to include: (1) a layer of a metal oxide; and (2) a layer of a semiconductor oxide. Substantial evidence supported the jury's finding that layers of both metal oxide and semiconductor oxide are present at the accused interface layer in Samsung's accused 14 nm FinFET devices.

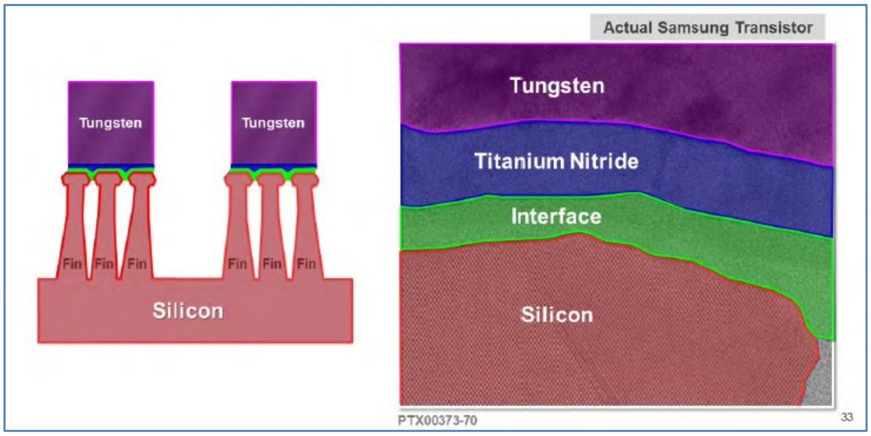
Dr. Edwin Piner, a professor of Physics at Texas State University with years of relevant experience with transistors and other semiconductor devices, Tr. 414:4-417:21, testified clearly, thoroughly, and credibly, over the course of hours, about the evidence supporting his conclusion that the accused interface layer includes both: (1) a layer of titanium silicon oxide (a metal oxide);

and (2) a layer of silicon oxide (a semiconductor oxide). He explained that his infringement analysis began with acquiring ten Samsung devices manufactured according to Samsung's 14 nm FinFET process, tearing them down, and performing elemental analyses on them. *Id.* at 418:18-419:12; 432:15-433:6; 597:20-598:5; *see also* Ex. B at 23 (list of FinFET devices Dr. Piner analyzed). He explained that his analysis also included reviewing internal Samsung documents and testimony related to Samsung's 14 nm FinFET devices. Tr. 418:18-419:12. He testified that all this information, together, supported his opinion that the accused interface layer includes both a layer of titanium silicon oxide and a layer of silicon oxide. Tr. 517:5-19. Samsung's various criticisms of his analysis do not render the verdict unreasonable.

A. Dr. Piner's Independent Tear-Downs of Samsung Accused Devices Demonstrate the Claimed Oxide Layers.

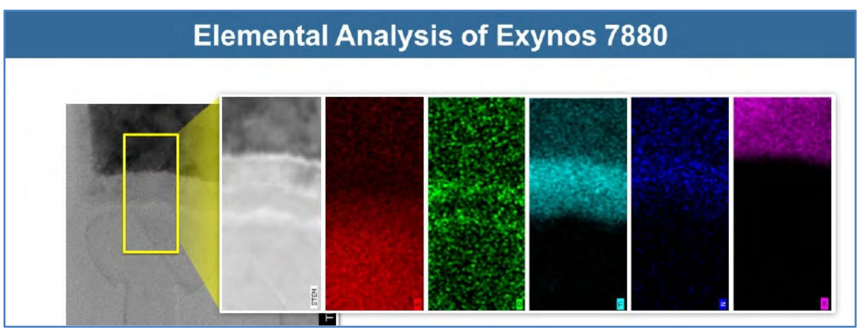
As to his tear-downs of ten accused Samsung devices, Dr. Piner testified that he purchased those devices on the open market to perform detailed analyses of "what materials were present" in the accused interface layer and "how they were located." *Id.* at 433:9-15. He explained that he broke open each device, extracted the relevant processor (or chip) therefrom, sliced the chip "in half through a specialized process, removed a portion, a very small portion of the cross-section of that chip," and then used complicated equipment to perform very, very close-up imaging analysis of that chip. *Id.* at 436:24-439:6; *see also* Ex. B at 27-30.

He showed and explained his imaging analysis to the jury. First, he oriented the jury as to the location of the accused interface layer in relation to other, known materials shown in his analysis. His demonstrative slides 30-33, for example, show increasingly zoomed-in images of an accused interface layer (all from PTX373), along with highlighting to designate the undisputed locations of tungsten, titanium nitride, and silicon in relation to the accused interface layer:



Ex. B at 33; *see also* Tr. 438:18-443:4.

Next, he explained and showed the chemical imaging analysis he performed to determine the materials present in and around the accused interface layer. *Id.* at 443:5-445:25. He explained that, in the below slide, the left-most, background image "is the microscopy image that I've already shown," and that the colored images spreading to the right each represent the presence, by signal intensity, of a particular element in the same yellow-boxed region, with "silicon shown in red, oxygen in green, titanium in light blue, nitrogen in dark blue, and tungsten in the purple. *Id.*



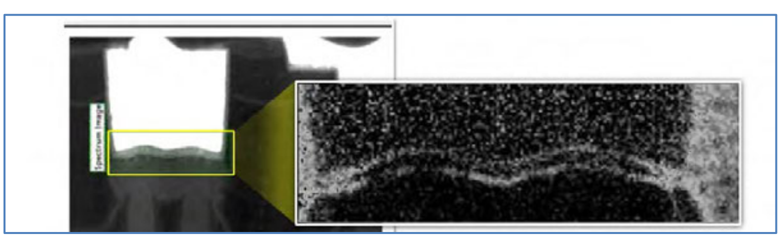
Ex. B at 36 (citing PTX373-72). He showed that his chemical imaging analysis for silicon, titanium, nitrogen, and tungsten was consistent with the elements that Samsung does not dispute are there. *Id.* at 443:5-445:25. Red is bright where silicon is expected to be, purple is bright where tungsten is expected to be, light blue is bright where titanium is expected to be, and dark blue, while not very bright, demonstrates the most intensity where nitrogen is expected to be. *Id.*; *see also* Ex. B at 37-41. He also explained why the light blue (titanium) appears brighter than the dark blue (nitrogen), even though the amounts of titanium and nitrogen in the titanium nitride layer should be "approximately equal." Tr. 445:14-25. He explained that "lighter elements, nitrogen in this case," do not "produce as intense a signal" as "compared to the heavier elements" like titanium, tungsten, and silicon, "even when the elemental ratios may be the same." *Id.*

Dr. Piner then turned to the oxygen signal, shown in green. He described the two "bands of intensity, oxygen intensity located in that interface region between the silicon and the titanium nitride." *Id.* at 450:18-451:4. He explained:

> The lower band is overlapping with the silicon – the silicon signal to the left of it, or the red signal; so that's indicating to me an oxide of silicon, which is a semiconductor, as the claim language calls out. The upper band is overlapping with titanium strongly and then [also some] silicon, and so I've identified that upper band as a separate and distinct layer of titanium silicon oxide, which is a metal oxide.

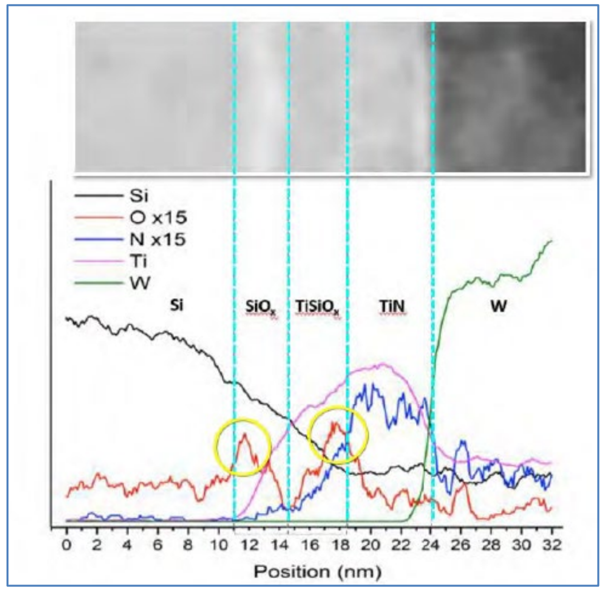
Id. at 451:4-12. He explained that oxygen is a lighter element, like nitrogen, and that, "even for equivalent amounts of that oxygen, it's not going to be as intense." *Id.* at 451:13-21. He testified that, based on the chemical signature of the oxygen that he saw in the images in PTX373, including the ones depicted above, his conclusion was "that there is a layer of silicon oxide above the silicon and a separate or a distinct layer of titanium silicon oxide above that [] present in the interface layer between the semiconductor and the contact." *Id.* at 451:22-452:3.

Dr. Piner next explained that he used a second chemical analysis technique, called EELS, to evaluate the presence of oxygen at the accused interface layer. Tr. 465:16-466:4. He showed an image of his EELS analysis that showed, in his words, "two continuous and distinct layers of oxide at the interface between the silicon source/drain and the contact." *Id.*



Ex. B at 67 (citing PTX373-11).

Finally, he explained that, in addition to the elemental "maps" discussed above, he created line scans to "basically take[] that region that I've shown the mapping data from, and [] compile[] the data in a graph-type form so that it can often be helpful in understanding some of the details." Tr. 466:5-13. He explained those line scans in great detail, including in particular how the oxygen signal in those line scans demonstrates peaks right in the regions that Dr. Piner had identified as a layer of silicon oxide and a layer of titanium silicon oxide. Tr. 466:5-468:14; *see also id.* at 495:25-497:6; Ex. B at 74, 102-103 (citing PTX373, PTX265, PTX302, PTX282).



He stated:

> The two regions in between now, which I've indicated are silicon oxide and titanium silicon oxide, there, the oxygen signal intensity shows these peaks or these bumps or humps in the data right in those locations.… But the left-hand side, corresponding with the silicon signal, is how I'm making my determination of silicon oxide; and then on the right-hand side, corresponding to the titanium, some silicon and the oxygen peak again in this titanium silicon oxide.

Id. at 467:16-468:1; *see also id.* at 474:11-18. He stated that the line scans he prepared, including those peaks of oxygen, further supported his conclusion that the accused interface layer includes a layer of silicon oxide and a layer of titanium silicon oxide. *Id.* at 475:25-477:12.

Dr. Piner noted that for the purpose of creating certain of his line scans, he multiplied both the oxygen and the nitrogen signals by a factor of 15, because "these are light elements; they don't have as strong an intensity naturally as the heavier elements." Tr. 468:2-14; *see also id.* at 474:19-475:4, 609:24-610:7, 612:24-613:3, 668:3-8; 673:8-14. Dr. Piner explained this further with reference to the nitrogen signal in one of his line scans. Tr. 673:22-675:6. He showed PTX373-65, in which the oxygen and nitrogen signals had not been multiplied. *Id.* He explained that, in that image, the nitrogen signal was consistently far smaller than the signals for the heavier elements like titanium, even though the amounts of nitrogen and titanium should be approximately equal at certain points in that chart. *Id.* He showed that, for that reason, the analysis group with which he had worked had provided him with two versions of the line scan, one to better show the heavier elements and one to better show the lighter elements. *Id.* at 675:9-676:9.

Dr. Piner explained that he has performed analyses like the one he performed for this case many times in his research, and that he did not do anything for this case that is inconsistent with his typical approach. *Id.* at 475:5-18. In particular, he testified that it is typical to "chart the elements in a way that magnifies some of them, to better show how the elements work together in a material analysis like this." *Id*. at 679:25-680:9. He even pointed to a document in which Samsung labeled its own analysis as having "arbitrary unit[s]." *Id.* at 680:10-681:4.

Finally, Dr. Piner pointed to an image of the accused interface layer region, and noted that it visually appears as two, distinct layers, which reinforced his opinion that the interface layer is made up of two, distinct layers of different materials. *Id.* at 476:5-24; *see also* Ex. B at 75-77.

B. Samsung's Process Flow and Documents Demonstrate the Claimed Layers.

Dr. Piner then analyzed and explained for the jury Samsung documents and testimony that supported his opinion as to the layers of metal oxide and silicon oxide. *See* Tr. 477:13-25. He reported that his "conclusion from that review of their documents is that there is a substantial agreement between what Samsung has shown in this interfacial layer region to what I have shown in my data…." *Id.* And that agreement is "that there are two layers of oxide present, two distinct layers of oxide present; one comprising of metal oxide, the other comprising of semiconductor

FILED UNDER SEAL PURSUANT TO PROTECTIVE ORDER

oxide in that interfacial region above the source/drain and below the contact." Tr. 478:1-6.

At the outset, he explained how the results of his chemical analysis made sense, in light of Samsung's process flow. He explained that, based on his review of Samsung's process flow and other internal documents, he believes that: (1) first, the silicon source/drain regions are formed; (2) second, native oxide grows on those silicon source/drain regions; (3) third, the native oxide is not fully removed by a SiCoNi etch step that occurs after the formation of the native oxide; (4) fourth, a titanium layer is added on top of the remaining native oxide; (5) fifth, a titanium nitride layer is placed on top of the titanium layer; and (6) sixth, a heating (anneal) process occurs that allows additional oxygen to flow through the titanium nitride layer and settle in the accused interface layer. Tr. 460:20-463:5; *see also* Ex. B at 55-63. He noted that there is no dispute that native oxide grows on the silicon source/drain regions of the accused devices. *Id.* at 461:8-10. He also noted and showed that a process similar to the one he described was known in the art to result in a layer of metal silicon oxide. *Id.* at 463:6-9, 464:24-465:2; *see also* Ex. B at 64-65 ([redacted]").

Next, Dr. Piner reviewed and categorized several different internal Samsung documents. He explained them and explained to the jury how each supported his opinion regarding:

[redacted]

[redacted]. [redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted] He concluded that "Samsung's analysis of their parts [] showed two distinct oxide layers present in the interface region of the source/drain structures." Tr. 689:7-15.

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted]

[redacted] Now, the SiCoNi etch step is important because that is the step that

Samsung claims removes all oxides that may be present at the accused interface region. *See* ECF No. 387 ("Mot.") at 10-11. That step involves [redacted] across the entirety of a wafer surface, and thus across trillions of source/drain regions of transistors located across that surface, to perform a chemical reaction with the native oxide and remove it. Ex. B at 119 (quoting PTX510); *see also* Tr. 768:20-769:22 (Reifsnider); *id.* at 869:7-870:1 (Bokor). [redacted]

[redacted]

[redacted]

[redacted]

[redacted][2]

[redacted] In sum, Dr. Piner presented a *wealth* of evidence—far more than simply substantial evidence—supporting the jury's infringement finding.

C. Samsung's Arguments Fail to Undermine the Substantial Evidence Supporting the Infringement Verdict.

Samsung offers several arguments in an attempt to undermine or discredit Dr. Piner's infringement opinion. Each one fails.

First, Samsung argues that its design specifications and process flows do not *intentionally place* layers of oxide at the accused interface layer, so they must not be there. Mot. at 8-12. But whatever the claimed goal of Samsung's process is, that does not undermine Dr. Piner's evidence about the results. This is especially so because:

- Dr. Piner identified two points in the process flow where oxygen is introduced, in layer form, into the interface layer: (1) when native oxide forms on the silicon source/drain region; and (2) when oxygen ingresses through the titanium nitride layer and oxidizes just below it, in the region that Dr. Piner identified as the layer of titanium silicon oxide. *See, e.g.*, Tr. 460:20-463:5.
- [redacted]

[2] Although not addressed by Dr. Piner, an additional internal Samsung document supports his opinion. [redacted]

[redacted]

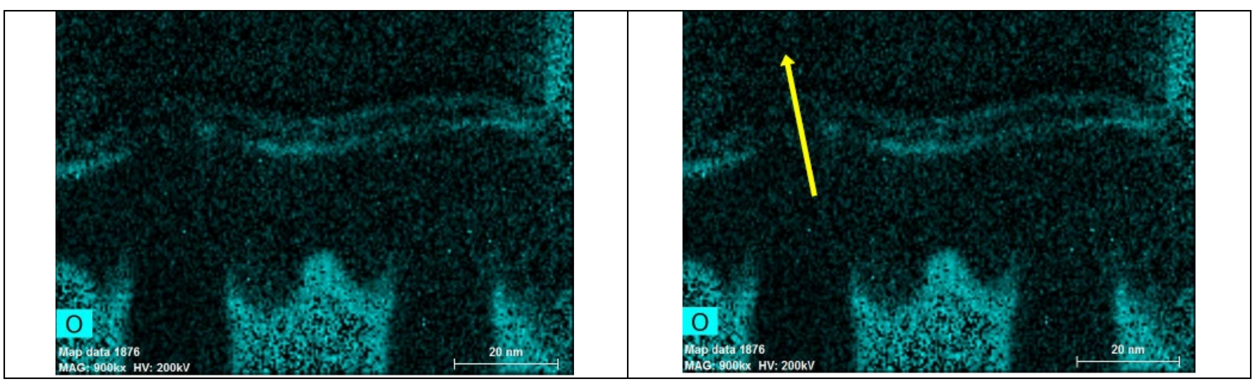
- [redacted]
- [redacted]
- [redacted] *id.* at 227:11-233:4 (Lam) (testifying that Samsung monitors whether there is native oxide left after the SiCoNi step only by: (1) measuring contact resistance and assuming good contact resistance means no oxide; and (2) assuming that the SiCoNi step will remove the same amounts of native silicon oxide from production and nonproduction wafers.); [redacted]
- [redacted]
- [redacted]
- Samsung's 30(b)(6) witness testified that, before testifying on whether there is oxide present at the accused interface layer, he chose not to check with the "failure analysis laboratory," which was most likely to have responsive information. Tr. 231:4-233:4.

- [redacted]

Second, Samsung argues that the "properly performed elemental analysis" of its own expert, Dr. Bokor, "confirms Samsung's products lack a layer of metal oxide" and a layer of silicon oxide. Mot. at 12-15, 26. But this is simply a credibility dispute. *See Papst*, 403 F. Supp. 3d at 586 ("The assignment of credibility or weight attributed between the experts is squarely within the province of the jury."). At any rate, Dr. Bokor's testimony, and the elemental analyses on which he based it, were shown at trial to be unreliable. First, unlike Dr. Piner, who presented elemental analyses of ten devices, Dr. Bokor only presented elemental analyses of two, one to represent the 14 nm FinFET process with the RF Etch step, and one to represent the 14 nm FinFET process without the RF Etch step. Tr. 959:24-960:10, 961:25-962:4. He admitted that a third party, EAG, performed the analysis of those two devices, and that he did not participate. Tr. 959:7-961:12. He further admitted that the two devices were selected by others, that he was not the one who told EAG what devices to analyze, and that he does not know "whether EAG, in fact, tested more phones and only sent [him a] report on two of them." *Id.* at 961:13-961:19. He further admitted that he agreed that there could be variation in the amount of oxygen shown at the interfacial region in question, depending on where on a wafer a chip was located. *Id.* at 961:25-962:25. In other words, Dr. Bokor agreed that a single transistor was not representative of all transistors for the purpose of infringement in this case, and yet could not say whether or not he had been selectively provided transistors with the lowest amounts of oxide. *See also id.* at 965:25-966:15. For these reasons alone, the jury was well within reason to disregard Dr. Bokor's elemental analysis.

Even assuming that Dr. Bokor presented representative devices, his testimony regarding his elemental analysis undermined the reliability of his opinion. For example, Dr. Bokor explained that his results were reported in atomic percentage units, rather than in signal intensity units. Tr. 971:16-972:21. He acknowledged that atomic percentage units are not raw data. *Id.* Instead, they are "a calculation performed on the raw intensity data by some combination of a machine and an operator of a machine." *Id.* Dr. Bokor acknowledged that, when "looking at very, very thin materials like this, the atomic percentage analysis is difficult because sometimes titanium can be mistaken for oxygen or vice versa." *Id.* Even so, as of the day he presented his data in his expert report, he could not explain "in any great detail" what analysis was performed to transform the raw data into the atomic percentage data. *Id.* For this reason as well, the jury was reasonable to credit Dr. Piner's signal intensity analysis, rather than Dr. Bokor's atomic percentage analysis.

Dr. Bokor even admitted that he hand-selected the line scans he presented, in order to show less oxygen at the accused interface region. For example, his analysis of the accused Exynos 7420 chip, DTX242, included the below left map showing oxygen at the accused interface layer.



DTX242-21; *see also* Ex. D at 5-11 (comparing DTX242-21 with DTX242-22). Dr. Bokor agreed that the blue areas in the bottom center and top right of this picture represent 66% oxygen. Tr. 968:10-969:6. And two bands of oxygen are clearly visible across the center of this image, in the region of the accused interface.[3] But when Dr. Bokor drew a line scan through a portion of the

[3] Two bands of oxygen are also visible in Dr. Bokor's elemental map of the Shannon 5510 device,

accused interface layer, as shown in the above right map, he drew his line scan through precisely the portion of the accused interface that showed the least amount of oxygen. Tr. 980:13-982:10.

In addition, Dr. Bokor was forced to admit that the line scan data that he presented did not accurately reflect the true atomic percentages of the elements depicted therein for at least two reasons. First, he admitted that, as a general principle, atomic percentage line scan data showing a "wide, low bump should, in fact, be turned into a skinner, taller bump." *Id.* at 937:5-938:7. In other words, a line scan showing a "peak" of oxygen at a certain atomic percentage should be interpreted as in fact having a higher atomic percentage.[4] Second, Dr. Bokor admitted that the thickness of the samples he analyzed caused his charts to show lower amounts of oxygen than what was actually in the accused interface layer.

> Q. So the height of the oxygen peak will be decreased in your line scans by the fact that the sample goes through this much silicon on this side and this much silicon on this side, right?
> A. That's part of the story.

Id. at 977:24-978:14; *see generally id.* at 972:22-978:14; *see also* Rayburn Decl. ¶¶ 8-12. He admitted that this principle explained: (1) his line scan showing only 30% tungsten in a region of expected 100% tungsten; (2) his line scan showing 25% titanium in a region of expected 0% titanium; and (2) his line scan showing 40% nitrogen in a region of expected 0% nitrogen. Tr. 972:22-978:14. Dr. Bokor further admitted that he did not explain either of these two principles to the jury when he showed them his atomic percentage line scans. Tr. 1008:15-1009:16.

Dr. Bokor additionally made multiple admissions regarding errors in his expert report, which further supported the jury's reasonable decision to credit Dr. Piner, not Dr. Bokor. *See, e.g.*,

as Dr. Bokor admitted. Tr. 971:1-13; *see also* DTX241-21.

[4] While discussing a prior art reference, Dr. Bokor suggested that this phenomenon could account for a "bump" of oxygen of approximately seven atomic percent in fact reflecting an atomic percentage on the order of 50 atomic percent. Tr. 936:17-938:7.

Tr. 982:11-988:23. Finally, when presented with his own atomic percentage line scan data and Samsung's internal line scan data from PTX702, which bear no resemblance to each other, Dr. Bokor was forced to admit that it was not his testimony "that EAG is better at analyzing Samsung's chips than Samsung is." Tr. 1009:18-1010:3; *see also* Ex. D at 12.

Given Dr. Bokor's various errors and admissions, including his admission that his line scans misreported atomic percentages by *up to 70%*, it is no wonder the jury considered Dr. Piner's signal intensity analysis more reliable.[5] This is especially so because, even with all the errors and selective analysis, Dr. Bokor's charts *did* show peaks of 5% and 15% oxygen at the accused interface layer, which are more than mere trace amounts. *See* Mot. at 14.

Third, Samsung criticizes Dr. Piner's signal intensity analysis of the Samsung Accused devices. Mot. at 15-19. A premise of that criticism is that "Dr. Piner's testing … cannot show there is enough oxygen to form any oxide … because it did not measure the concentration of oxygen …." Mot. at 15. This argument is based on the idea that an oxide of titanium requires 33% oxygen, while an oxide of silicon requires 50% oxygen. *See* Mot. at 13, 26. But this is another battle of the experts. Dr. Piner never agreed with either point, and Dr. Bokor's testimony on these points was conclusory, at best. There was certainly not anything at trial *requiring* the jury to believe in Samsung's claimed percentage requirements. *See Papst*, 403 F. Supp. 3d at 581–82.

As to Dr. Piner, he consistently disagreed with counsel for Samsung on these points:

[redacted]

[5] Samsung argues that "Dr. Piner did not offer any testimony challenging Dr. Bokor's test data." Mot. at 15, *see also id.* at 25. Dr. Piner could not address Dr. Bokor's test data, because Dr. Piner served the opening report on infringement, Dr. Bokor served the responsive report, and Dr. Piner was not given an opportunity to further respond. ECF No. 288 at 3.

[redacted]

[redacted] *see also id.* at 690:8-10 ("Q. Does that mean that a layer of an oxide of silicon has to have 50 percent oxygen in it? A. No, it does not."), 605:13-18, 606:17-20. [redacted] At best for Samsung, Dr. Piner's testimony established that a metal oxide should have more oxygen in it than prior art silicides had, and that it was "possible" that prior art silicides had "some detectible amount of oxygen." Tr. 593:23-594:25. But Dr. Piner made clear that his own data showed amounts of oxygen "substantially higher" than mere trace amounts. *Id.* at 671:21-24.

As to Dr. Bokor, his testimony regarding 50% oxygen for silicon oxide lacked any basis:

> Q. Dr. Bokor, yesterday you testified that a layer of silicon oxide requires at least 50 percent oxygen, right?
> A. Yes.
> …
> Q. And you didn't cite any scientific paper for this 50% oxygen principle, did you?
> A. Well, not yesterday.

Tr. 932:1-14; *see also id.* at 993:2-994:7 (discussing relevant portion of expert report without adding substance); 932:24-934:6 (no reference to 50% in claim language, original or as-construed). He even admitted that silicon oxide does not *strictly* require 50% oxygen, because there could be impurities in the silicon oxide. *Id.* at 1010:24-1011:20.

Dr. Bokor simply did not give any testimony regarding what percentage of oxygen in titanium silicide is sufficient to form a titanium silicon oxide. Tr. 935:6-18; 1010:4-1010:22. While he did offer a conclusory opinion about what percent of oxygen is required to form *titanium oxide*, *see* Tr. 994:20-23, that opinion did not relate to the question at hand, because the oxide that

Dr. Piner identified is titanium *silicon* oxide. *See* Tr. 521:16-522:8.[6] Indeed, Dr. Bokor admitted that he has opined, in a different context, that Acorn's asserted metal oxide claim limitations were practiced by a piece of prior art, even though he "did not know how much oxygen was present in a layer that included titanium, oxygen, and silicon." Tr. 935:19-936:12. He testified that it was not important "how much titanium oxide was in a mixed layer of titanium oxide and titanium silicide because … [a]s long as there is some in there, then it comprises.'" *Id.*; *see also id.* at 691:4-11 (Piner) (explaining the lack of a 50% requirement in the claim limitations at issue).[7] This testimony is consistent with how Samsung's engineers themselves analyze the presence of oxides at the accused interface layer. Samsung's documents talking about oxides consistently do so without first assessing the precise atomic percentage of oxygen. *See* Tr. 934:7-935:5 (Bokor).

For these reasons, Dr. Piner's signal intensity analysis does not fail for not identifying a specific percentage of oxygen. To the contrary, Dr. Piner emphasized that he identified oxide in the analyses he performed by "looking at the peaks above what's around them in the oxygen signal." Tr. 612:20-23. He further explained that he *chose* signal intensity as the more reliable form for this data, because "signal intensity is the data in its raw form," while "atomic percents … is a modeling of the raw data" through a mathematical conversion. Tr. at 688:10-689:3. He explained that performing that atomic percentage conversion without access to a "standard" has "very limited value." Tr. 601:19-602:22; *see also* PTX373 at 112. And indeed, Dr. Bokor's testimony regarding his own atomic percentage analysis proved that point. Dr. Piner is a highly qualified expert who testified that he has performed similar analyses numerous times, *id.* at 475:5-18, 679:25-680:9, and it was reasonable for the jury to credit his signal intensity analysis.

[6] Dr. Bokor did not challenge that titanium silicon oxide is a metal oxide.
[7] The only reference made during trial to the amount of oxide sufficient to turn titanium silicide into an oxide only stated that 5% oxygen was not quite sufficient to turn titanium silicide from a conductor to a material with higher resistance, such as an oxide. Tr. 1010:18-23, 1012:5-1013:2.

But Dr. Piner did not simply perform his signal intensity analysis and stop. Instead, he added to his analysis Samsung internal documents, including documents that report oxygen at the accused interface in atomic percentages, as well as documents that conclude that there are *oxides* in the accused interface. *See, e.g.*, Tr. 689:4-23, *supra* Section III.B. All this evidence, taken together, is more than enough to support the jury's conclusion that there are layers of metal oxide and silicon oxide at the accused interface. Indeed, Samsung stoops to the suggestion that "it is possible to make it look like a sample has more oxygen simply by brightening the oxygen color map." Mot. at 17. But there was simply nothing at trial supporting the idea that Dr. Piner manipulated his data in that way, and he testified clearly that he did not artificially brighten the intensity of any the color and intensity maps he presented. Tr. 686:21-688:5.

Samsung also argues that Dr. Piner introduced oxygen into his samples by leaving them exposed to air for too long. Mot. at 13-14, 17-18. But Dr. Piner testified conclusively that he understands and accounts for oxygen contamination in his work, and that oxygen contamination did not impact the results of his analysis. Tr. 691:12-23. This makes sense. Dr. Piner was focusing on the peaks in the oxygen data, as compared to the background oxygen levels. Samsung never explains why or how exposing the samples to oxygen for any amount of time would create the distinctive peaks of oxygen specifically in the accused interface region that Dr. Piner explained and observed. [redacted]

Samsung also criticizes Dr. Piner's decision to display his analysis with a multiplication factor applied to the gaseous elements, oxygen and nitrogen. But Dr. Piner explained to the jury why he did that. *Supra* Section III.A. He also explained clearly that he did *not* do so in an attempt to manipulate the date or mislead the jury:

> Q. Dr. Piner, did you manipulate your data in an effort to mislead the jury?
> A. Absolutely not, no.
> Q. Did you hand the jury your slides without any explanation of what they meant?
> A. No. I went through testimony and explained in detail on Friday, you know, what's meant in the slides, as well as all my notes and commentary in the report itself.
> …
> Q. And the "x15" on both the oxygen and the nitrogen, did you hide those indications from the jury?
> A. No . I pointed them out in the legend, and I discussed that at length in my testimony.
> …
> Q. So was it an attempt to help the jury see what your expert eyes see?
> A. For the jury and everyone, yes.

Tr. 672:4-12.

Finally, Samsung criticizes the variation in the amount of oxygen across the different chips that Dr. Piner analyzed. Mot. at 18. But Dr. Piner explained that too, when he explained that Samsung's internal documents show that there is variation in the levels of oxygen at the accused interface layer, depending on where on the wafer the tested transistor was originally located. *Supra* Section III.B. Dr. Bokor did not disagree with this point. Tr. 961:25-962:25. And this is why Dr. Piner's analysis, which tested ten different chips, was valuable, while Dr. Bokor's, which tested only two chips, was not.

In all, Samsung had the opportunity to cross-examine Dr. Piner about the opinions Samsung now criticizes. *See Daubert v. Merrell Dow Pharms., Inc.*, 509 U.S. 579, 596, 113 S.Ct. 2786, 125 L.Ed.2d 469 (1993) ("Vigorous cross-examination, presentation of contrary evidence, and careful instruction on the burden of proof are the traditional and appropriate means of attacking shaky but admissible evidence."). And Samsung's arguments regarding the reliability of Dr. Piner's methods have already been raised, and rejected, during *Daubert* motion practice. *See, e.g.*, ECF No. 145 (Samsung's Motion to Exclude Dr. Piner); ECF No. 166 (Acorn's Opposition);

Pretrial Tr. 70:17-20 (counsel for Samsung arguing that Dr. Piner's opinions are inadmissible because "the claims require proving oxides, the elemental intensity analysis only can at best prove the presence of these materials, not the extent of them; not how many there are and not what percent"); *id.* at 83:2-11 (the Court denying Samsung's *Daubert* motion, reasoning "the Court is persuaded that this is another battle of the experts and that despite the arguments, none of the alleged infirmities of this expert's report rise to the level of outright exclusion. It clearly appears to the Court that the best course is vigorous cross examination in front of the fact-finder."). The Federal Circuit does not countenance attempts to convert *Daubert* challenges into motions for judgment as a matter of law. *See Versata Software, Inc. v. SAP America, Inc*., 717 F.3d 1255, 1264 (Fed. Cir. 2013) (rejecting JMOL challenges to expert's damages methodology as "improperly raised" and holding, "[u]nder the guise of sufficiency of the evidence, SAP questions the admissibility of Versata's expert testimony and whether his damages model is properly tied to the facts of the case. Such questions should be resolved under the framework of the Federal Rules of Evidence and through a challenge under Daubert . . . ."); *Rembrandt Wireless Techs., LP v. Samsung Elecs. Co.*, No. 2:13-CV-213-JRG, 2016 WL 362540, at *4 (E.D. Tex. Jan. 29, 2016), *aff'd*, 853 F.3d 1370 (Fed. Cir. 2017) (J. Gilstrap) ("[A] JMOL is not the appropriate context for renewing attacks on an expert's methodology[;] … [a]ccordingly, to the extent that Samsung now merely re-urges its prior *Daubert* arguments, the Court rejects such as improper.").

Fourth, Samsung criticizes Dr. Piner's reliance on Samsung's internal documents relating to Samsung's accused devices. With regard to PTX702, which was a Failure Analysis document related to the accused Exynos 8890 product (not a test device), Samsung suggests that the "reference" devices depicted in that document cannot be relied upon, because "the 'Ref' transistor was indisputably part of a failed product and only a couple hundred nanometers from 'Fail' transistors." Mot. at 22-23. The problem with this argument is that Samsung's own expert, Dr. Bokor, gave contrary testimony. He testified, as to PTX702 specifically, that he had "no basis for saying whether [his] own EAG line scans or Samsung's line scans [were] more reliable." Tr. 941:7-941:22. And Dr. Piner testified conclusively that Samsung would not use a bad transistor as a "reference transistor," that a reference transistor is a "known good device," a "gold standard," and that his opinion on that point was not impacted by the fact that the reference transistor was located near a failed transistor. Tr. 681:23-684:18. He further testified that this sort of deep, detailed analysis is more likely to occur in a failure analysis document than for a wafer with no failures, simply because Samsung has no incentive to destroy good chips or wafers. *Id.* at 684:19-686:3. This testimony is consistent with Samsung's own 30(b)(6) testimony that the failure analysis lab would be the group most likely to have detailed elemental analyses of the accused interface layer. Tr. 232:4-233:4 (Moreau). Samsung's 30(b)(6) witness simply chose not to check those records in preparing for his testimony. *Id.*

Samsung also argues that PTX702 cannot be relied upon because the samples therein were exposed to air for an unknown period of time. Mot. at 23. But Dr. Piner explained, based on his review of PTX702, that it appeared to him that the Samsung engineers performing that analysis had specifically chosen to investigate the oxygen, that this was "something that Samsung would typically look for and observe in this particular part," and that it was "a standard characterization that's conducted in these source/drain regions by Samsung." Tr. 686:4-20; [redacted]. In addition, as explained above, there is no basis for the suggestion that exposing the samples to air for an unknown period of time would cause the two distinctive bumps of oxygen shown in both Dr. Piner's and Samsung's analyses.

Finally, Samsung argues that the atomic percentages of oxygen shown in the line scan data in PTX702 are not sufficient to form a layer of metal oxide. Mot. at 23. But this argument is based entirely on Dr. Bokor's unsupported statements about the atomic percentages necessary to form silicon oxide and titanium oxide, with which Dr. Piner did not agree. Dr. Piner stated clearly that the atomic percentages shown *are* sufficient to show a layer of metal oxide. Tr. 689:7-15.

[redacted]

[redacted]

[redacted] Any wafer that Samsung was testing, and reporting results for, is a test wafer. Tr. 947:8-10 (Bokor) (“Q. If Samsung chooses to cut open a working chip and test it, that becomes a test chip, doesn’t it? A. I guess that’s – I guess I can agree with that.”). That does not undermine its usefulness to Dr. Piner’s analysis. *See* Tr. 692:8-19 (Piner) (“Test wafers are wafers that Samsung produces, as a part of their normal experimentation, to understand their process.”). [redacted]

[redacted]

S[redacted] [redacted]

[redacted]

Fifth, Samsung criticizes Dr. Piner's explanation of how, during Samsung's 14 nm FinFET process, oxygen ingresses through the titanium nitride layer to form a layer of titanium silicon oxide in the accused interface region. Mot. at 24. Samsung argues that its internal documents state that what was "oxidized" was "the titanium nitride contact metal, which is undisputedly not part of the interface relevant to Acorn's patent claims." *Id.* This demonstrates a misunderstanding of Dr. Piner's testimony, as well as the testimony of Samsung's own witness. [redacted] Samsung now argues that its internal documents on this point, which reflected significant atomic percentages of oxygen, suffered from a carbon contamination issue. Mot. at 24. But Samsung does not explain how or why that carbon contamination issue would impact the amount of oxygen shown. [redacted]

[redacted]

Sixth, Samsung criticizes Dr. Piner's use of gray scale TEM images to show what appear to be two, distinct layers in the accused interfacial region. Mot. at 25. But those images correspond to Dr. Piner's opinions, based on his signal intensity analyses and Samsung's internal documents, that there are two oxide layers there. And they undermine Samsung's blind assertion that there is only one layer of titanium silicide there. Tr. 476:5-24; *see also* Ex. B at 75-77.

Seventh, Samsung criticizes Dr. Piner's explanation, based on Samsung's own documents, that chips closer to the wafer edge may demonstrate more oxygen at the accused interface layer than chips further from the wafer edge. Mot. at 27-28. Samsung argues that "the etch rate being lower at the wafer edge does not mean that native oxide remains at the wafer edge." *Id.* at 28. [redacted]

FILED UNDER SEAL PURSUANT TO PROTECTIVE ORDER

[redacted]

Eighth, Samsung argues that the [redacted] silicon oxide that Samsung *admits* were "accumulat[ing]" at the bottom of the contact hole as a result of the RF Etch step were insufficient to form a "layer" of silicon oxide. Mot. at 28-29. This appears to be a late attempt at a claim construction of "layer" that Samsung never proposed. *See Hewlett-Packard Co. v. Mustek Sys., Inc.*, 340 F.3d 1314, 1320–21 (Fed. Cir. 2003) ("[I]t is too late at the JMOL stage to argue for or adopt a new and more detailed interpretation of the claim language and test the jury verdict by that new and more detailed interpretation."). Samsung's attempt—at this late date—to ascribe required dimensions and properties to the plain and ordinary meaning of the term "layer" should be rejected.

[redacted]

IV. CONCLUSION

Acorn requests that the Court deny Defendants' motion because it highlights credibility and admissibility disputes, rather than showing a lack of substantial evidence.

Respectfully submitted,

Dated: August 25, 2021

By: */s/ Christina V. Rayburn*

John C. Hueston (CA SBN 164921)
Douglas J. Dixon (CA SBN 275389)
Christina V. Rayburn (CA SBN 255467)
Joseph Reiter (CA SBN 294976)
Neil G. Anderson (CA SBN 307668)
Daniel Vinson (CA SBN 308797)
Julia Haines (CA SBN 321607)
Justin J. Sorensen (CA SBN 324817)
HUESTON HENNIGAN LLP
620 Newport Center Dr., Suite 1300
Newport Beach, CA 92660
Telephone: (949) 226-6741
jhueston@hueston.com
ddixon@hueston.com
crayburn@hueston.com
jreiter@hueston.com
nanderson@hueston.com
dvinson@hueston.com
jhaines@hueston.com
jsorensen@hueston.com

AND

Robert W. Weber (SBN 21044800)
SMITH WEBER LLP
5505 Plaza Drive
Texarkana, Texas 75503
Telephone: (903) 223-5656
bweber@smithweber.com

Attorneys for Plaintiff Acorn Semi, LLC

CERTIFICATE OF SERVICE

I hereby certify that a true and correct copy of the foregoing document was filed electronically in compliance with Local Rule CV-5 on August 25, 2021. As of this date, all counsel of record have consented to electronic service and are being served with a copy of this document through the Court's CM/ECF system under Local Rule CV-5(a)(3)(a) and by email.

/s/ Christina V. Rayburn
Christina V. Rayburn

CERTIFICATE OF AUTHORIZATION TO FILE UNDER SEAL

I certify that the following document is authorized to be filed under seal pursuant to the Protective order entered in this case.

/s/ Christina V. Rayburn
Christina V. Rayburn