

Micron Technology, Inc. (Petitioner)
v.
Yangtze Memory Technologies Company, Ltd. (Patent Owner)

PGR2025-00021 (US Patent 12,010,838)

Patent Owner YMTC's Demonstratives

June 4, 2026



'838 Patent Overview

Claim Construction - Portions

Ground 1 (Kim) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 3 (Lee) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 1 and 5 - Curved Side Surface *Claims 13-15*

Ground 2 (Kim + Yang) *Claims 3, 18*

Ground 4 (Lee + Haller) *Claims 3, 18*



'838 Patent Overview

Claim Construction - Portions

Ground 1 (Kim) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 3 (Lee) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 1 and 5 - Curved Side Surface *Claims 13-15*

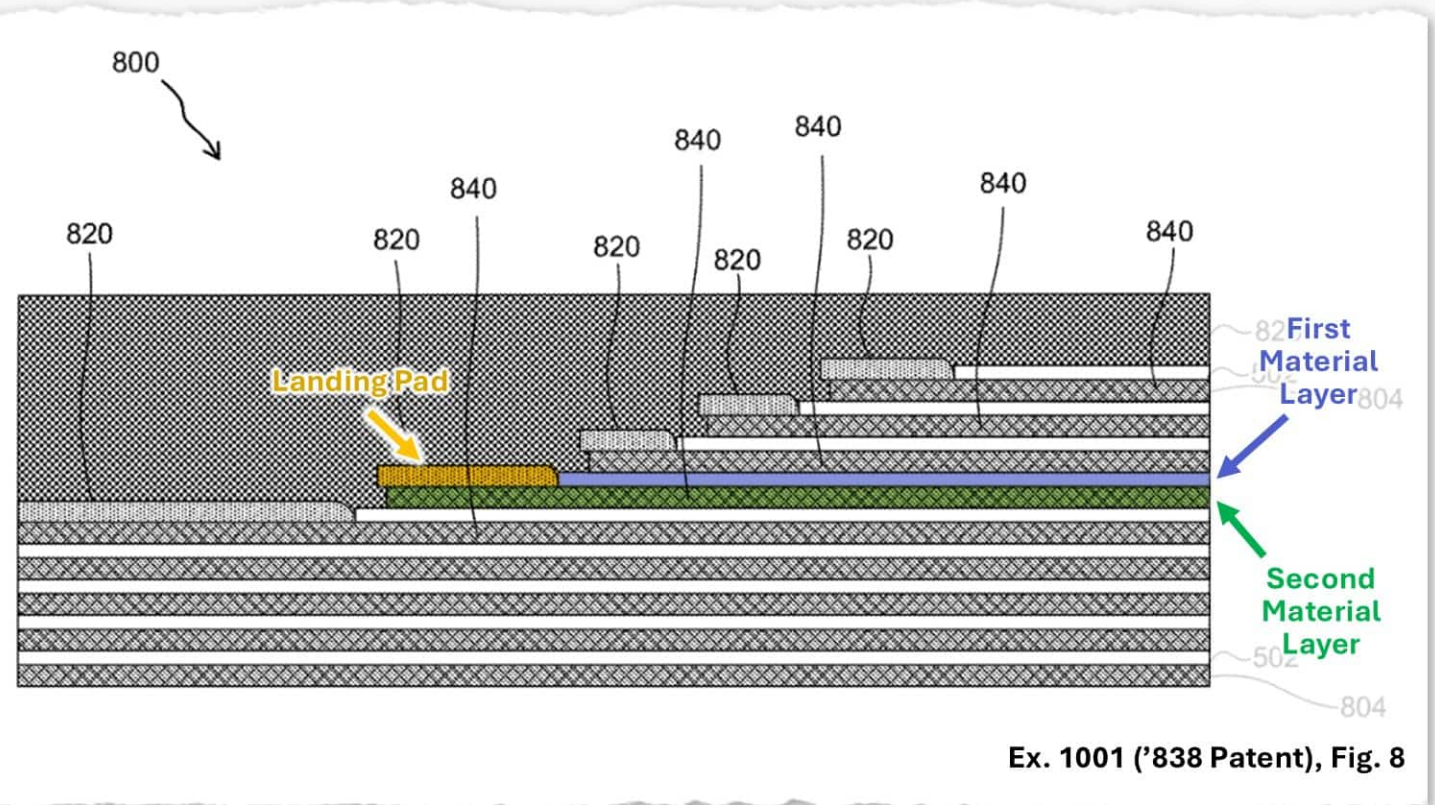
Ground 2 (Kim + Yang) *Claims 3, 18*

Ground 4 (Lee + Haller) *Claims 3, 18*

'838 Patent

1. A staircase structure of a memory device, comprising: a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and a landing pad disposed over a second portion of the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

Ex. 1001 ('838 Patent), Claim 1

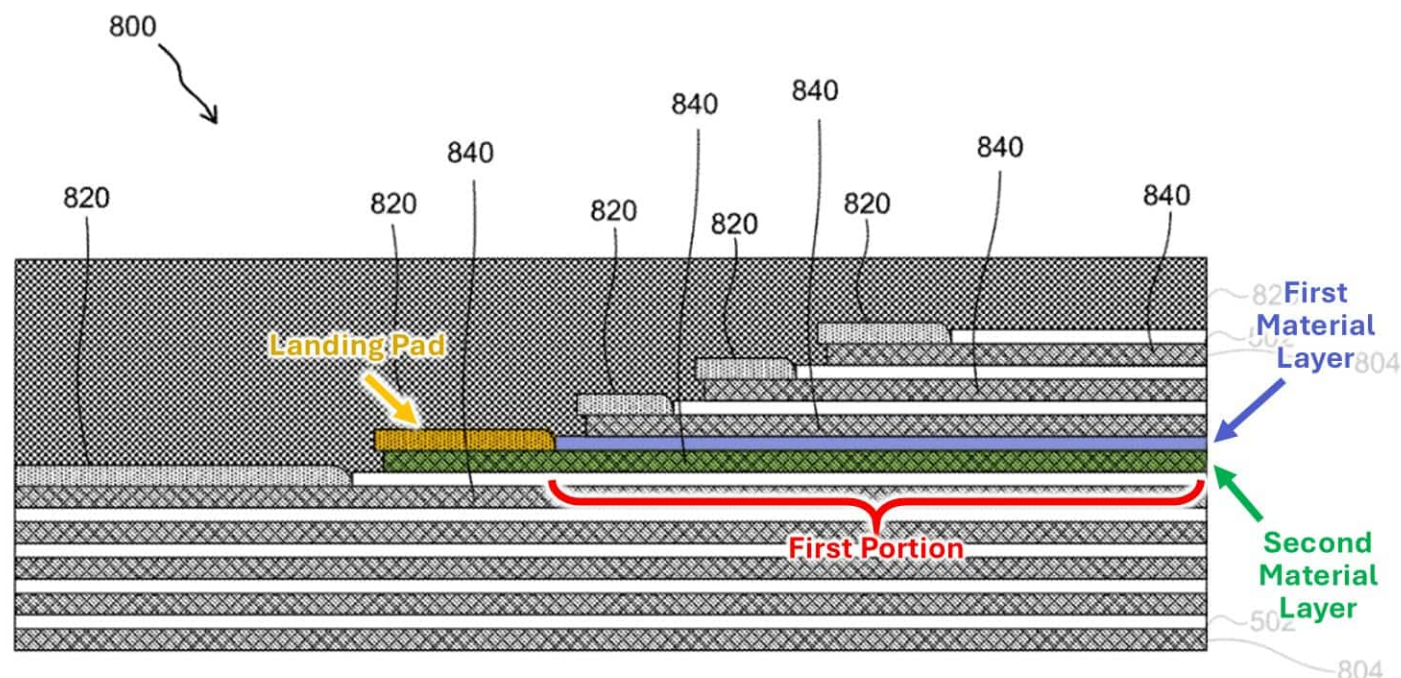


Ex. 1001 ('838 Patent), Fig. 8

'838 Patent

1. A staircase structure of a memory device, comprising: a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and a landing pad disposed over a second portion of the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

Ex. 1001 ('838 Patent), Claim 1

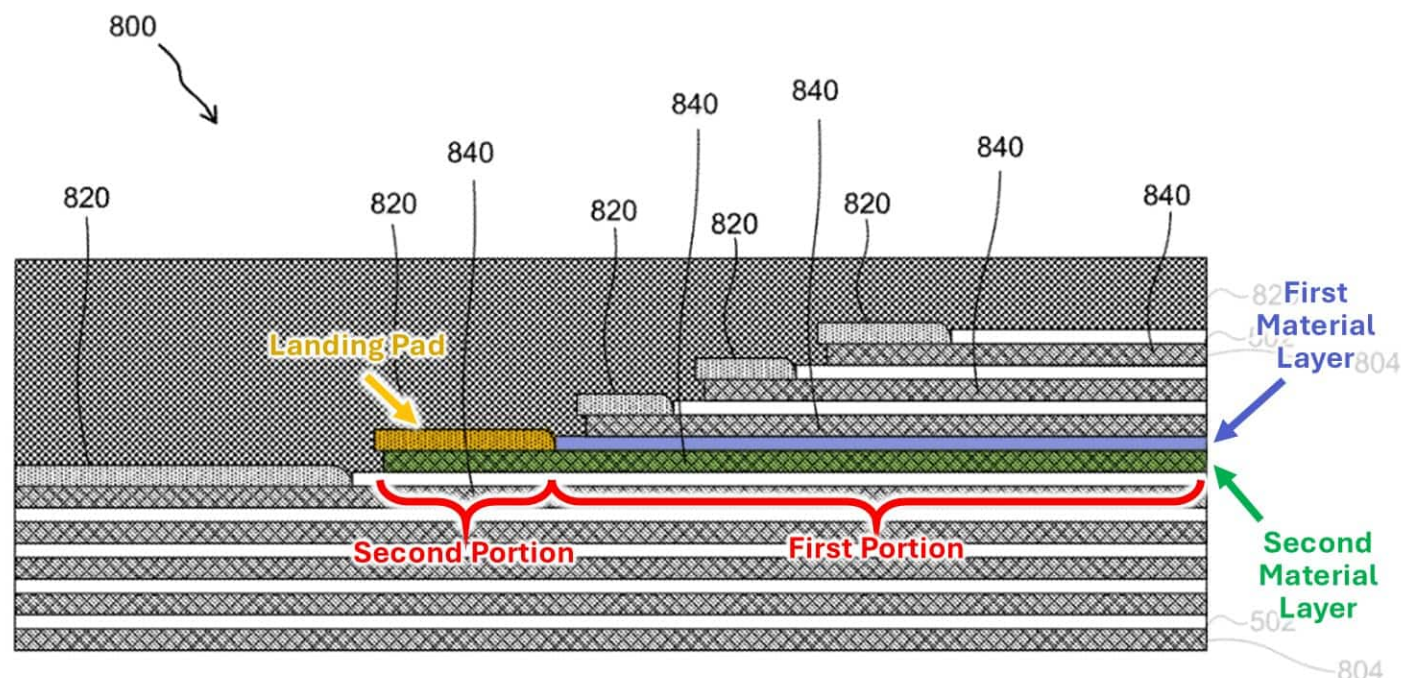


Ex. 1001 ('838 Patent), Fig. 8

'838 Patent

1. A staircase structure of a memory device, comprising:
 - a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and
 - a landing pad disposed over a second portion of the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

Ex. 1001 ('838 Patent), Claim 1

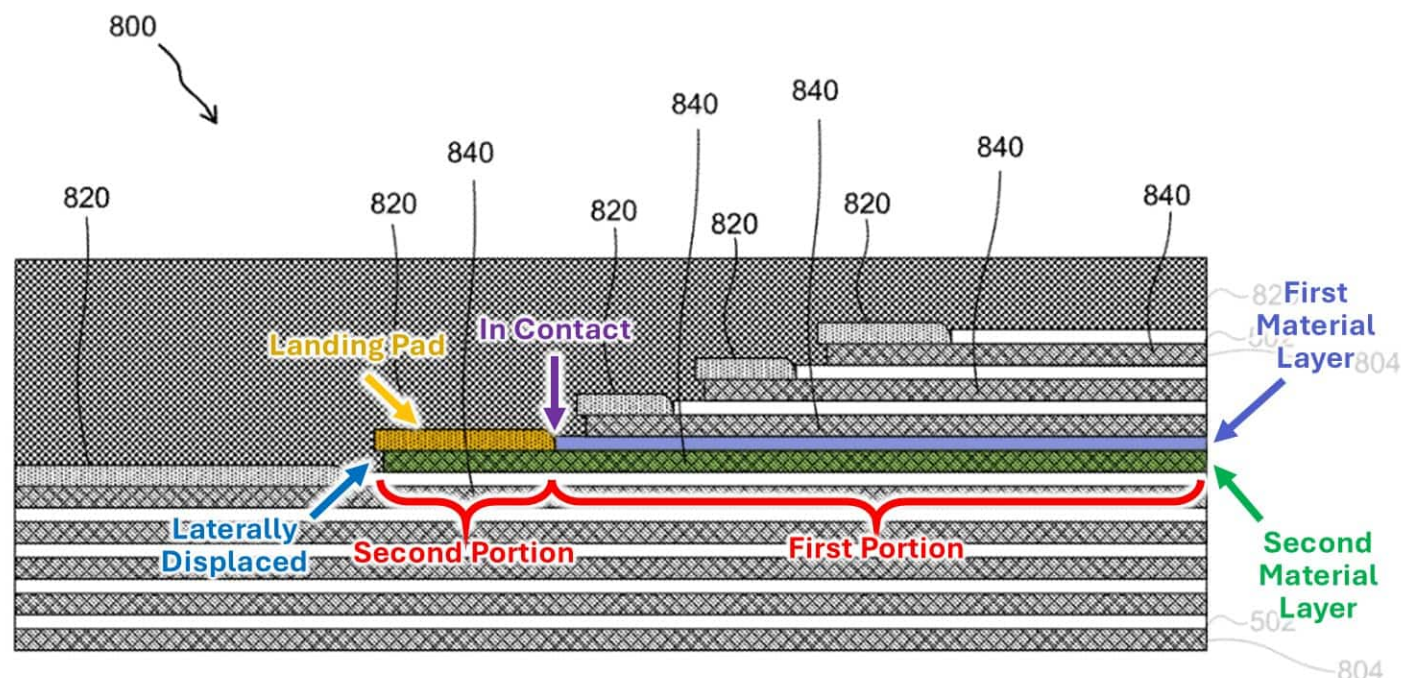


Ex. 1001 ('838 Patent), Fig. 8

'838 Patent

1. A staircase structure of a memory device, comprising: a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and a landing pad disposed over a second portion of the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

Ex. 1001 ('838 Patent), Claim 1



Ex. 1001 ('838 Patent), Fig. 8



'838 Patent Overview

Claim Construction - Portions

Ground 1 (Kim) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 3 (Lee) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 1 and 5 - Curved Side Surface *Claims 13-15*

Ground 2 (Kim + Yang) *Claims 3, 18*

Ground 4 (Lee + Haller) *Claims 3, 18*

Petitioner's Arbitrary Treatment Of The Claims

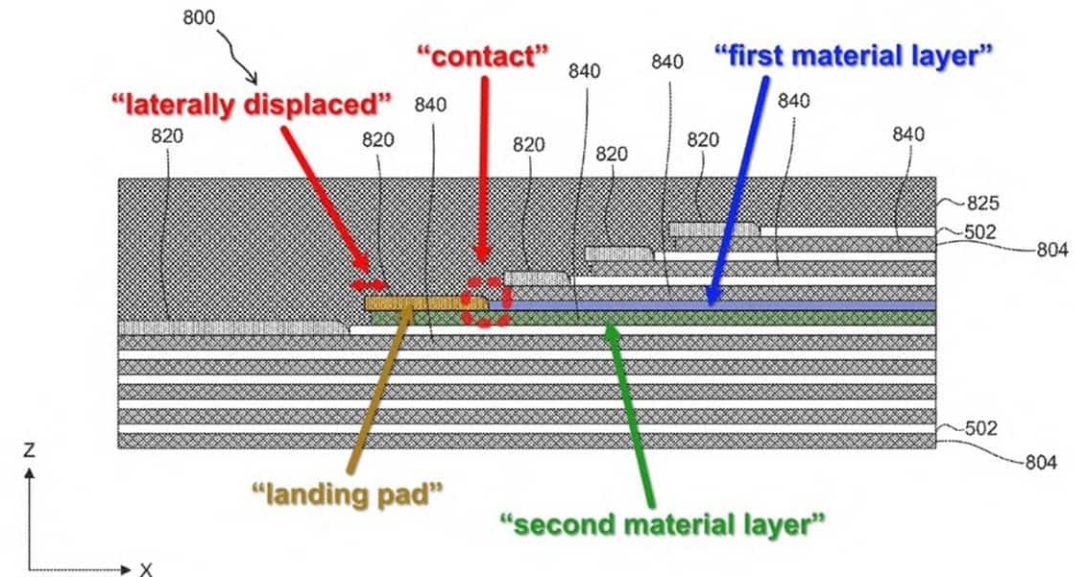
Petition

The '838 patent's claims a memory device with a particular type of landing pad. This Petition addresses independent claims 1 and 12. Both of these claims require "landing pad[s]" located on top of a conductive or "second material layer." Each "landing pad" must have a "first side surface" that is "in contact" with an adjacent insulating layer or "first material layer." The "second side surface" of this same "landing pad" must be "laterally displaced" from the side of the underlying conductive layer. An example of a landing pad structured this way is shown in

Pet. 1

Petition

Figure 8:

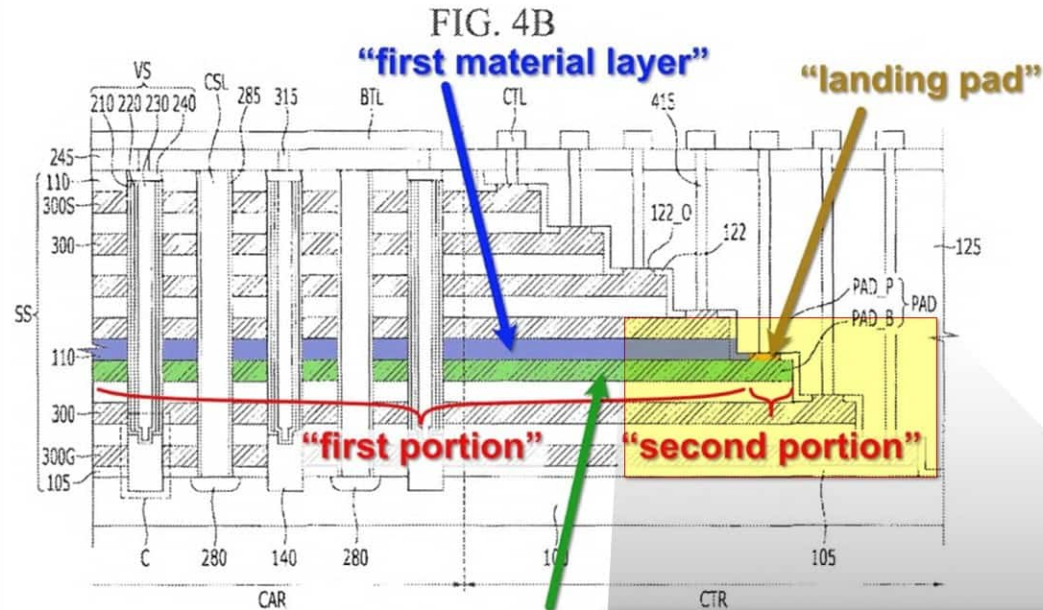


The prior art makes clear, however, that there was nothing patentable about this.

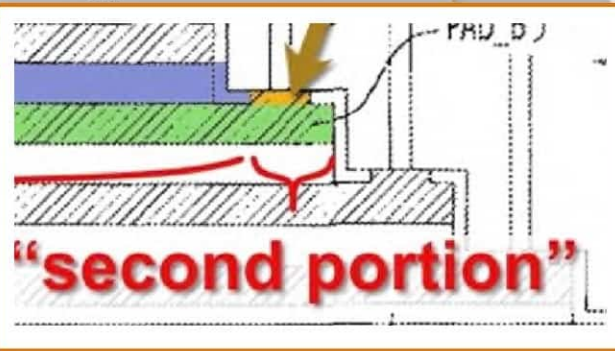
Pet. 2

Petitioner's Arbitrary Treatment Of The Claims

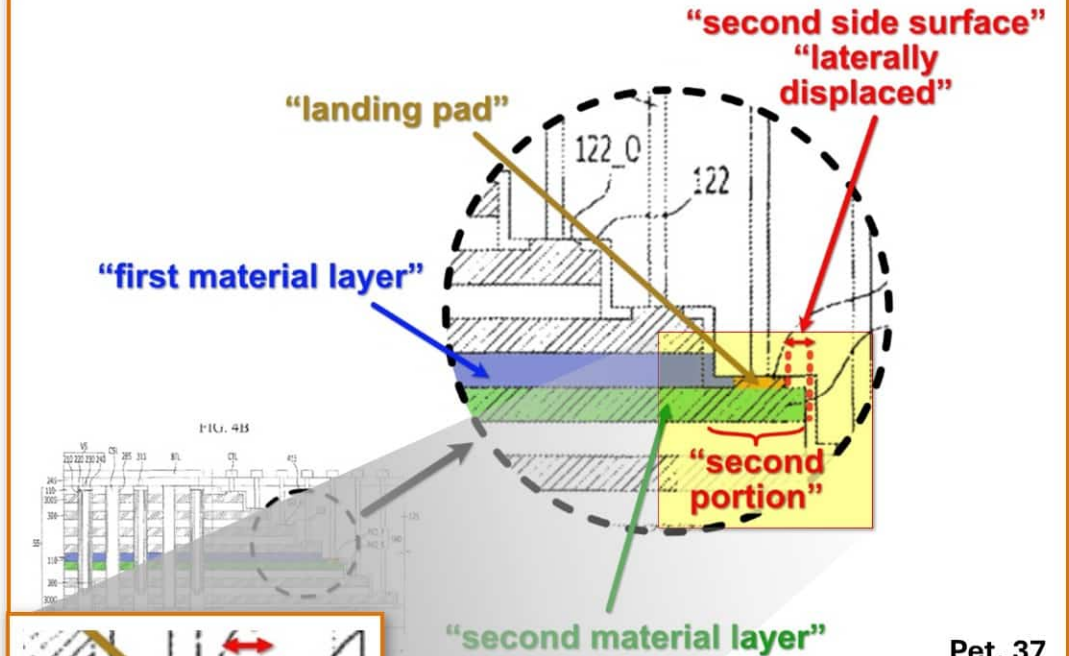
Petition



Pet. 31



Petition



Pet. 37





Petitioner's Arbitrary Treatment Of The Claims

Petitioner's Reply

Claim 1 (and claim 12) merely refer to a “second material layer” (a conductive layer) that has “a first portion” and “a second portion.” ’838 patent, claims 1/12.

The term “portion” has a straightforward plain and ordinary meaning: a “part” of a larger whole. *E.g.*, Ex. 1077, 406 (defining “portion” as “a part of a whole”). The ’838 patent itself repeatedly uses the term “portion” this way. ’838 patent, 5:40-43 (discussing both “an upper portion” and “lower portion” of a “staircase”), 5:66-6:1 (referencing “a portion of a top surface of a layer”); *see also* 4:39-40, 7:15-17, 8:20-33, 8:34-65, 11:60-64, 12:38-59. The patent never uses “portion” to require specific, definite dimensions or layout

Reply 4-5



Petitioner's Arbitrary Treatment Of The Claims

Petitioner's Reply

“The words of a claim are generally given their ordinary and customary meaning...” *Thorner v. Sony Comput. Entmt. Am., LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012). Here, the claims require only that the “first portion” and “second portion” be parts of a larger conductive layer. Ex. 1075, ¶¶ 8-32. Kim includes such a

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Petitioner's Arbitrary Treatment Of The Claims

Petitioner's Reply

“The words of a claim are generally given their ordinary and customary meaning as understood by a person of ordinary skill in the art when read in the context of the specification and prosecution history.” *Thorner v. Sony Comput. Entm't Am., LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012).

Here, the claims require only that the “first portion” and “second portion” be parts of a larger conductive layer. Ex. 1075, ¶¶ 8-32. Kim includes such a

Reply 6 (blue text added)

Petitioner's Arbitrary Treatment Of The Claims

Petitioner's Reply

“The words of a claim are generally given their ordinary and customary meaning...” *Thorner v. Sony Comput. Entmt. Am., LLC*, 669 F.3d 1362, 1365 (Fed. Cir. 2012). Here, the claims require only that the “first portion” and “second portion” be parts of a larger conductive layer. Ex. 1075, ¶¶ 8-32. Kim includes such a structure: each of its “gate electrode[s] 300” includes a “PAD_B” at its “end.” Kim, 7:58-67. Indeed, Kim explicitly characterizes this “PAD_B” as the “part” of the gate electrode” “exposed through the stepwise structure.” *Id.* (emphasis added). So just as the claims require, Kim teaches a memory with a “second material layer” (gate electrode 300). A “landing pad” (PAD_P) is over a “second portion” (PAD_B) of this layer, and a “first material layer” (dielectric layers 110 and 122) is over a “first portion” (the rest of gate electrode 300 not “exposed” by the stepwise structure to form PAD_B) of the same layer. Petition, 27-31; Ex. 1075, ¶¶ 39-45.

Reply 6

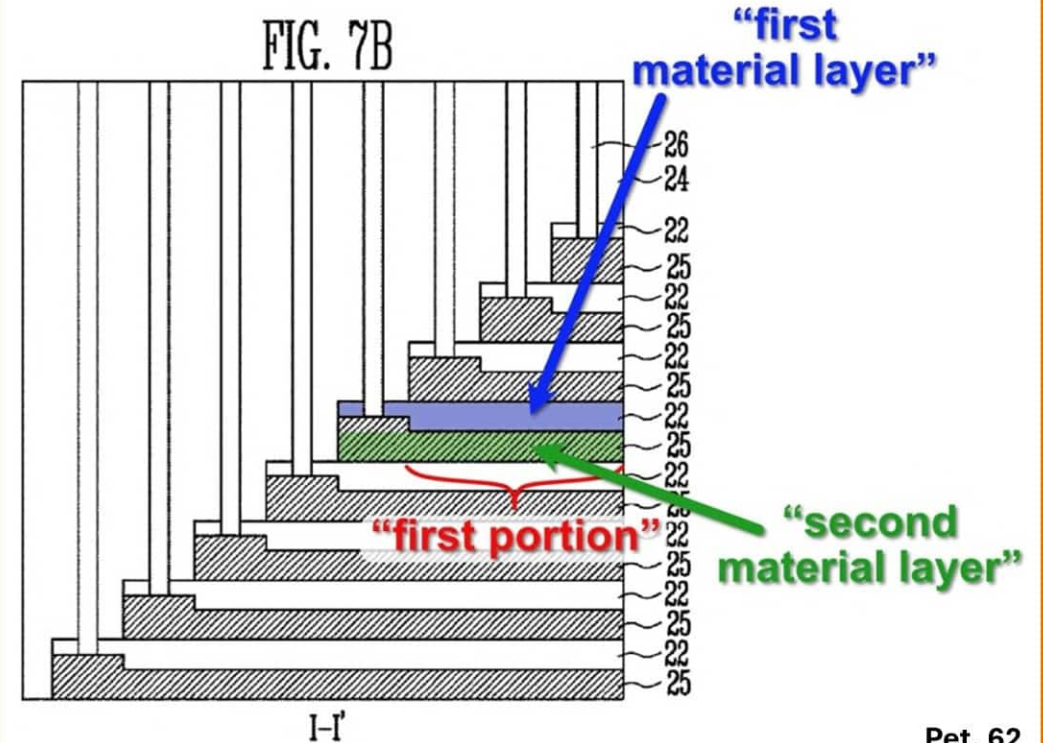
Petitioner's Arbitrary Treatment Of The Claims

Petition

Id., Fig. 7B (annotated); *see also id.*, Figs. 1A, 6B; Ex. 1003, ¶¶ 348-354. While layer 22 extends over the entirety of the conductive layer 25 below it, this is not precluded by claims 1 or 12. The claims require only that an insulating layer be “disposed over a first portion” of an underlying conductive layer. They do not prohibit the insulating layer from also covering other portions of the same conductive layer.

Pet. 62

Petition



Pet. 62

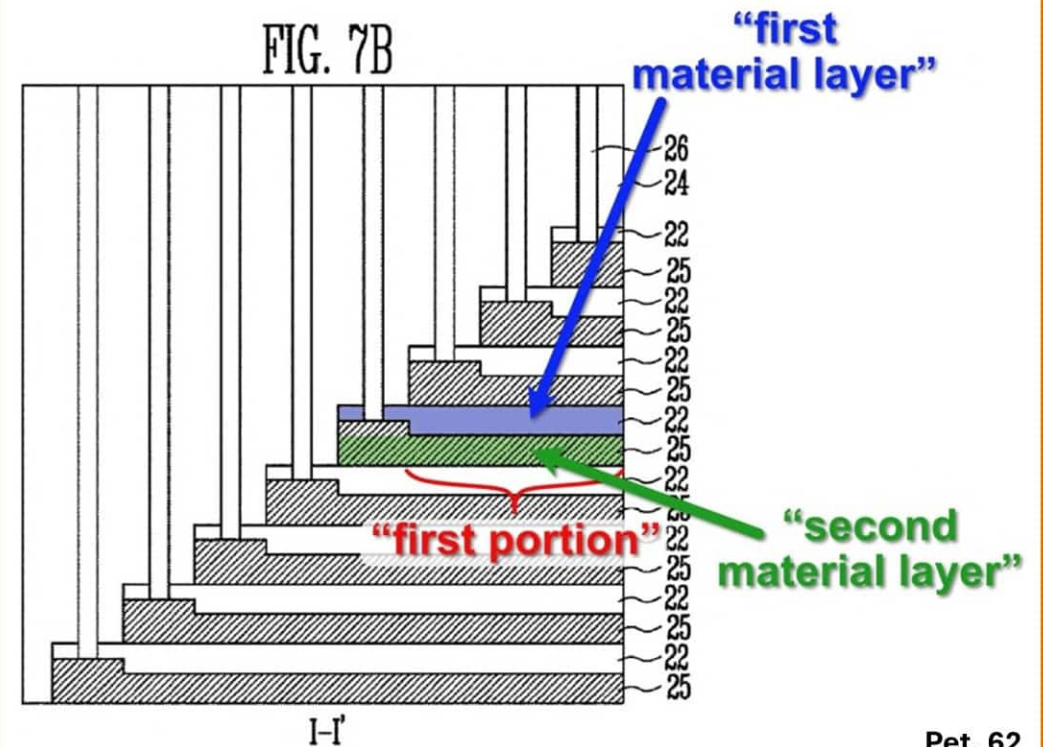
Petitioner's Arbitrary Treatment Of The Claims

Petitioner's Reply

Response, 72. This argument fails for the same reason discussed above: the '838 patent does not "define" the terms "first portion" and "second portion" in the same, narrow way Patent Owner does. *Supra* Section II.A.1. The claims also do not exclude structure where the "first material layer" extends over the "second portion" (as this has no basis in the claim language and would read out the '838 patent's only embodiment). *Id.*

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Petition



Petitioner's Reply

The term “portion” has a straightforward plain and ordinary meaning: a “part” of a larger whole. *E.g.*, Ex. 1077, 406 (defining “portion” as “a part of a whole”). The

Response, 72. This argument fails for the same reason discussed above: the '838 patent does not “define” the terms “first portion” and “second portion” in the same, narrow way Patent Owner does. *Supra* Section II.A.1. The claims also do not exclude structure where the “first material layer” extends over the “second portion” (as this has no basis in the claim language and would read out the '838 patent’s only embodiment). *Id.*

FIG. 7B

“first material layer”

“second material layer”

“first portion”

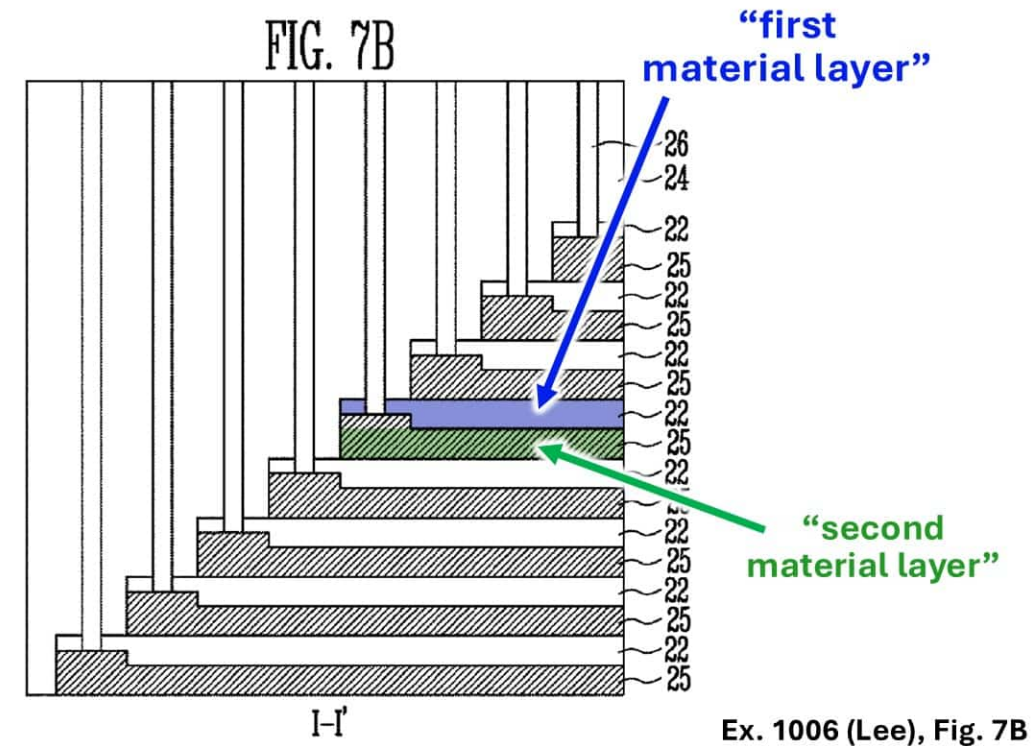
I-I'

Ex. 1006 (Lee), Fig. 7B

Petitioner Reads “portion” Out Of The Claims

1. A staircase structure of a memory device, comprising: a first material layer and a second material layer, wherein the first material layer is disposed over ~~a first portion of~~ the second material layer; and
- a landing pad disposed over a second portion of the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

Ex. 1001 ('838 Patent), Claim 1





Petitioner Reads “portion” Out Of The Claims

1. A staircase structure of a memory device, comprising:
a first material layer and a second material layer, wherein the first material layer is disposed over ~~a first portion of~~ the second material layer; and
a landing pad disposed over ~~a second portion of~~ the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of ~~the second portion of~~ the second material layer.

Ex. 1001 ('838 Patent), Claim 1

Petition

The '838 patent relates generally to 3D NAND memory devices. Typical, prior art 3D NAND devices include vertically oriented strings of memory cells. These memory cell strings pass through alternating layers of conductive and insulating material stacked on a substrate. The stacked conductive/insulating layers of these types of devices were routinely formed with a staircase structure outside of the area where the memory cells are located. This staircase structure allows for electrical interconnection with landing pads on each of the conductive layers.

Pet. 1

Petitioner Improperly Renders Claim Language Superfluous



Intel

“*First*, because every buffer in our (physical) world is ultimately implemented on a physical device (*i.e.*, hardware), a ‘hardware buffer’ must mean something more than just a ‘buffer implemented in hardware,’ as Intel urges, or else the word ‘hardware’ would be erased from the claims. That consequence, while not inevitably disqualifying a construction in every patent, is counter to an important principle of interpretation, for patent claims as for statutes: ‘It is highly disfavored to construe terms in a way that renders them void, meaningless, or superfluous.’”

Intel Corp. v. Qualcomm Inc., 21 F.4th 801, 809-10 (Fed. Cir. 2021)

Patent Owner's Construction Gives Meaning To Each Term



SSI Techs.

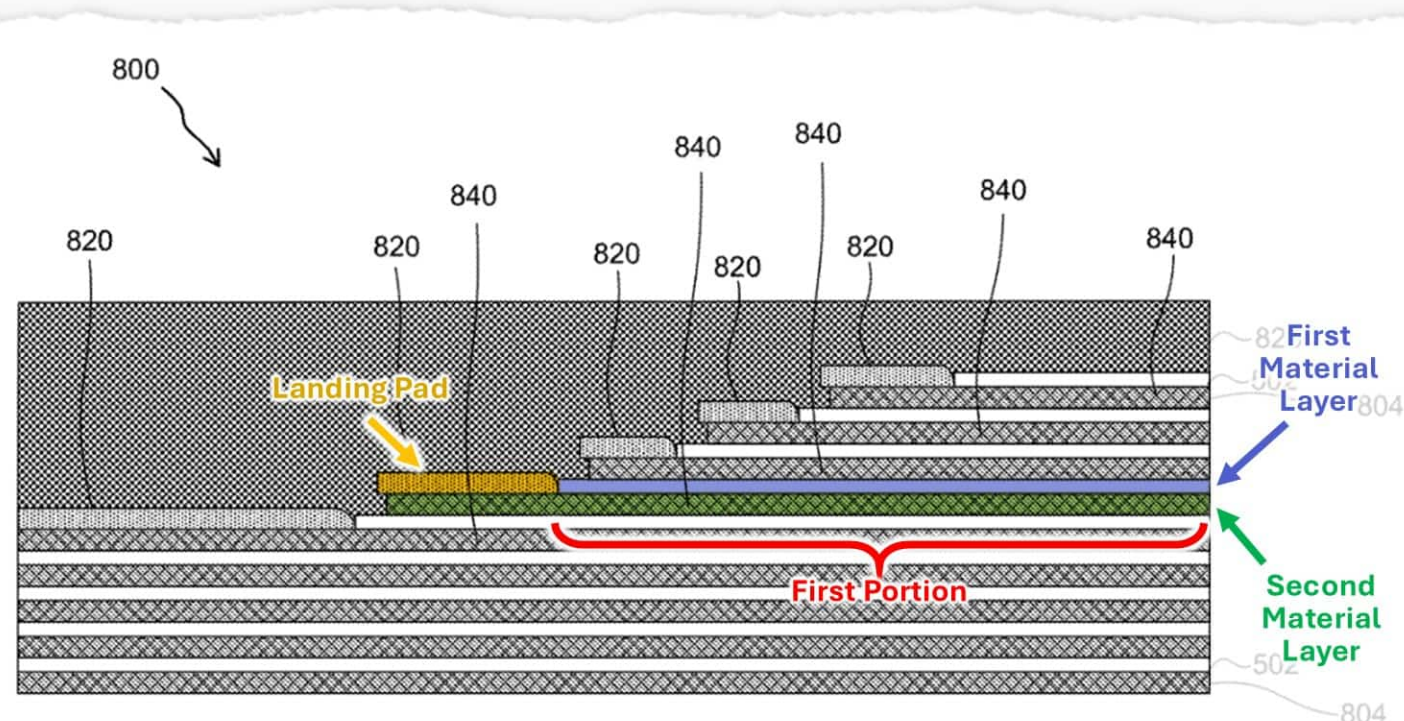
“However, if that were true, the word ‘measured’ would be superfluous, as the word ‘volume’ alone would be sufficient to give the claim the scope that DZEM proposes. The use of the term ‘measured volume’ therefore indicates that claim 1 requires that the volume of the liquid in the tank must be determined and considered as part of the contamination analysis recited in claim 1. *See Merck & Co. v. Teva Pharms. USA, Inc.*, 395 F.3d 1364, 1372 (Fed. Cir. 2005) (‘A claim construction that gives meaning to all the terms of the claim is preferred over one that does not do so.’).”

SSI Techs., LLC v. Dongguan Zhengyang Elec. Mech. LTD, 59 F.4th 1328, 1334-35 (Fed. Cir. 2023)

Patent Owner's Construction Gives Meaning To Each Term

1. A staircase structure of a memory device, comprising: a **first material layer** and a **second material layer**, wherein the first material layer is disposed over a first portion of the second material layer; and
- a **landing pad** disposed over a second portion of the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

Ex. 1001 ('838 Patent), Claim 1



Ex. 1001 ('838 Patent), Fig. 8

Patent Owner's Construction Gives Meaning To Each Term

1. A staircase structure of a memory device, comprising:
 - a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and
 - a landing pad disposed over a second portion of the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

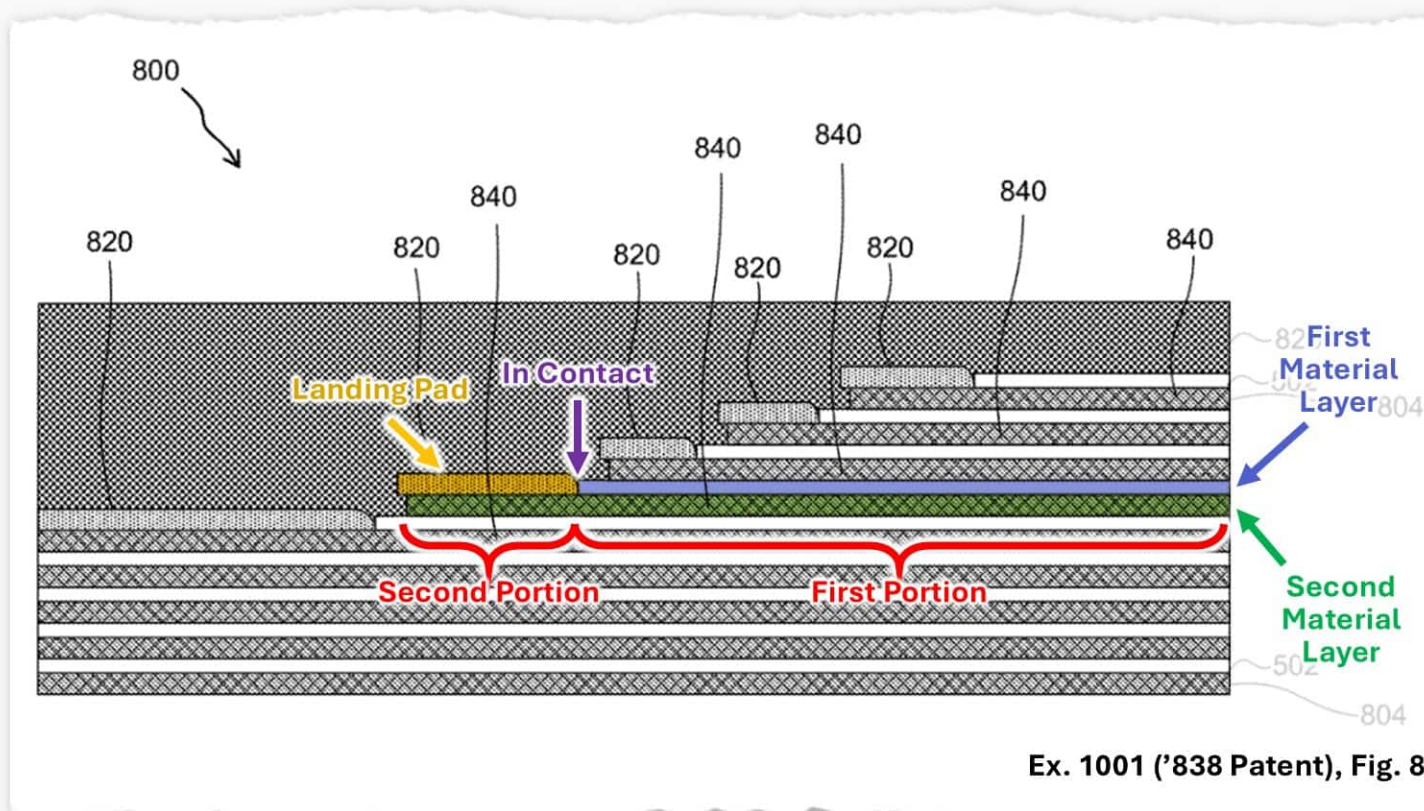
Ex. 1001 ('838 Patent), Claim 1

Petitioner's Expert

Q. So your opinion is that the first and second portion of layer 804 are divided by the intersection of the insulating layer and landing pad above them.

A. That's right.

Ex. 2030 (Jack C. Lee, Ph. D.), 141:11-15



Ex. 1001 ('838 Patent), Fig. 8

Patent Owner's Construction Gives Meaning To Each Term

- **“first portion of the second material layer”**
 - “a portion of the second material layer beneath the first material layer that is separate and distinct from the second portion of the second material layer”

ALTERNATIVELY

- **“wherein the first material layer is disposed over a first portion of the second material layer”**
 - “wherein the first material layer is disposed over a first portion of the second material layer but not a second portion of the second material layer”
- **“a landing pad disposed over a second portion of the second material layer”**
 - “a landing pad disposed over the second portion of the second material layer but not the first portion of the second material layer”

Petitioner's Expert

A. I think that's what I answered, that the first and second portion -- portions are part of the second material layer, and that a person of ordinary skill in the art would understand them to be different, nonoverlapping regions, at least in the context of the '838 patent and the prior art that I use in invalidating the claims of the '838 patent.

Patent Owner's Response

[illegible]

POR 72



Petitioner Ignores *Liberty*

Claim language:

“a body including a nose portion and tail portion, said body further including an interface portion disposed intermediate opposite ends of said body”

Trial Court's Construction:

“that the interface is positioned between or in the middle of the opposite ends of the forward end of the nose portion and the trailing end of the tail portion”

Trial Court Refused To Include:

“such that the interface does not extend all of the way to the front or to the end of the projectile”



Liberty

“In other words, the trial court concluded that so long as the interface was positioned, in part, between the forward end and the trailing end of the projectile, it did not matter if the interface was also positioned outside of that prescribed area.”

Liberty Ammunition, Inc. v. United States, 835 F.3d 1388, 1399 (Fed. Cir. 2016)



Petitioner Ignores *Liberty*

Petition

Id., Fig. 7B (annotated); *see also id.*, Figs. 1A, 6B; Ex. 1003, ¶¶ 348-354. While layer 22 extends over the entirety of the conductive layer 25 below it, this is not precluded by claims 1 or 12. The claims require only that an insulating layer be “disposed over a first portion” of an underlying conductive layer. They do not prohibit the insulating layer from also covering other portions of the same conductive layer.

Pet. 62



Liberty

“In other words, the trial court concluded that so long as the interface was positioned, in part, between the forward end and the trailing end of the projectile, it did not matter if the interface was also positioned outside of that prescribed area.”

Liberty Ammunition, Inc. v. United States, 835 F.3d 1388, 1399 (Fed. Cir. 2016)

Petitioner Ignores *Liberty*



Liberty

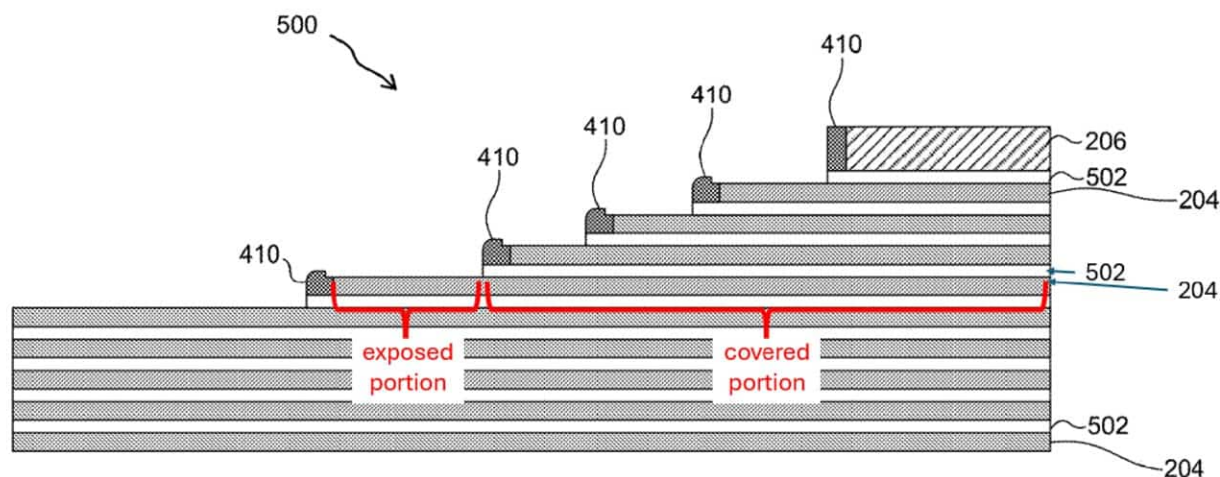
“The trial court’s refusal to limit the projectile’s interface so that it does not extend all of the way to the forward or trailing ends of the projectile goes against this admonition and significantly diminishes the ‘intermediate opposite ends’ limitation, almost to the point of rendering it a nullity.”

The very essence of the ‘intermediate opposite ends’ limitation is to define a precise position for the interface: between the nose and tail ends of the projectile. The trial court’s construction chips away at this precision by permitting an interface that is not only between the opposing ends, but also outside that position to read on the claim language.”

Liberty Ammunition, Inc. v. United States, 835 F.3d 1388, 1399 (Fed. Cir. 2016)

Petitioner Ignores The Specification

Patent Owner's Response



PОР 16

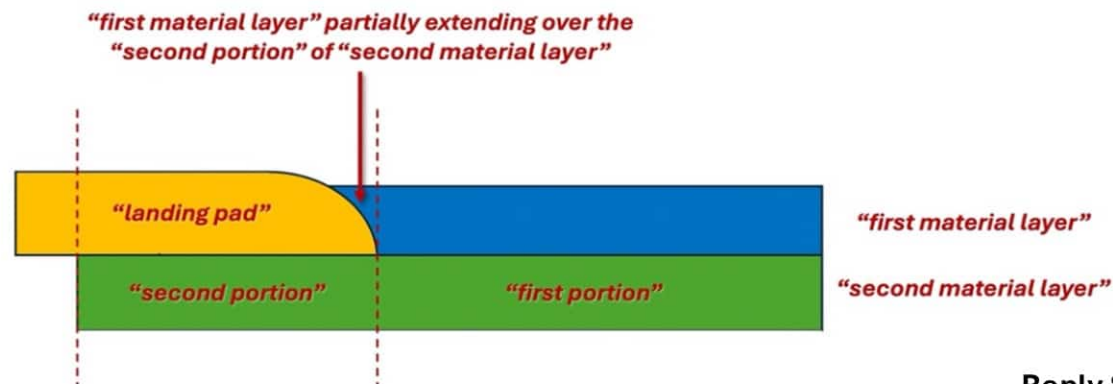
FIG. 5 illustrates a cross-sectional view of a staircase structure **500** after removal of a portion of insulating layer **202**, according to some embodiments. In FIG. 5, the portion of insulating layer **202** of each SC layer of staircase structure **400** is removed using spacers **410** and hard mask layer **206** as masks. Insulating layer **502** is formed after removing the portion of insulating layer **202** using similar techniques as removing insulating layer **102**. As illustrated in FIG. 5, each SC layer of staircase structure **500** exposes a portion of a top surface of sacrificial layer **204** and spacer **410** of each SC layer. In some embodiments, a side of insulating layer **502** of each SC layer of staircase structure **500** is exposed.

Ex. 1001 ('838 Patent), 8:34-45

Petitioner Resorts To Making Up Figures

Reply

Not only does it lack support in the intrinsic record, but Patent Owner's construction improperly excludes the '838 patent's only embodiment. Per Patent Owner, Figure 8 (the only figure showing a complete staircase structure), depicts "landing pads" with a side surface "curved in the x-z plane...." Response, 8. The '838 patent's claims require that the "side surface" be "in contact" with "the first material layer." *E.g.*, '838 patent, claim 1. For there to be contact with this type of curved "side surface," the "first material layer" must at least partially extend over the "second portion" of the "second material layer":



Reply 8

Petitioner Resorts To Making Up Figures

Reply

*"first material layer" partially extending over the
"second portion" of "second material layer"*



Reply 8

Petitioner's Expert

A. ...So a person of ordinary skill in the art looking at this figure would not have concluded there's a -- there's a curve -- curved side. At least it's not conclusive. It appears to be, basically, a straight angle, and then a vertical line.

Ex. 2030 (Jack C. Lee, Ph. D.), 136:1-6

Petitioner's Expert

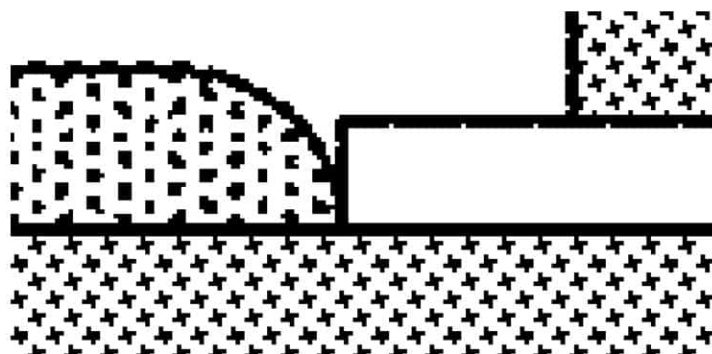
what is shown). The blue "first material layer" includes both insulating layer 502 and whatever other insulation exists between the end of layer 502 and the landing pad 820 (such as dielectric layer 825).

Ex. 1075 (Lee Reply Decl.) ¶ 35

2. The staircase structure of claim 1, further comprising a dielectric layer in contact with a bottom surface of the landing pad, the second side surface of the landing pad, and the side surface of the second portion of the second material layer.

Ex. 1001 ('838 Patent), Claim 2

Petitioner Resorts To Making Up Figures



Ex. 1001 ('838 Patent), Fig. 7 (Zoomed in)

Reply

*"first material layer" partially extending over the
"second portion" of "second material layer"*



Reply 8

Petitioner's Expert

Q. So you'd agree with me that the intersection between 502 and 820 is vertical and perpendicular to the XY plane. Correct?

A. That is correct.

Ex. 2030 (Jack C. Lee, Ph. D.), 136:11-14



Petitioner Ignores The Prosecution History

Reply

Patent Owner also spends pages discussing the prosecution history. Response, 18-21. Neither the Examiner nor the applicant discussed the meaning of either “first portion” or “second portion.” *See* Ex. 1002. Patent Owner itself appears to recognize this, conceding that the prosecution history “suggests neither an expansion nor disavowal of claim scope....” Response, 9; *Renishaw PLC v. Marposs Societa’ per Azioni*, 158 F.3d 1243, 1249 (Fed. Cir. 1998) (non-standard claim term definitions must be set forth in intrinsic record with clarity, deliberateness, or precision).

Reply 7-8



Petitioner Relies On Art The Examiner Had

Petition

The '838 patent also identifies itself as a continuation three other applications. See Ex. 1001, Cover. Prior art was discussed during prosecution of these applications. See, e.g., Exs. 1015-1017. But none of this art was used to reject the '838 patent's claims. See generally Ex. 1002. And none includes the same disclosure as Kim and Lee. Moreover, the claims at issue in these other applications were materially different from claims 1 and 12 of the '838 patent. See, e.g., Ex. 1018, pp. 21-24; Ex. 1019, pp. 36-39; Ex. 1020, pp. 31-32.

Pet. 19

(19) **United States**
(12) **Patent Application Publication**
LEE et al.

(10) **Pub. No.: US 2014/0191389 A1**
(43) **Pub. Date: Jul. 10, 2014**

Ex. 1006 (Lee)

United States Patent Lu et al.

Patent No.: US 12,010,838 B2
Date of Patent: Jun. 11, 2024

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9,006,884 B2 4/2015 Lee et al.
9,331,082 B2 5/2016 Lee et al.

(12) **United States Patent**
Lu et al.

(10) **Patent No.: US 12,010,838 B2**
(45) **Date of Patent: Jun. 11, 2024**

MEMORY

(52) U.S. Cl.
CPC H10B 41/35 (2023.02); H01L 21/0273 (2013.01); H01L 21/31144 (2013.01); (Continued)

(58) **Field of Classification Search**
None
See application file for complete search history.

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9,331,082 B2 5/2016 Lee et al.
(Continued)

Ex. 1001 ('838 Patent)

(12) **United States Patent**
Lee et al.

(10) **Patent No.: US 9,006,884 B2**
(45) **Date of Patent: Apr. 14, 2015**

United States Patent Lee et al.

Patent No.: US 9,006,884 B2
Date of Patent: Apr. 14, 2015

Prior Publication Data

US 2014/0191389 A1 Jul. 10, 2014

CONDUCTOR

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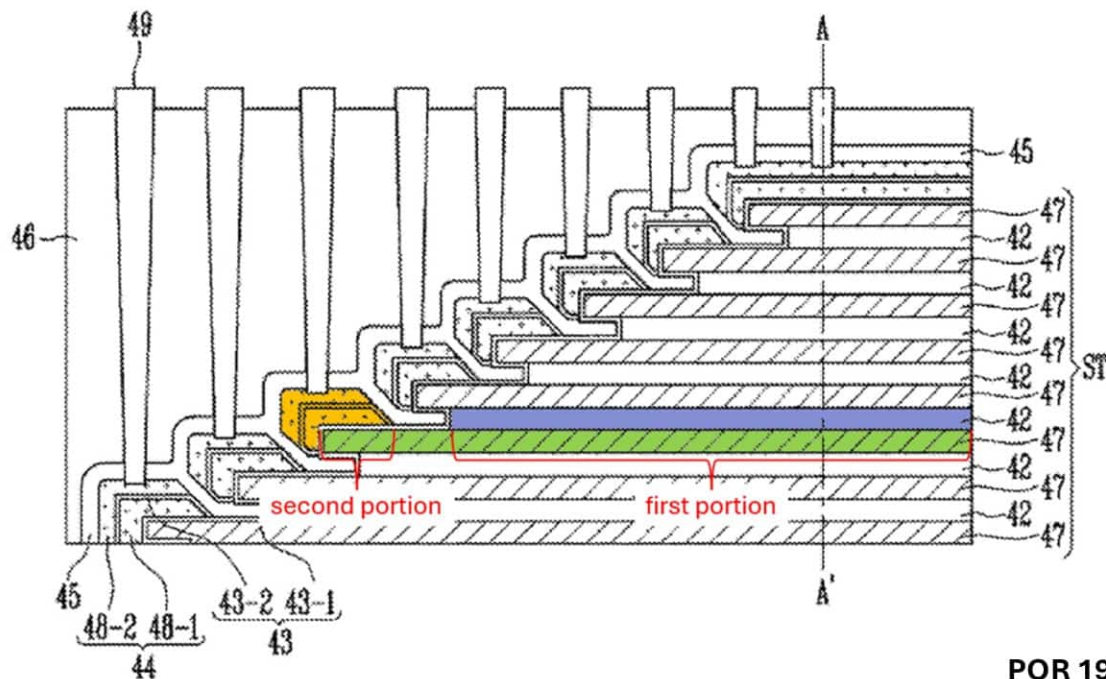
Ex. 2020 ('884 Patent)

(65) **Prior Publication Data**
US 2014/0191389 A1 Jul. 10, 2014

The Prosecution History Supports Patent Owner's Construction

Patent Owner's Response

FIG. 4C



POR 19

Patent Owner's Response

FIG. 2H



POR 20



'838 Patent Overview

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Ground 3 (Lee) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 1 and 5 - Curved Side Surface *Claims 13-15*

Ground 2 (Kim + Yang) *Claims 3, 18*

Ground 4 (Lee + Haller) *Claims 3, 18*



Petitioner Insists On Reading Out Claim Language

Reply

Patent Owner begins by arguing that Kim lacks a “second material layer” with the claimed “first portion” and “second portion.” Response, 42-47. But rather than responding to the Petition’s straightforward argument, Patent Owner fabricated its own, completely different way to characterize Kim. *Id.*, 9-20. According to Patent

Reply 3

Reply

Here, Patent Owner once again ignored the Petition and fabricated its own, different way to characterize the prior art to argue that Lee lacks a “second material layer” with separate, non-overlapping “portion[s]”:

Reply 22

Petitioner's Expert

12. I disagree with Dr. Giapis’s opinion for multiple reasons. First, Dr. Giapis relies on an erroneous claim construction. A POSITA would not understand the claims to be limited in the manner he proposes. Second, Dr. Giapis contradicts and ignores Kim’s own identification and labeling of the different parts of its conductive layers (these Kim identified parts are the “portions” I identified in my original declaration). Third, Dr. Giapis also ignores that Kim’s landing pad is also implemented as a “step.” Such a pad satisfies even his narrow interpretation of the claims. I will address each of these opinions below.

Ex. 1075 (Lee Reply Decl.) ¶ 12



Ground 1 Does Not Rely On Kim Figure 5

Institution Decision

We acknowledge Patent Owner's contention that Petitioner's expert does not cite to Figure 5 of Kim. However, as noted above, the Petition itself does cite to this Figure in its discussion of the landing pad, and is thus considered in our analysis. *See* Pet. 35–36. As such, on the present record, we disagree that the Petition misrepresents Kim's structure and ignores that Kim's first material layer (auxiliary layer 122) surrounds the landing pad on all four sides and extends to the end of the second material layer.

Institution Decision 19



Ground 1 Does Not Rely On Kim Figure 5

Petitioner's Expert

Q. Do you cite in your declaration Figure 5 of Kim?

A. Not in these paragraphs.

Ex. 2030 (Jack C. Lee, Ph. D.), 59:9-11

Petitioner's Expert

Q. Did you cite Figure 5 of Kim anywhere in your declaration?

A. I just searched for it. I don't think so.

Q. So you're not aware of anyplace in your declaration where you cited to Figure 5 of Kim?

A. Not at this moment.

Ex. 2030 (Jack C. Lee, Ph. D.), 59:21-60:5

Board Cannot Adopt Arguments On Behalf Of Petitioner



Magnum Oil

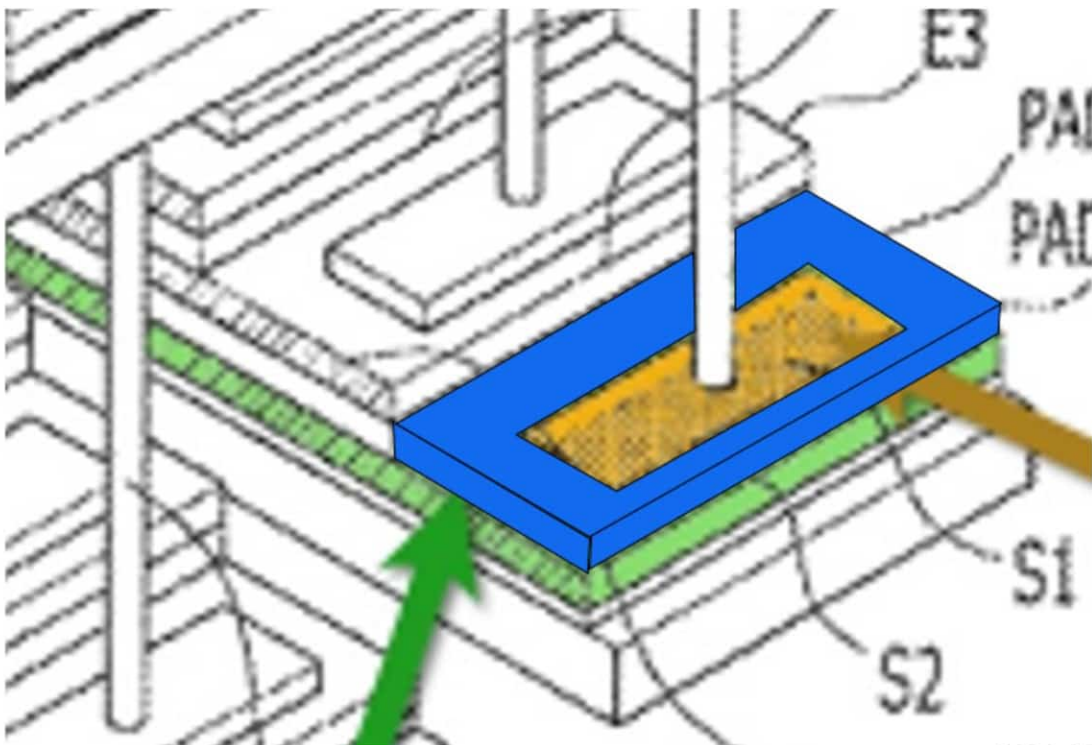
“[W]e find no support for the PTO’s position that the Board is free to adopt arguments on behalf of petitioners that could have been, but were not, raised by the petitioner during an IPR. ... Here, it was petitioner’s burden to demonstrate both that a skilled artisan would have been motivated to combine the teachings of the prior art references to achieve the claimed invention, and that the skill artisan would have had a reasonable expectation of success in doing so.”

In re Magnum Oil Tools Int’l, Ltd., 829 F.3d 1364, 1381 (Fed. Cir. 2016) (quotations omitted and cleaned up)



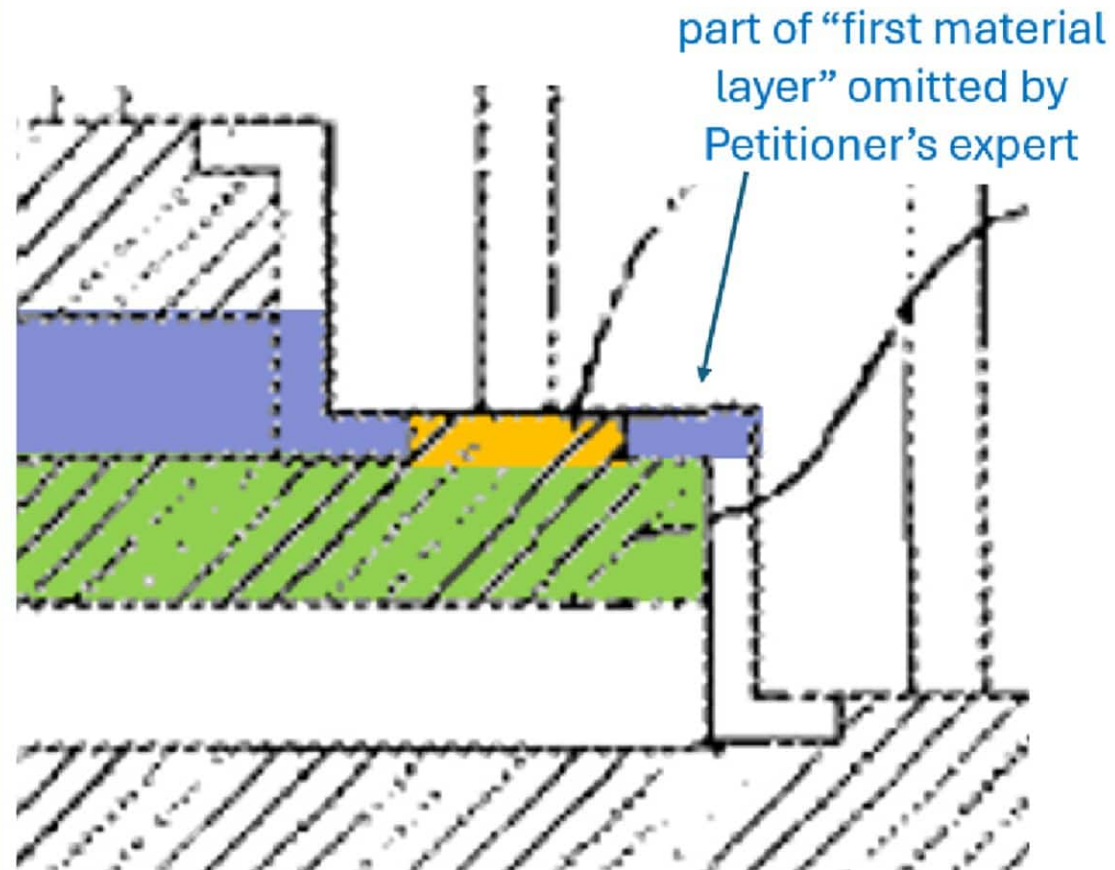
Island Pads Fail To Show Lateral Displacement

Patent Owner's Response



POR 45

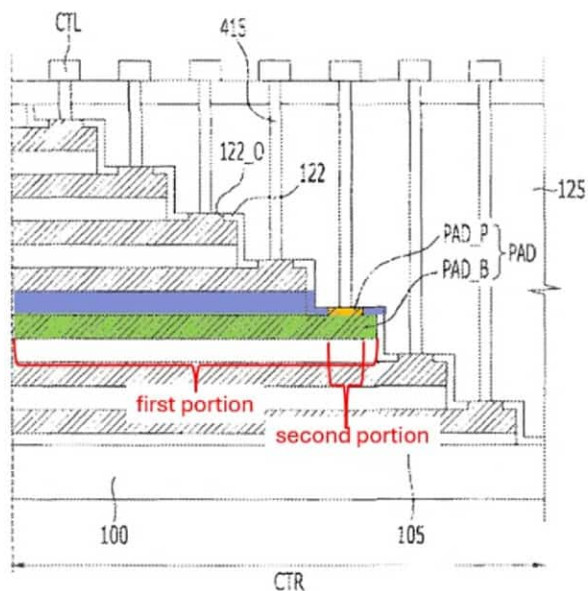
Patent Owner's Response



POR 46

Petitioner And Dr. Lee Do Not Address The Arguments

Petitioner's Expert



Id., ¶ 107. Dr. Giapis then concludes that this cannot satisfy the claims, because “Kim’s ‘first portion’ and the ‘second portion’ of the second material layer overlap.”

Id. Indeed, Dr. Giapis goes so far to argue that the ’838 patent’s claims somehow exclude all “island shaped” landing pads. *Id.*, ¶ 108.

Ex. 1075 (Lee Reply Decl.) ¶ 11

Patent Owner's Expert

108. By ignoring Kim’s express teachings, Petitioner’s expert’s labels are entirely arbitrary and hindsight-driven. As claims 1 and 12 require, there is a correspondence between the “first material layer” and the “first portion of the second material layer.” Likewise, there is a correspondence between the “landing pad” and the “second portion of the second material layer.” Thus, in light of Kim’s teachings, the “second portion” is an island shaped portion in the second material layer just below the PAD_P landing pad. But an island shaped “second portion” does not render claims 1 and 12 obvious because it does not show “the second side surface [of the landing pad] is laterally displaced from a side surface of the second portion of the second material layer” as required. Instead, they are coterminous when viewed from above and there is no lateral displacement.

Ex. 2019 (Giapis Decl.) ¶ 108



'838 Patent Overview

Claim Construction - Portions

Ground 1 (Kim) *Claims 1, 4-7, 12, 16-17, 19-20*

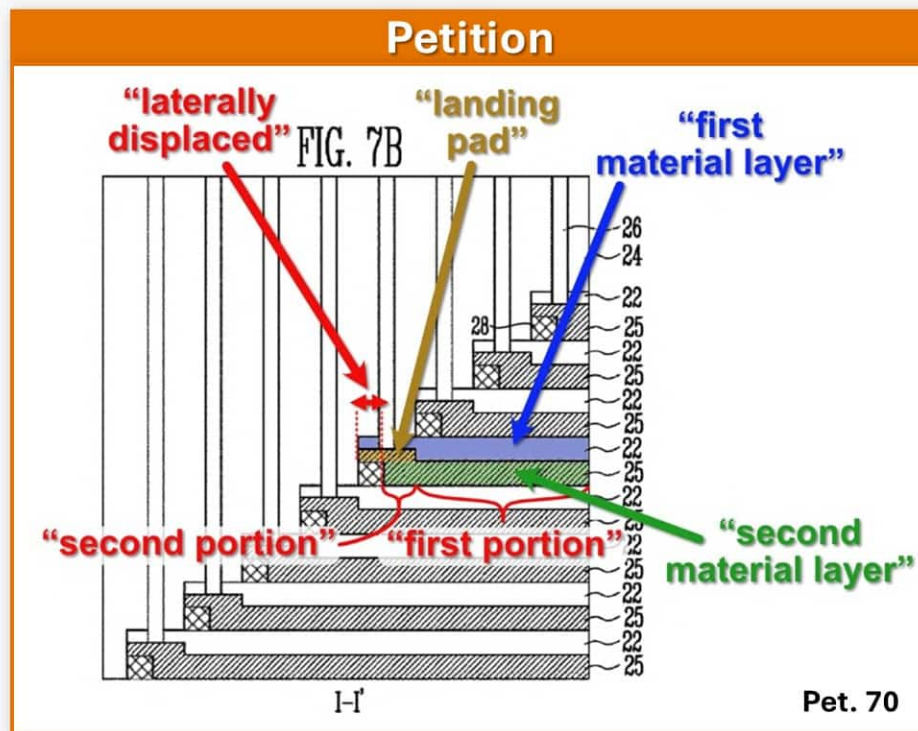
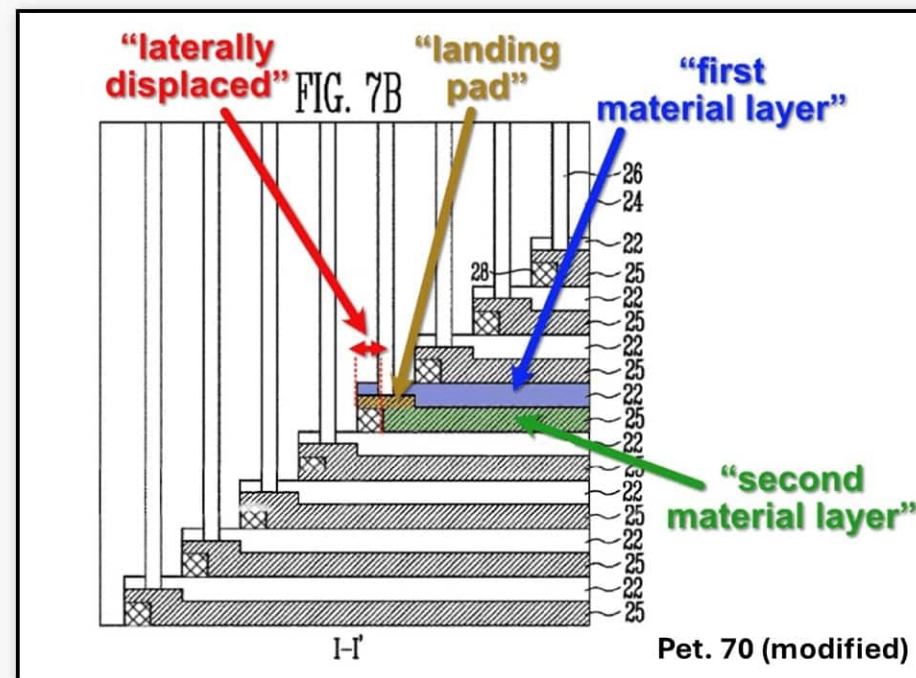
Ground 3 (Lee) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 1 and 5 - Curved Side Surface *Claims 13-15*

Ground 2 (Kim + Yang) *Claims 3, 18*

Ground 4 (Lee + Haller) *Claims 3, 18*

Lee Does Not Have A “first portion”



1. A staircase structure of a memory device, comprising: a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and

Ex. 1001 ('838 Patent), Claim 1



'838 Patent Overview

Claim Construction - Portions

Ground 1 (Kim) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 3 (Lee) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 1 and 5 - Curved Side Surface *Claims 13-15*

I. Claim Construction

II. **Ground 1 (Kim)** *Claims 13-15*

III. **Ground 5 (Lee + Park)** *Claims 13-15*

Ground 2 (Kim + Yang) *Claims 3, 18*

Ground 4 (Lee + Haller) *Claims 3, 18*



Construction Of “curved side surface”

A “curved side surface” is a vertical surface curved along a direction (e.g., the z-axis), perpendicular to the top surface of the structure

Claim Language Supports Patent Owner's Construction

12. A memory device, comprising:

- a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and
- a landing pad disposed over a second portion of the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

13. The memory device of claim 12, wherein the first side surface comprises a curved side surface.

1. A staircase structure of a memory device, comprising:
a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and
a landing pad disposed over a second portion of the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

2. The staircase structure of claim 1, further comprising a dielectric layer in contact with a bottom surface of the landing pad, the second side surface of the landing pad, and the side surface of the second portion of the second material layer.

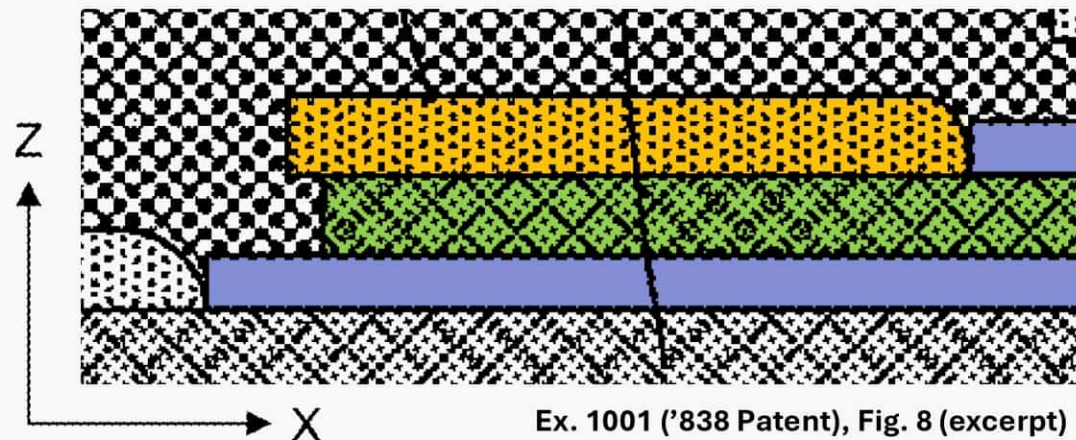
Ex. 1001 ('838 Patent), Claims 1-2, 12-13

Claim Language Supports Patent Owner's Construction

1. A staircase structure of a memory device, comprising:
a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and
a landing pad disposed over a second portion of the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

2. The staircase structure of claim 1, further comprising a dielectric layer in contact with a bottom surface of the landing pad, the second side surface of the landing pad, and the side surface of the second portion of the second material layer.

Ex. 1001 ('838 Patent), Claims 1-2



Ex. 1001 ('838 Patent), Fig. 8 (excerpt)

Petitioner's Expert

Q. So the top surface of the substrate is a horizontal surface; is that fair to say?

A. **The top surface of the substrate is a horizontal surface parallel to the x-axis.**

Ex. 2031 (Jack C. Lee, Ph. D.), 48:1-6

Q. Got it. So when the '666 patent refers to a top surface, it's referring to a horizontal surface; is that fair?

A. **Yes. The top surface is a horizontal surface parallel to the top surface and the bottom surface of the substrate parallel to the x-y plane.**

Ex. 2031 (Jack C. Lee, Ph. D.), 69:3-9



Claim Language Supports Patent Owner's Construction

1. A semiconductor structure, comprising:
a substrate; and
a staircase structure disposed over the substrate, wherein the staircase structure comprises:
a plurality of layer stacks, each layer stack comprising a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and
a plurality of landing pads respectively disposed on the plurality of layer stacks, wherein each landing pad is disposed over a second portion of the second material layer of a respective layer stack of the plurality of layer stacks, and wherein the each landing pad comprises:
a bottom surface; and
a top surface opposite to the bottom surface, wherein the top surface is above an other top surface of the first material layer of the respective layer stack.

Ex. 2021 ('666 Patent), Claim 1

2. The semiconductor structure of claim 1, wherein each of the plurality of landing pads comprises a first side surface and a second side surface, wherein the first side surface is in contact with the first material layer of the respective layer stack, and wherein the second side surface is laterally displaced from a third side surface of the second portion of the second material layer of the respective layer stack.

Ex. 2021 ('666 Patent), Claim 2

Petitioner's Expert

Q. So by claims 1 and 2 claiming a top and bottom surface, the term "side surface" in claim 1 and 2 excludes top and bottom surfaces, fair?

A. I said that the applicants knew how to craft a claim that exclude the top and bottom surfaces of a layer from the scope of the term "side surface," in claim 1 and 2, but not in claim 17. Okay? That exclusion only applied to claim 1 and 2. But the applicant deliberately chose not to do so in claim 17.

Ex. 2047 (Jack C. Lee, Ph. D.), 133-141 (65:7-73:8)



Claim Language Supports Patent Owner's Construction

1. A staircase structure of a memory device, comprising:
a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and
a landing pad disposed over a second portion of the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

2. The staircase structure of claim 1, further comprising a dielectric layer in contact with a bottom surface of the landing pad, the second side surface of the landing pad, and the side surface of the second portion of the second material layer.

Ex. 1001 ('838 Patent), Claims 1-2

Petitioner's Expert

Q. So by claims 1 and 2 claiming a top and bottom surface, the term "side surface" in claim 1 and 2 excludes top and bottom surfaces, fair?

A. I said that the applicants knew how to craft a claim that exclude the top and bottom surfaces of a layer from the scope of the term "side surface," in claim 1 and 2, but not in claim 17. Okay? That exclusion only applied to claim 1 and 2. But the applicant deliberately chose not to do so in claim 17.

Ex. 2047 (Jack C. Lee, Ph. D.), 133-141 (65:7-73:8)

Petitioner Misapplies Claim Construction Law

- The same claim term should be construed consistently



In re Varma

“[T]he principle that the same phrase in different claims of the same patent should have the same meaning is a strong one, overcome only if ‘it is clear’ that the same phrase has different meanings in different claims.”

In re Varma, 816 F.3d 1352, 1363 (Fed. Cir. 2016) (internal citations omitted)



Phillips v. AWH

“Because claim terms are normally used consistently throughout the patent, the usage of a term in one claim can often illuminate the meaning of the same term in other claims.”

Phillips v. AWH Corp., 415 F.3d 1303, 1314 (Fed. Cir. 2005) (internal citations omitted)

Specification Supports Patent Owner's Construction

1. A staircase structure of a memory device, comprising: a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and a landing pad disposed over a second portion of the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

2. The staircase structure of claim 1, further comprising a dielectric layer in contact with a bottom surface of the landing pad, the second side surface of the landing pad, and the side surface of the second portion of the second material layer.

Ex. 1001 ('838 Patent), Claims 1-2

In the present disclosure, a staircase structure refers to a set of surfaces that include at least two horizontal surfaces (e.g., along an x-y plane) and at least two vertical surfaces (e.g., along a z-axis). Each horizontal surface is adjoined to a first vertical surface that extends upward from a first edge of the horizontal surface, and is also adjoined to a second vertical surface that extends downward from a second edge of the horizontal surface. Each of the horizontal surfaces is referred as a “step” or “stair” of the staircase structure. A horizontal direction can refer to a direction (e.g., the x-axis or the y-axis) parallel with a top surface of the substrate (e.g., the substrate that provides the fabrication platform for formation of structures over it). A vertical direction can refer to a direction (e.g., the z-axis) perpendicular to the top surface of the structure.

Ex. 1001 ('838 Patent), 5:47-61

A “curved side surface” is a vertical surface curved along a direction (e.g., the z-axis), perpendicular to the top surface of the structure



Specification Supports Patent Owner's Construction

Patent Owner's Expert

67. The specification supports my opinion as well. In particular, the patent references a “top surface” or “bottom surface” 28 times. Every reference to a “top” or “bottom” surface would have been understood to refer to a horizontal surface. Meanwhile, the '838 patent refers to a “side” surface (without the modifier “top” or “bottom”) 60 times, each time referring to a vertical surface. This is detailed in my discussion below and reflects consistent usage throughout the specification of any “side surface” being a vertical surface.

Ex. 2019 (Giapis Decl.) ¶ 67

Specification Supports Patent Owner's Construction

As used herein, the term “substrate” refers to a material onto which subsequent material layers are added. The substrate includes a top surface and a bottom surface. The top surface of the substrate is where a semiconductor device is formed, and therefore the semiconductor device is formed at a top side of the substrate. The bottom surface is opposite to the top surface and therefore a bottom side of the substrate is opposite to the top side of the substrate. The substrate itself can be patterned. Materials added on top of the substrate can be patterned or can remain unpatterned. Furthermore, the substrate can include a wide array of semiconductor materials, such as silicon, germanium, gallium arsenide, indium phosphide, etc. Alternatively, the substrate can be made from an electrically non-conductive material, such as a glass, a plastic, or a sapphire wafer.

As used herein, the term “layer” refers to a material portion including a region with a thickness. A layer has a top side and a bottom side where the bottom side of the layer is relatively close to the substrate and the top side is relatively away from the substrate. A layer can extend over the entirety

Ex. 1001 ('838 Patent), 4:24-43

File History Supports Patent Owner's Construction

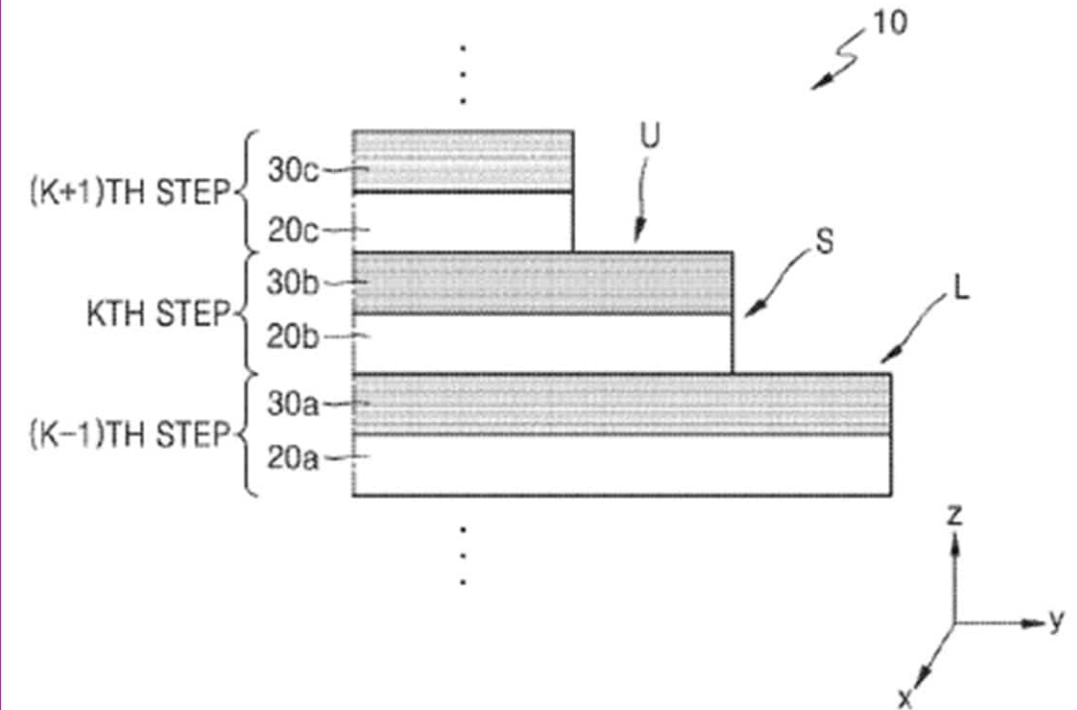
Patent Owner's Response

Id. Fig. 6A. Thus, the cited prior art, like the '838 patent, describes “side surfaces” as being vertical surfaces, as opposed to horizontal surfaces, which are described as either “top”/“bottom”/“upper”/“lower” “surfaces.” *See, e.g., Id.* [0103], Fig. 6A; '838 patent 7:6-12, 8:1-7, 8:16-65, cls. 1-3, 6, 8, 11-15, 18, 20.

POR 40

Patent Owner's Response

FIG. 6A



POR 40

Petitioner Ignores The Intrinsic Evidence

12. A memory device, comprising:

- a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and
- a landing pad disposed over a second portion of the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

13. The memory device of claim 12, wherein the first side surface comprises a curved  surface.

Ex. 1001 ('838 Patent), Claims 12-13

Petitioner's Expert

58. Again, it is my opinion that none of the '838 patent's claim terms require construction: they are all readily understandable. This includes the term "curved side surface." The term "curved side surface" would be understood to simply refer to a surface that is curved, i.e., deviating from a planar surface, without limitation to a particular axis or orientation, i.e., there is no requirement that the curve be in the vertical z-axis direction, perpendicular to a substrate surface, or the like. Any curved surface qualifies.

Ex. 1075 (Lee Reply Decl.) ¶ 58

Petitioner Ignores The Intrinsic Evidence

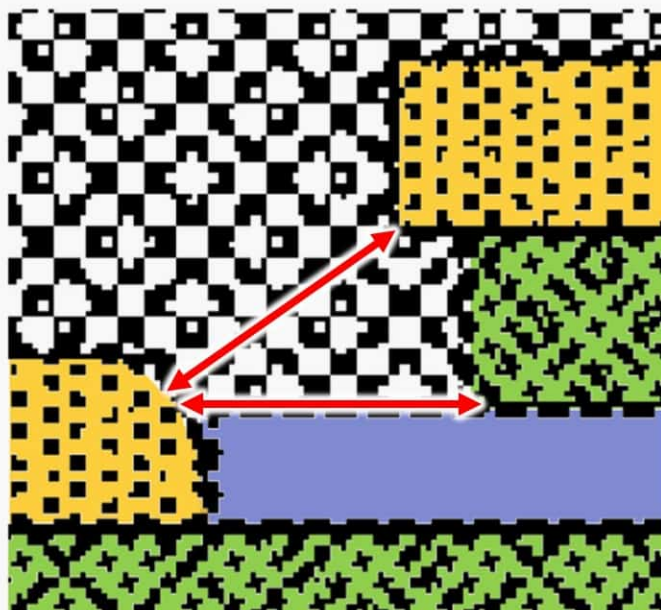
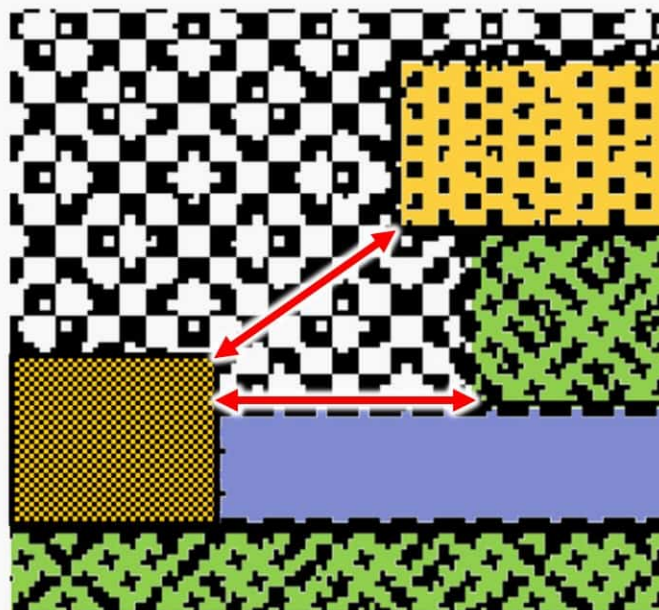


Fig. 8 of the '838 Patent
(zoomed in with annotations)



Other Structures

Ex. 2019 (Giapis Decl.) ¶ 43-44

Petitioner's Expert

245. Additionally, a POSITA would have recognized that using a “curved” side surface with Kim’s pads would have improved Kim by increasing the minimum distance between the pad and adjacent conductive layers, thereby reducing the risk of short circuit.

Ex. 1003 (Lee Decl.) ¶ 245

Petitioner's Expert

94. Kim explains both that its pads can have different widths (Kim, 11:57-12:7) and different shapes (*id.*, 8:29-34). A POSITA would have understood that a rounded contact pad that is slightly wider than a square or rectangular pad is one of the shapes Kim contemplates for use. Moreover, a rounded pad would have provided two clear benefits: (1) the bottom of the pad would be wider, thus producing a more extensive thicker area for purposes of preventing contact punch-through during manufacture while (2) the top of the pad would be narrower, which would increase the distance between the pads and adjacent conductive structures.

Ex. 1075 (Lee Reply Decl.) ¶ 94



No Dispute That Depicted Curve Is Curved Along Vertical Direction

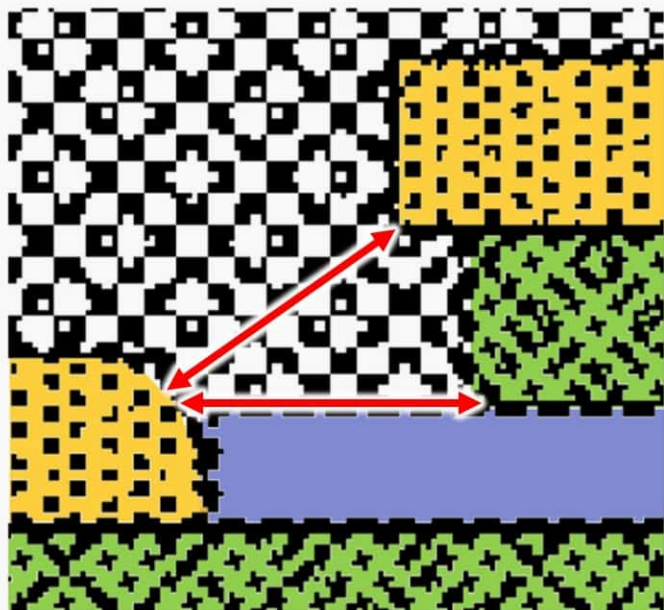


Fig. 8 of the '838 Patent
(zoomed in with annotations)

Ex. 2019 (Giapis Decl.) ¶ 43-44

Petitioner's Expert

Q. Okay. But I don't think that answered my question. I'm just asking, are there any processes described in the '666 patent that would form a curved side surface curved along the X-Y direction?

A. Well, the deposition techniques such as LPCVD and ALD by themselves would not produce vertically curved landing pad side surface like those shown in the '666 patent. And these techniques can, however, produce landing pad that a curve in x-y plane, as I describe in paragraph 29.

Ex. 2047 (Jack C. Lee, Ph. D.), 162 (94:4-15)



Petitioner Ignores The Intrinsic Evidence

'838 Patent

Top View of Fig. 8

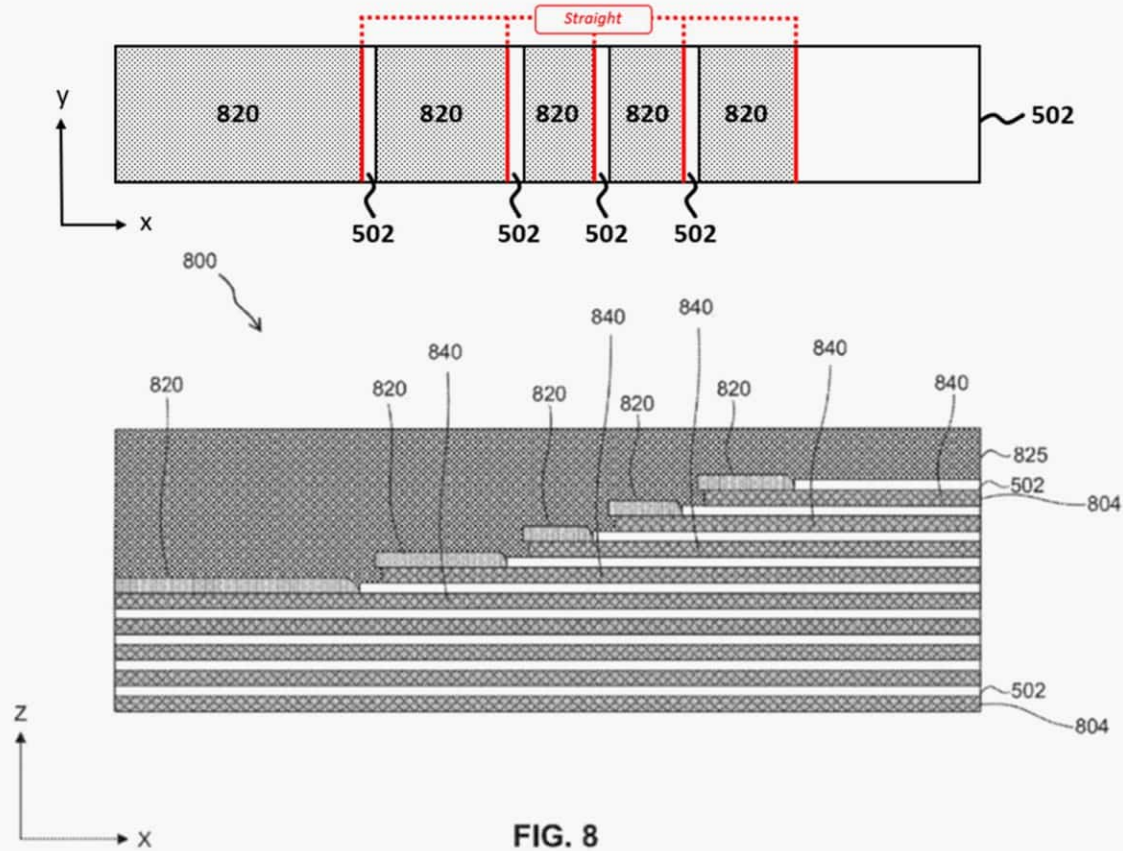


FIG. 8

POR 35; Ex. 2019 (Giapis Decl.) ¶ 79-80

NOT '838 Patent

Top and Side View of Fig. 8 if Curved in X-Y Plane and Not X-Z Plane

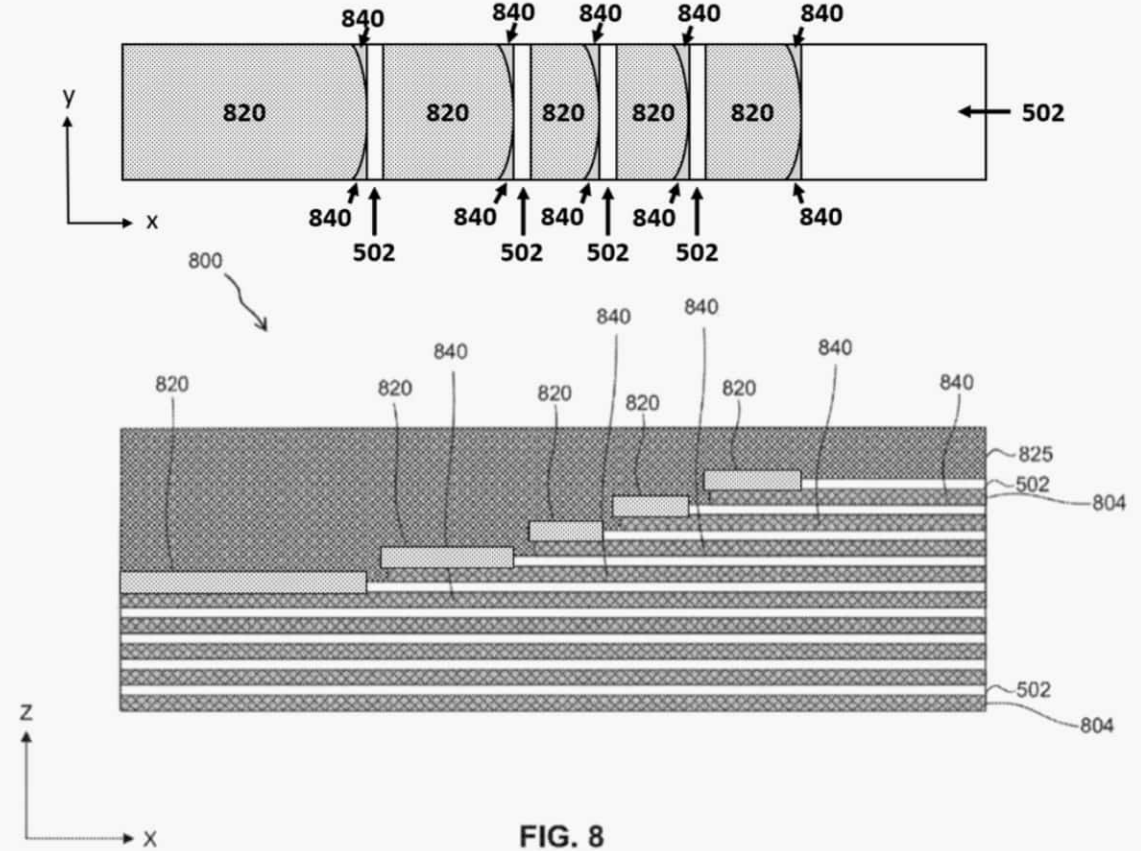


FIG. 8

POR 38; Ex. 2019 (Giapis Decl.) ¶ 83

Petitioner Ignores The Intrinsic Evidence

■ Petitioner incorrectly argues that PO's construction limits to one embodiment

Petitioner's Reply

Patent Owner also argues that “curved side surface” must be narrowly interpreted because the patent’s “only embodiment”—shown in Figure 8—includes a vertically oriented surface that is purportedly curved in the z-axis direction. Response, 30-31. Patent Owner similarly posits that this “is the only kind of curved side surface that can be formed from the only process disclosed in the ’838 patent.” *Id.*, 32. But the ’838 patent makes clear that Figure 8 is an “embodiment[.]” ’838 patent, 1:41-45, 2:66-3:4, 13:14-40. The claims cannot properly be limited to just this. *Promptu Sys.*, 92 F.4th at 1379. Further, the specification says nothing about how “curved” pad sides are to be formed. It does not mention use of a method with “directional and isotropic flux components” like that discussed by Patent Owner (Response, 32-33). Instead, the patent is expressly open to the use of “any suitable deposition techniques” capable of forming a variety of structures. ’838 patent, 2:41-47, 8:66-9:12; Ex. 1079, 34:3-35:8 (CVD can produce good step coverage); Ex. 1075, ¶¶ 70-75. Nor does the prosecution history re-define “curved side surface” in

Reply 14-15

12. A memory device, comprising:

- a first material layer and a second material layer, wherein the first material layer is disposed over a first portion of the second material layer; and
- a landing pad disposed over a second portion of the second material layer, wherein the landing pad comprises a first side surface and a second side surface, and wherein the first side surface is in contact with the first material layer and the second side surface is laterally displaced from a side surface of the second portion of the second material layer.

13. The memory device of claim 12, wherein the first side surface comprises a curved side surface.

Ex. 1001 ('838 Patent), Claims 12-13

Petitioner Ignores The Intrinsic Evidence

■ Petitioner incorrectly argues that PO's construction limits to one embodiment

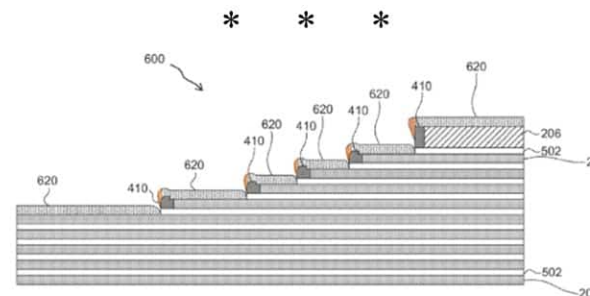
Petitioner's Reply

Patent Owner also argues that “curved side surface” must be narrowly interpreted because the patent’s “only embodiment”—shown in Figure 8—includes a vertically oriented surface that is purportedly curved in the z-axis direction. Response, 30-31. Patent Owner similarly posits that this “is the only kind of curved side surface that can be formed from the only process disclosed in the ’838 patent.” *Id.*, 32. But the ’838 patent makes clear that Figure 8 is an “embodiment[.]” ’838 patent, 1:41-45, 2:66-3:4, 13:14-40. The claims cannot properly be limited to just this. *Promptu Sys.*, 92 F.4th at 1379. Further, the specification says nothing about how “curved” pad sides are to be formed. It does not mention use of a method with “directional and isotropic flux components” like that discussed by Patent Owner (Response, 32-33). Instead, the patent is expressly open to the use of “any suitable deposition techniques” capable of forming a variety of structures. ’838 patent, 2:41-47, 8:66-9:12; Ex. 1079, 34:3-35:8 (CVD can produce good step coverage); Ex. 1075, ¶¶ 70-75. Nor does the prosecution history re-define “curved side surface” in

Reply 14-15

Patent Owner's Expert

36. A dielectric material is deposited onto the staircase structure so that the ensuing “layer 620 has poor step coverage on staircase structure 500.” ’838 patent 8:56-57. A POSITA would have understood what the ’838 patent meant by “poor step coverage.” See, e.g., Plummer (Ex. 2028) 509-510. The term



’838 patent Fig. 6 (annotated).

37. The overhang reduces (shadows) further the delivery of additional depositing molecules to the bottom corner of each step from the space above the structure. As the overhang grows out, progressively less-and-less material is deposited directly below it, resulting in a layer (620) with a surface that curves into the corner by the step sidewall, precisely where layer 620 meets the insulating layer 502 of the respective layer stack. ’838 patent 8:46-9:12, 12:37-49, Fig. 6.

Ex. 2019 (Giapis Decl.) ¶¶ 36-37

Petitioner Ignores The Intrinsic Evidence

■ Petitioner incorrectly argues that PO's construction limits to one embodiment

Petitioner's Reply

Patent Owner also argues that “curved side surface” must be narrowly interpreted because the patent’s “only embodiment”—shown in Figure 8—includes a vertically oriented surface that is purportedly curved in the z-axis direction. Response, 30-31. Patent Owner similarly posits that this “is the only kind of curved side surface that can be formed from the only process disclosed in the ’838 patent.” *Id.*, 32. But the ’838 patent makes clear that Figure 8 is an “embodiment[.]” ’838 patent, 1:41-45, 2:66-3:4, 13:14-40. The claims cannot properly be limited to just this. *Promptu Sys.*, 92 F.4th at 1379. Further, the specification says nothing about how “curved” pad sides are to be formed. It does not mention use of a method with “directional and isotropic flux components” like that discussed by Patent Owner (Response, 32-33). Instead, the patent is expressly open to the use of “any suitable deposition techniques” capable of forming a variety of structures. ’838 patent, 2:41-47, 8:66-9:12; Ex. 1079, 34:3-35:8 (CVD can produce good step coverage); Ex. 1075, ¶¶ 70-75. Nor does the prosecution history re-define “curved side surface” in

Reply 14-15

Petitioner's Expert

Q. In column 8, lines 51 through 52 of the ’666 patent, it says “In some embodiments, dielectric layer 620 has poor step-coverage on staircase structure 500,” correct?

A. That’s what it says in that -- in column 8, line 51 to 52.

Q. What is “poor step-coverage”?

A. Well, a step-coverage -- right? --

Q. Uh-huh.

A. -- and I -- let me go to my declaration. Sorry. (Pause in testimony.)

A. We don’t talk about that. I’m trying to see.

Ex. 2031 (Jack C. Lee, Ph. D.), 81:5-20



A POSITA Understands Relationship Between Process And Structure

Petitioner's Expert

Q. Is the structure of a landing pad determined by the manufacturing process used to create it?

A. Of course.

Ex. 2047 (Jack C. Lee, Ph. D.), 210 (142:13-16)



Patent Owner's Construction Follows Federal Circuit Precedent



Phillips

“Ultimately, the interpretation to be given a term can only be determined and confirmed with a full understanding of what the inventors actually invented and intended to envelop with the claim. The construction that stays true to the claim language and most naturally aligns with the patent’s description of the invention will be, in the end, the correct construction.”

Phillips v. AWH Corp., 415 F.3d 1303, 1316 (Fed. Cir. 2005) (internal citation omitted)



'838 Patent Overview

Claim Construction - Portions

Ground 1 (Kim) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 3 (Lee) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 1 and 5 - Curved Side Surface *Claims 13-15*

I. Claim Construction

II. Ground 1 (Kim) *Claims 13-15*

III. Ground 5 (Lee + Park) *Claims 13-15*

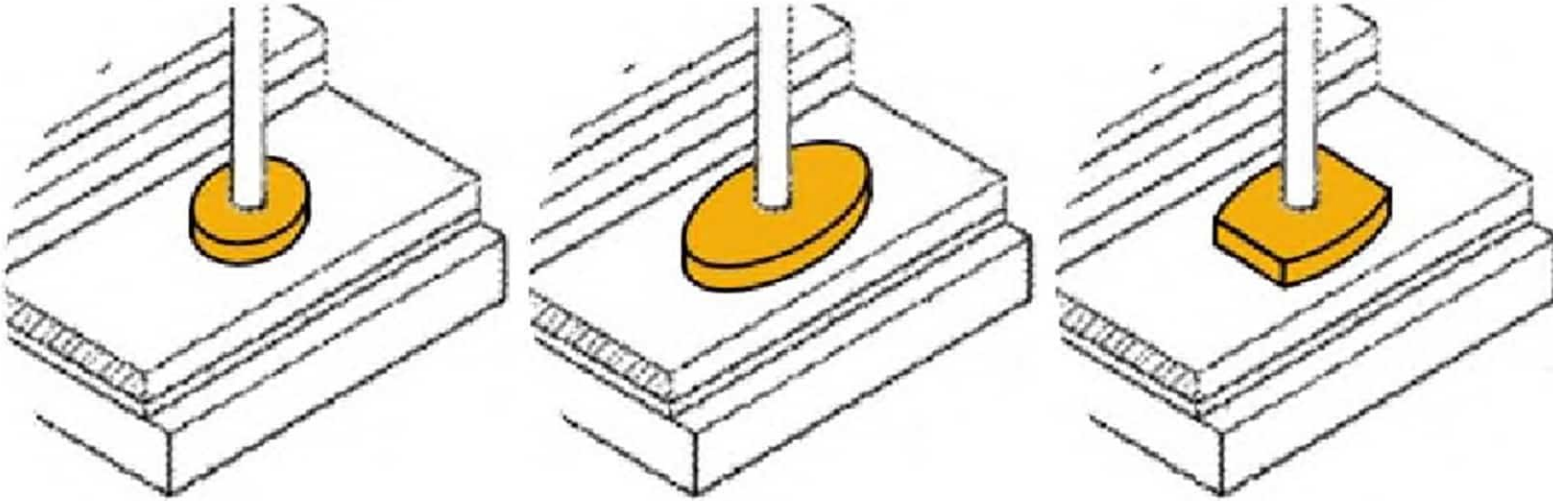
Ground 2 (Kim + Yang) *Claims 3, 18*

Ground 4 (Lee + Haller) *Claims 3, 18*



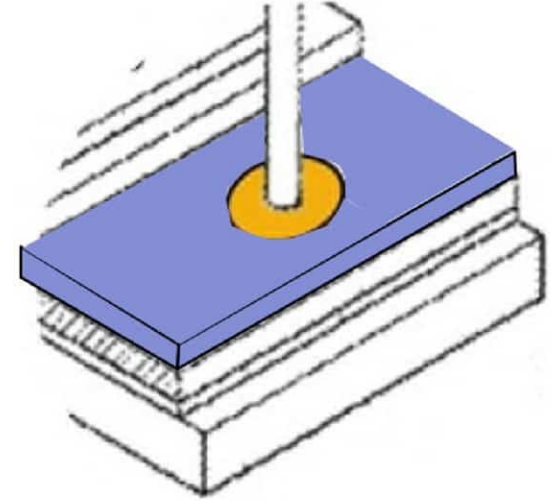
Kim's Island Cylindrical Pads Do Not Show The Independent Claims

Petition



Pet. 47

Patent Owner's Expert

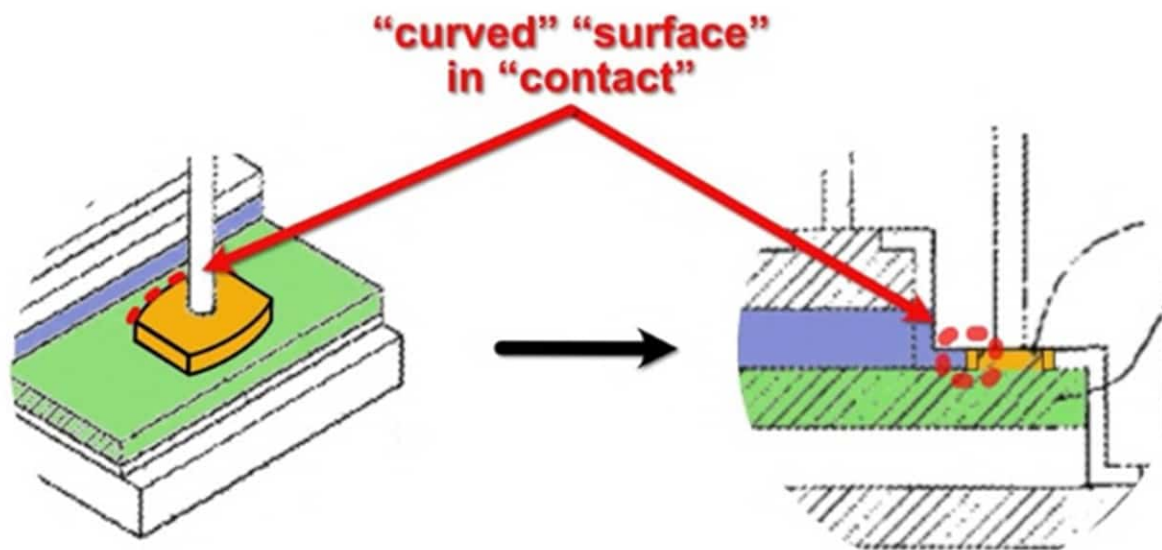


Ex. 2019 (Giapis Decl.) ¶ 219

Kim's Cylindrical Pads Are Not A “curved side surface”

Petitioner's Reply

Generally cylindrical pad:



Reply 12

Ground 1 Is Kim Alone

Petition

Petitioner challenges claims 1, 3-7, and 12-20 on the following grounds:

Ground 1: Claims 1, 4-7, and 12-17, and 19-20 are obvious over Kim;

Ground 2: Claims 3 and 18 are obvious over Kim and Yang;

Ground 3: Claims 1, 4-7, 12, 16-17, and 19-20 are obvious over Lee;

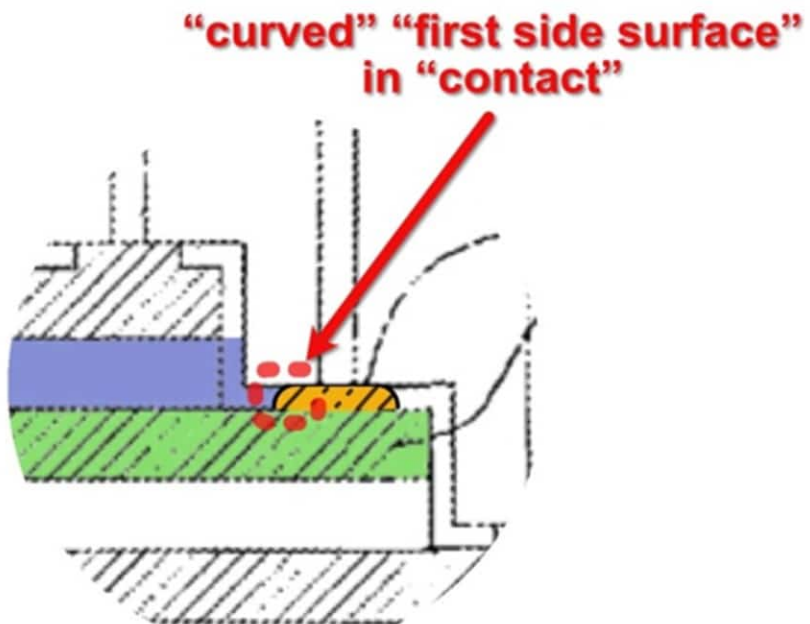
Ground 4: Claims 3 and 18 are obvious over Lee and Haller; and

Ground 5: Claims 13, 14, and 15 are obvious over Lee and Park.

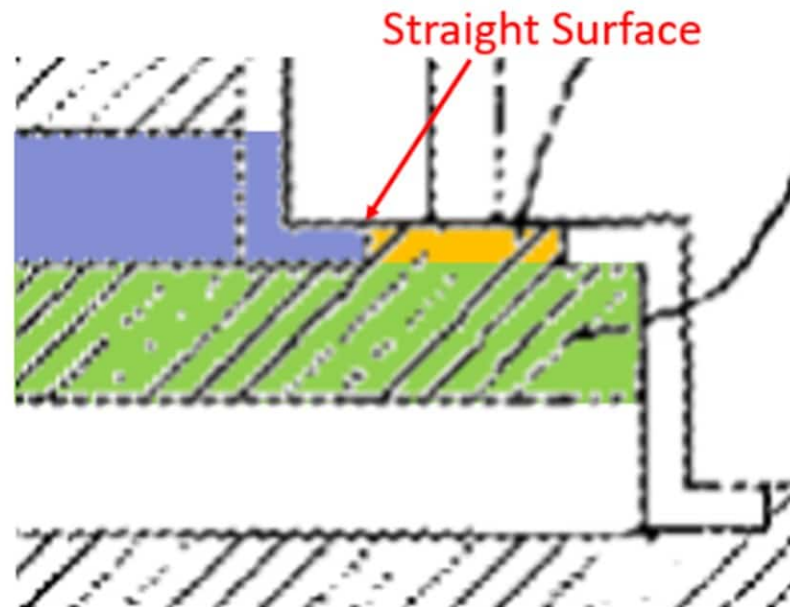
Kim Does Not Teach A “curved side surface”

Patent Owner's Response

Petitioner's Modified Figure (Pet. 42)



Actual Figure from Kim

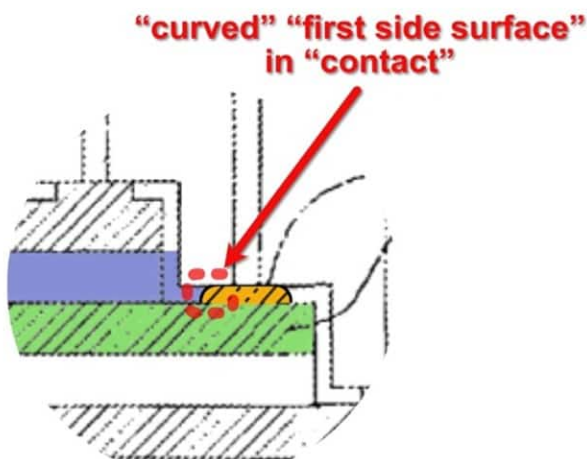


POR 49

Dr. Lee's *Ipse Dixit* Is Insufficient

Petition

For example, a POSITA would have understood that when Kim references a “curved surface based on a virtual rectangular parallel[] shape,” PAD_P would obviously be shaped in the manner shown in the demonstrative below:



Ex. 1003, ¶¶ 222-225 (annotated, modified). As can be seen, just as Kim teaches,

Pet. 41-42

Petitioner's Expert

224. In my opinion, a POSITA would have understood that this teaches a variety of different protrusion pad PAD_P shapes, many of which have the type of “*curved*” side surface Claim 13 requires. This includes, for instance, pads with curved sides when viewed in cross-section or pads with curved sides when viewed above.

225. More particularly, a POSITA would have understood that when Kim references a “curved surface based on a virtual rectangular parallel[] shape,” PAD_P would obviously be shaped in the manner shown in the demonstrative below. This demonstrative was created using an expanded version of Figure 4B. The rectangular pad shown by that figure has been replaced with a pad with curved sides following Kim’s teachings:

Ex. 1003 (Lee Decl.) ¶¶ 224-225



Ground 1 Is Kim Alone – But Petitioner Relies On Combinations

Petitioner's Reply

Patent Owner's arguments regarding Kim's pads that are "curved" in cross section also lack merit. Here, Patent Owner wrongly characterizes the Petition as trying to "alter" Kim by substituting various prior art pad designs into Kim. *E.g.*, Response, 54-55. This, however, is something a POSITA would have understood that Kim already teaches. Kim references not only "cylindrical" pads but also pads that "includ[e] a curved surface..." Kim, 8:29-35. A POSITA would have considered this to be an obvious reference to the types of vertically curved pads routinely disclosed in and used by the art. Petition, 42-45 (Exs. 1009, 1021, and 1022 examples of "curved" pads); Ex. 1076, 77:12-78:5 (Kim open to other pad

Reply 15



Ground 1 Is Kim Alone – But Petitioner Relies On Combinations

Petitioner's Reply

Here Patent Owner appears to improperly assume that Kim is limited to just one pad manufacturing method. It is not. Kim repeatedly makes clear that the process it discusses is merely an example. Kim, 12:12-15 (“some embodiments” employ the discussed method); 12:38-42 (“not limited” to its example process); 12:61-13:4 (“ion injection process may be performed”) (all emphasis added). In other words, Kim allows for use of any method capable of producing the types of contact pads it discusses. Park (Ex. 1009), Nam (Ex. 1022), and Yun (Ex. 1021) all provide examples of how “curved” pads would be manufactured. Petition, 32-45; Ex. 1003, ¶¶ 226-240, 251-260.

Next, even if a POSITA did attempt to maintain as much of Kim’s existing manufacturing process as possible, a rounded contact pad would still have been readily achievable. The Petition—and Petitioner’s expert Dr. Lee—already

Reply 16



Ground 1 Is Kim Alone – But Petitioner Relies On Combinations

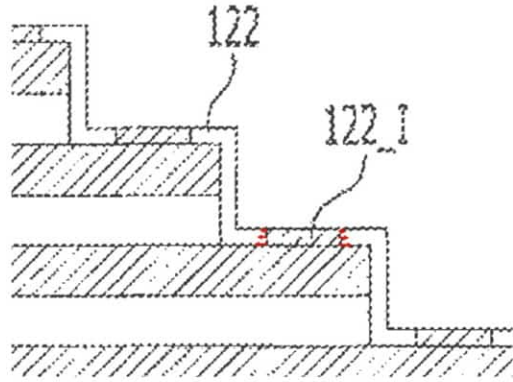
Petitioner's Reply

Here Patent Owner appears to improperly assume that Kim is limited to just one pad manufacturing method. It is not. Kim repeatedly makes clear that the process it discusses is merely an example. Kim, 12:12-15 (“some embodiments” employ the discussed method); 12:38-42 (“not limited” to its example process); 12:61-13:4 (“ion injection process may be performed”) (all emphasis added). In other words, Kim allows for use of any method capable of producing the types of contact pads it discusses. Park (Ex. 1009), Nam (Ex. 1022), and Yun (Ex. 1021) all provide examples of how “curved” pads would be manufactured. Petition, 32-45; Ex. 1003, ¶¶ 226-240, 251-260.

Next, even if a POSITA did attempt to maintain as much of Kim's existing manufacturing process as possible, a rounded contact pad would still have been readily achievable. The Petition—and Petitioner's expert Dr. Lee—already

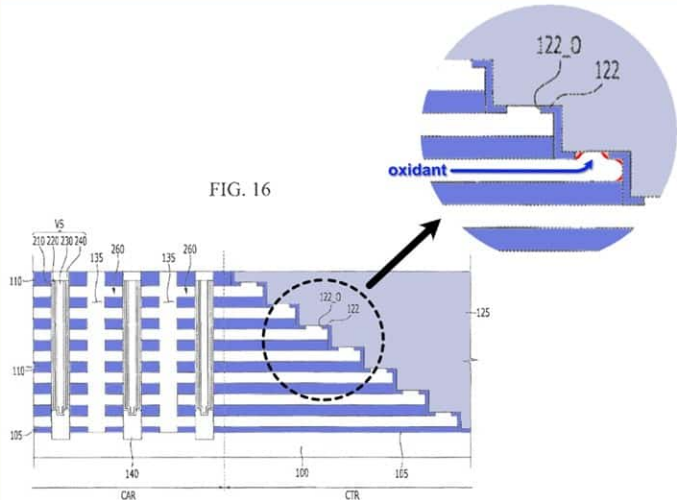
Reply 16

Ground 1 Is Kim Alone – But Petitioner Relies On Combinations



Kim, Fig. 13 (excerpted and annotated).

Ex. 1075 (Lee Reply Decl.) ¶ 88



Ex. 1075 (Lee Reply Decl.) ¶ 84

Petitioner's Expert

86. Alternatively, a POSITA would have considered it obvious to employ

Nam's process to obtain landing pads with curved side surfaces in Kim.

Ex. 1075 (Lee Reply Decl.) ¶ 86

Petitioner's Expert

Q. So it's your -- is it your opinion that a person of ordinary skill in the art would combine Kim with Park's oxidation-based rounding techniques to form the curved side surface?

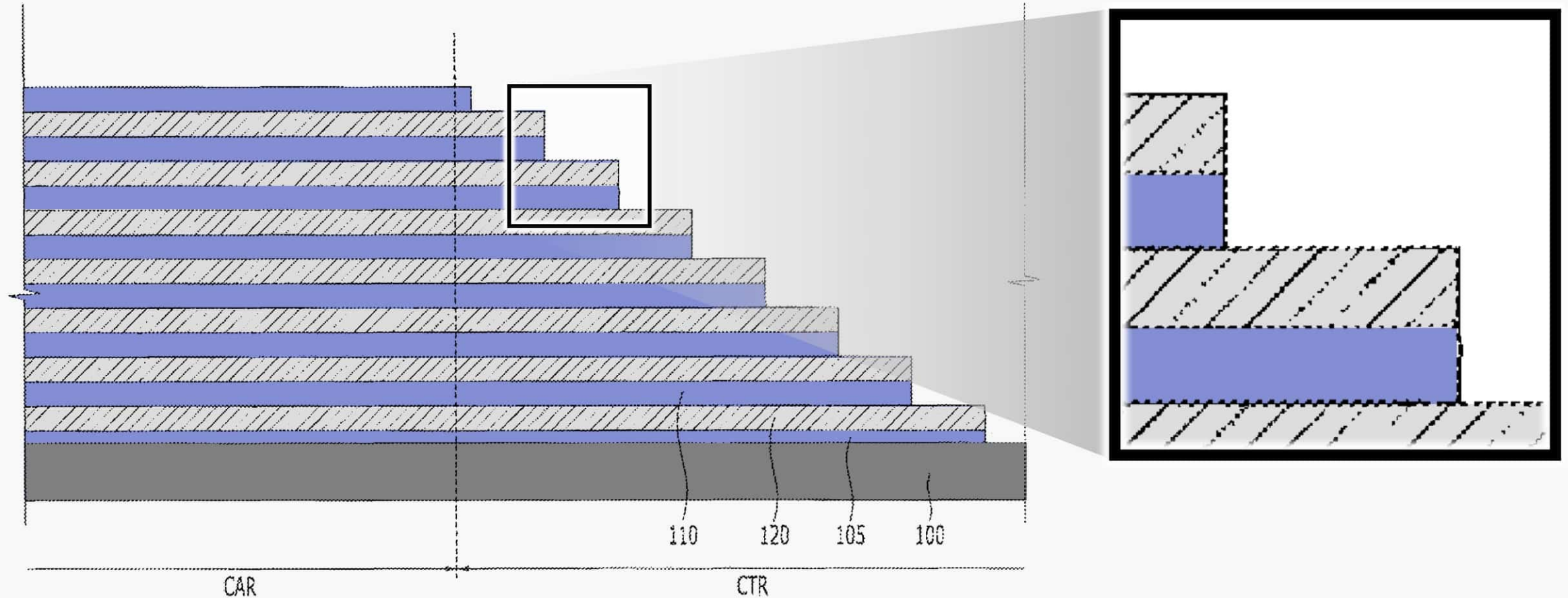
A. I'm saying that a person of ordinary skill in the art would understand that Park's oxidation-based rounding technique could be applied to Kim's structure to form rounded landing pads.

Ex. 2047 (Jack C. Lee, Ph. D.), 47:10-18

See also Ex. 2047 (Jack C. Lee, Ph. D.), 195-196 (127:20-128:6); 223 (155:13-17); 203 (135:5-14)

Kim's Process Does Not Form Vertical Curved Side Surfaces

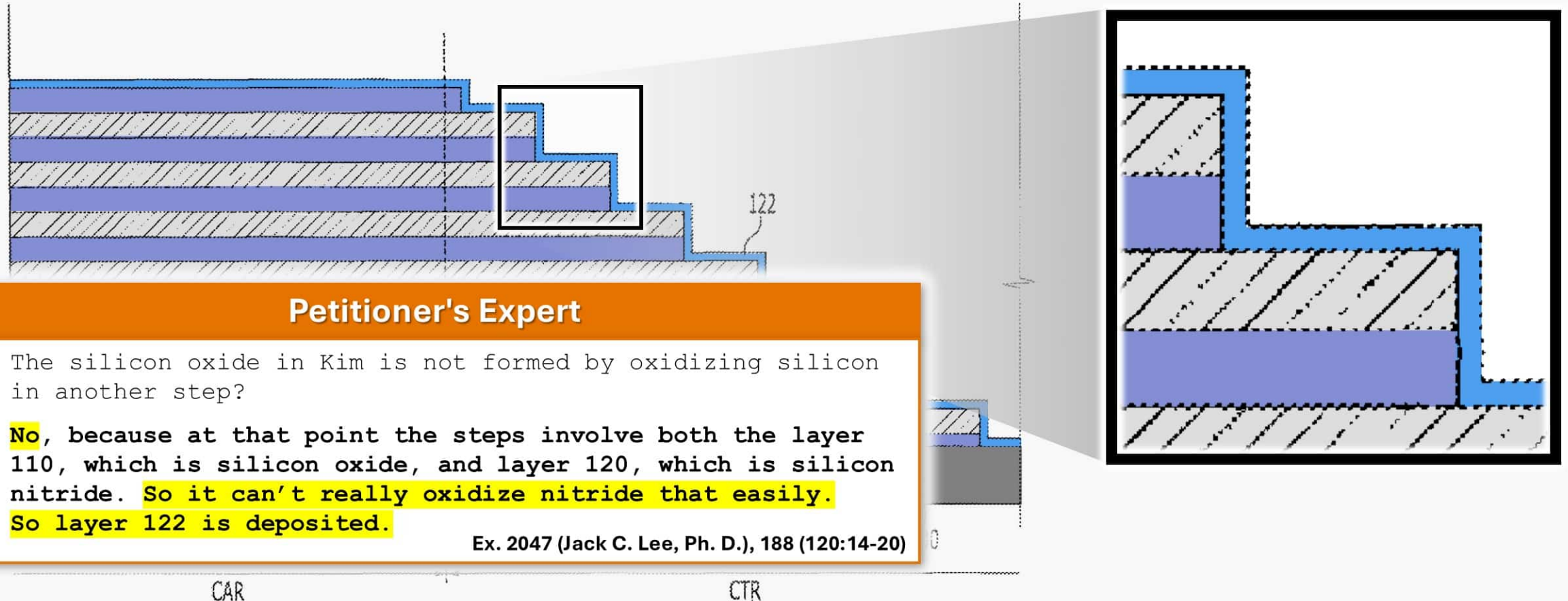
FIG. 11



Ex. 1005 (Kim), Fig. 11 (modified)

Kim's Process Does Not Form Vertical Curved Side Surfaces

FIG. 11

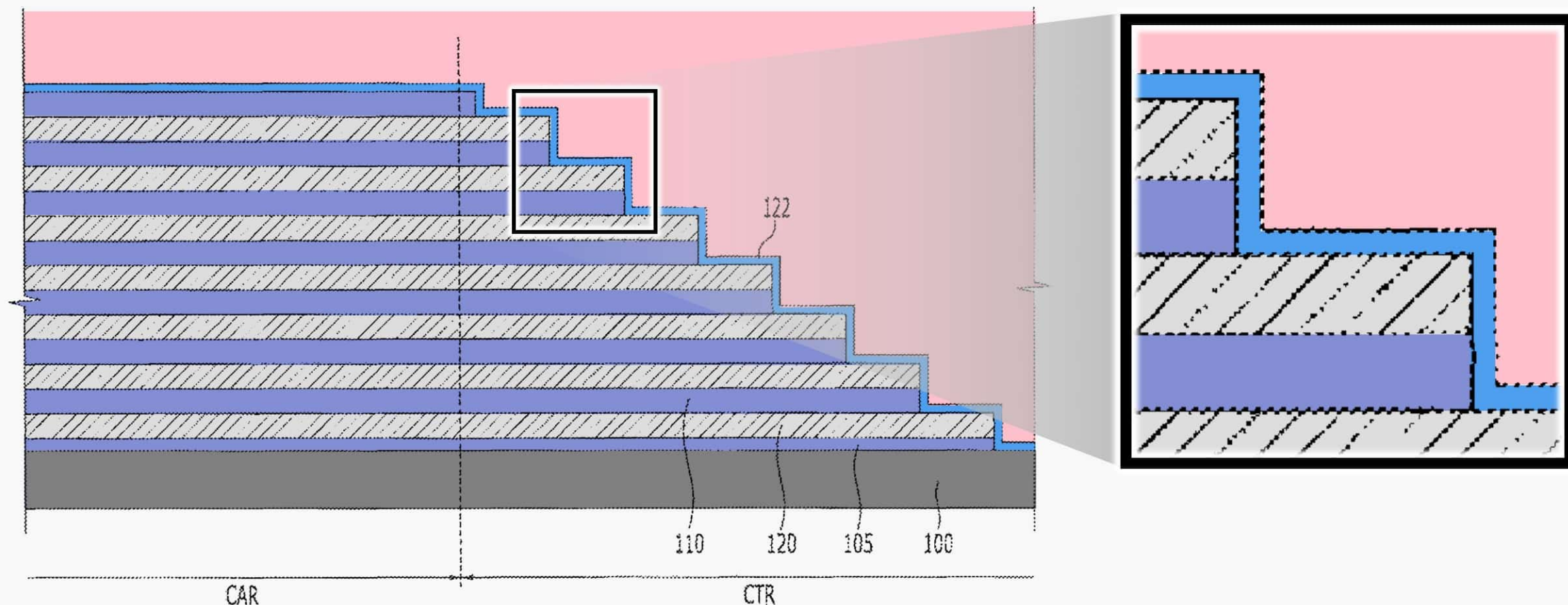


Ex. 1005 (Kim), Fig. 11



Kim's Process Does Not Form Vertical Curved Side Surfaces

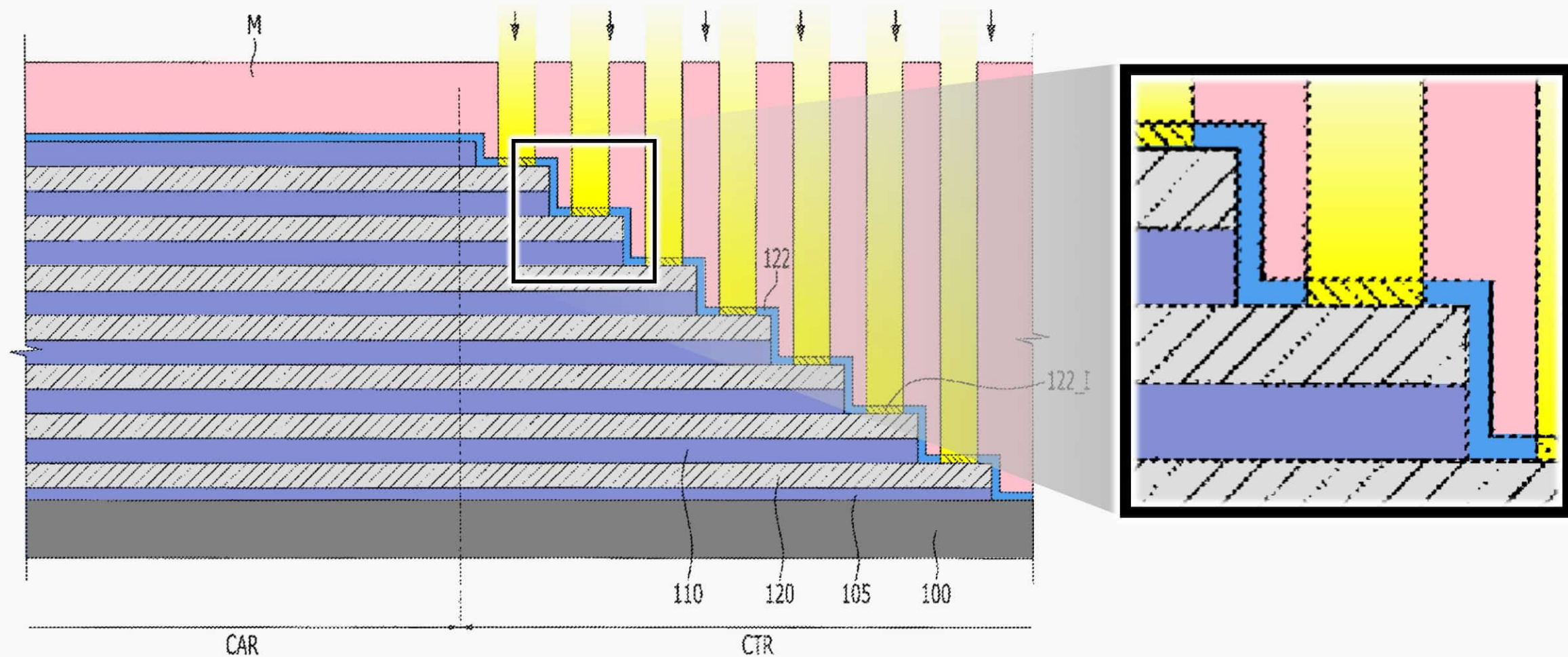
FIG. 11



Ex. 1005 (Kim), Fig. 11

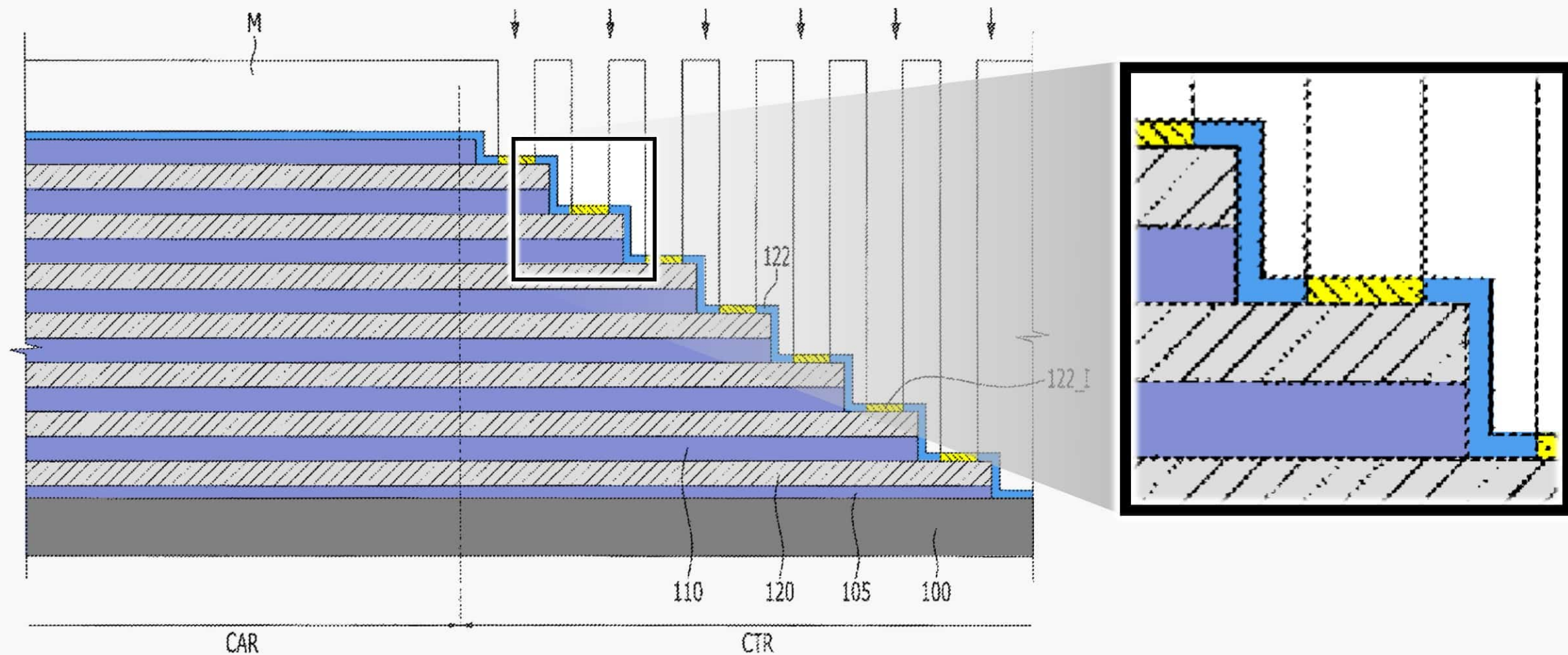
Kim's Process Does Not Form Vertical Curved Side Surfaces

FIG. 12



Ex. 1005 (Kim), Fig. 12

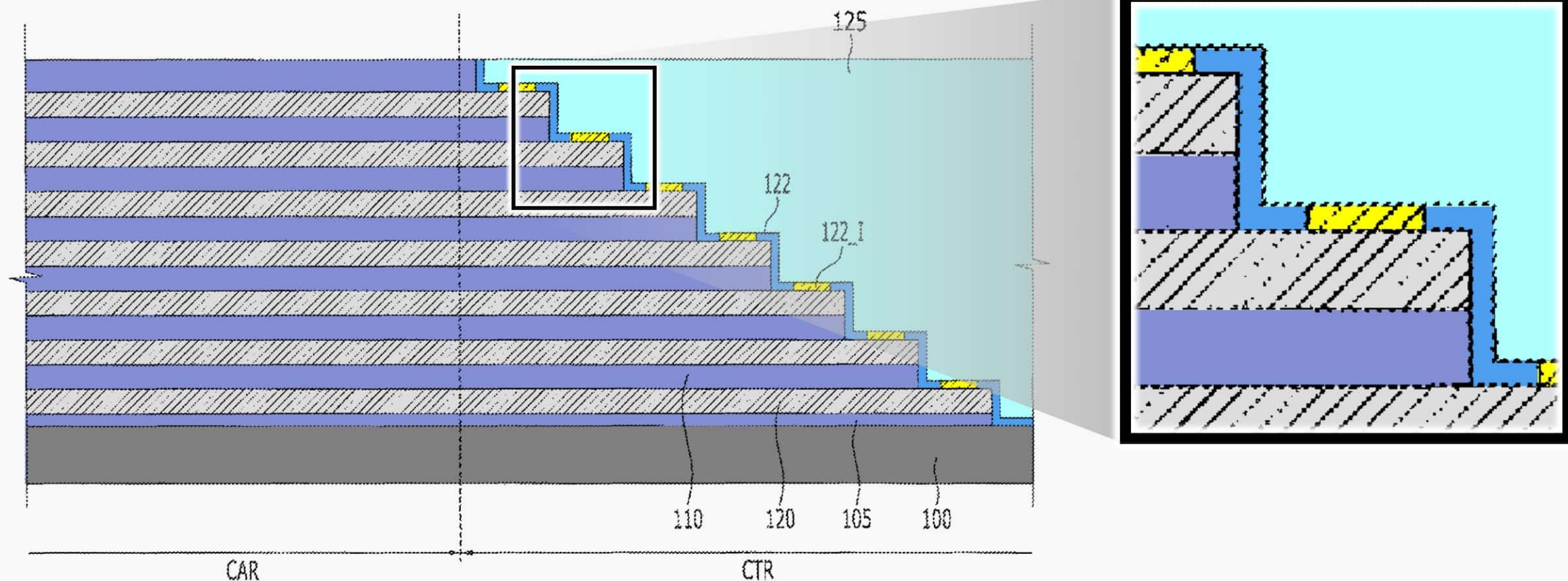
FIG. 12



Ex. 1005 (Kim), Fig. 12

Kim's Process Does Not Form Vertical Curved Side Surfaces

FIG. 13

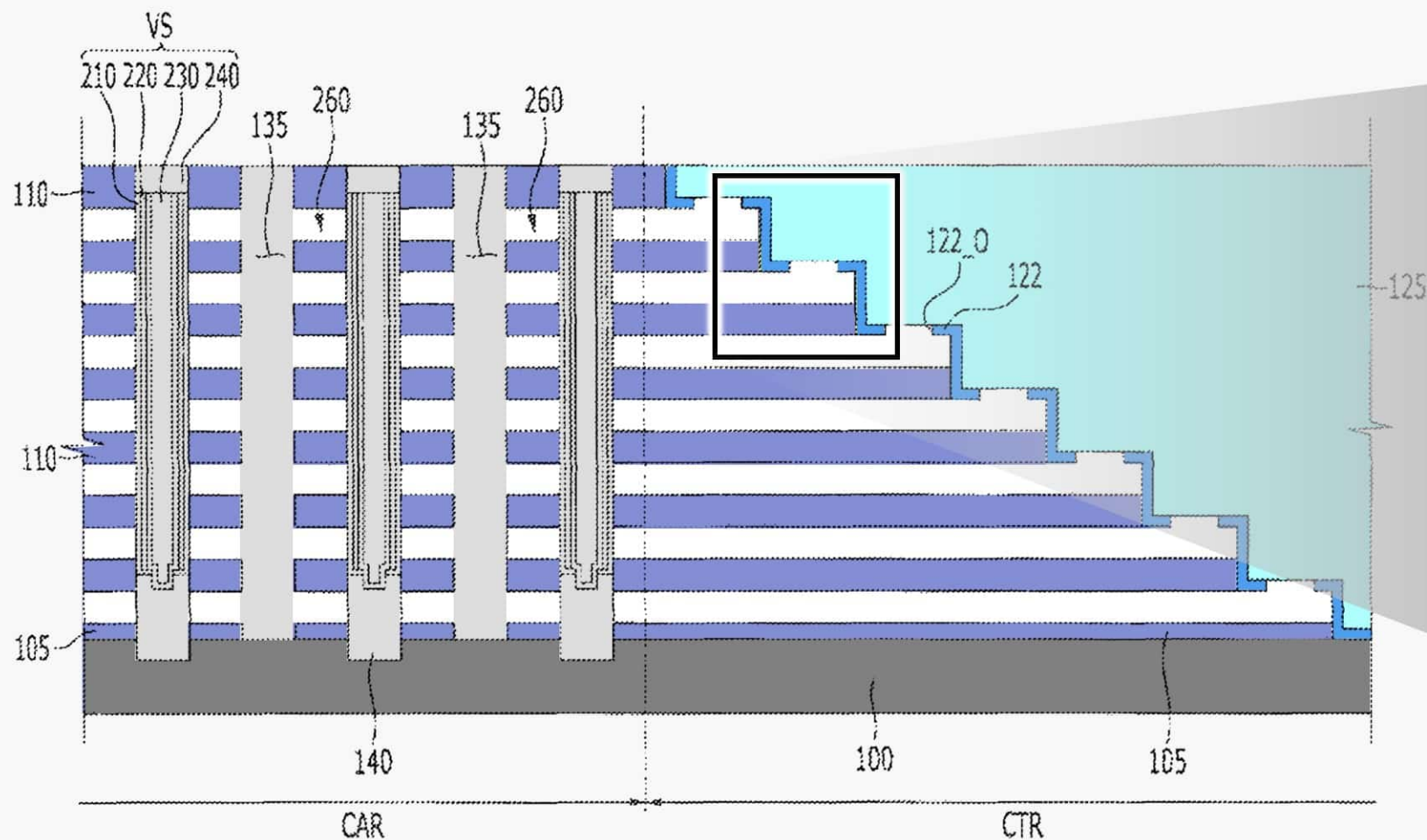
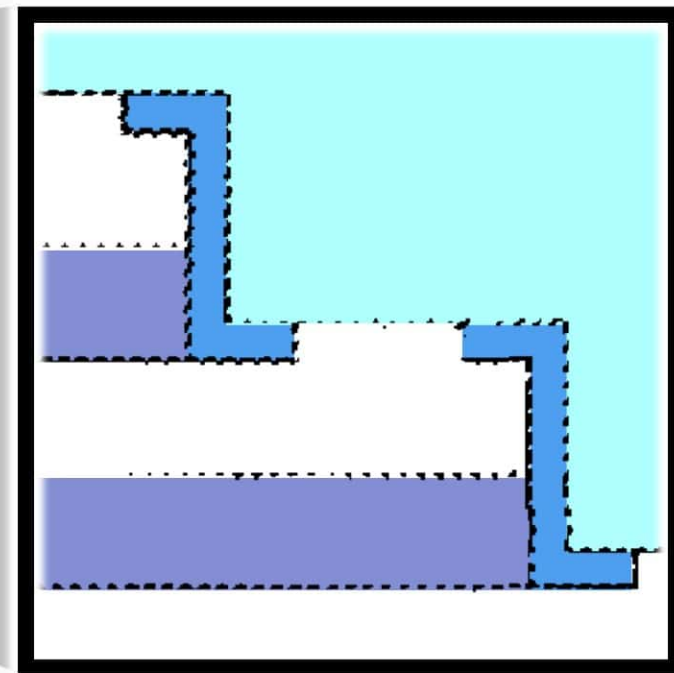


Ex. 1005 (Kim), Fig. 13



Kim's Process Does Not Form Vertical Curved Side Surfaces

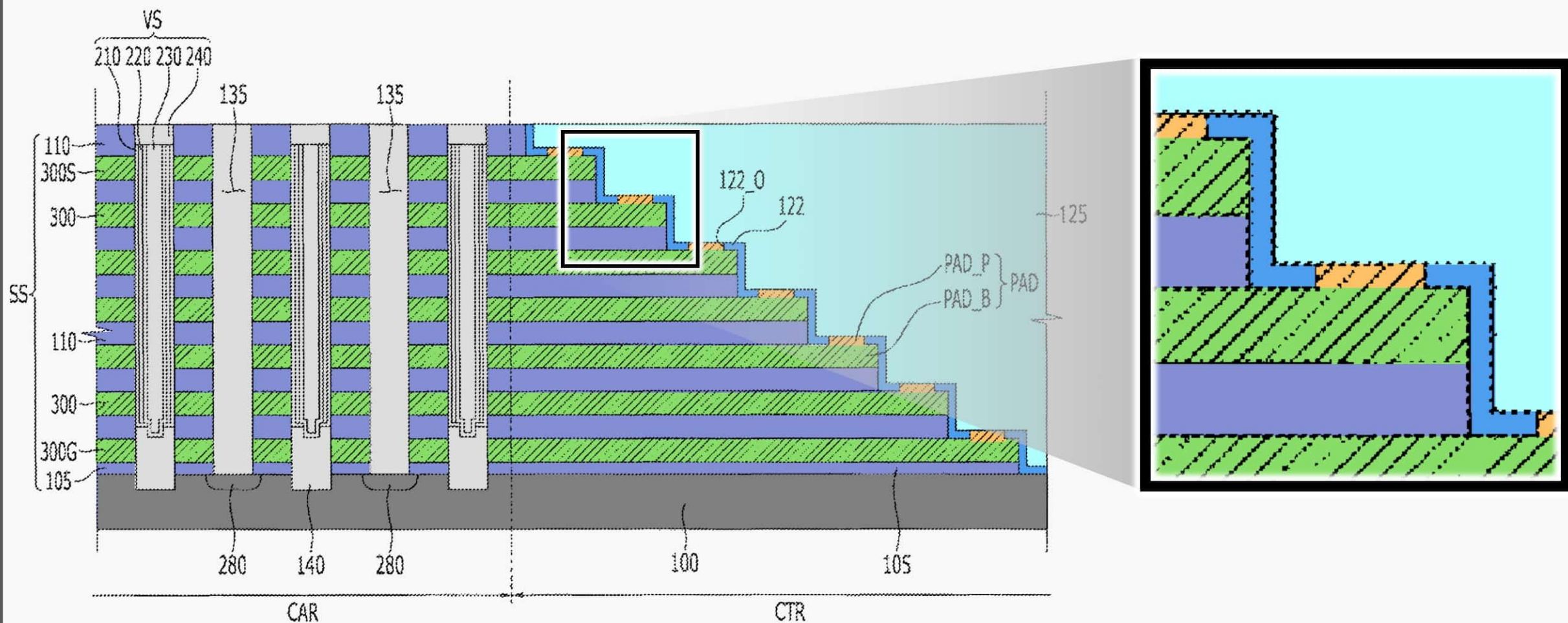
FIG. 16



Ex. 1005 (Kim), Fig. 16

Kim's Process Does Not Form Vertical Curved Side Surfaces

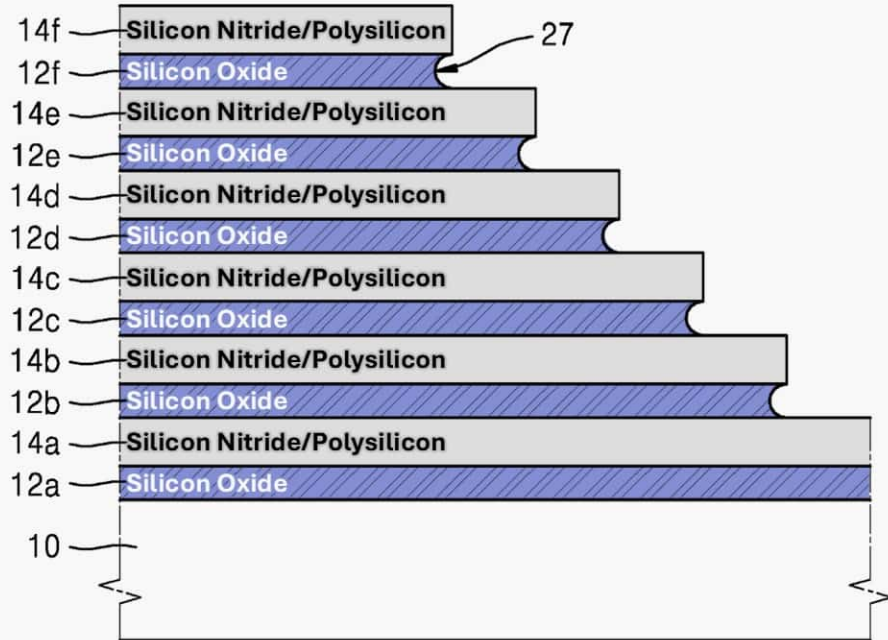
FIG. 17



Ex. 1005 (Kim), Fig. 17

Park's Process Cannot Be Combined With Kim

FIG. 6B



Ex. 1009 (Park), Fig. 6B

Park

As shown in FIG. 6C, an additional insulating layer 40 is formed by oxidizing surfaces and side surfaces of the stepped sacrificial layer patterns 14a through 14f that are externally exposed. The additional insulating layer 40 may be formed by thermally oxidizing the surfaces and the side surfaces of the sacrificial layer patterns 14a through 14f. The additional insulating layer 40 may be formed on the surfaces and side surfaces of the sacrificial layer patterns 14a through 14f not covered by the interlayer insulating layer patterns 12b through 12f. One end of the additional insulating layer 40 may be rounded by an oxidation process. When one end

Ex. 1009 (Park), 8:28-38

Petitioner's Expert

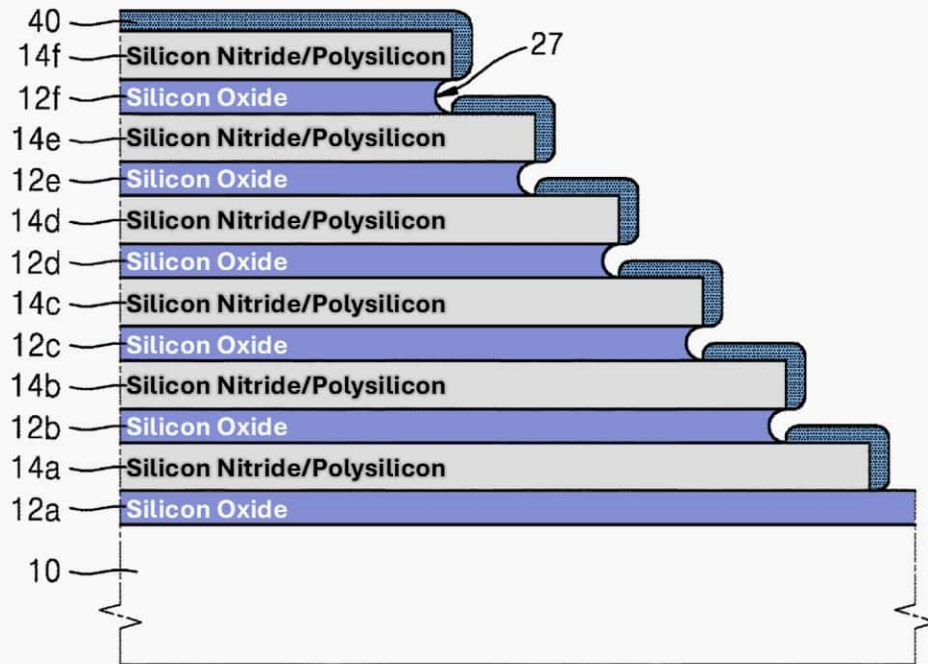
Q. Okay. Can you point to me where the oxidant is added in Park Figure 7 to form the rounded pads?

A. Well, it's due to the oxidation step as shown in Figure 6C. Figure 6C is -- the additional insulating layer 40 is formed by oxidizing the surface and the side surface of the step sacrificial layer patterns 14a through 14f that are externally exposed.

Ex. 2047 (Jack C. Lee, Ph. D.), 204 (136:14-22)

Park's Process Cannot Be Combined With Kim

FIG. 6C



Ex. 1009 (Park), Fig. 6C

Park

As shown in FIG. 6C, an additional insulating layer 40 is formed by oxidizing surfaces and side surfaces of the stepped sacrificial layer patterns 14a through 14f that are externally exposed. The additional insulating layer 40 may be formed by thermally oxidizing the surfaces and the side surfaces of the sacrificial layer patterns 14a through 14f. The additional insulating layer 40 may be formed on the surfaces and side surfaces of the sacrificial layer patterns 14a through 14f not covered by the interlayer insulating layer patterns 12b through 12f. One end of the additional insulating layer 40 may be rounded by an oxidation process. When one end

Ex. 1009 (Park), 8:28-38

Petitioner's Expert

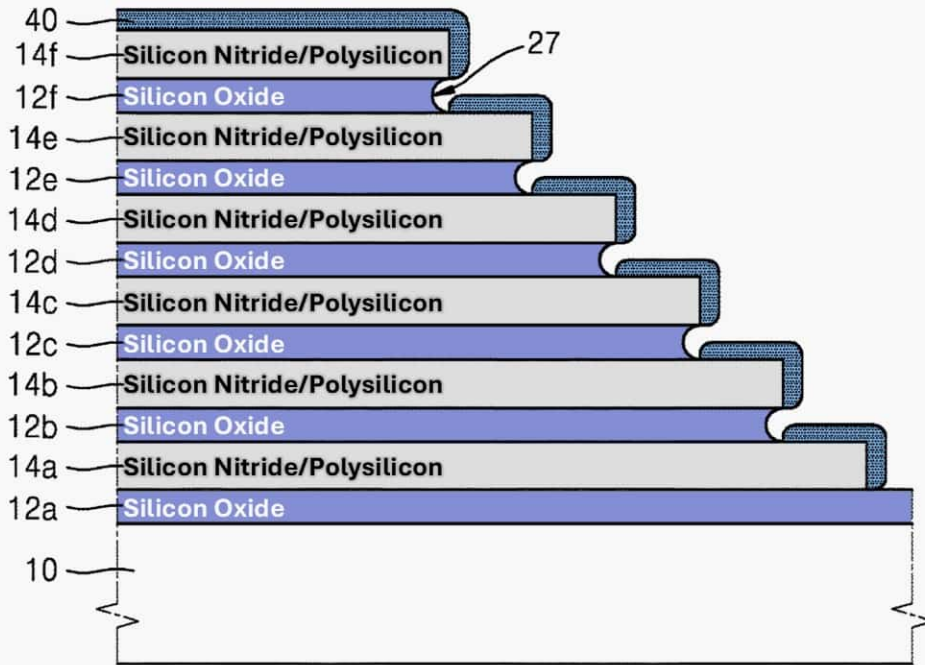
Q. Okay. Can you point to me where the oxidant is added in Park Figure 7 to form the rounded pads?

A. Well, it's due to the oxidation step as shown in Figure 6C. Figure 6C is -- the additional insulating layer 40 is formed by oxidizing the surface and the side surface of the step sacrificial layer patterns 14a through 14f that are externally exposed.

Ex. 2047 (Jack C. Lee, Ph. D.), 204 (136:14-22)

Park's Process Cannot Be Combined With Kim

FIG. 6C



Ex. 1009 (Park), Fig. 6C

Park

The interlayer insulating layer patterns 12a through 12f may be formed of a silicon oxide layer. The sacrificial layer patterns 14a through 14f may be formed of a material having an etching selectivity with respect to the interlayer insulating layer patterns 12a through 12f. The sacrificial layer patterns 14a through 14f may be formed of a material such as a silicon nitride layer or a polysilicon layer. The interlayer insulating layer patterns 12a through 12f and the sacrificial layer patterns 14a through 14f may be formed by a deposition process such as chemical vapor deposition (CVD) or atomic layer deposition (ALD).

Ex. 1009 (Park), 8:1-11

Petitioner's Expert

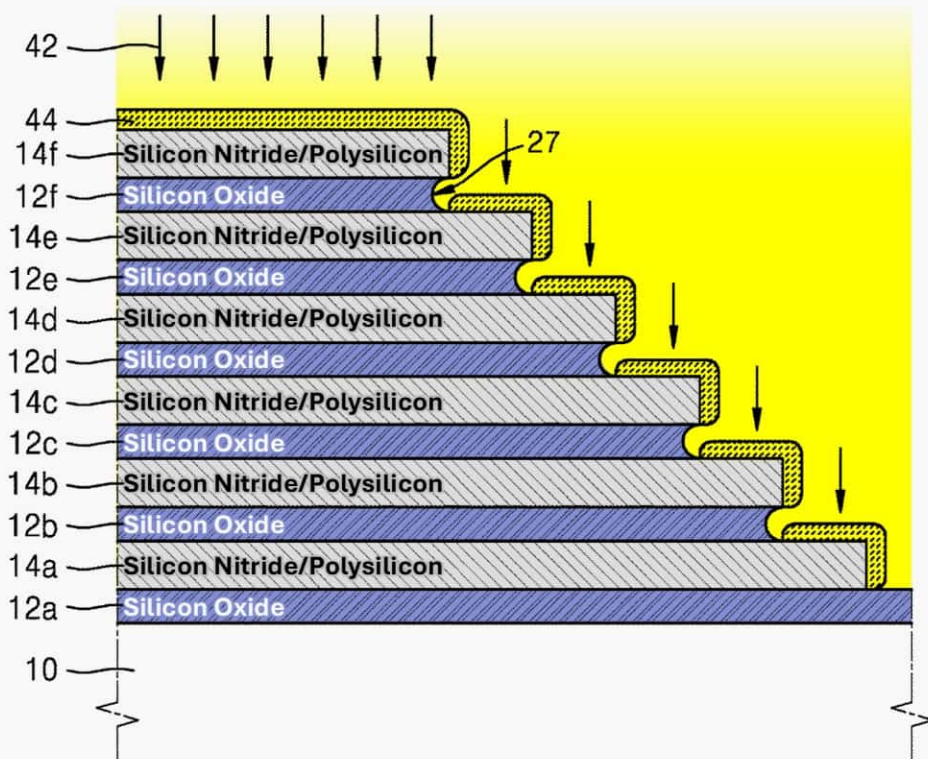
Q. Okay. Can you point to me where the oxidant is added in Park Figure 7 to form the rounded pads?

A. Well, it's due to the oxidation step as shown in Figure 6C. Figure 6C is -- the additional insulating layer 40 is formed by oxidizing the surface and the side surface of the step sacrificial layer patterns 14a through 14f that are externally exposed.

Ex. 2047 (Jack C. Lee, Ph. D.), 204 (136:14-22)

Park's Process Cannot Be Combined With Kim

FIG. 6D



Ex. 1009 (Park), Fig. 6D

Park

As shown in FIG. 6C, an additional insulating layer 40 is formed by oxidizing surfaces and side surfaces of the stepped sacrificial layer patterns 14a through 14f that are externally exposed. The additional insulating layer 40 may be formed by thermally oxidizing the surfaces and the side surfaces of the sacrificial layer patterns 14a through 14f. The additional insulating layer 40 may be formed on the surfaces and side surfaces of the sacrificial layer patterns 14a through 14f not covered by the interlayer insulating layer patterns 12b through 12f. One end of the additional insulating layer 40 may be rounded by an oxidation process. When one end

Ex. 1009 (Park), 8:28-38

Petitioner's Expert

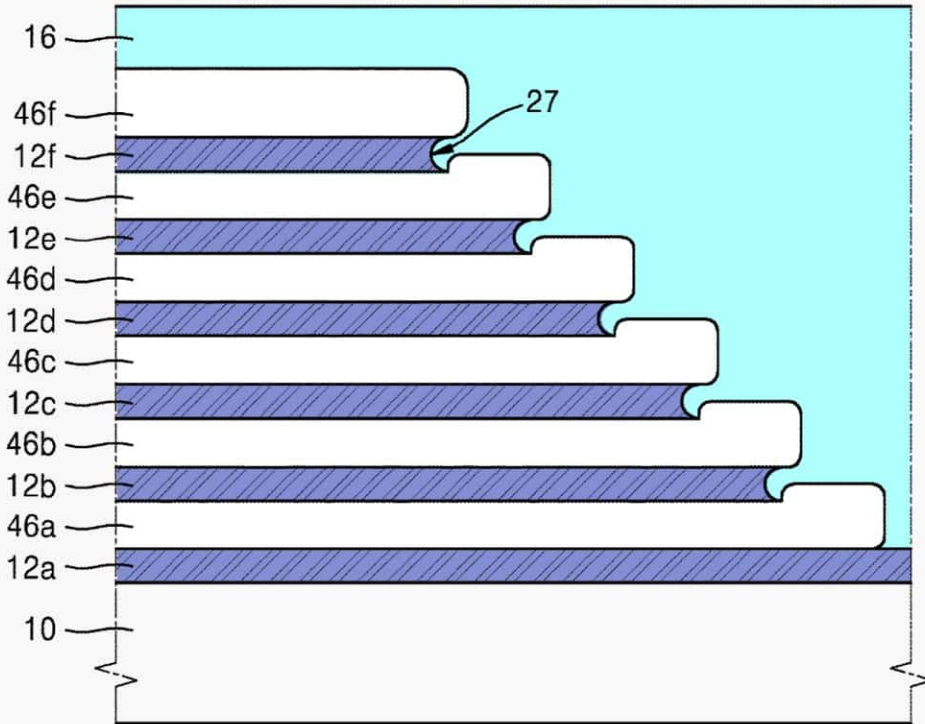
Q. Okay. Can you point to me where the oxidant is added in Park Figure 7 to form the rounded pads?

A. Well, it's due to the oxidation step as shown in Figure 6C. Figure 6C is -- the additional insulating layer 40 is formed by oxidizing the surface and the side surface of the step sacrificial layer patterns 14a through 14f that are externally exposed.

Ex. 2047 (Jack C. Lee, Ph. D.), 204 (136:14-22)

Park's Process Cannot Be Combined With Kim

FIG. 6E



Ex. 1009 (Park), Fig. 6E

Park

As shown in FIG. 6C, an additional insulating layer 40 is formed by oxidizing surfaces and side surfaces of the stepped sacrificial layer patterns 14a through 14f that are externally exposed. The additional insulating layer 40 may be formed by thermally oxidizing the surfaces and the side surfaces of the sacrificial layer patterns 14a through 14f. The additional insulating layer 40 may be formed on the surfaces and side surfaces of the sacrificial layer patterns 14a through 14f not covered by the interlayer insulating layer patterns 12b through 12f. One end of the additional insulating layer 40 may be rounded by an oxidation process. When one end

Ex. 1009 (Park), 8:28-38

Petitioner's Expert

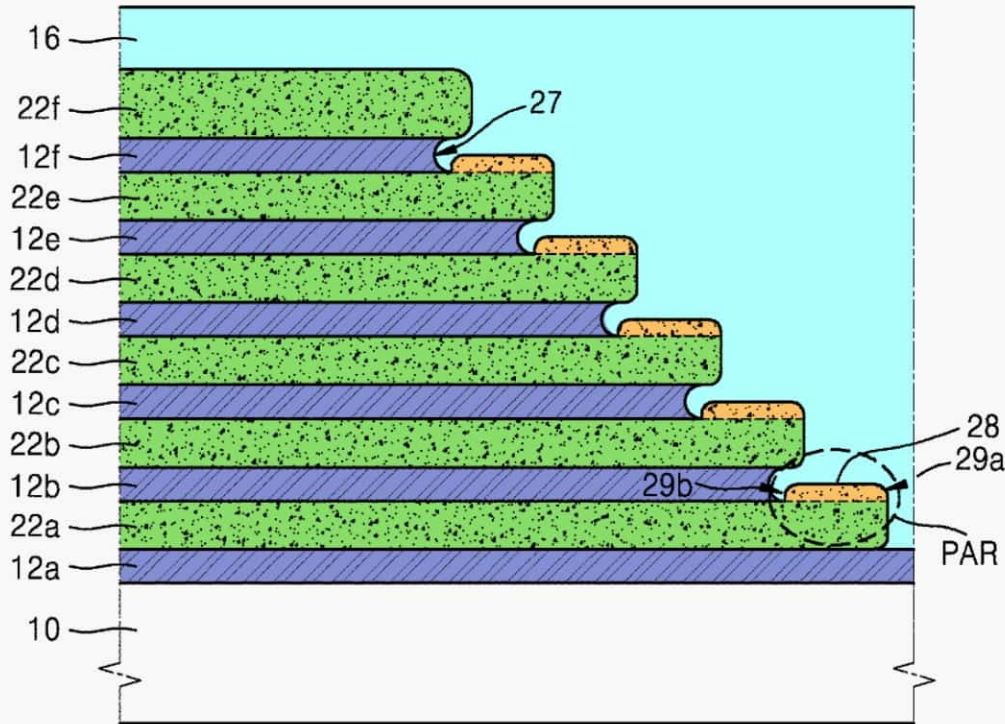
Q. Okay. Can you point to me where the oxidant is added in Park Figure 7 to form the rounded pads?

A. Well, it's due to the oxidation step as shown in Figure 6C. Figure 6C is -- the additional insulating layer 40 is formed by oxidizing the surface and the side surface of the step sacrificial layer patterns 14a through 14f that are externally exposed.

Ex. 2047 (Jack C. Lee, Ph. D.), 204 (136:14-22)

Park's Process Cannot Be Combined With Kim

FIG. 6F



Ex. 1009 (Park), Fig. 6F

Park

As shown in FIG. 6C, an additional insulating layer 40 is formed by oxidizing surfaces and side surfaces of the stepped sacrificial layer patterns 14a through 14f that are externally exposed. The additional insulating layer 40 may be formed by thermally oxidizing the surfaces and the side surfaces of the sacrificial layer patterns 14a through 14f. The additional insulating layer 40 may be formed on the surfaces and side surfaces of the sacrificial layer patterns 14a through 14f not covered by the interlayer insulating layer patterns 12b through 12f. One end of the additional insulating layer 40 may be rounded by an oxidation process. When one end

Ex. 1009 (Park), 8:28-38

Petitioner's Expert

Q. Okay. Can you point to me where the oxidant is added in Park Figure 7 to form the rounded pads?

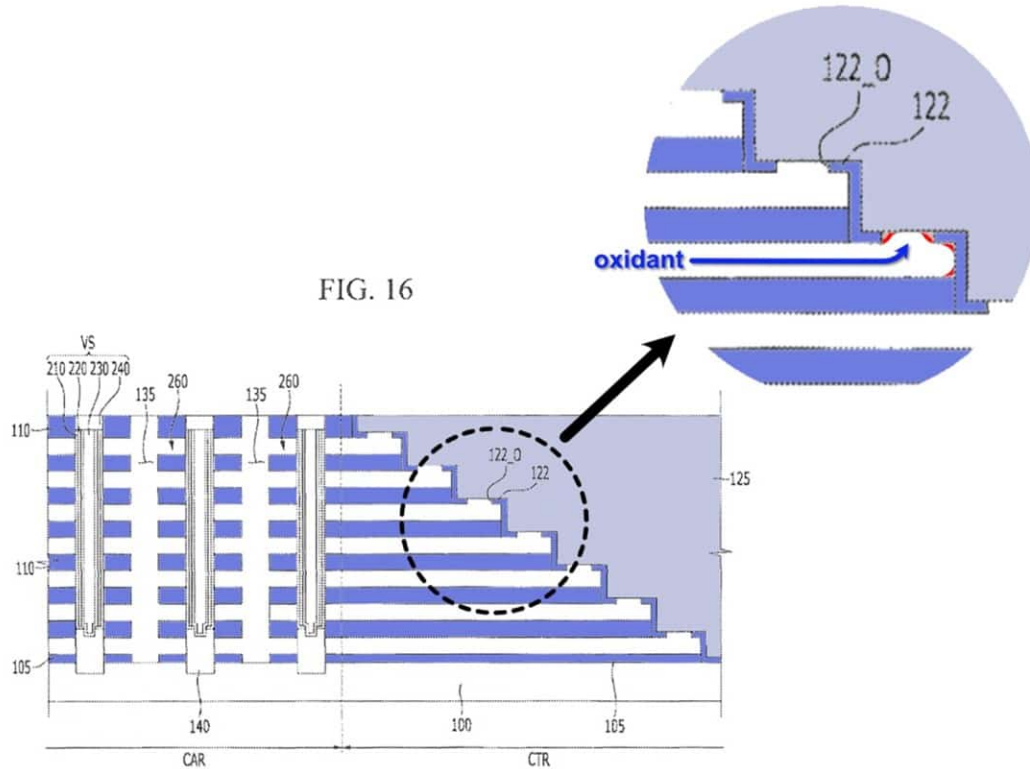
A. Well, it's due to the oxidation step as shown in Figure 6C. Figure 6C is -- the additional insulating layer 40 is formed by oxidizing the surface and the side surface of the step sacrificial layer patterns 14a through 14f that are externally exposed.

Ex. 2047 (Jack C. Lee, Ph. D.), 204 (136:14-22)

Park's Process Cannot Be Combined With Kim

Petitioner's Expert

84. Further oxidation would occur and silicon oxide would form preferentially in the corners and exposed edges of the oxide layers:



Ex. 1075 (Lee Reply Decl.) ¶ 84

Petitioner's Expert

Q. The silicon oxide in Kim is not formed by oxidizing silicon in another step?

A. **No**, because at that point the steps involve both the layer 110, which is silicon oxide, and layer 120, which is silicon nitride. **So it can't really oxidize nitride that easily. So layer 122 is deposited.**

Ex. 2047 (Jack C. Lee, Ph. D.), 188 (120:14-20)

Q. If oxidation in Lee occurred on the edge of the staircase, would layer 22 be oxidized?

A. **Well, it depends on the state of layer 22, but layer 22 is deposited as an oxide. So -- a silicon dioxide. So at least the purpose of the -- of the process is that that layer is not subject to any subsequent oxidations.**

Q. So layers 22 is not subject to any subsequent oxidation, correct?

A. **You're right. It's not -- in general, even if it is exposed to even -- it might oxidize slightly but not very much. At least it's not designed to oxidize.**

Ex. 2047 (Jack C. Lee, Ph. D.), 253-254 (185:17-186:9)

New Theory Is A Stretch

Deposited films of silicon dioxide regions

microelectronic structures

dielectric layers to electrically separate conducting

Petitioner's Expert

133. This is discussed in numerous references. For example, the Plummer text cited by Dr. Giapis explains that CVD “deposited films of silicon dioxide” used in “microelectronic structures” as “dielectric layers to electrically separate conductive regions” “can be nonstoichiometric.” Ex. 2028, 563-64.

Ex. 1075 (Lee Reply Decl.) ¶ 133

can be nonstoichiometric

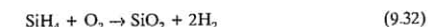
Ex. 2028

9.3.4 Silicon Dioxide Deposition

Deposited films of silicon dioxide are utilized throughout silicon microelectronic structures as described in the CMOS process flow in Chapter 2 (see, for example, Figures 2-29 and 2-38). They are used for dielectric layers to electrically separate conducting regions as well as for masks against implantation and diffusion. The requirements for the films will be discussed in more detail in Chapter 11, but obtaining films of good quality in terms of density, purity, and thermal stability, as well as good step coverage and filling properties are of major concern.

Most oxide films today are deposited at relatively low temperatures, from 200°C to 500°C using CVD techniques. Sputtered oxide films have worse coverage and more particulates (mostly due to flaking off of the metal chamber walls) than CVD oxides. Atmospheric systems have been used for many years, but today LPCVD and PECVD systems have become more commonly used.

Silane and oxygen are common source gases for CVD silicon dioxide deposition, following the net reaction

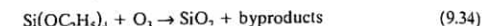


Oxidants other than O_2 are sometimes used, such as N_2O , NO , and CO_2 . When non-plasma, silane-based deposition of SiO_2 is done at temperatures less than 500°C, it is commonly referred to as Low-Temperature Oxide, or “LTO,” deposition.

Other sources of silicon are also used. One such source is tetraethoxysilane— $\text{Si}(\text{OC}_2\text{H}_5)_4$ —or “TEOS.” It can form silicon dioxide by decomposing via the reaction



(O_2 is often added as an extra oxidizer to reduce the carbon content in the film.) This deposition occurs at higher temperatures, in the 650–800°C range, but because of the low sticking coefficient of TEOS compared to silane, more conformal films are produced. The deposition temperature can be lowered to below 400°C by either utilizing plasma enhanced deposition, or by including ozone, O_3 , in the chamber:



Because at low pressures (<150 torr) the deposition using TEOS and O_3 is limited by O_3 and gives worse film properties, a so-called Sub-Atmospheric CVD (SACVD) system has been developed for doped premetal films and undoped intermetal films [9.22, 9.23]. The deposition pressure in this system is at higher pressures (200–400 torr) and the deposition temperature is 300–550°C. Oxide films with good gap fill and reflow ability can be obtained with this system.

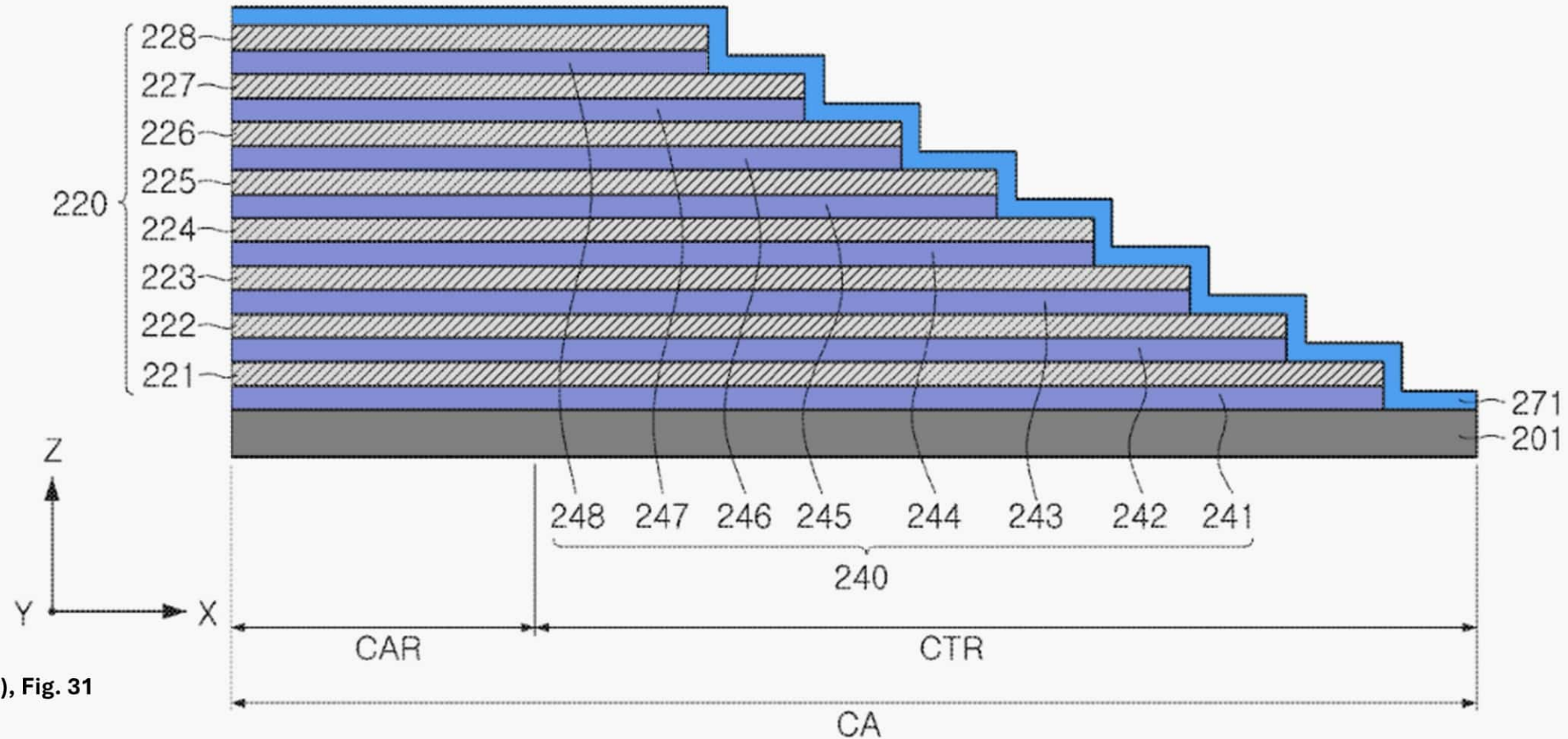
The major drawbacks to using TEOS are that it is a more difficult source to use (it is an organometallic liquid), the relatively high levels of carbon in the deposited film (from the TEOS itself), and the more porous films that are sometimes formed. But TEOS is still commonly used due to the conformality of the films it produces.

Silicon dioxide films deposited using LPCVD or APCVD at low temperatures (less than 500°C) can be nonstoichiometric and are often porous. They can also exhibit in-

Ex. 2028 (Silicon VLSI Technology), 563-64

Nam's Process Cannot Be Combined With Kim

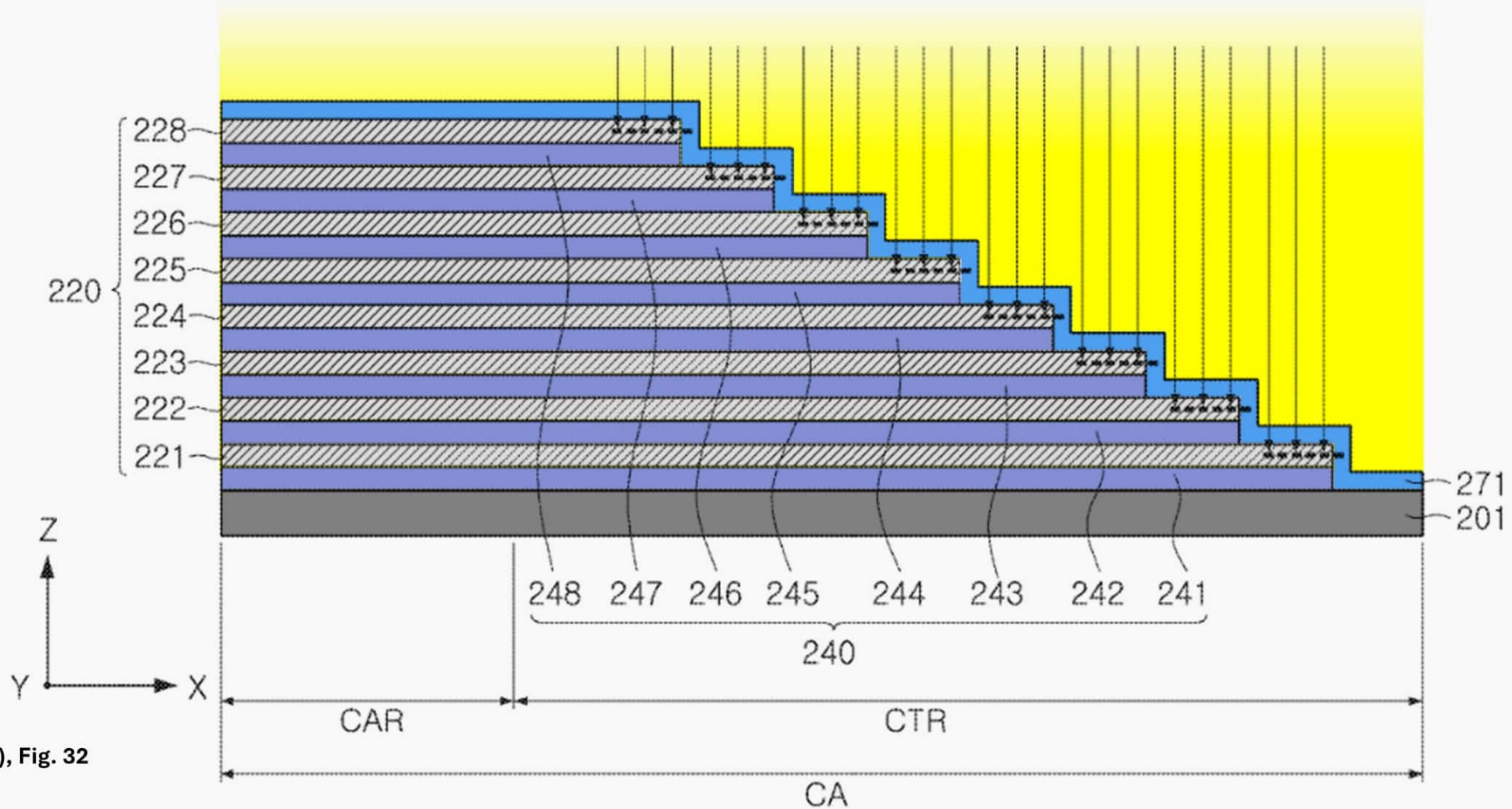
FIG. 31



Ex. 1022 (Nam), Fig. 31

Nam's Process Cannot Be Combined With Kim

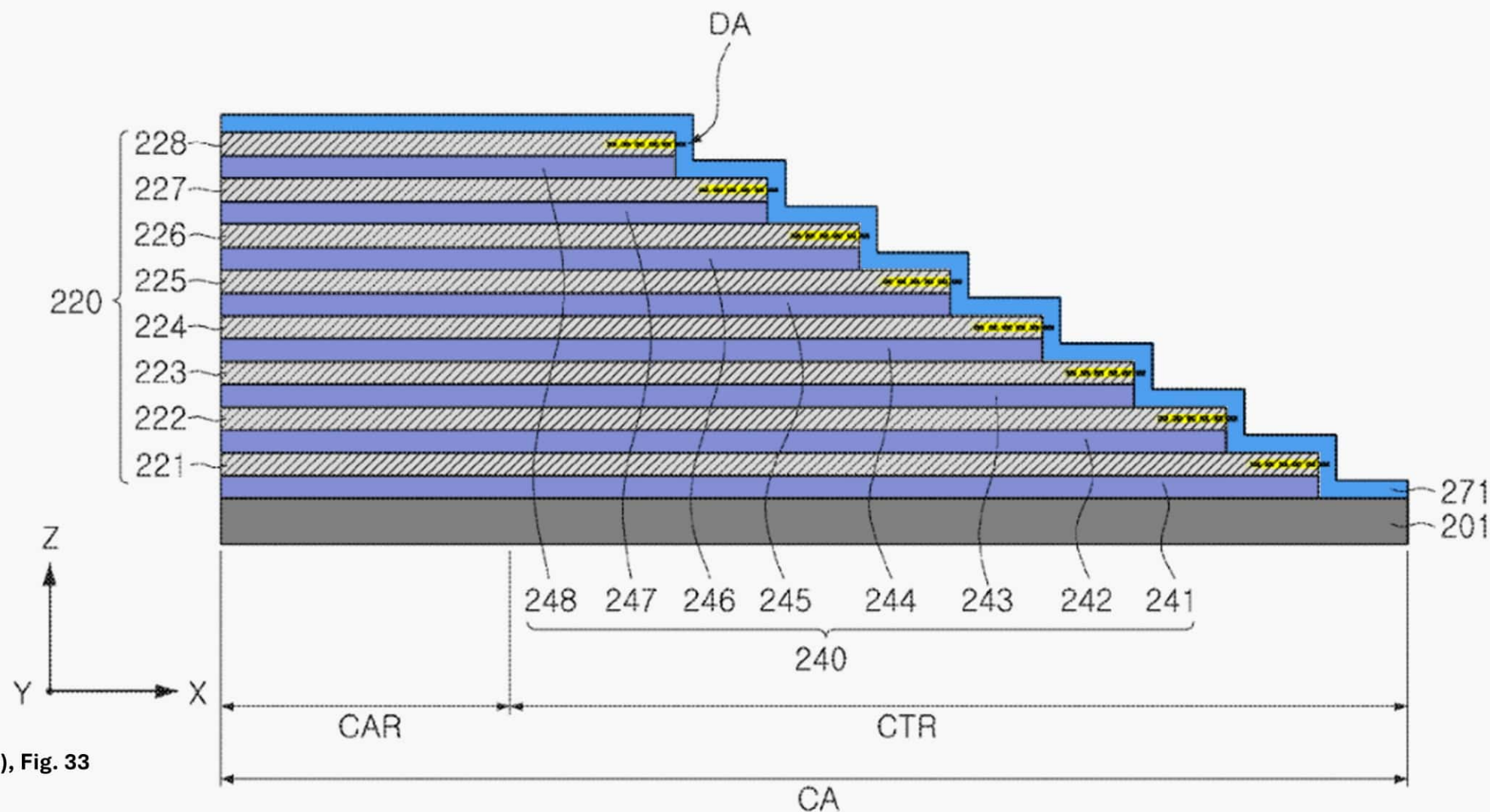
FIG. 32



Ex. 1022 (Nam), Fig. 32

Nam's Process Cannot Be Combined With Kim

FIG. 33



Ex. 1022 (Nam), Fig. 33

Nam's Process Cannot Be Combined With Kim

FIG. 34

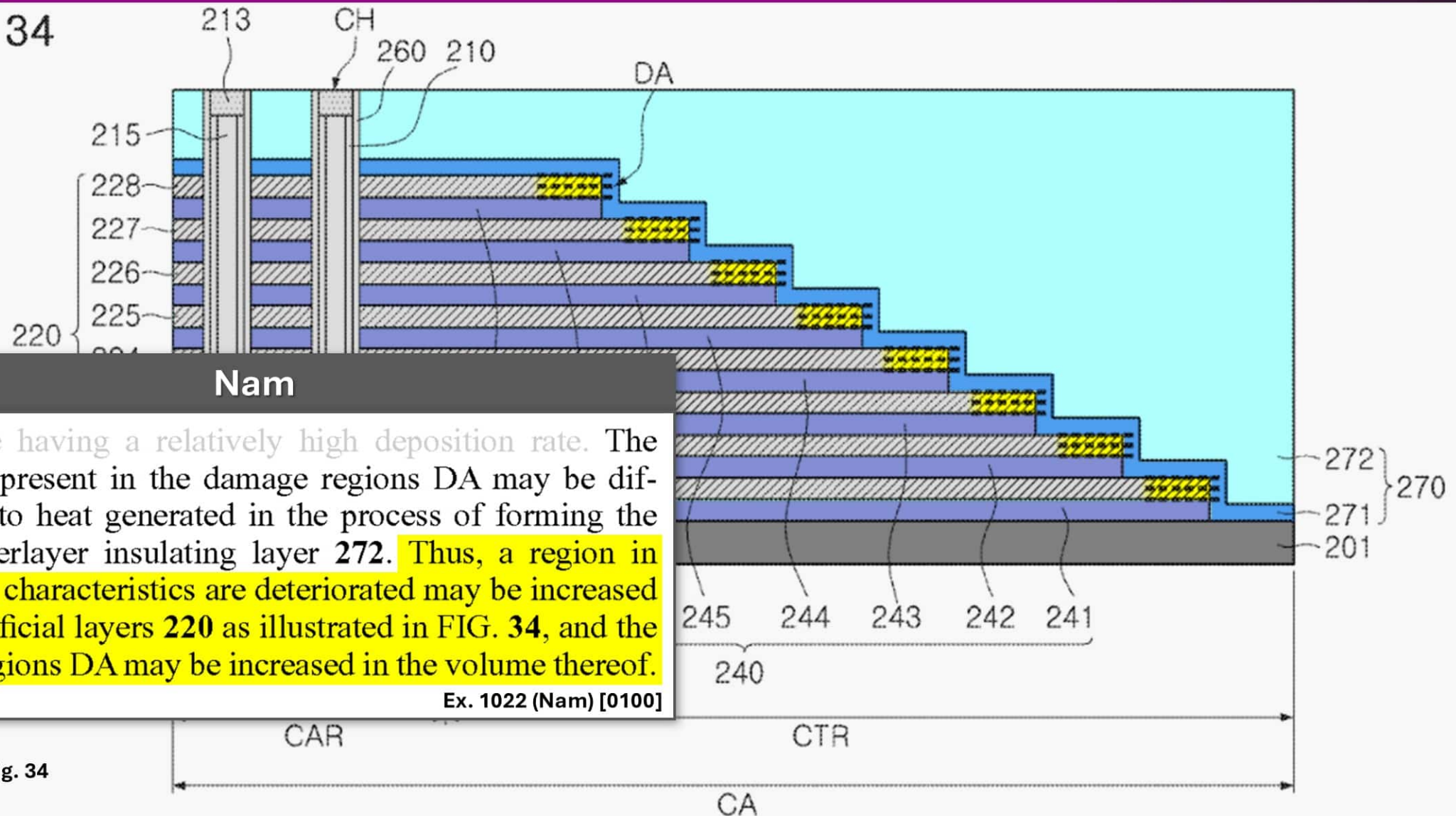
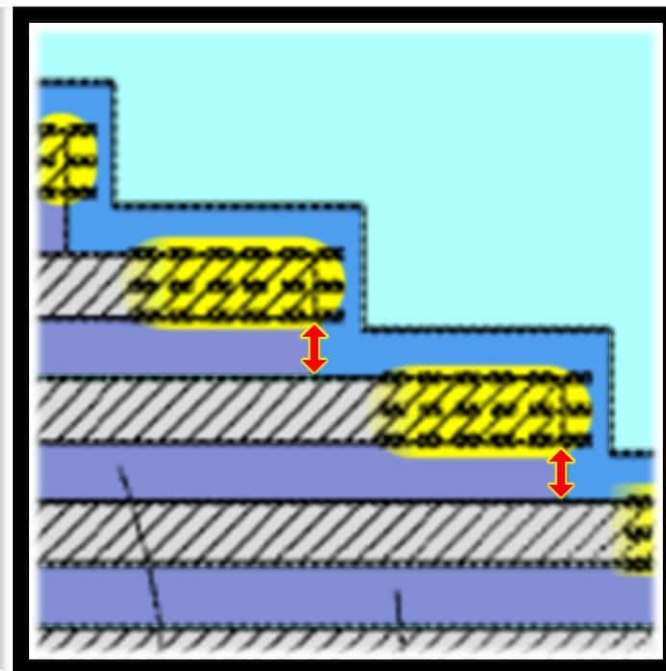


FIG. 34

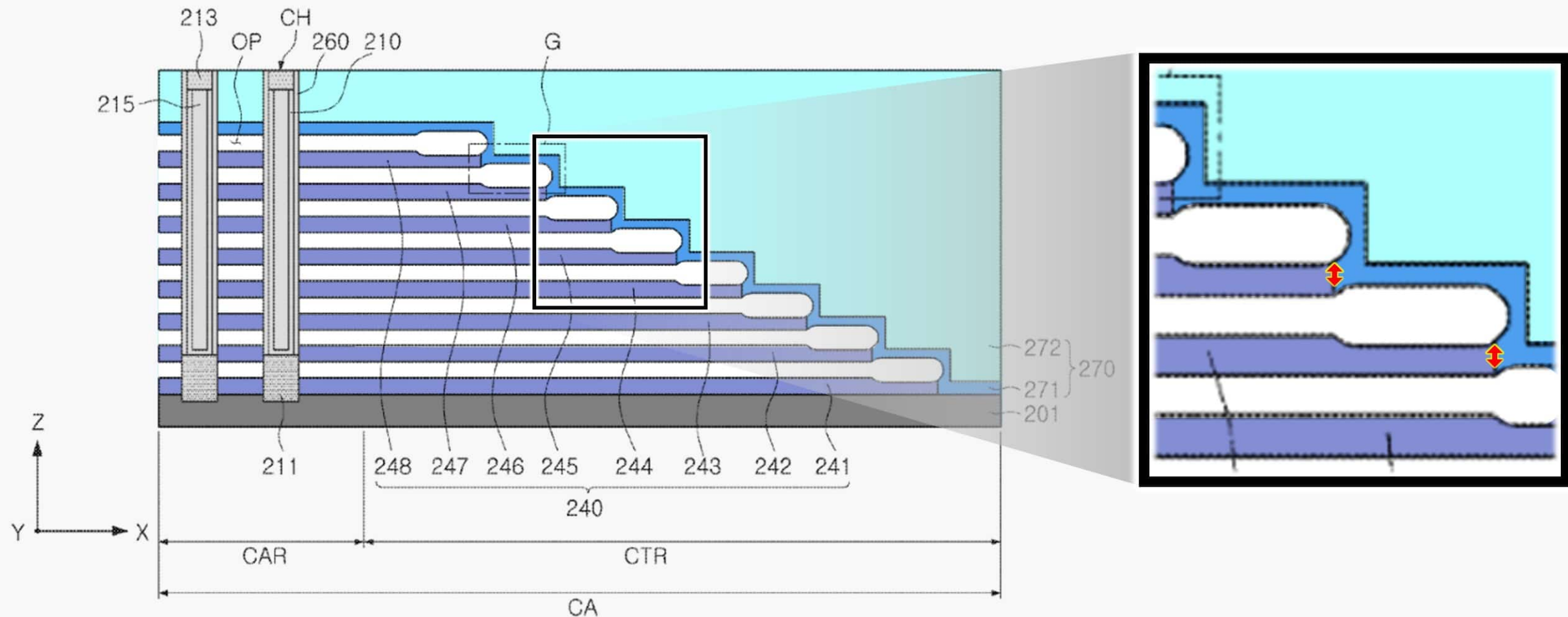


Ex. 1022 (Nam), Fig. 34



Nam's Process Cannot Be Combined With Kim

FIG. 36

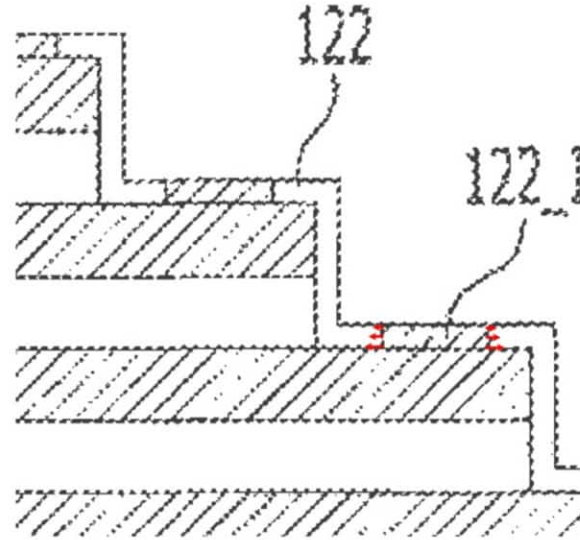


Ex. 1022 (Nam), Fig. 36

Nam's Process Cannot Be Combined With Kim

Petitioner's Expert

88. An example of this is shown below. Application of heat will cause the impurities implanted in Kim's insulating layer 122 in area 122_I to spread, resulting in a damaged region with a rounded shape (and curved side surfaces). The spread is indicated with small red arrows. This in turn will produce a rounded landing pad like that depicted in Nam:



Ex. 1075 (Lee Reply Decl.) ¶ 88

FIG. 5



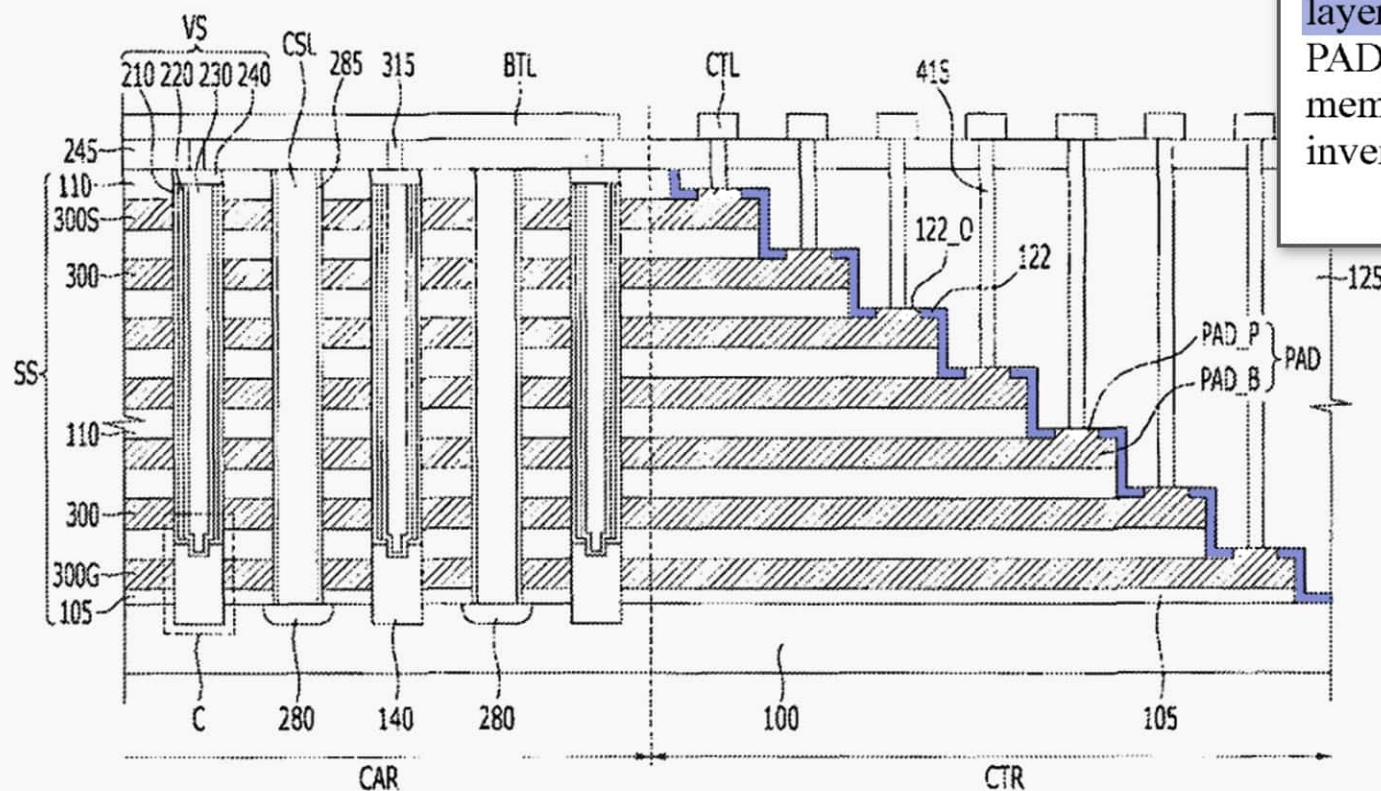
Further, the semiconductor memory device may include the protrusion pad PAD_P inside from the edge of a surface of the base pad PAD_B to prevent the short-circuit between the pad units PAD positioned at different rows.

Ex. 1005 (Kim), 9:46-49



Petitioner Provides No Motivation To Modify Kim

FIG. 4B



Ex. 1005 (Kim), Fig. 4B

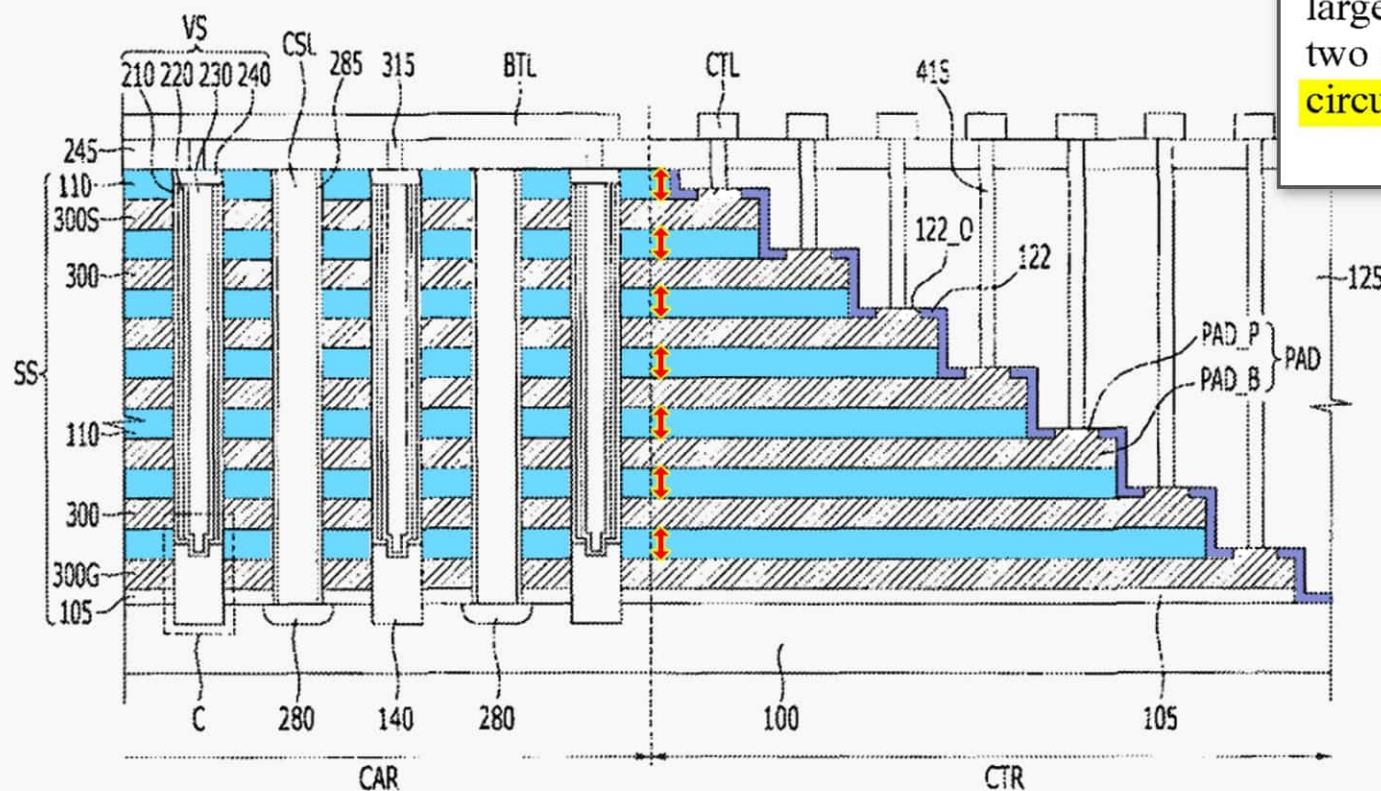
Kim

Further, the short-circuit between the pad units PAD may be effectively prevented through the auxiliary insulating layer 122 positioned between the adjacent protrusion pads PAD_P positioned at different rows. The semiconductor memory device according to same embodiments of the inventive concepts may have enhanced reliability.

Ex. 1005 (Kim), 9:50-55

Petitioner Provides No Motivation To Modify Kim

FIG. 4B



Ex. 1005 (Kim), Fig. 4B

Kim

positioned at the $n+1$ -th row based on the substrate 100. A z-direction thickness of the insulating layer 110 may be larger than the minimum distance in the z-direction between two adjacent pad units PAD to effectively prevent a short-circuit between the two adjacent pad units PAD.

Ex. 1005 (Kim), 9:7-11



'838 Patent Overview

Claim Construction - Portions

Ground 1 (Kim) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 3 (Lee) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 1 and 5 - Curved Side Surface *Claims 13-15*

I. Claim Construction

II. Ground 1 (Kim) *Claims 13-15*

III. Ground 5 (Lee + Park) *Claims 13-15*

Ground 2 (Kim + Yang) *Claims 3, 18*

Ground 4 (Lee + Haller) *Claims 3, 18*



Ground 5 Fails For Three Reasons

1

Lee cannot be oxidized to form a “curved side surface”

2

A POSITA would not be motivated to oxidize Lee layer 22 because oxidation would increase risk of electrical failure

3

A POSITA would not be motivated to add a “curved side surface” to Lee because it is redundant of Lee’s protections



Ground 5 Fails For Three Reasons

1

Lee cannot be oxidized to form a “curved side surface”

2

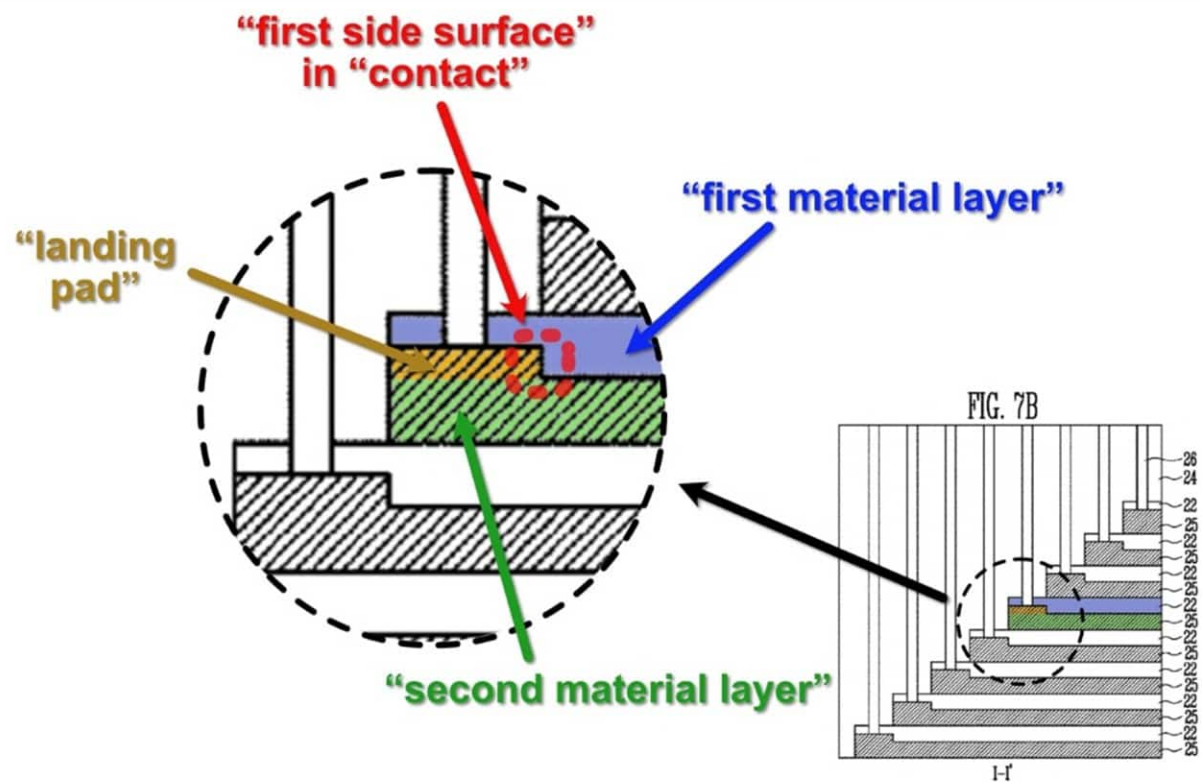
A POSITA would not be motivated to oxidize Lee layer 22 because oxidation would increase risk of electrical failure

3

A POSITA would not be motivated to add a “curved side surface” to Lee because it is redundant of Lee’s protections

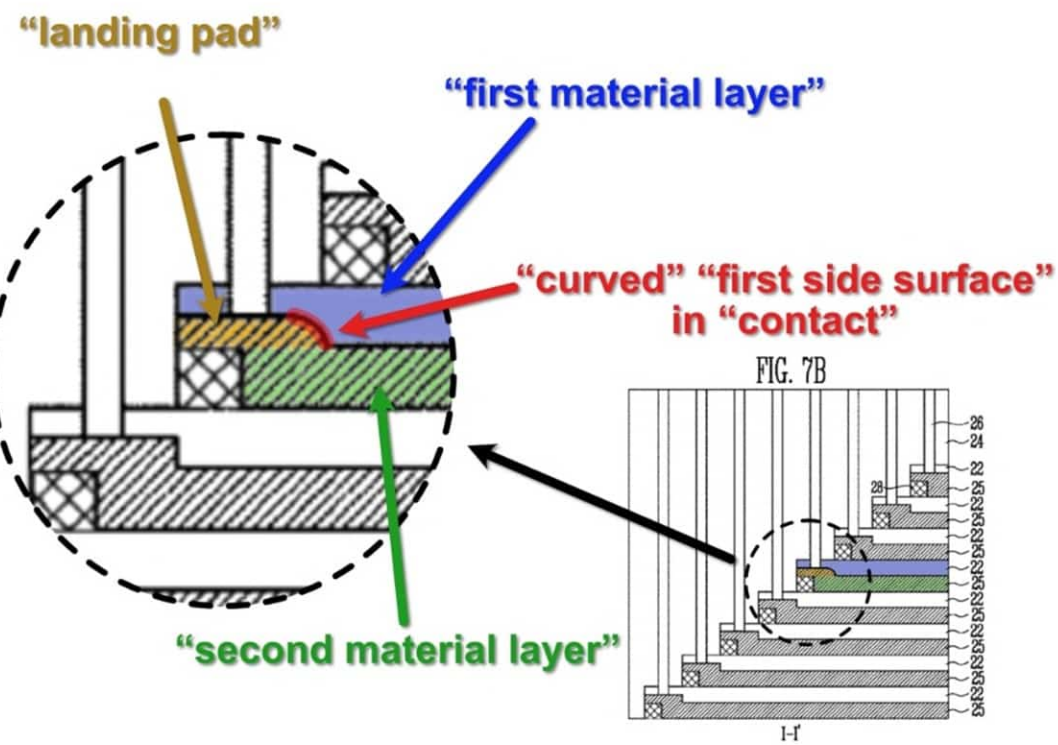
Lee Does Not Teach A “curved side surface”

Actual Figure From Lee



Pet. 65

Petitioner's Modified Figure

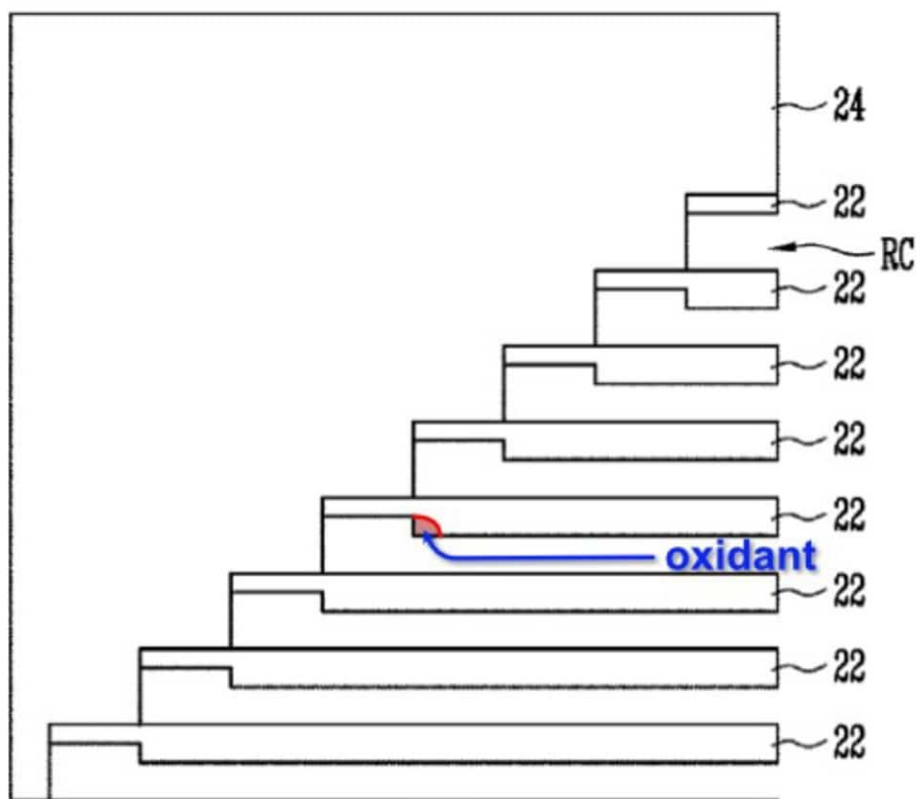


Pet. 83

Petitioner's Modification Of Lee Is Technically Unfeasible

Petitioner's Expert

FIG. 5B



Ex. 1003 (Lee Decl.) ¶ 474; Pet. 82-83

Petitioner's Modified Figure

"landing pad"

"first material layer"

"curved" "first side surface" in "contact"

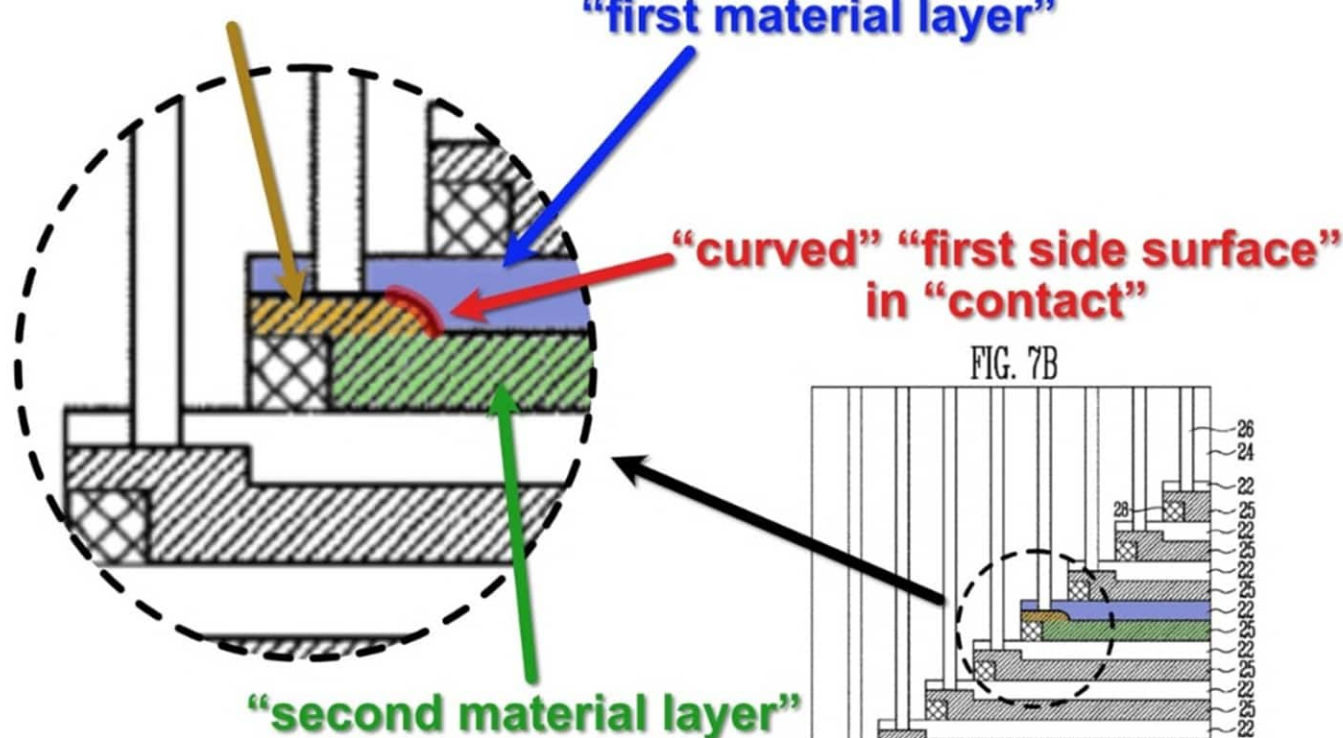
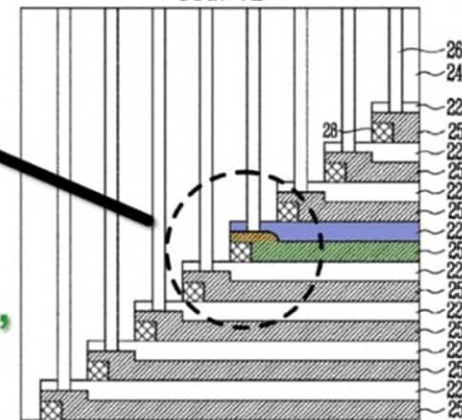


FIG. 7B

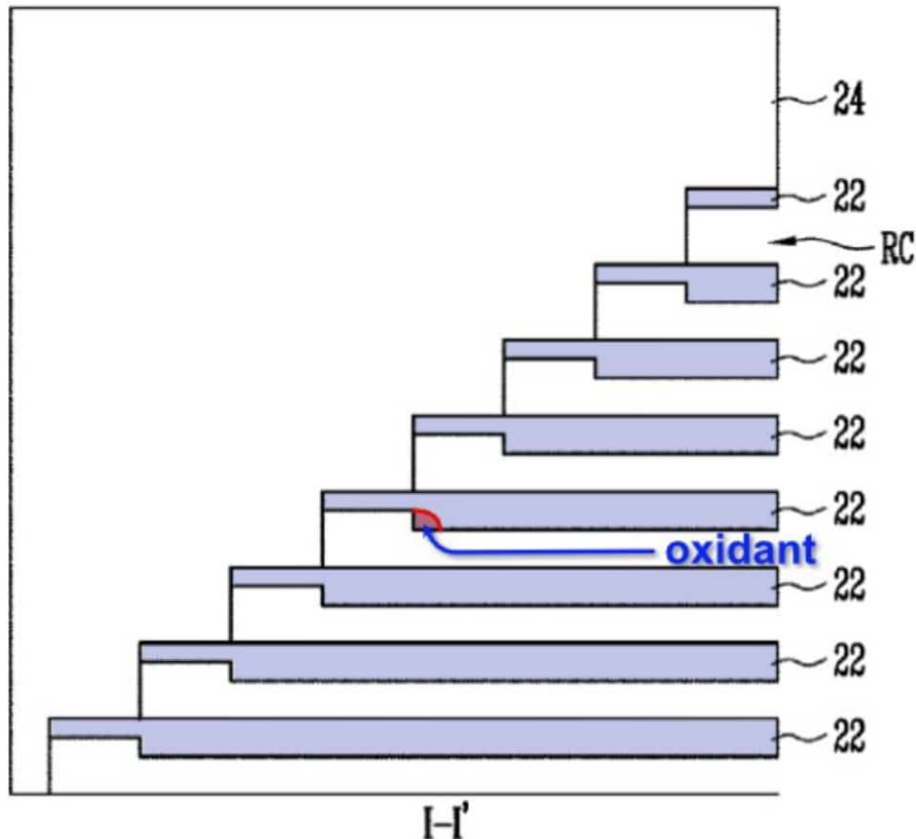


Pet. 83

Lee's Layer 22 Does Not Oxidize

Petitioner's Expert

FIG. 5B



Ex. 1003 (Lee Decl.) ¶ 474; Pet. 82-83 (modified)

Lee

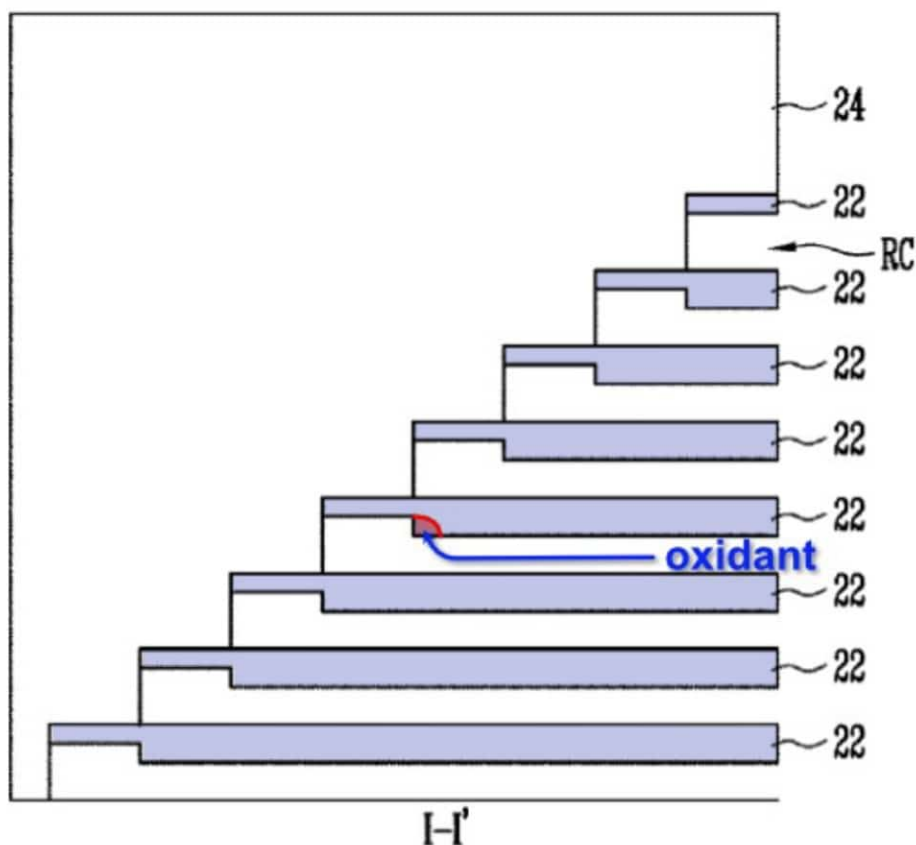
[0030] The first material layers 21 may be formed of materials having a high etch selectivity with respect to the second material layers 22. For example, the first material layers 21 may include a conductive layer such as a polysilicon layer, and the second material layers 22 may include an insulating layer such as an oxide layer. In another example, the first material layers 21 may include a sacrificial layer such as a nitride layer, and the second material layers 22 may include an insulating layer such as an oxide layer.

Ex. 1006 (Lee) [0030]

Dr. Lee Admits “Lee does not oxidize layer 22”

Petitioner's Expert

FIG. 5B



Ex. 1003 (Lee Decl.) ¶ 474; Pet. 82-83 (modified)

Petitioner's Expert

Q. So Lee never describes oxidizing layer 22, correct?

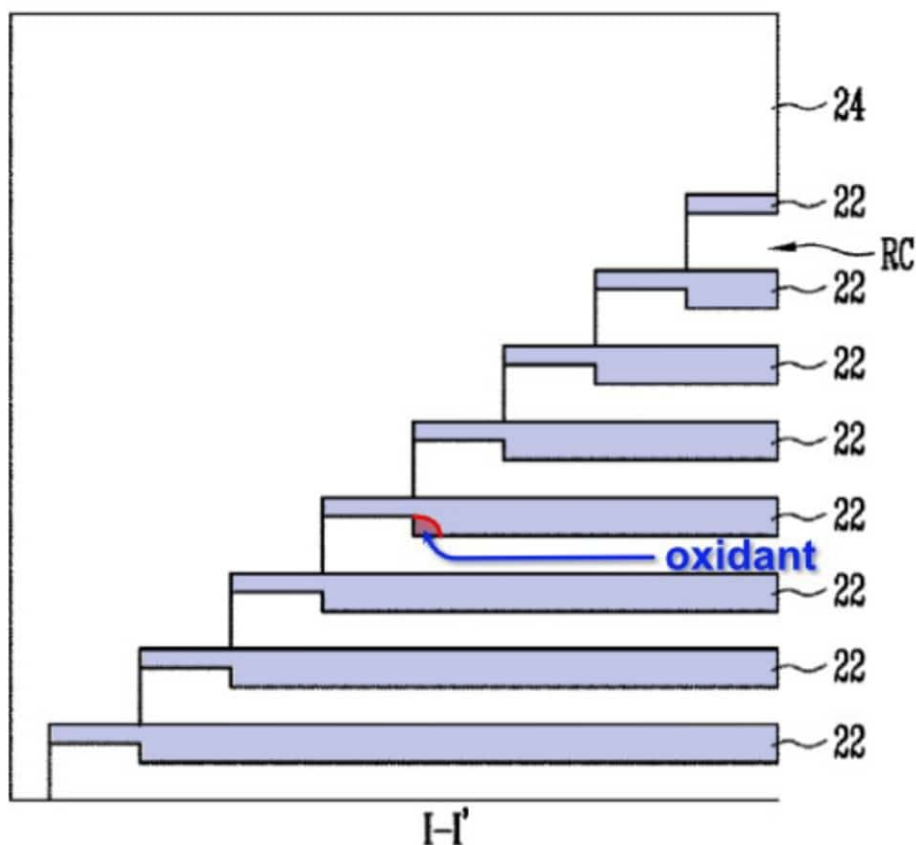
A. Sorry, it's getting late and -- I believe you're correct. Lee does not oxidize layer 22.

Ex. 2047 (Jack C. Lee, Ph. D.), 253 (185:13-16)

Dr. Lee Admits Lee's Layer 22 Is "not designed to oxidize"

Petitioner's Expert

FIG. 5B



Ex. 1003 (Lee Decl.) ¶ 474; Pet. 82-83 (modified)

Petitioner's Expert

Q. So layers 22 is not subject to any subsequent oxidation, correct?

A. You're right. It's not -- in general, even if it is exposed to even -- it might oxidize slightly but not very much. At least **it's not designed to oxidize.**

Q. If layer 22 were able to be oxidized at the end of the staircase, these pads would be shortened. Is that fair to say?

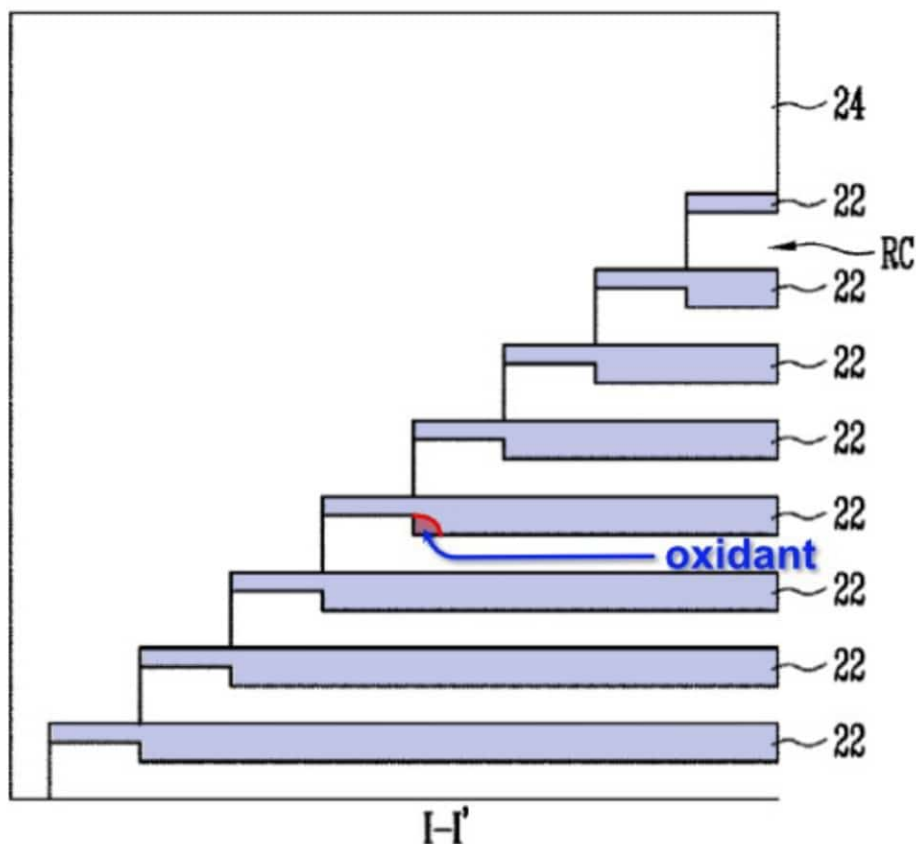
A. Again, **it's not designed to be oxidized.**

Ex. 2047 (Jack C. Lee, Ph. D.), 254 (186:3-14)

Lee's Layer 22 Does Not Oxidize

Petitioner's Expert

FIG. 5B



Ex. 1003 (Lee Decl.) ¶ 474; Pet. 82-83 (modified)

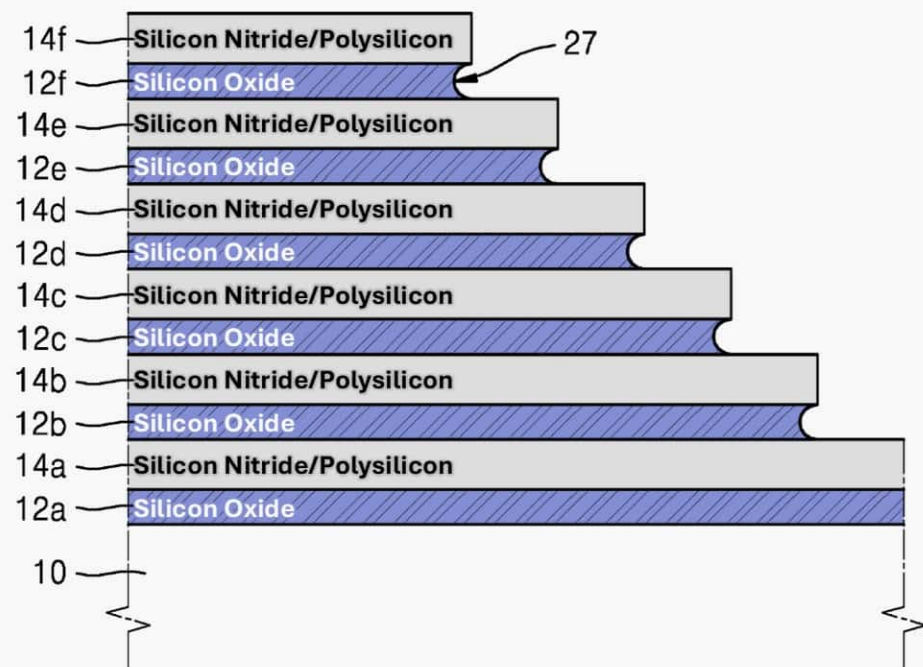
Patent Owner's Expert

193. In contrast to Park, introducing such an oxidant into the openings of Lee's structure above will not promote further oxidation to the existing oxide layers 22. Any sacrificial layer 21 has already been removed in the relevant region that Dr. Lee annotates in Lee Figure 5B, so nothing remains to be oxidized. *See* Lee [0036]. Nor would introducing an oxidant change the shape of the existing oxide layers 22. It is not possible to further oxidize a stable solid oxide material with oxygen gas as in Park. That is why Park's thermal oxidation

Ex. 2019 (Giapis Decl.) ¶ 193

Park Does Not Oxidize Oxide Layers

FIG. 6B



Ex. 1009 (Park), Fig. 6B (annotated)

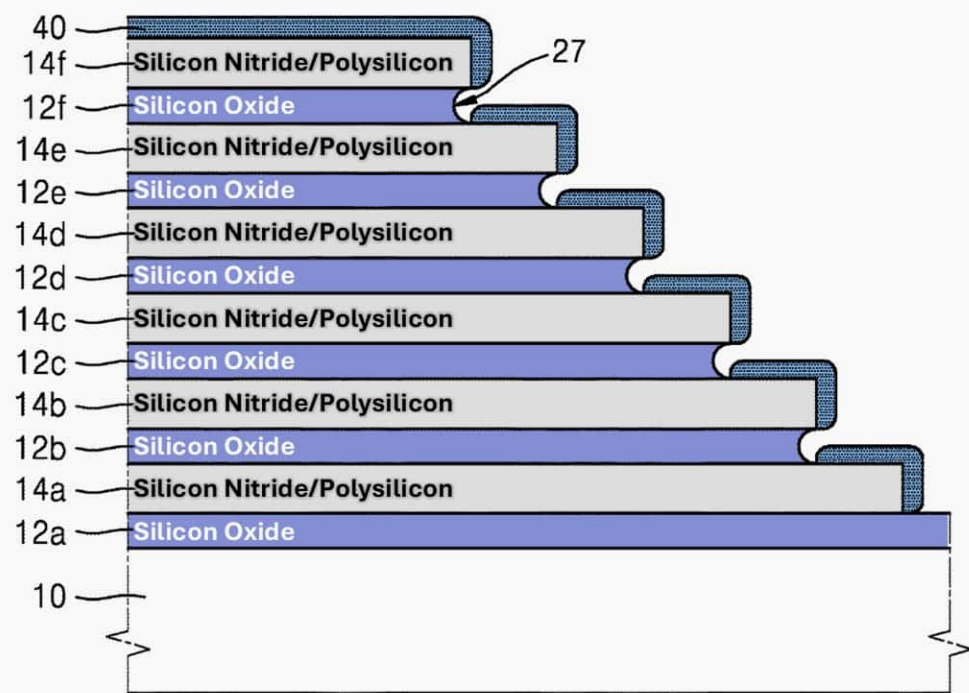
Park

The interlayer insulating layer patterns 12a through 12f may be formed of a silicon oxide layer. The sacrificial layer patterns 14a through 14f may be formed of a material having an etching selectivity with respect to the interlayer insulating layer patterns 12a through 12f. The sacrificial layer patterns 14a through 14f may be formed of a material such as a silicon nitride layer or a polysilicon layer. The interlayer

Ex. 1009 (Park), 8:1-7

Park Does Not Oxidize Oxide Layers

FIG. 6C



Ex. 1009 (Park), Fig. 6C (annotated)

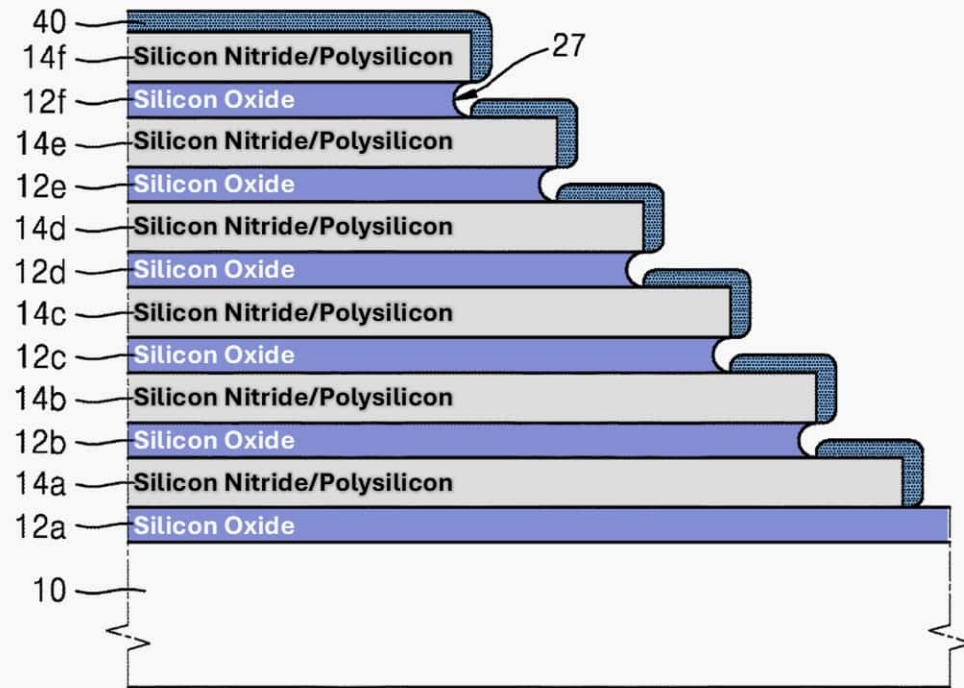
Park

As shown in FIG. 6C, an additional insulating layer 40 is formed by oxidizing surfaces and side surfaces of the stepped sacrificial layer patterns 14a through 14f that are externally exposed. The additional insulating layer 40 may

Ex. 1009 (Park), 8:28-31

Park Does Not Oxidize Oxide Layers

FIG. 6C



Ex. 1009 (Park), Fig. 6C (annotated)

Petitioner's Expert

Q. Okay. Can you point to me where the oxidant is added in Park Figure 7 to form the rounded pads?

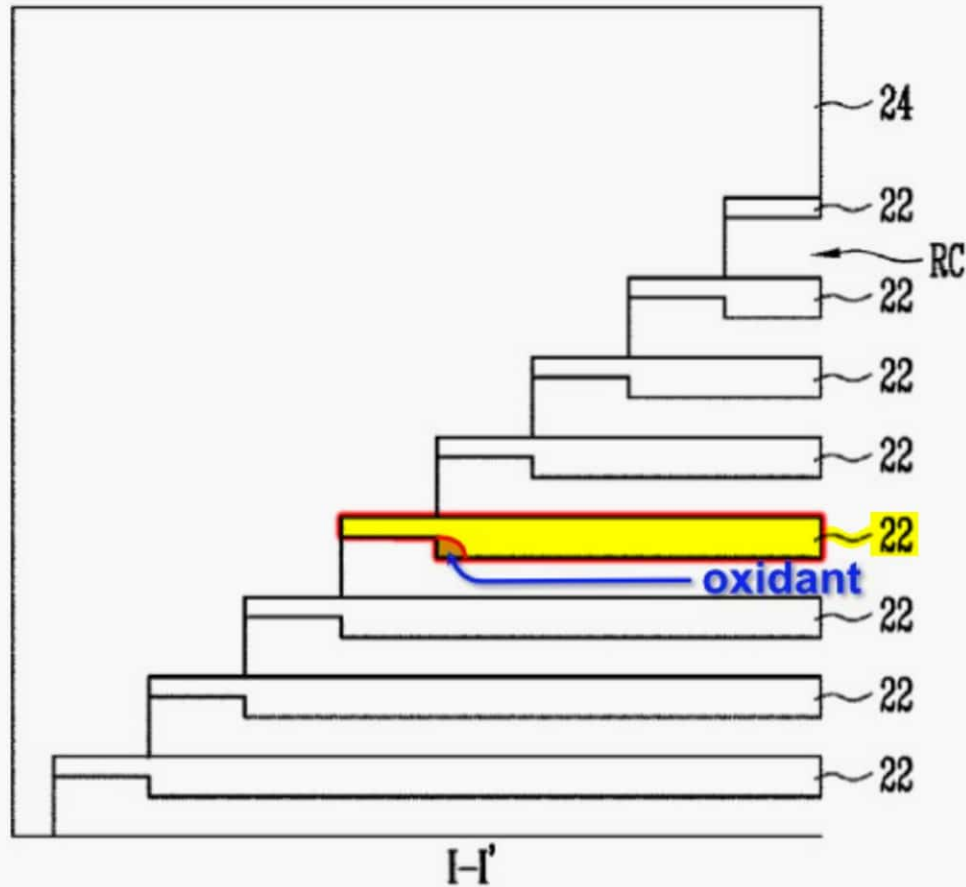
A. Well, it's due to the oxidation step as shown in Figure 6C. Figure 6C is -- the additional insulating layer 40 is **formed by oxidizing the surface and the side surface of the step sacrificial layer patterns 14a through 14f that are externally exposed.**

Ex. 2047 (Jack C. Lee, Ph. D.), 253-254 (136:14-22)



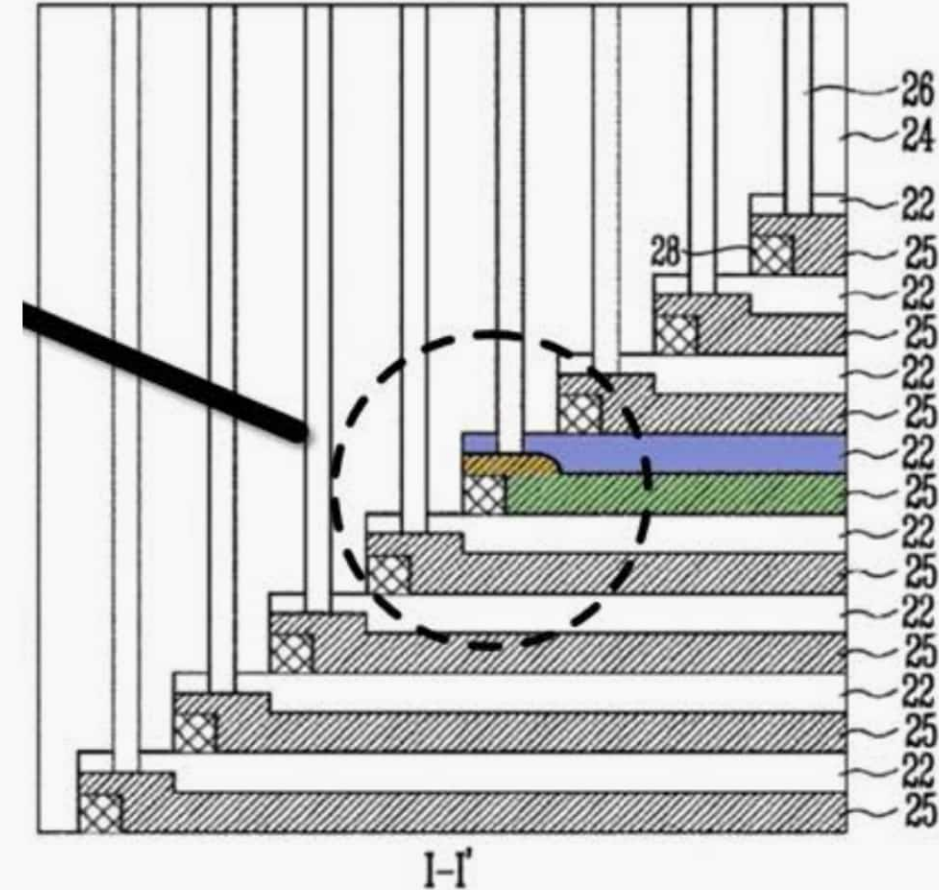
Petitioner's Change Removes Parts Of Layer 22

FIG. 5B



Ex. 1006 (Lee), Fig. 5B (modified)

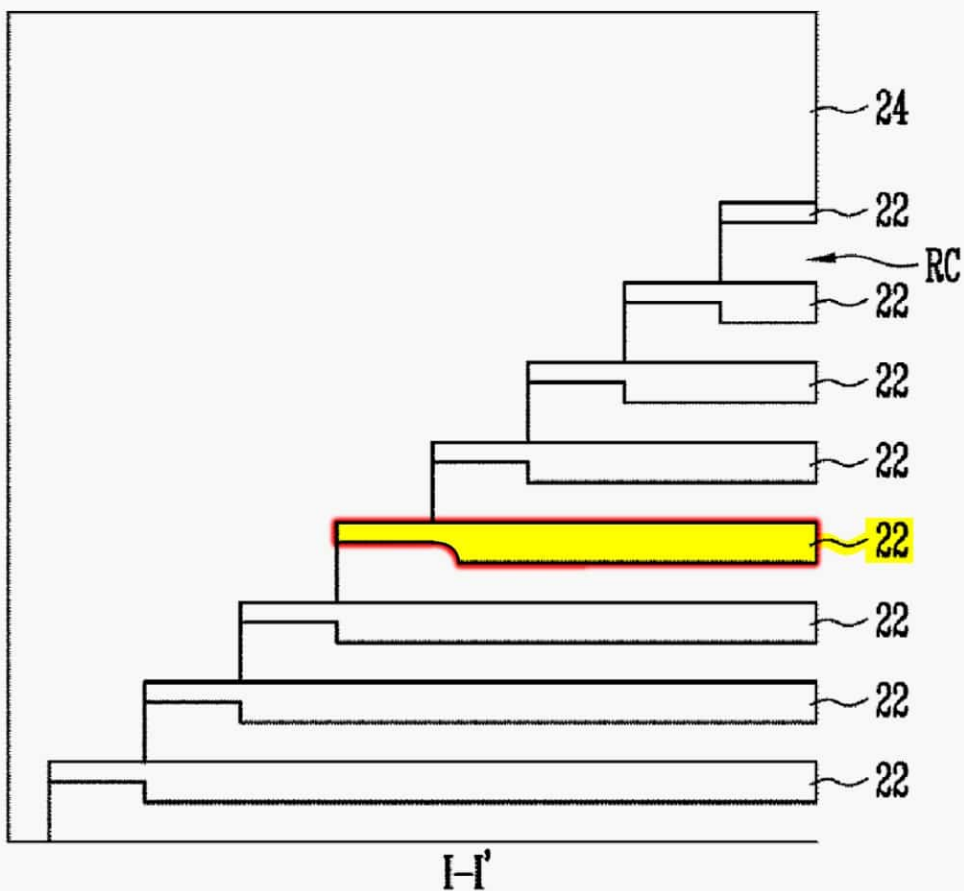
FIG. 7B



Ex. 1003 (Lee Decl.) ¶ 477

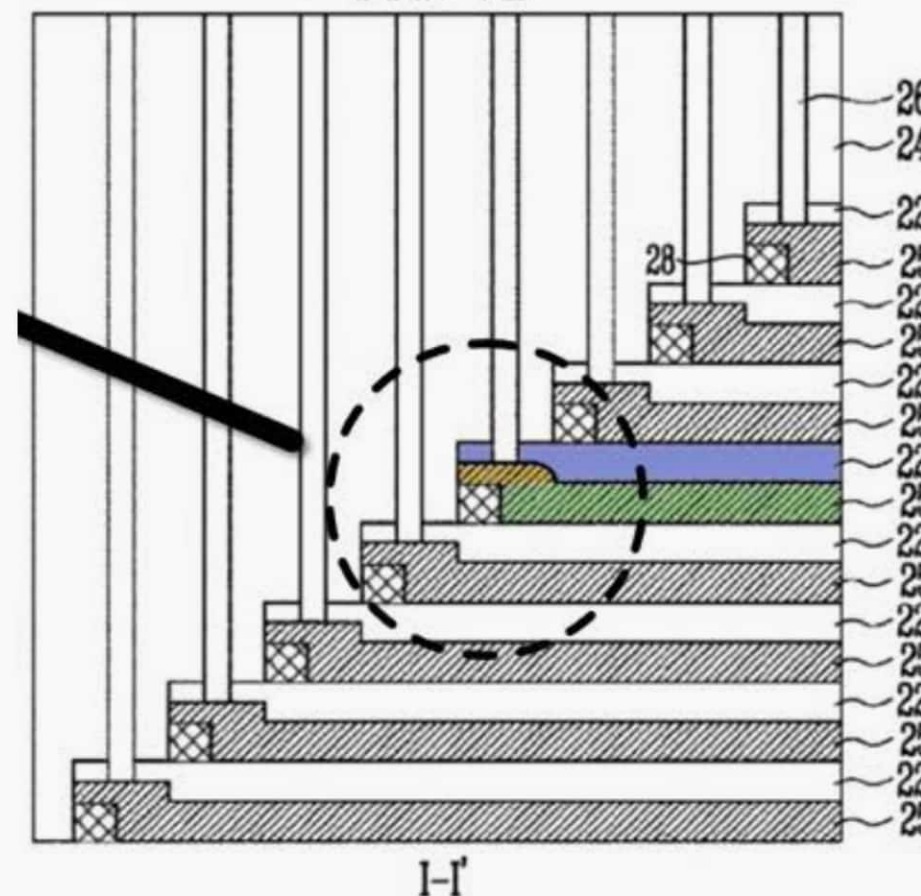
Petitioner's Change Removes Parts Of Layer 22

FIG. 5B



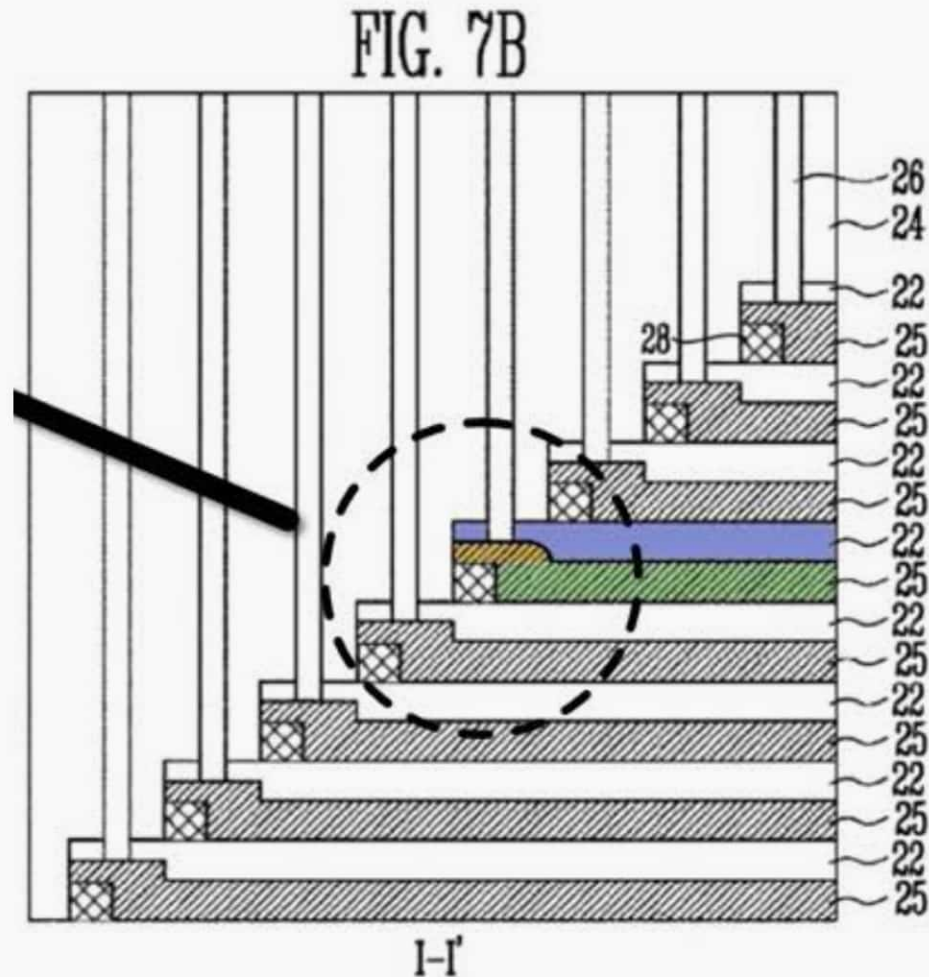
Ex. 1006 (Lee), Fig. 5B (modified)

FIG. 7B



Ex. 1003 (Lee Decl.) ¶ 477

Oxidation Processes Grow The Layer, Not Remove It



Ex. 1003 (Lee Decl.) ¶ 477

Patent Owner's Expert

196. To go from the above figure to Dr. Lee's figure under paragraph 477 of his declaration suggests that he is somehow removing part of insulating layer 22, but Dr. Lee never mentions any removal. By contrast, the oxidation process in Park that he is combining with Lee is a growing of an oxide layer. This can be

Ex. 2019 (Giapis Decl.) ¶ 196

FIG. 5B



Ex. 1003 (Lee Decl.) ¶ 474; Pet. 82-83

A. ... As a result, due to the configurations, due to the convex and concave corners -- and I describe that in my declarations -- that because of this -- the different oxidation rate at the corners versus the planar surface, causing both corners to -- convex and concave corners to be round off. And so the figure is not -- the annotated drawing in paragraph 474, I did not intend to imply that the corner would be eaten away by the oxidation process.

Ex. 2030 (Jack C. Lee, Ph. D.), 126:19-127:7

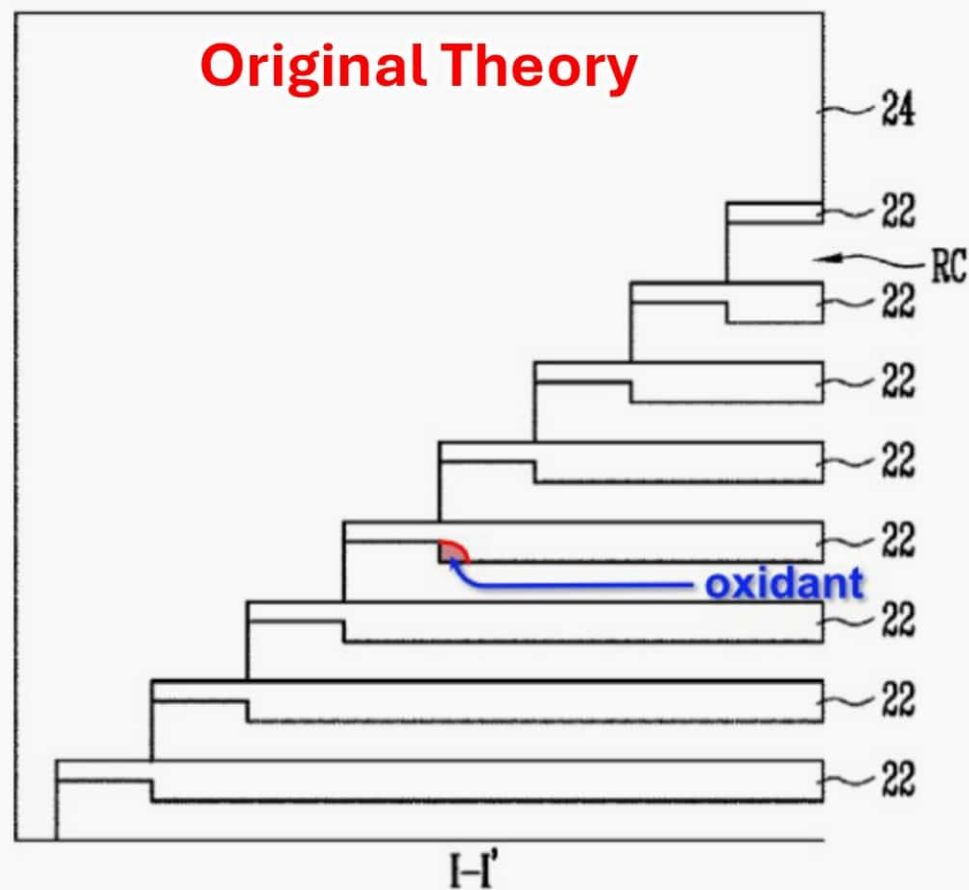
Q. Have you formed any new opinions in this case since submitting your declaration?

A. No, I have not. However, there's some figures in my declaration I could have drawn it more clearly. And I can explain it during the deposition.

Ex. 2031 (Jack C. Lee, Ph. D.), 24:11-17

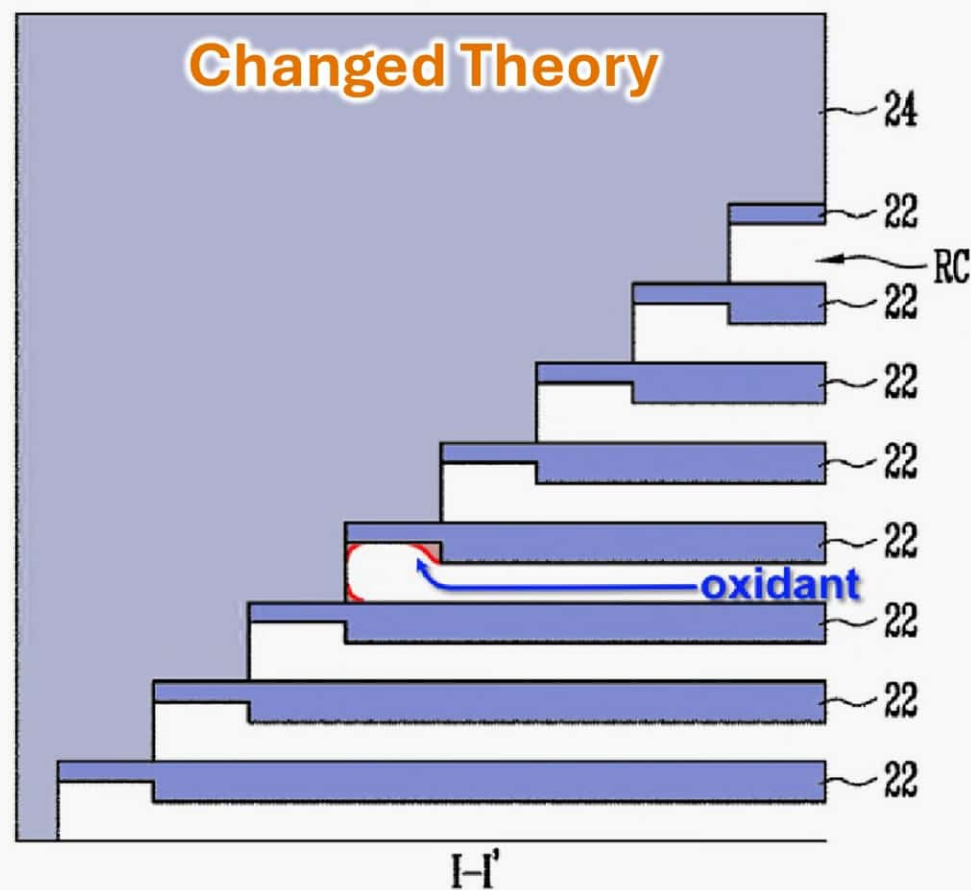
Petitioner Changes Its Theory In Reply

FIG. 5B



Ex. 1003 (Lee Decl.) ¶ 474; Pet. 82-83

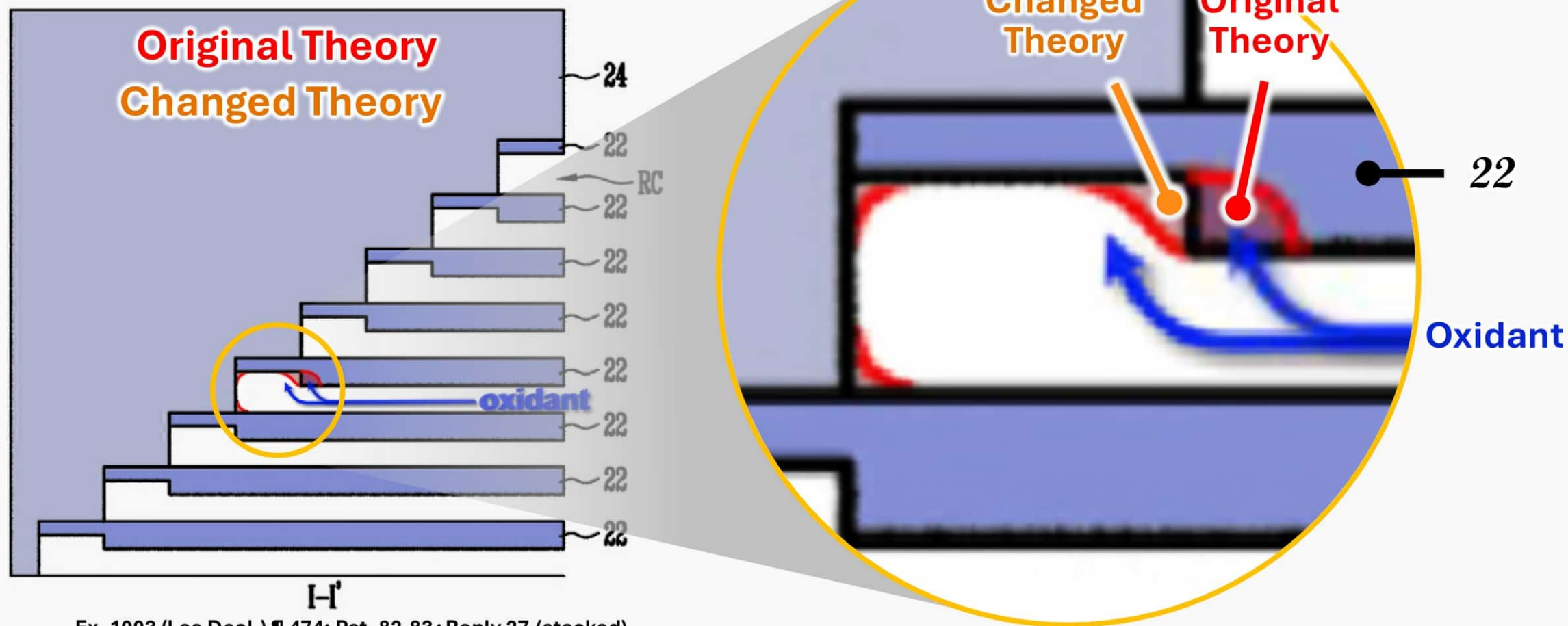
FIG. 5B



Reply 27

Petitioner Changes Its Theory In Reply

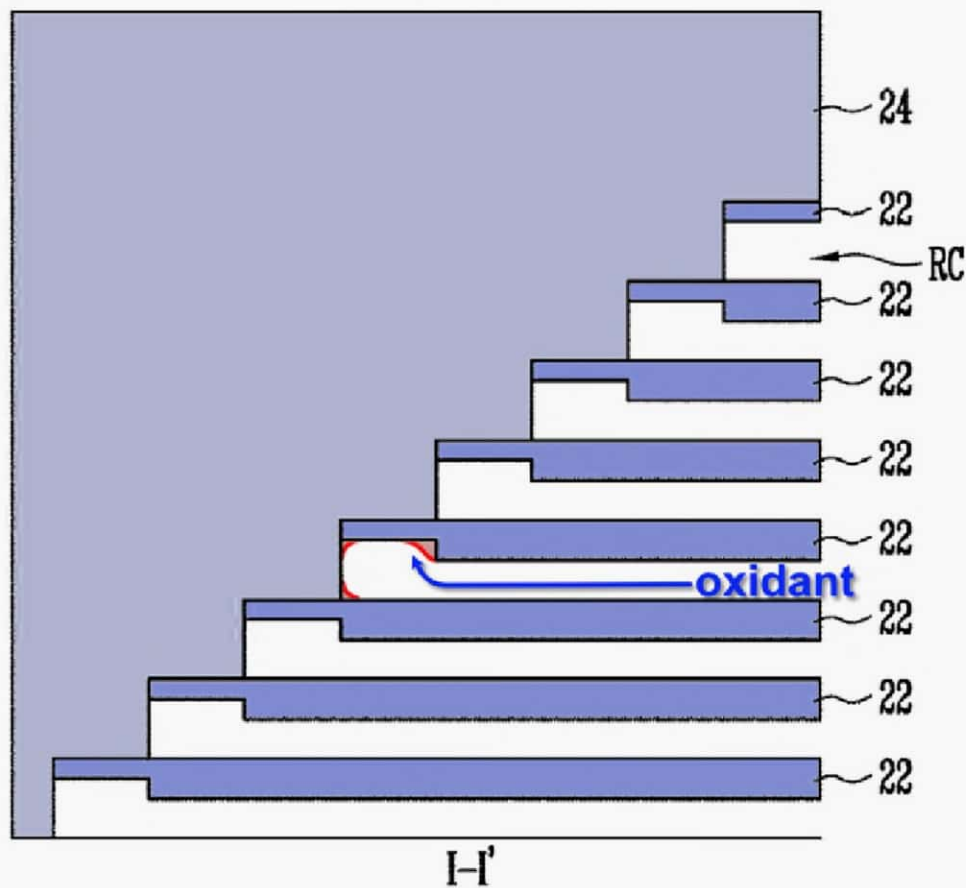
FIG. 5B



Ex. 1003 (Lee Decl.) ¶ 474; Pet. 82-83; Reply 27 (stacked)

Petitioner's New Theory Argues Layer 22 Is Nonstoichiometric Oxide

FIG. 5B



Reply 27

Reply

sacrificial layers are removed. Petition, 84-85. According to Patent Owner, it is not possible to “further oxidize[]” Lee’s “solid oxide.” Response, 82-83. Lee explains that its insulation layers are formed from, for instance, “silicon oxide.” Lee, ¶ [0030].

* * *

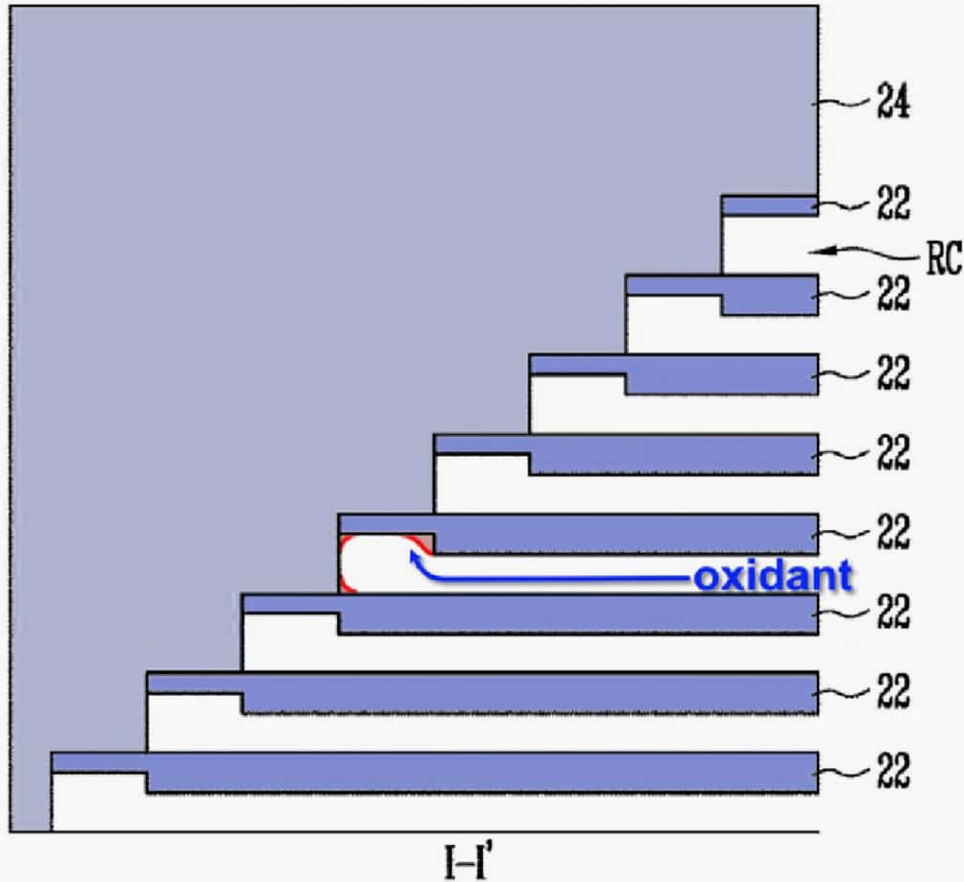
used as an “insulating layer” in a 3D memory). Because it contains excess silicon,

this type of non-stoichiometric oxide layer is further oxidized when it is exposed to oxidant. Ex. 1075, ¶¶ 126-147; Ex. 2031, 261:20-266:1. Moreover, this material is

Reply 26

Lee Layer 22 Is Deposited As “silicon dioxide”

FIG. 5B



Reply 27

Petitioner's Expert

Q. If oxidation in Lee occurred on the edge of the staircase, would layer 22 be oxidized?

A. Well, it depends on the state of layer 22, but layer 22 is deposited as an oxide. So -- a silicon dioxide. So at least the purpose of the -- of the process is that that layer is not subject to any subsequent oxidations.

Ex. 2047 (Jack C. Lee, Ph. D.), 253-254 (185:17-186:2) (objections omitted)



Nonstoichiometric Silicon Oxide Not Used In 3D NAND

Patent Owner's Expert

204. Non-stoichiometric SiO_x ($x < 2$) contains a high density of defects and traps, such as oxygen vacancies, sub-oxide species (Si^+ , Si^{2+} , Si^{3+}) and weak Si-O networks. Chen 1-10; Barranco 1-8. These defects can allow for charge trapping and/or electron hopping that affects the layer's insulating properties.

* * *

dielectric strength and breakdown characteristics. These deficiencies render non-stoichiometric oxide unsuitable for structural dielectric use in NAND memories.

207. In summary, good and stable electrical isolation between word lines in 3D NAND is critical, and cannot be met by the inferior insulating and structural properties of silicon sub-oxide. A POSITA would avoid using non-stoichiometric silicon oxide layers between word lines.

Ex. 2019 (Giapis Decl.) ¶¶ 204, 207



Ground 5 Fails For Three Reasons

1

Lee cannot be oxidized to form a “curved side surface”

2

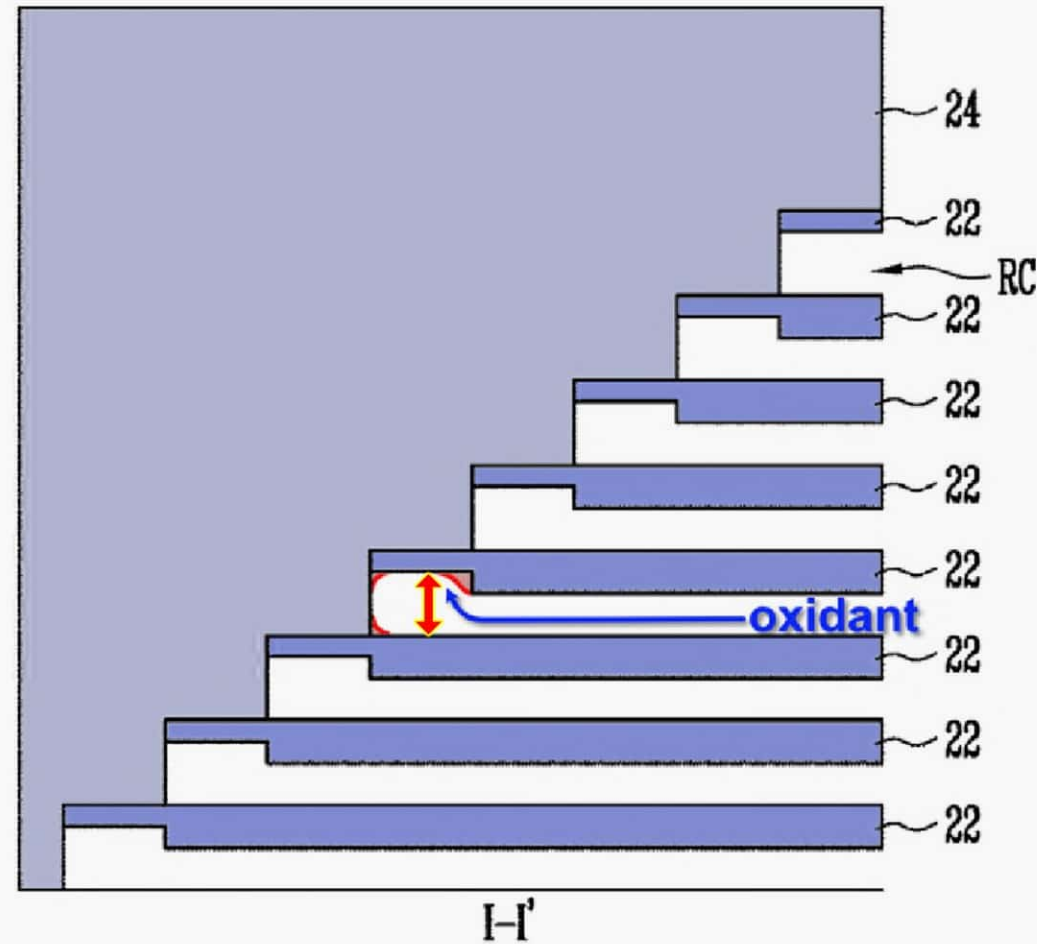
A POSITA would not be motivated to oxidize Lee layer 22 because oxidation would increase risk of electrical failure

3

A POSITA would not be motivated to add a “curved side surface” to Lee because it is redundant of Lee’s protections

Petitioner Theory Increases Risk Of Short Circuits

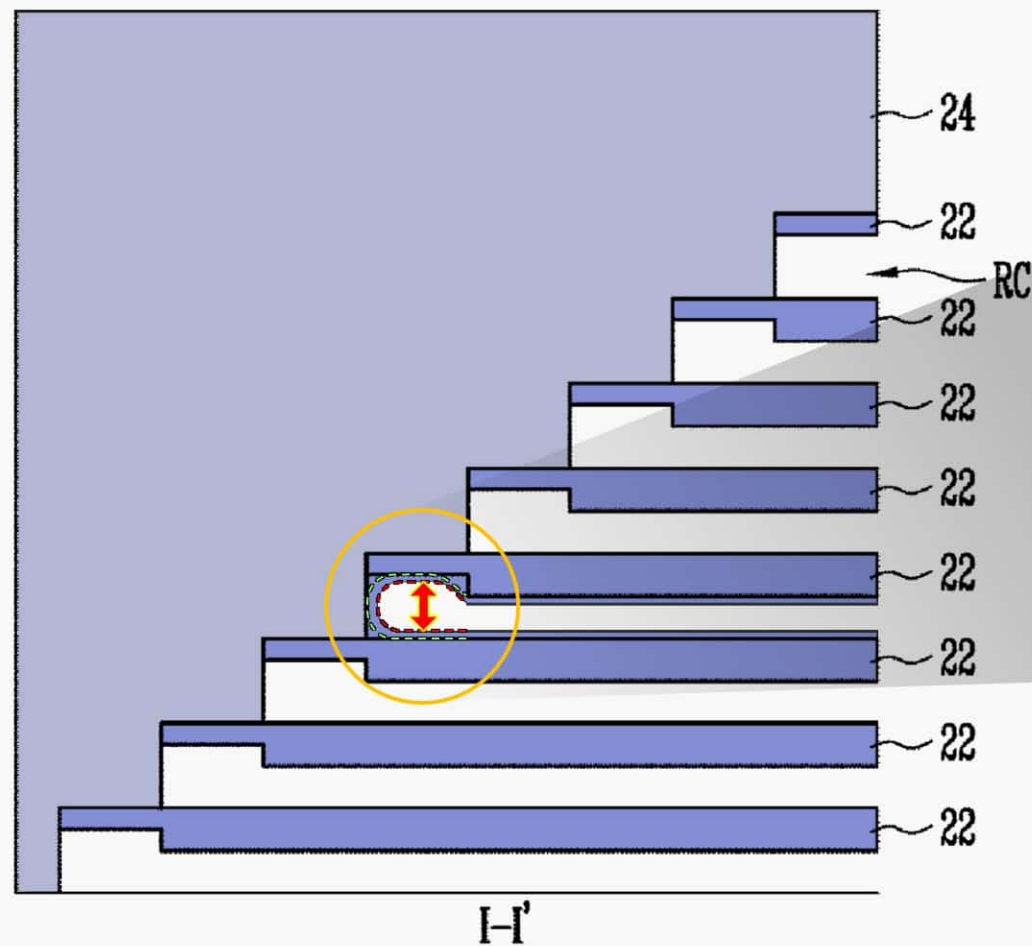
FIG. 5B



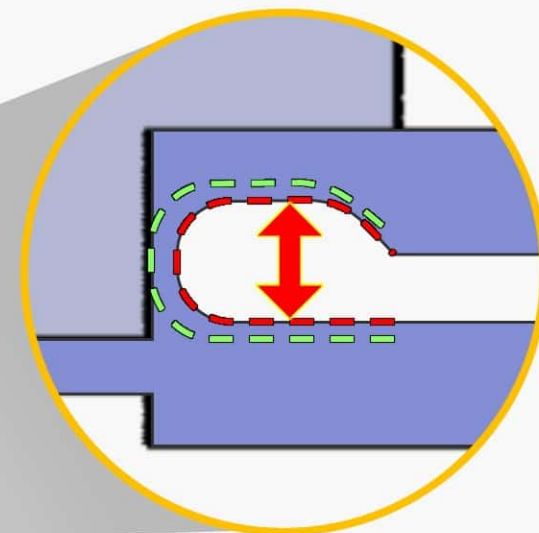
Reply 27

Petitioner Theory Increases Risk Of Short Circuits

FIG. 5B



Thinner Pad Increases Risk of Short Circuits Due To Punchthrough



Ex. 1006 (Lee), Fig. 5B (modified)



Dr. Lee Admits Thinner Pads Increase Risk Of Short Circuit

Petitioner's Expert

Q. Does increasing the thickness of the pad help prevent damage to the pad during the manufacturing process?

A. Yes. Of course.

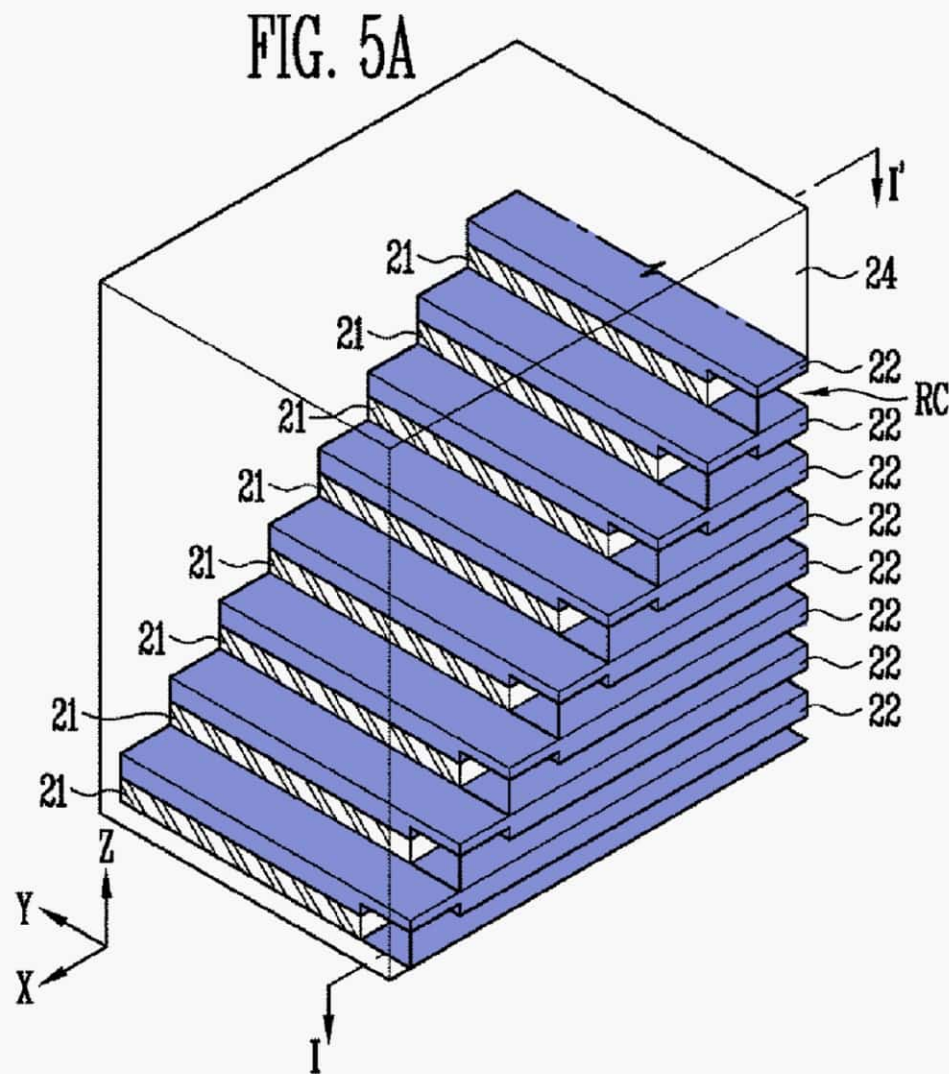
Q. Okay.

A. Because those pads are eventually used to form the conductive veer, meaning the vertical conduit. And if the pad is thin, that it can -- you know, first you do an oxide etch of the field oxide, and then you deposit the -- the content material, conductive material.

Those process, if the contact pad is thin, can easily damage the contact region and such that the -- you would have a potential shorting issues.

Ex. 2031 (Jack C. Lee, Ph. D.), 168:17-169:10

Petitioner's Theory Heightens Risk Of Electrical Failure



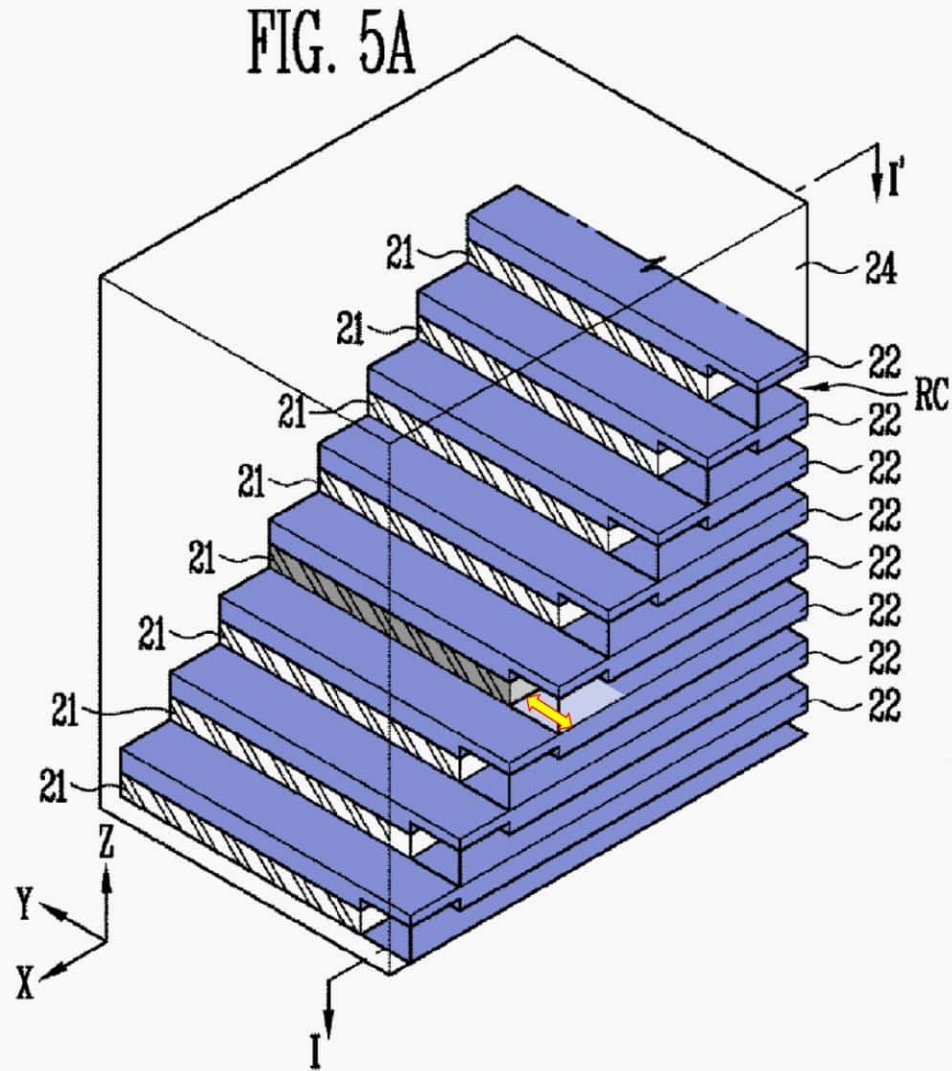
Ex. 1006 (Lee), Fig. 5A

Lee

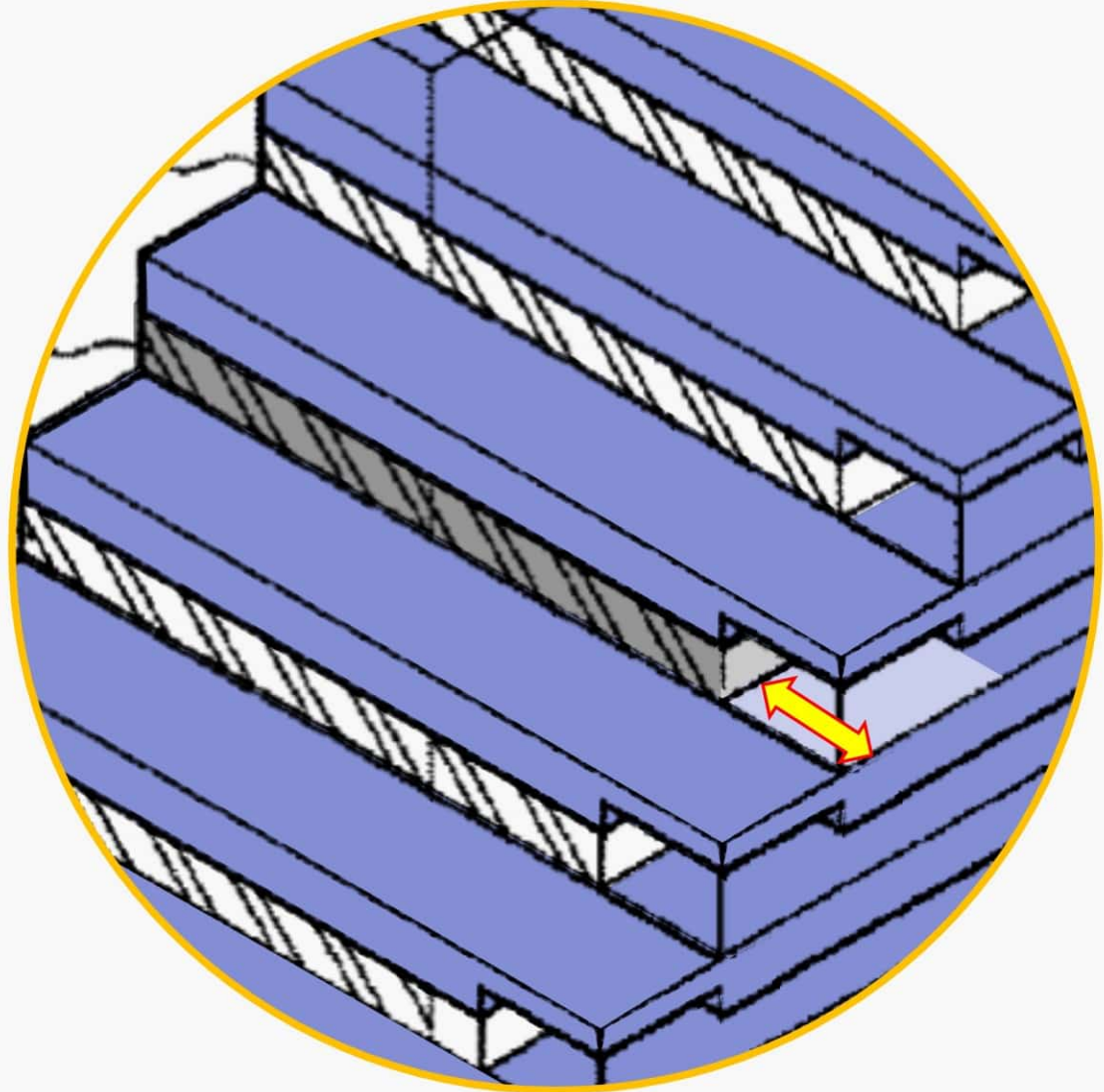
[0030] The first material layers **21** may be formed of materials having a high etch selectivity with respect to the second material layers **22**. For example, the first material layers **21** may include a conductive layer such as a polysilicon layer, and the second material layers **22** may include an insulating layer such as an oxide layer. In another example, the first material layers **21** may include a sacrificial layer such as a nitride layer, and the second material layers **22** may include an insulating layer such as an oxide layer.

Ex. 1006 (Lee) [0030]

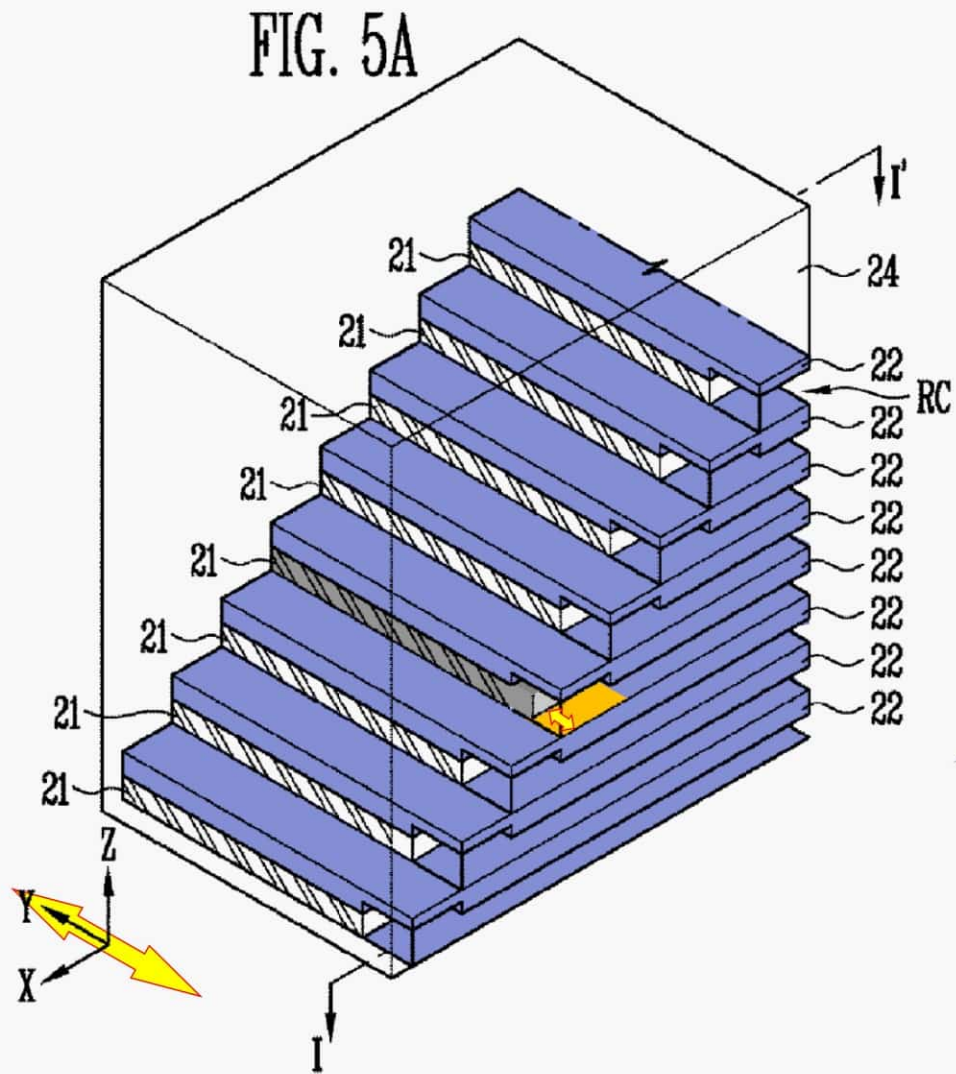
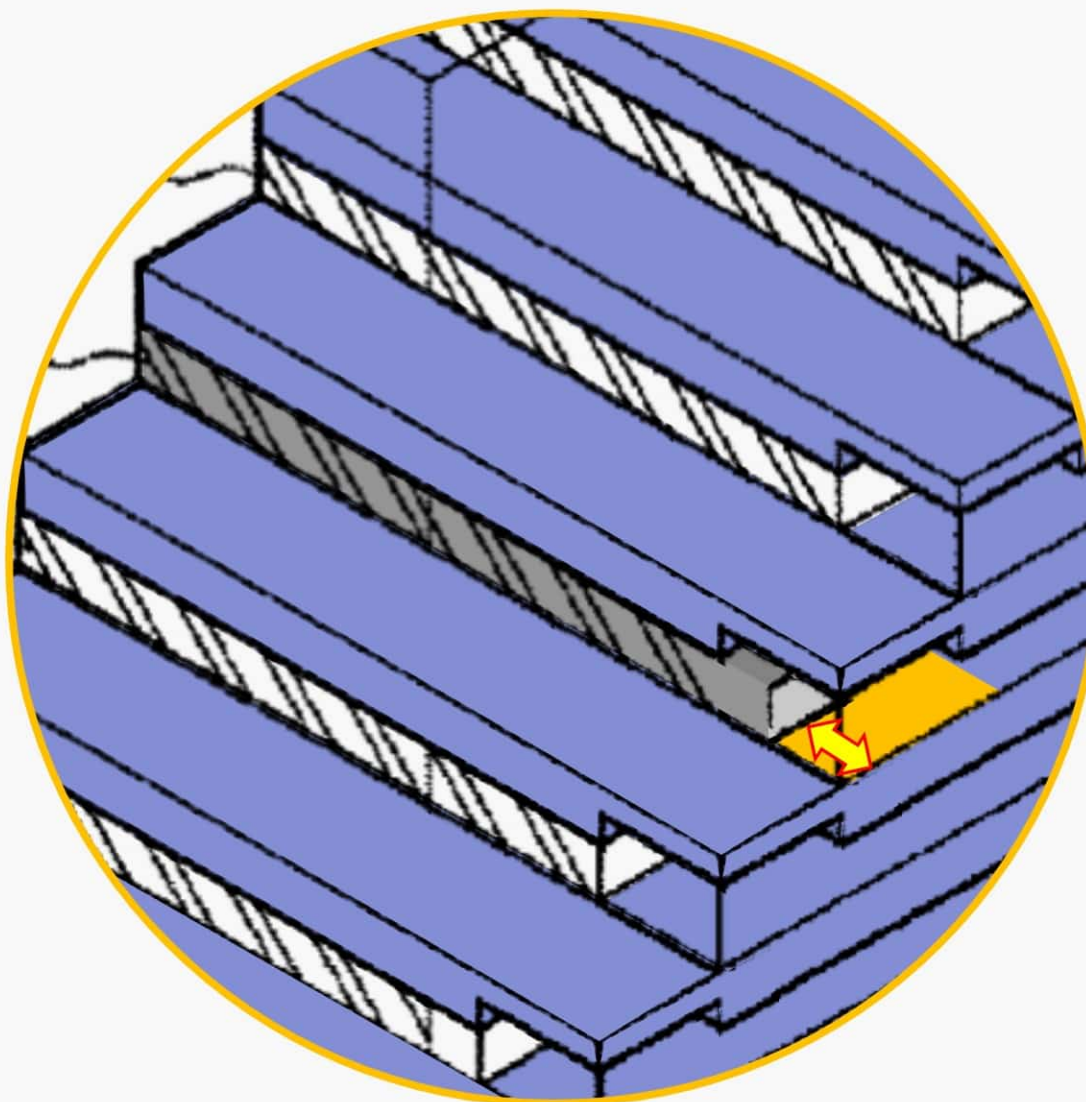
Petitioner's Theory Heightens Risk Of Electrical Failure



Ex. 1006 (Lee), Fig. 5A



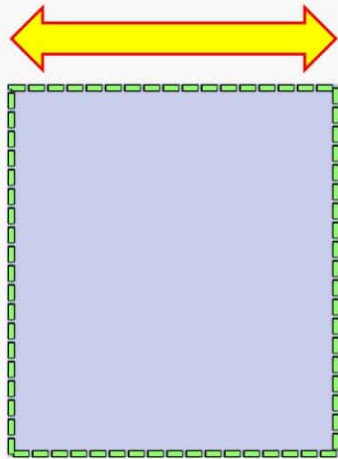
Petitioner's Theory Heightens Risk Of Electrical Failure



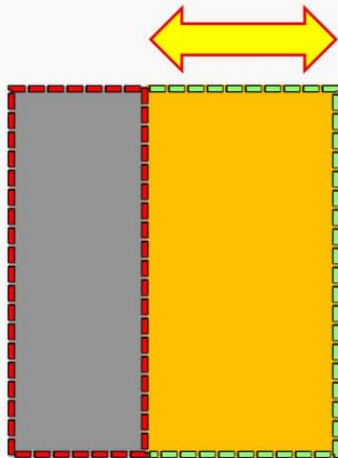
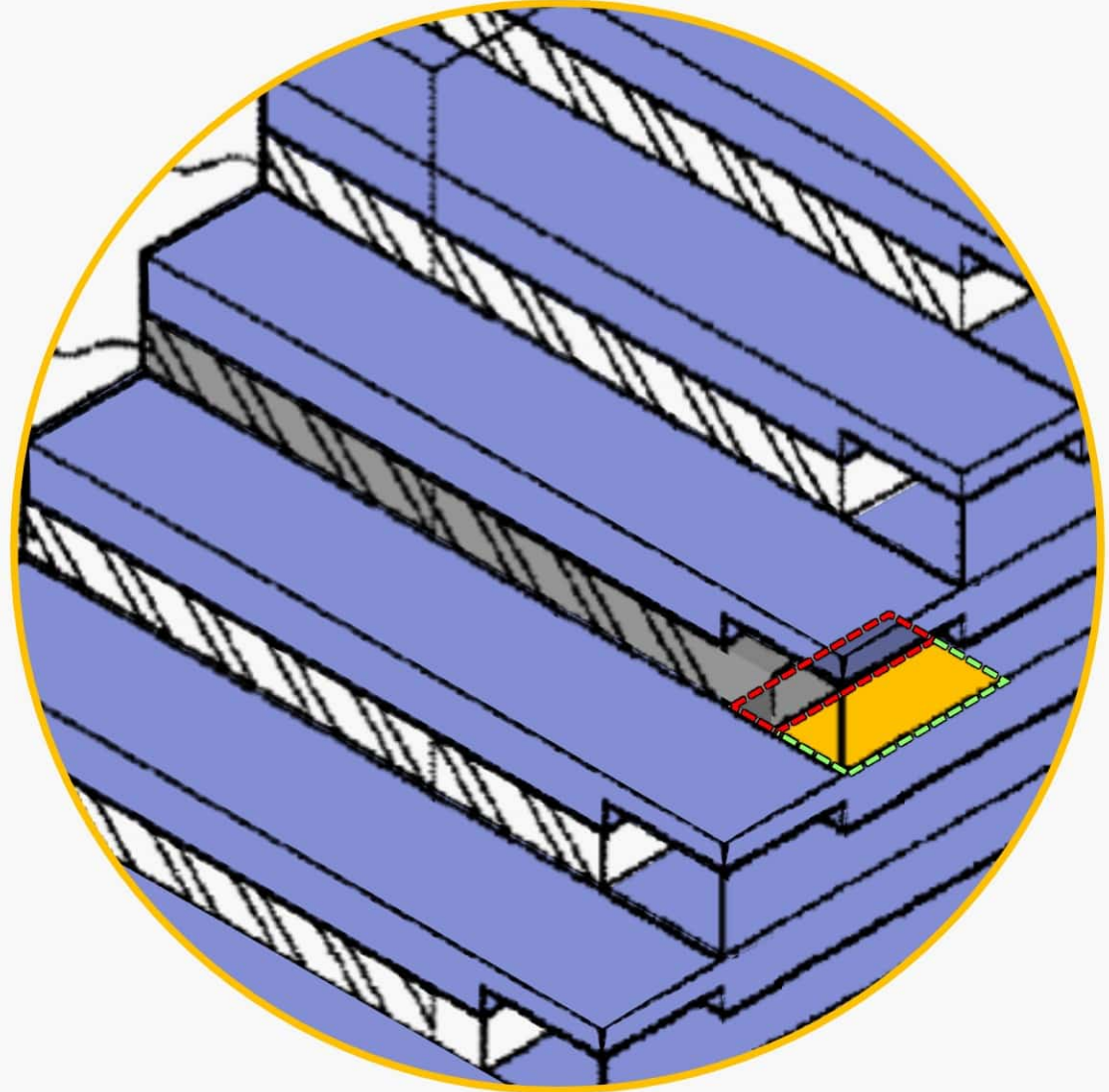
Ex. 1006 (Lee), Fig. 5A



Petitioner's Theory Heightens Risk Of Electrical Failure



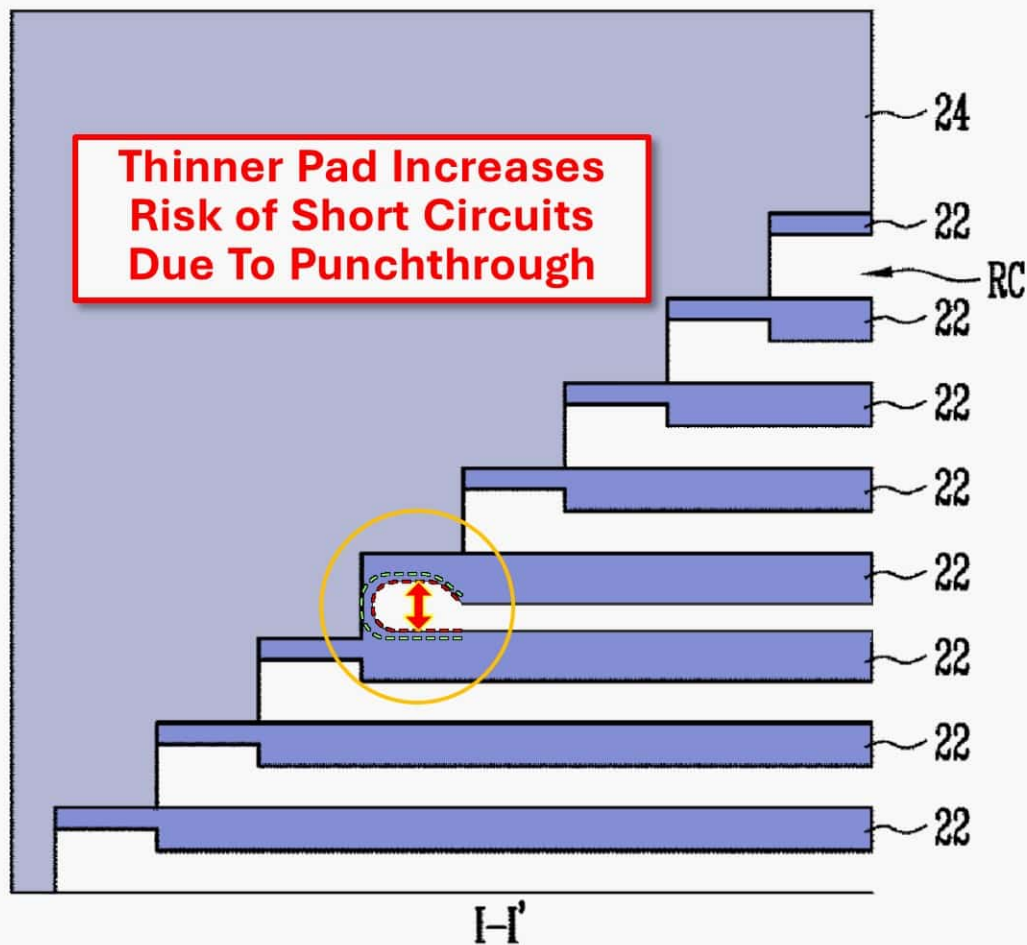
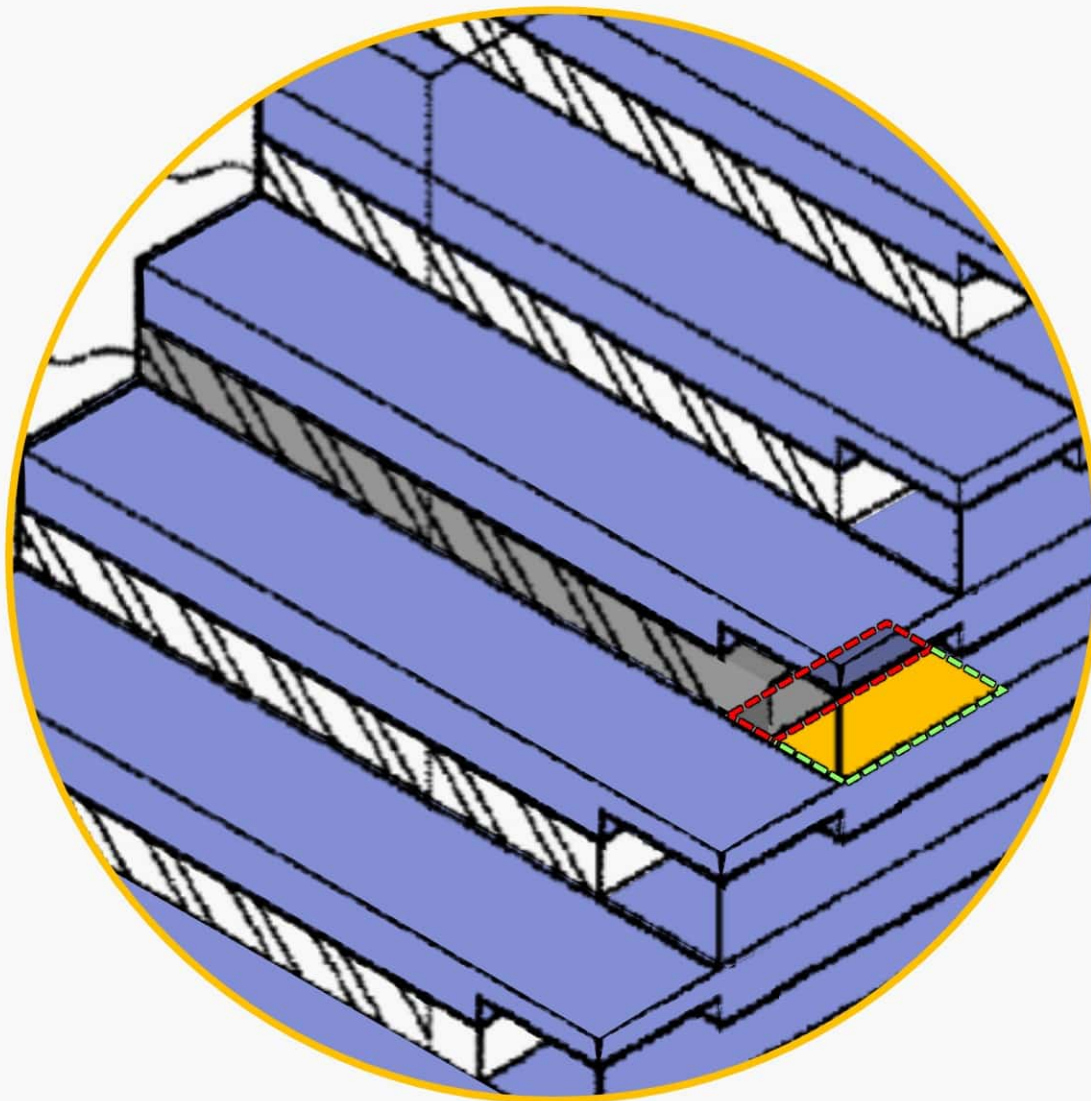
**Contact Pad
Decreases**





Oxidizing Lee Would Increase, Not Decrease, Risk Of Electrical Failure

FIG. 5B



Oxidizing Lee Contradicts Lee's Purpose Of Reducing Short Circuits



Trivascular

“We find no error in the Board’s rejection of TriVascular’s argument that it would have been obvious to substitute the recessed barbs of Samuels ’851 with the protuberances of Todd, since TriVascular’s proposed substitution **would destroy the basic objective of the barbs**, which is to *penetrate* surrounding tissue.”

Trivascular, Inc. v. Samuels, 812 F.3d 1056, 1068 (Fed. Cir. 2016)



Ground 5 Fails For Three Reasons

1

Lee cannot be oxidized to form a “curved side surface”

2

A POSITA would not be motivated to oxidize Lee layer 22 because oxidation would increase risk of electrical failure

3

A POSITA would not be motivated to add a “curved side surface” to Lee because it is redundant of Lee’s protections

Rounding Corners Is Redundant Of Lee's Electrical Failure Protections

Lee

the X direction during an etch process. Conventionally, the distance between the stacked conductive layers (pad portions) may decrease, and therefore a breakdown voltage of the conductive layers **25** may be deteriorated. However, according to an embodiment of the present invention, since an etch margin is ensured by the barrier layers **27** and **28**, a sufficient distance may be ensured between the stacked conductive layers (pad portions) to prevent any deterioration.

Ex. 1006 (Lee) [0049]

No Motivation To Add Redundant Features



Kinetic Concepts

“In addition, both of these references independently accomplish similar functions, namely, draining fluids. Because each device independently operates effectively, a person having ordinary skill in the art, who was merely seeking to create a better device to drain fluids from a wound, would have no reason to combine the features of both devices into a single device.”

Kinetic Concepts, Inc. v. Smith & Nephew, Inc., 688 F.3d 1342, 1369 (Fed. Cir. 2012)



'838 Patent Overview

Claim Construction - Portions

Ground 1 (Kim) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 3 (Lee) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 1 and 5 - Curved Side Surface *Claims 13-15*

Ground 2 (Kim + Yang) *Claims 3, 18*

Ground 4 (Lee + Haller) *Claims 3, 18*



Kim Does Not Disclose The Claimed Dimensions

3. The staircase structure of claim 1, wherein a lateral distance between the second side surface and the side surface of the second portion of the second material layer is between 10 nm and 300 nm.

Ex. 1001 ('838 Patent), Claim 3

Petitioner's Expert

Q. Do you agree that Kim does not teach a lateral distance as claimed in Claims 3 and 18 of the '838 patent?

A. Yeah, as I mentioned, that Kim does not provide a numerical example quantify --quantifying the distance between the side of this landing pad and the side of the conductive layer below it.

Ex. 2030 (Jack C. Lee, Ph. D.), 63:18-64:3

Petitioner's Hindsight Reconstruction

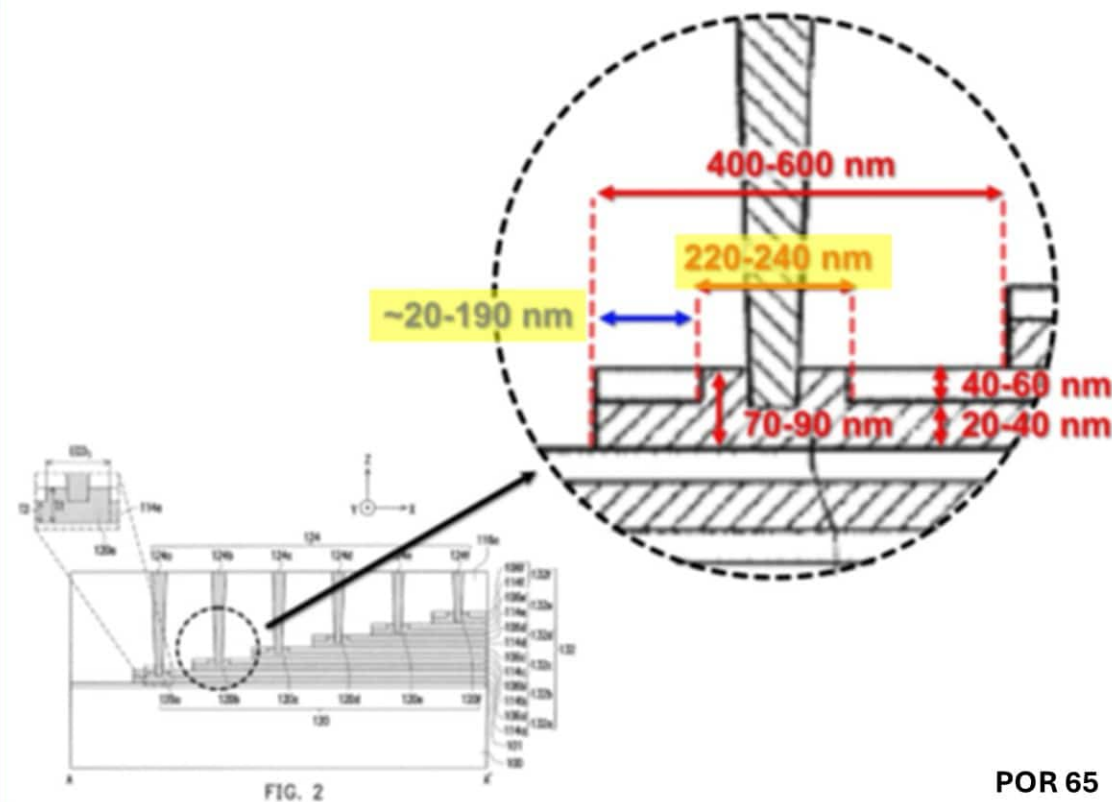
Petitioner's Expert

311. Yang also explains that its contact pads have a “width ECDs” that “is greater than the sum of the width ECDc of the contact openings 122” connecting to the pads and “two specification values S (i.e., $ECDs > ECDc + 2S$).” Yang, 10:7-21.

Yang provides an example where the contact opening is formed using a “193 nm-ArF excimer laser stepper” with a “specification value S ... in a range of 10 nm to 20 nm, for instance.” *Id.*, 10:17-21. In other words, in this example, ECDc would be 193 nm (or ~200 nm), and S would be in the range of 10-20 nm. This in turn means that ECDs (the size of the contact pad) is greater than either 200 nm + 20 nm or 200 + 40 nm, or a value in the range of ~220-240 nm.

Ex. 1003 (Lee Decl.) ¶ 311

Patent Owner's Response



POR 65

Petitioner's Hindsight Reconstruction

Petitioner's Expert

311. Yang also explains that its contact pads have a “width ECDs” that “is greater than the sum of the width ECDc of the contact openings 122” connecting to the pads and “two specification values S (i.e., $ECDs > ECDc + 2S$).” Yang, 10:7-21.

Yang provides an example where the contact opening is formed using a “193 nm-ArF excimer laser stepper” with a “specification value S ... in a range of 10 nm to 20 nm, for instance.” *Id.*, 10:17-21. In other words, in this example, ECDc would be 193 nm (or ~200 nm), and S would be in the range of 10-20 nm. This in turn means that ECDs (the size of the contact pad) is greater than either 200 nm + 20 nm or 200 + 40 nm, or a value in the range of ~220-240 nm.

Ex. 1003 (Lee Decl.) ¶ 311

Petitioner's Expert

Q. Are you aware of whether the ASML 193 nanometer ArF excimer laser stepper can create contact openings smaller than 193 nanometers?

A. As I mentioned, that 193 nanometer means it's the optical resolution limit, and obviously that by using various pattern, technique, or so-called pattern tricks such as double patterning or spacer base multi -- multiple patterning, one can use -- one can create dimension much smaller than 193 nanometer.

Ex. 2030 (Jack C. Lee, Ph. D.), 74:6-15
See id. 75:13-77:5

Petitioner Compounds Hindsight With New (Incorrect) Theory

Reply

“miss[ing] the landing pad”). Next, while it is true that the laser referenced in Yang can form features either smaller or larger than 200nm, this is not what Yang discloses. In Yang, the landing pads have a “width ECDs.” Yang, 8:7-10; Fig. 2. Per Yang, this “width ECDs” is double the “thickness T3” (the thickness of insulation layer 112 deposited during manufacture). *Id.* And thickness T3 “must be greater than the thickness of the” pairs of conductive and insulating layers. *Id.*, 8:12-13. Since these layers can be up to 100nm thick (*id.*, 6:24-28), Yang’s landing pad will be on the order of 200nm wide, just as noted in the Petition. Ex. 1075, ¶¶ 102-

Reply 21

Yang

With reference to FIG. 3I and FIG. 3J, an insulation layer 112 is formed on the substrate 100. The insulation layer 112 covers the surface of the stair step structure 102' and fills into the openings 105a-105f. In an embodiment of the invention, a thickness T3 of the insulation layer 112 may be greater than half the width ECDs of the opening 105a, so as to make sure the openings 105a-105f full. In another aspect, as shown in FIG. 3J, the thickness T3 of the insulation layer 112 must be greater than the thickness of the material pair 102a, such that the opening 105a can be filled with the insulation layer 112. According to an embodiment, the insulation layer 112 includes silicon nitride, and a method of fabricating the insulation layer 112 is, for example, a chemical vapor deposition (CVD) process.

Ex. 1007 (Yang), 8:4-18

Petitioner Compounds Hindsight With New (Incorrect) Theory

Reply

“miss[ing] the landing pad”). Next, while it is true that the laser referenced in Yang can form features either smaller or larger than 200nm, this is not what Yang discloses. In Yang, the landing pads have a “width ECDs.” Yang, 8:7-10; Fig. 2. Per Yang, this “width ECDs” is double the “thickness T3” (the thickness of insulation layer 112 deposited during manufacture). *Id.* And thickness T3 “must be greater than the thickness of the” pairs of conductive and insulating layers. *Id.*, 8:12-13. Since these layers can be up to 100nm thick (*id.*, 6:24-28), Yang’s landing pad will be on the order of 200nm wide, just as noted in the Petition. Ex. 1075, ¶¶ 102-

Reply 21

Yang

With reference to FIG. 3I and FIG. 3J, an insulation layer 112 is formed on the substrate 100. The insulation layer 112 covers the surface of the stair step structure 102' and fills into the openings 105a-105f. In an embodiment of the invention, a thickness T3 of the insulation layer 112 may be greater than half the width ECDs of the opening 105a, so as to make sure the openings 105a-105f full. In another aspect, as shown in FIG. 3J, the thickness T3 of the insulation layer 112 must be greater than the thickness of the material pair 102a, such that the opening 105a can be filled with the insulation layer 112. According to an embodiment, the insulation layer 112 includes silicon nitride, and a method of fabricating the insulation layer 112 is, for example, a chemical vapor deposition (CVD) process.

Ex. 1007 (Yang), 8:4-18

Petitioner Compounds Hindsight With New (Incorrect) Theory

Yang

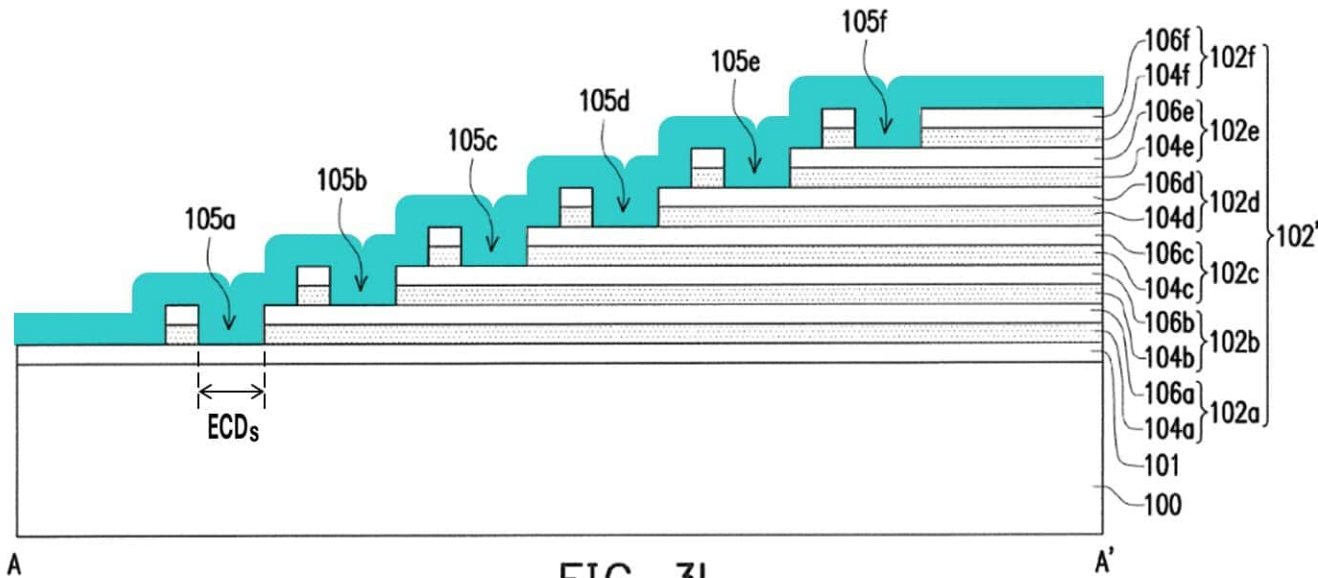


FIG. 3I

Ex. 1007 (Yang), Fig. 3J

Yang

With reference to FIG. 3I and FIG. 3J, an insulation layer 112 is formed on the substrate 100. The insulation layer 112 covers the surface of the stair step structure 102' and fills into the openings 105a-105f. In an embodiment of the invention, a thickness T3 of the insulation layer 112 may be greater than half the width ECDs of the opening 105a, so as to make sure the openings 105a-105f full. In another aspect, as shown in FIG. 3J, the thickness T3 of the insulation layer 112 must be greater than the thickness of the material pair 102a, such that the opening 105a can be filled with the insulation layer 112. According to an embodiment, the insulation layer 112 includes silicon nitride, and a method of fabricating the insulation layer 112 is, for example, a chemical vapor deposition (CVD) process.

Ex. 1007 (Yang), 8:4-18

Petitioner Compounds Hindsight With New (Incorrect) Theory

Yang

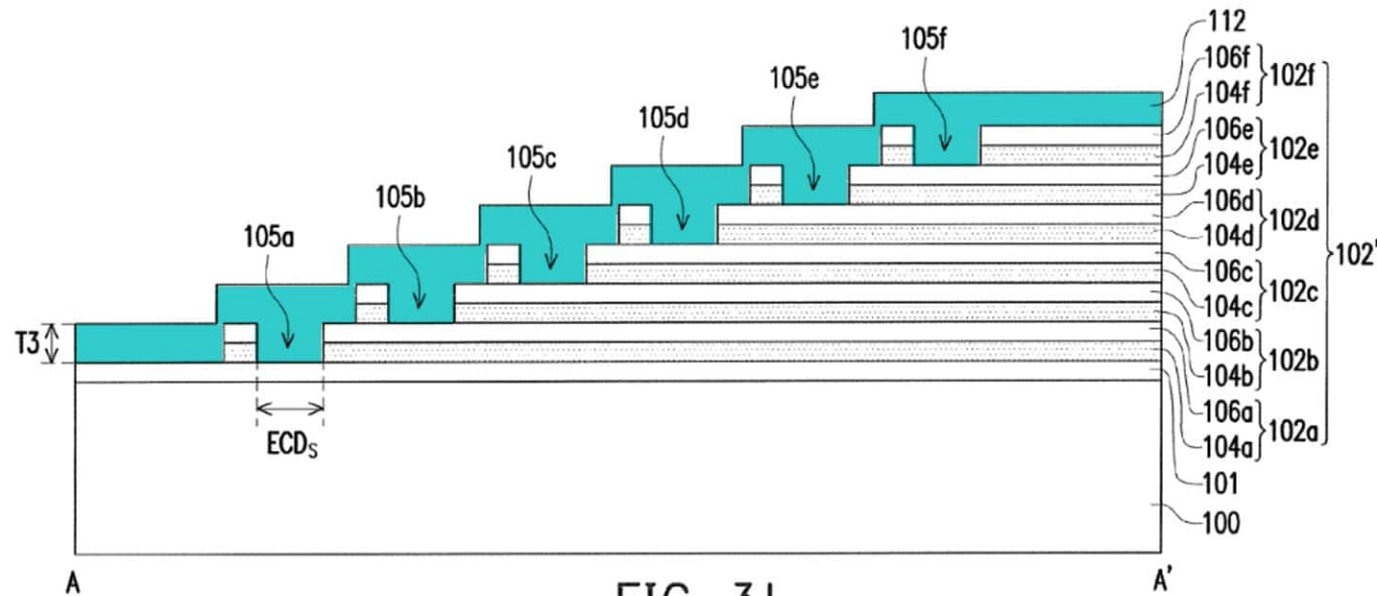


FIG. 3J

Ex. 1007 (Yang), Fig. 3J

Yang

With reference to FIG. 3I and FIG. 3J, an insulation layer 112 is formed on the substrate 100. The insulation layer 112 covers the surface of the stair step structure 102' and fills into the openings 105a-105f. In an embodiment of the invention, a thickness T3 of the insulation layer 112 may be greater than half the width ECDs of the opening 105a, so as to make sure the openings 105a-105f full. In another aspect, as shown in FIG. 3J, the thickness T3 of the insulation layer 112 must be greater than the thickness of the material pair 102a, such that the opening 105a can be filled with the insulation layer 112. According to an embodiment, the insulation layer 112 includes silicon nitride, and a method of fabricating the insulation layer 112 is, for example, a chemical vapor deposition (CVD) process.

Ex. 1007 (Yang), 8:4-18



'838 Patent Overview

Claim Construction - Portions

Ground 1 (Kim) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 3 (Lee) *Claims 1, 4-7, 12, 16-17, 19-20*

Ground 1 and 5 - Curved Side Surface *Claims 13-15*

Ground 2 (Kim + Yang) *Claims 3, 18*

Ground 4 (Lee + Haller) *Claims 3, 18*



Lee Does Not Disclose The Claimed Dimensions

3. The staircase structure of claim 1, wherein a lateral distance between the second side surface and the side surface of the second portion of the second material layer is between 10 nm and 300 nm.

Ex. 1001 ('838 Patent), Claim 3

Petitioner's Expert

436. Lee does not provide an example of layer 28's thickness.

Ex. 1003 (Lee Decl.) ¶ 436

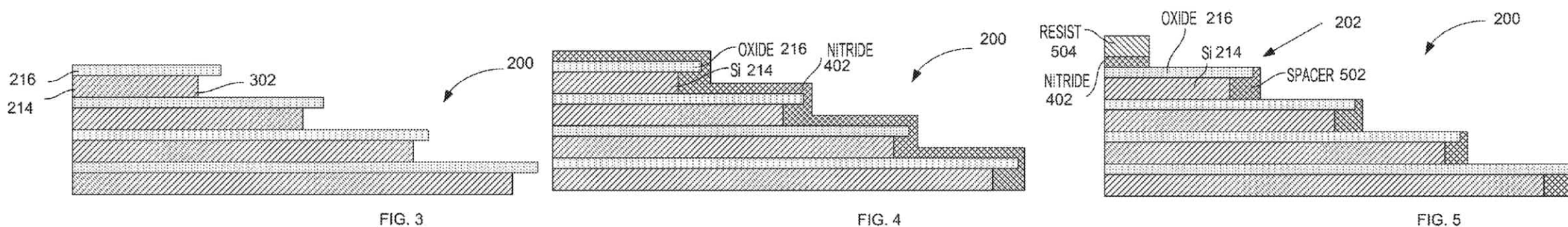
Petitioner's Hindsight Reconstruction

Petition

Id., Fig. 9; 6:28-63. Haller explains that the spacer 502 is formed by depositing “insulative dielectric material” into a “recess” that is “30 nm in length.” *Id.*, 4:37-5:7; Figs. 3-5; *see also* Ex. 1003, ¶¶ 433-446.

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Haller



Ex. 1008 (Haller), Figs. 3-5



Petitioner's Hindsight Reconstruction

Petition

Id., Fig. 9; 6:28-63. Haller explains that the spacer 502 is formed by depositing “insulative dielectric material” into a “recess” that is “30 nm in length.” *Id.*, 4:37-5:7; Figs. 3-5; *see also* Ex. 1003, ¶¶ 433-446.

Pet. 78

shown in Figure 7B to produce a modified structure. Lee, [0047]. For instance, “before an impurity implantation process is performed, side walls of the first material layer 21 exposed at respective steps may be oxidized to thereby form a plurality of barrier layers 28.” *Id.*, [0048]. Lee explains that this “barrier layer” is included “in order to ensure an etch margin when the ends of the recessed regions RC are extended.” *Id.*, [0049]. In particular, while the “recessed region RC” continues to “extend ... in a Z direction and thereby increase the thickness of the pad portions PAD,” extension in the “X direction” is now limited by the barrier. *Id.* This

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Petitioner's Hindsight Reconstruction

Petition

contacts to the device's wordline layers. *Id.*, 1:30-35. In particular, the etch may either “punch[] through” the wordline or “leak[]” over the wordline edge “creating an undesired short circuit.” *Id.* To avoid this, Haller includes an “etch stop” at the

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Petitioner's Expert

Q. Okay. So would it be correct to say that Haller's spacer keeps the silicide layer from expanding on to the adjacent wordline?

A. Yeah, you can say that because the wordline contact structure 902 basically is a silicide 802 and the spacer 502 is a dielectric layer, so -- nitride layer, right, and...

Ex. 2030 (Jack C. Lee, Ph. D.), 123:10-16

Haller

dry etch process. Further, the spacer 502 of the etch stop 902 may prevent the wordline contact structure 902 from leaking over the end 906 of the wordline 920, formed by the spacer 502, to the adjacent wordline 922. Accordingly, undesirable short circuits between adjacent wordlines may be prevented.

Ex. 1008 (Haller), 6:59-63

Petitioner's Hindsight Reconstruction

Haller

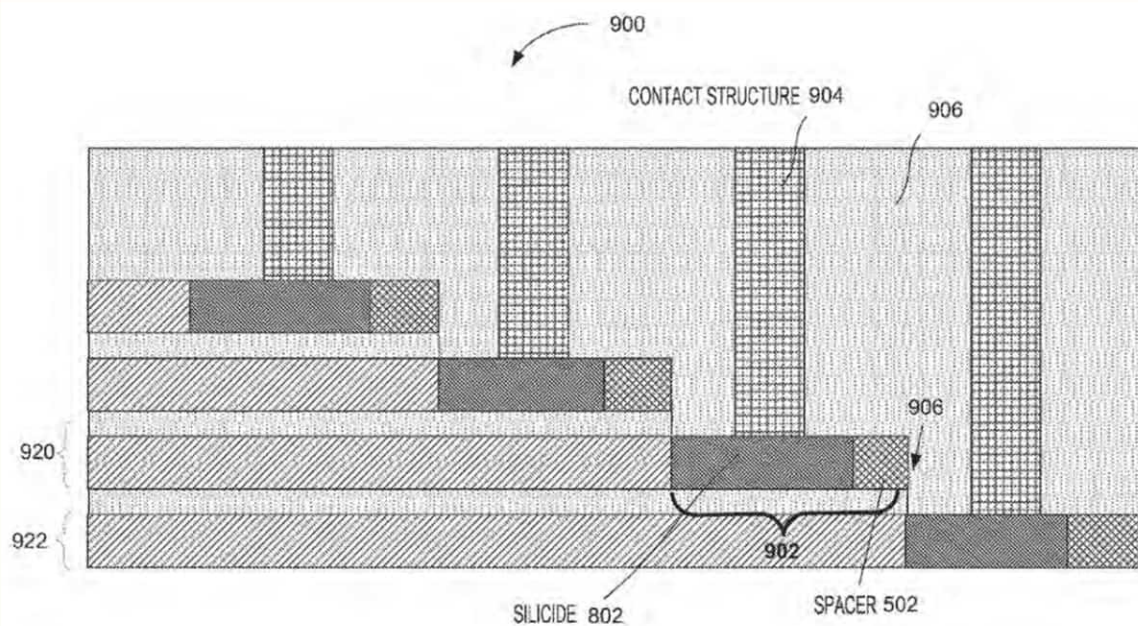
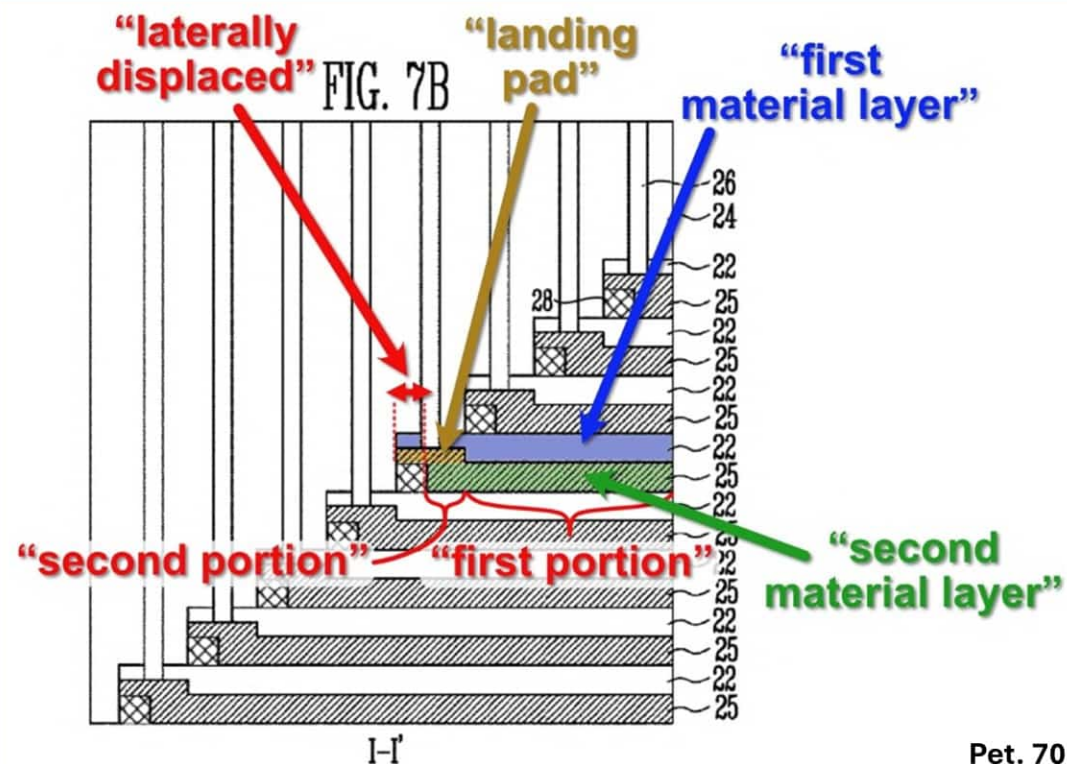


FIG. 9

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Modified Lee



I-I'

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