

UNITED STATES PATENT AND TRADEMARK OFFICE

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BEFORE THE PATENT TRIAL AND APPEAL BOARD

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SAMSUNG ELECTRONICS CO., LTD. AND  
SAMSUNG ELECTRONICS AMERICA, INC.,

Petitioners,

v.

HARBOR ISLAND DYNAMIC, LLC,

Patent Owner.

Patent No. 7,772,673

Filing Date: March 16, 2007

Issue Date: August 10, 2010

Inventors: Kevin Q. Yin, Amol Kalburge, David J. Howard,  
Arjun Kar-Roy, and Dieter Dornisch

Title: DEEP TRENCH ISOLATION AND METHOD OF FORMING SAME

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**PATENT OWNER'S RESPONSE**

Case No. IPR2024-01403

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**LIST OF EXHIBITS**

| <b>Exhibit No.</b> | <b>Description of Documents</b>                                                                                                                                                                           |
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| 2001               | Docket Control Order, Dkt. 38, in <i>Harbor Island Dynamic, LLC v. Samsung Elecs. Co.</i> , Case No. 2:24-cv-00140-JRG-RSP (E.D. Tex. Aug. 5, 2024)                                                       |
| 2002               | Order Denying Samsung's Motion to Stay Pending <i>Inter Partes</i> Review, Dkt. 62, in <i>Harbor Island Dynamic, LLC v. Samsung Elecs. Co.</i> , Case No. 2:24-cv-00140-JRG-RSP (E.D. Tex. Dec. 19, 2024) |
| 2003               | Defendants' Invalidity Contentions, served on September 26, 2024, in <i>Harbor Island Dynamic, LLC v. Samsung Elecs. Co.</i> , Case No. 2:24-cv-00140-JRG-RSP (E.D. Tex.)                                 |
| 2004               | Declaration of Mr. John Berg                                                                                                                                                                              |
| 2005               | CV of Mr. John Berg                                                                                                                                                                                       |
| 2006               | Tsou, et.al., "Determination of Thermal Expansion Coefficient of Thermal Oxide," <i>Sensors and Materials</i> , Vol. 17, No. 8 (2005)                                                                     |
| 2007               | H Watanabe, et.al., "Linear Thermal Expansion Coefficient of Silicon from 293 to 1000 K," <i>International Journal of Thermophysics</i> , Vol. 25, No. 1, Jan. 2004                                       |
| 2008               | J-H Chae, et. al., "Measurement of Thermal Expansion Coefficient of poly-Si Using Microgauge Sensors," <i>Sensors and Actuators</i> , 75 (1999)                                                           |
| 2009               | <a href="https://anysilicon.com/semipedia/deep-trench-isolation-dti/">https://anysilicon.com/semipedia/deep-trench-isolation-dti/</a>                                                                     |
| 2010               | Deposition transcript of Scott E. Thompson, Ph.D., taken                                                                                                                                                  |

## I. INTRODUCTION

On September 20, 2024, Samsung Electronics Co., Ltd. and Samsung Electronics America, Inc. (collectively, “Petitioner”) submitted a Petition (Paper 1, “Petition” or “Pet.”) to institute *inter partes* review (“IPR”) of U.S. Patent No. 7,772,673 (Ex. 1001, the “’673 Patent”), challenging Claims 1-17 (the “Challenged Claims”). The Petition asserts that: (i) Claims 1-17 would have been obvious over U.S. Patent No. 6,995,449 to Yin (“Yin” or Ex. 1004) in view of United States Patent Application Publication No. US 2005/0181569 to Koshimizu et al. (“Koshimizu” or Ex. 1005); (ii) Claims 1, 3, 5, 7-8, 10, 12, and 14-16 are anticipated by U.S. Patent No. 6,121,102 to Norström et al. (“Norström” or Ex. 1006); and (iii) Claims 7 and 15 are rendered obvious over Norström. As explained below, and supported by the testimony of Mr. John Berg (Ex. 2004), the Board should issue a Final Written Decision finding all claims not proven to be unpatentable.

With respect to the first ground, the secondary reference relied upon by the Petition to show the “chamfered corner” claim element (Koshimizu) is not analogous art. Koshimizu’s field of endeavor is the manufacture of semiconductor devices having a hetero-junction bipolar transistor, while the ’673 Patent’s field of endeavor is the formation of deep trench isolation regions. A reference that is not in the same

field of endeavor as the challenged patent is not available as prior art for an obviousness analysis.

The second Ground fails because the allegedly anticipatory prior art, Norström, does not disclose the claimed trench that is both i) situated in a substrate and ii) having chamfered corners as required by the Challenged Claims. Rather, the Petition identifies two trenches located under the transistor as the claimed trench in the substrate, then identifies a completely different trench located elsewhere on the die as disclosing the claimed chamfered corners. This reference does not and cannot anticipate the Challenged Claims.

Ground 3 relates only to two dependent claims which the Petition claims are obvious over Norström, but the obviousness analysis does not extend to the underlying independent claims, and therefore Ground 3 does not cure the deficiencies in Ground 1.

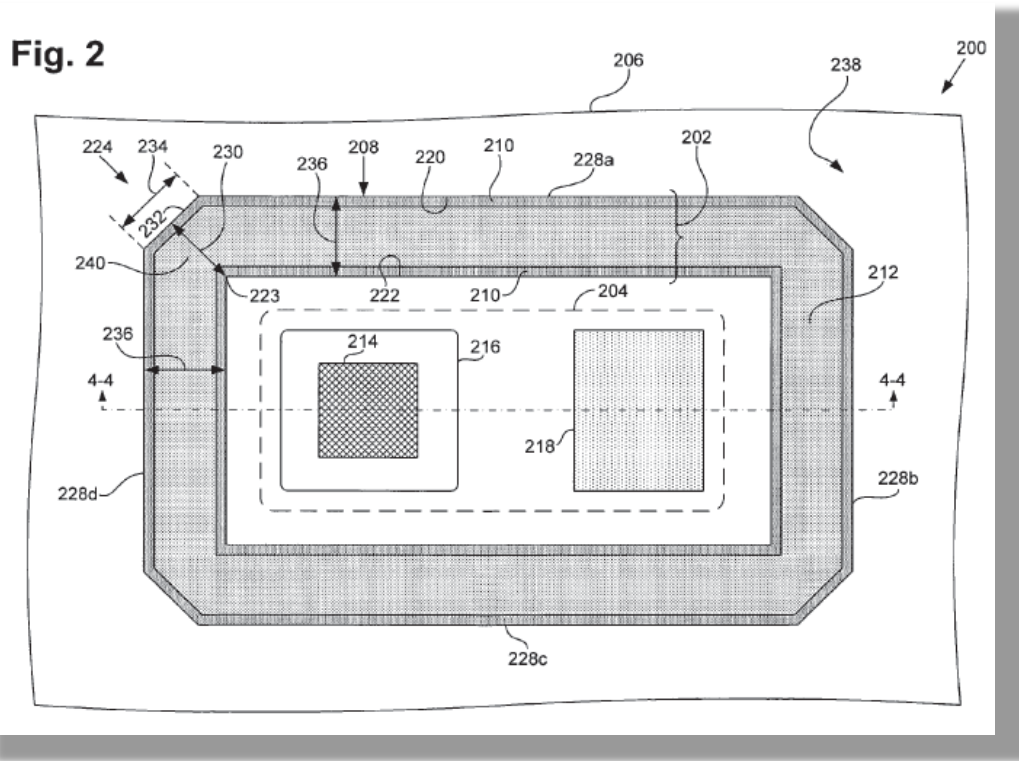
Accordingly, the Board should issue a Final Written Decision finding all claims not proven to be unpatentable.

## **II. THE '673 PATENT**

The '673 Patent (Ex. 1001) is titled “Deep Trench Isolation and Method For Forming Same” and issued on August 10, 2010. The '673 Patent states that “the

invention is in the field of isolation region formation in semiconductor substrates.”  
'673 Patent, 1:8-10. The '673 Patent explains problems with existing deep trenches, namely that when using a “rectangular-shaped trench,” a “thick layer of polysilicon can be required to adequately fill the trench.” *Id.* 1:32-34. This reduces throughput. *Id.* at 1:35-38; 4:41-45. Moreover, the use of a thick polysilicon layer causes a significant amount of polysilicon flaking, requiring more frequent cleaning of the deposition furnaces and increasing manufacturing costs. *Id.* at 1:35-38; 4:45-50. Ex. 2004, Berg Declaration, ¶ 30.

The '673 Patent presents a novel solution, which is shown in Figure 2 of the '673 Patent, below:



The corners of the deep trench 208, which includes outside wall 220 and inside wall 222, are “chamfered” to “significantly reduce trench corner width.” *Id.*, 4:24-36. Use of the claimed invention substantially reduces the thickness of the polysilicon layer, which “increases polysilicon fill process throughput and also significantly increases the average time between polysilicon deposition furnace cleaning.” *Id.* at 5:21-36. Ex. 2004, ¶¶ 31-32.

### III. THE ALLEGED PRIOR ART

#### A. Yin

U.S. Patent No. 6,995,449 to Yin et al. (Ex. 1004)<sup>1</sup> is titled “Deep Trench Isolation Region With Reduced-Size Cavities In Overlying Field Oxide” and issued on Feb. 7, 2006. Yin is related to “forming isolation regions in semiconductor substrates.” Ex. 1004, 1:12-14. Yin discloses problems with existing methods of forming deep trenches, noting that they cause “severe lateral etching of the field oxide region situated on the sidewalls of the trench.” *Id.* 1:57-59. Yin discloses and claims a proposed solution, which is to create an “oxide liner” on the sidewalls of the trench by using Chemical Vapor Deposition, or CVD. *Id.* 2:38-41. As admitted by Petitioner, Yin does not disclose deep trenches used for isolation that are formed with chamfered corners. Ex. 2004, ¶¶ 34-36.

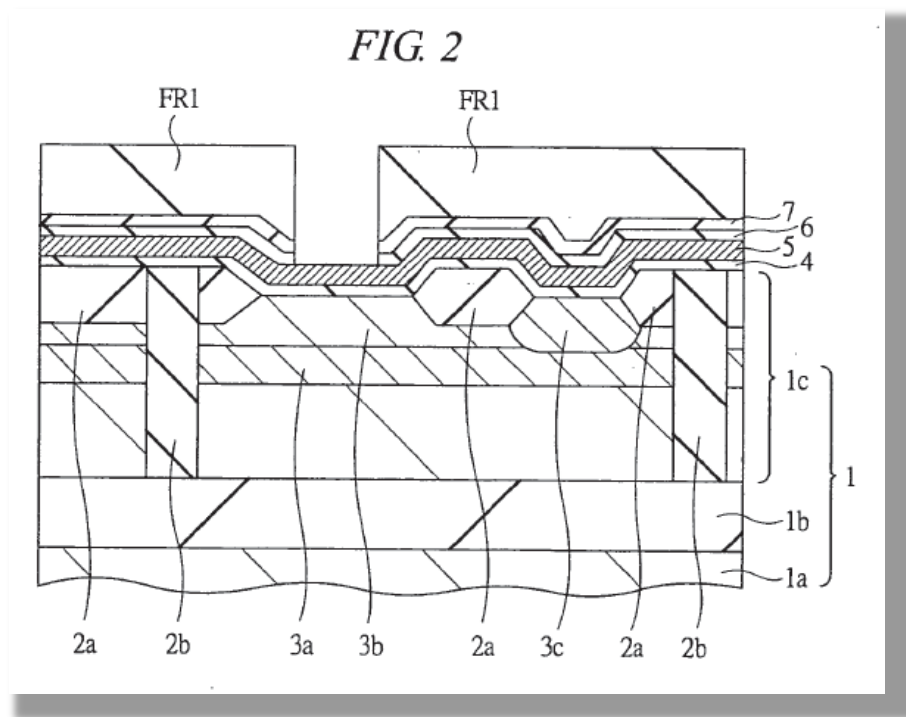
#### B. Koshimizu

U.S. Patent Application Publication No. US 2005/0181569 to Koshimizu et al. (Ex. 1005) published on August 18, 2005. Koshimizu relates to “a technique effectively applied to a semiconductor device having a hetero-junction bipolar transistor.” Ex. 1005, ¶ [0001]. Koshimizu’s technique prevents “the sidewall-

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<sup>1</sup> Yin shares two inventors with the ’673 Patent.

insulation film formed on the side surface” in a first opening portion from blocking the growth of a crystalline layer formed in a second opening portion. *Id.*, ¶¶ [0008]-[0012]. Ex. 2004, ¶ 37.

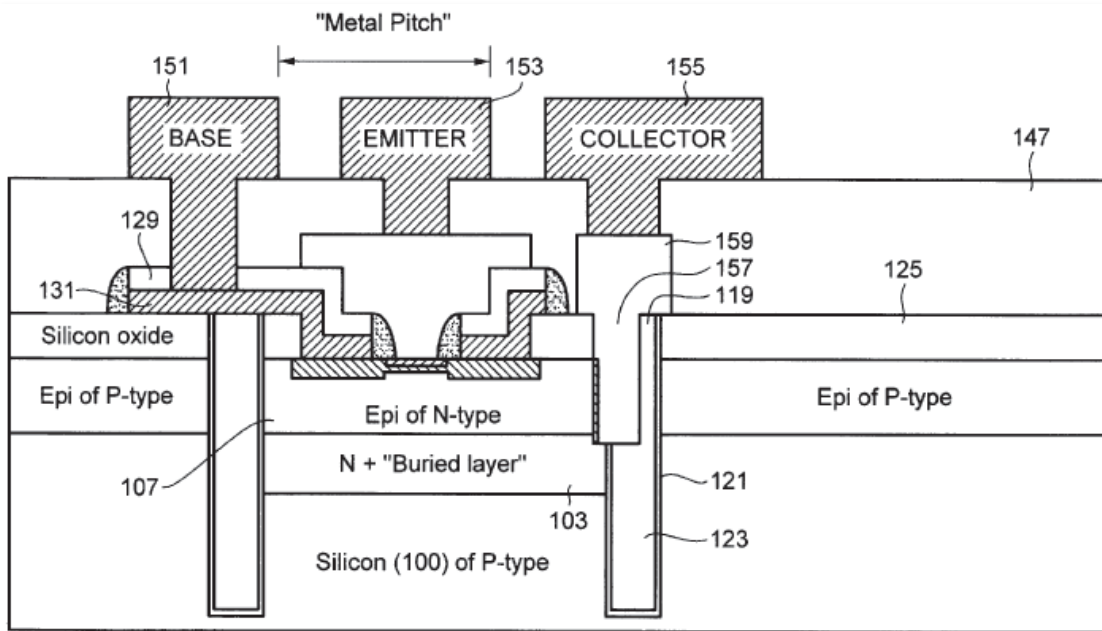


As shown above in Figure 2, Koshimizu discloses a deep isolation trench 2b, but does not disclose that this trench is filled with polysilicon. *Id.* ¶ [0052]. Koshimizu’s deep trench 2b “is formed by embedding, for example, a silicon oxide film in a deep trench dug so as to reach the insulation layer 1b through the isolation 2a and the semiconductor layer 1c from the upper surface of the isolation 2a. *Id.* Ex. 2004, ¶ 38.

**C. Norström**

U.S. Patent No. 6,121,102 to Norström et al. (Ex. 1006) is titled “Method of Electrical Connection Through an Isolation Trench to Form Trench-Isolated Bipolar Devices” and issued on Sept. 19, 2000. Norström “relates to bipolar semiconductor devices, in particular bipolar transistors and semiconductor diodes, which are electrically isolated or confined by trenches.” Ex. 1006, 1:7-10. An object of the invention of Norström is to “provide a trench isolated transistor having good performance which takes a little area on a substrate.” *Id.* at 31:21-23. Norström discloses and claims the use of a “hole” in the trench under the active region of the bipolar device, which is filled with conducting material. *Id.* at 3:56-67. Ex. 2004, ¶ 39.

The “hole” 157 in the trench 119 is disclosed below in Figure 13a:



“The resulting hole 157 will then . . . have one of its sidewalls in direct contact with the N-doped epitaxial layer 107 and the bottom diffusion 103 and have its opposite sidewall located against the inner material in the trench.” *Id.* at 10:48-52. Ex. 2004, 40.

#### IV. LEVEL OF ORDINARY SKILL IN THE ART

As Mr. Berg explains, a POSITA would have (1) a Bachelor of Science degree or equivalent degree in electrical engineering, physics, materials science, or a similar field; and (2) at least two years of industry experience in semiconductor design

and/or fabrication. A person could also have qualified as a POSITA with some combination of (1) more formal education (such as Master of Science degrees) and less technical experience, or (2) less formal education and more technical or professional experience in the fields listed above. Ex. 2004, ¶¶ 25-27.

Petitioner’s proposed level of skill in the art – “at least a master’s degree in electrical engineering or a similar field and at least two years of experience working with semiconductor systems”—imposes a requirement of a master’s degree. Pet., 22-23. As Mr. Berg explains, engineers working in this field, and implementing designs such as those described in the ’673 Patent, typically have bachelor’s degrees. Ex. 2004, ¶ 27. Such engineers are the target audience for the ’673 Patent, and thus, a POSITA need not have a master’s degree. *Id.*

## **V. CLAIM CONSTRUCTION**

Patent Owner agrees that no claim construction is required to resolve this proceeding.

## **VI. NO CLAIMS ARE ANTICIPATED OR RENDERED OBVIOUS UNDER GROUNDS 1-3**

To anticipate the claimed invention, a prior art reference must “disclose all elements of the claim within the four corners of the document,” and it must “disclose those elements ‘arranged as in the claim.’” *Net MoneyIN, Inc. v. VeriSign, Inc.*, 545

F.3d 1359, 1369 (Fed. Cir. 2008) (quoting *Connell v. Sears, Roebuck & Co.*, 722 F.2d 1542, 1548 (Fed. Cir. 1983)). “However, a reference can anticipate a claim even if it ‘d[oes] not expressly spell out’ all the limitations arranged or combined as in the claim, if a person of skill in the art, reading the reference, would ‘at once envisage’ the claimed arrangement or combination.” *Kennametal, Inc. v. Ingersoll Cutting Tool Co.*, 780 F.3d 1376, 1381 (Fed. Cir. 2015) (quoting *In re Petering*, 301 F.2d 676, 681 (C.C.P.A. 1962)).

The question of obviousness is resolved on the basis of underlying factual determinations, including: (1) the scope and content of the prior art, (2) any differences between the claimed subject matter and the prior art, (3) the level of skill in the art, and (4) so-called secondary considerations where in evidence. *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 17-18 (1966); *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. *Stratoflex, Inc. v. Aeroquip Corp.*, 713 F.2d 1530, 1537 (Fed. Cir. 1983).

The Board has held that a failure to identify the differences between the claimed subject matter and the prior art is fatal to an obviousness challenge. *See*,

*Apple, Inc. v. Contentguard Holdings, Inc.*, IPR2015-00355, Decision Denying Institution of *Inter Partes* Review, Paper 9 at 9-10 (P.T.A.B. June 26, 2015) (denying institution for failure to identify the differences between the claimed subject matter and the prior art).

In arriving at an obviousness determination, the Board must sufficiently explain and support the conclusions that the prior art references disclose all the elements recited in the Challenged Claims and a relevant, skilled artisan not only could have made, but would have been motivated to combine all the prior art references in the way the patent claims and reasonably expected success. *Pers. Web Techs., LLC v. Apple, Inc.*, 848 F.3d 987, 994 (Fed. Cir. 2017). That is, even if all the claim elements are found across a number of references, an obviousness determination must consider whether a person of ordinary skill in the art would have the motivation to combine those references. *Intelligent Bio-Sys., Inc. v. Illumina Cambridge Ltd.*, 821 F.3d 1359, 1368 (Fed. Cir. 2016); *Los Angeles Biomedical Rsch. Inst. at Harbor-UCLA Med. Ctr. v. Eli Lilly & Co.*, 849 F.3d 1049, 1067 (Fed. Cir. 2017) (vacating and remanding an obviousness determination, in part, because the Board did not make factual finding as to whether there was an apparent reason to combine all three prior art references to achieve the claimed invention and whether

a person of skill in the art would have had a reasonable expectation of success from such a combination). This combinability determination, as supported by an articulated motivation to combine, requires a plausible rationale as to why those prior art references would have worked together. *Broadcom Corp. v. Emulex Corp.*, 732 F.3d 1325, 1335 (Fed. Cir. 2013). Absent some articulated rationale, a “common sense” finding is no different than the conclusory statement “would have been obvious.” *In re Van Os*, 844 F.3d 1359, 1361 (Fed. Cir. 2017). Of additional importance, “knowledge of a problem and motivation to solve it are entirely different from motivation to combine particular references . . . .” *Innogenetics, N.V. v. Abbott Lab’ys.*, 512 F.3d 1363, 1373 (Fed. Cir. 2008).

To demonstrate inherent obviousness, an inherent limitation must necessarily be present in the combination of references. *See Pers. Web Techs., LLC v. Apple, Inc.*, 917 F.3d 1376 (Fed. Cir. 2019); *LBT IP I LLC v. Apple Inc.*, No. 2022-1613, 2023 WL 3914920, at \*3 (Fed. Cir. June 9, 2023). It is not enough to merely show that it is likely to be present. *Id.*

**A. Ground 1: No Claims Are Obvious Under Ground 1  
Because Koshimizu Is Not Analogous Art to the '673  
Patent**

Petitioner relies on Koshimizu for the critical “chamfered corner” limitation found in all Challenged Claims. But Koshimizu is not analogous art to the '673 Patent because it is not in the same field of endeavor and Koshimizu is not reasonably pertinent to the problem with which the '673 Patent inventors were involved. *K-Tec, Inc. v. Vita-Mix Corp.*, 696 F.3d 1364, 1375 (Fed. Cir. 2012) (“To qualify as prior art for an obviousness analysis, a reference must qualify as “analogous art,” *i.e.*, it must satisfy one of the following conditions: (1) the reference must be from the same field of endeavor; or (2) the reference must be reasonably pertinent to the particular problem with which the inventor is involved.”).

**1. The '673 Patent's Field of Endeavor Is “the formation of  
deep trench isolation regions”**

As Mr. Berg explains, the field of endeavor for the '673 Patent is “the formation of deep trench isolation regions.” Ex. 2004, ¶ 41. Mr. Berg's opinion is based on the patent's stated field of the invention (“the invention is in the field of isolation region formation in semiconductor substrates”), as well as the specification's explanation that “the present invention is directed to deep trench isolation and method for forming same.” '673 Patent, 1:5-10, 2:20-23; 1:45-49. *See*

*also id.*, Title. The '673 Patent's specification provides detailed instructions on manufacturing a deep trench and filling it with polysilicon, and no discussion of manufacturing a transistor or other device. Ex. 2004, ¶ 41. '673 Patent, 5:42-9:3; Figs. 3, 4.

Petitioner fails to set out any contention for the '673 Patent's field of endeavor. Instead, Petitioner finds teachings in the '673 Patent that overlap with parts of the prior art, and then deems the prior art analogous because of that overlap. In so doing, Petitioner states that the '673 Patent is "directed to" three separate types of subject matter. Pet., 8, 11, 14. Even if the Board considers Petitioner's characterization of what the '673 Patent is "directed to" as setting out the field of endeavor, Petitioner's contentions are wrong and inconsistent. Indeed, Petitioner's characterization of the '673 Patent varies based on which reference it is attempting to analogize.

In its discussion of Yin, Petitioner states that the '673 Patent is directed to "a semiconductor die with a deep trench isolation region that electrically isolates an electronic device such as a bipolar transistor." Pet., 8 (citing '673 Patent, Field of Invention). However, when claiming that Koshimizu is analogous, Petitioner alters its view of the '673 Patent to being "directed to the manufacture of a silicon-based

bipolar transistor employing a deep isolation region to isolate the transistor from neighboring transistors.” Pet., 11 (citing ’673 Patent, Field of Invention). Finally, in its discussion of Norström, Petitioner provides yet another field, “the manufacture of ‘bipolar semiconductor devices, in particular bipolar transistors and semiconductor diodes, which are electrically isolated or confined by trenches.” Pet., 14 (citing ’673 Patent, Field of Invention).

In each case, Petitioner cites the same passage from the ’673 Patent (1:6-10), but arrives at a different field of endeavor. Petitioner provides no reasoning for the different fields, and its expert merely parrots the same statements. Curiously, the cited portion of the ’673 Patent reads “[t]he present invention is generally in the field of semiconductor fabrication. More particularly, the invention is in the field of isolation region formation in semiconductor substrates.” ’673 Patent, 1:5-10. The passage makes no mention of manufacture of transistors.

Accordingly, the ’673 Patent’s field of endeavor is the formation of deep trench isolation regions. Ex. 2004, ¶ 41.

**2. Koshimizu's Field of Endeavor Is "the manufacture of semiconductor devices having a hetero-junction bipolar transistor"**

Koshimizu explains that its field of endeavor is the manufacture of semiconductor devices having a hetero-junction bipolar transistor. Ex. 1005, [0001] ("The present invention relates . . . particularly to a technique effectively applied to a semiconductor device having a hetero-junction bipolar transistor (hereinafter abbreviated as "HBT") and to a manufacturing method for the semiconductor device."); Ex. 2004, ¶ 42.

Koshimizu's disclosure is focused on manufacturing a bipolar transistor. Its specification describes an earlier method of manufacturing a bipolar transistor and notes several problems with the conventional technique. Ex. 2004, ¶¶ 45-46; Ex. 1005, [0002]-[0004], [0045]-[0047]. The problems Koshimizu identifies are unrelated to electrical isolation or forming deep trench regions. Ex. 2004, ¶ 47. Instead, they are related to forming openings in the films lying atop the substrate as part of the process for manufacturing electrodes. *Id.*; Ex. 1005, [0003]-[0004], [0047]; *see also* Ex. 1005, [0007]-[0012].

Koshimizu devotes its specification to improved transistor manufacturing process. Ex. 2004, ¶ 48; Ex. 1005, [0052]-[0064]. In contrast to the '673 Patent,

Koshimizu mentions deep trench isolation in one paragraph, and does not provide any details of the formation of the region. Ex. 1005, [0052]. Koshimizu's discussion of forming the deep trench isolation is merely "the deep trench isolation 2b is formed by embedding, for example, a silicon oxide film in a deep trench dug so as to reach the insulation layer 1b through the isolation 2a and the semiconductor layer 1e from the upper surface of the isolation 2a." *Id.*, Ex. 2004, ¶ 48.

Accordingly, a POSITA would recognize that Koshimizu's field of endeavor is the manufacture of semiconductor devices having a hetero-junction bipolar transistor. Ex. 2004, ¶¶ 42-48

### **3. Koshimizu Is Not Analogous Art to the '673 Patent**

The '673 Patent and Koshimizu are not in the same field of endeavor. *Id.*, ¶¶ 41-48. As explained above, the '673 Patent's field of endeavor is the formation of deep trench isolation regions. Koshimizu's field of endeavor, in contrast, is the manufacture of semiconductor devices having a hetero-junction bipolar transistor. These fields are not the same, as evidenced by the lack of detail in each document as to the other's focus. *Id.*, ¶¶ 42-48.

The '673 Patent is agnostic as to the type of device being isolated. Indeed, it specifically, and repeatedly, states that it uses a bipolar transistor as merely an

illustrative example of the type of device that can be isolated under its invention. *Id.*, ¶ 43; '673 Patent, 2:35-38 (“It is noted that although a bipolar device is utilized as an example of an electronic device to illustrate the present invention, the invention’s deep trench isolation region can be utilized to isolate[] electronic devices other than bipolar devices.”); 3:51-55 (“It is again noted that although a bipolar device (i.e., a bipolar transistor) is utilized as an example of an electronic device to illustrate the present invention, the invention’s deep trench isolation region can be utilized to isolated electronic devices other than bipolar devices.”).

Koshimizu, in contrast, spends little space on its deep trench isolation. It merely sets out that the isolation exists, and focuses on the components of the transistor. Ex. 2004, ¶ 48; Ex. 1005, [0052].

Petitioner cannot carry its burden to show that Koshimizu is analogous art to the '673 Patent. At the outset, Petitioner entirely fails to set out the field of endeavor for the '673 Patent. The statements Petitioner does make do not remedy its failure. Indeed, Petitioner cites the same portion of the '673 Patent with respect to all three prior art references, but arrives at different fields each time without explanation. This inconsistency alone shows that Petitioner fails to carry its burden. *E.g., Apple, Inc. v. Gesture Tech. Partners, LLC*, IPR2021-00923, Paper No. 27, 13-14 (P.T.A.B.

Dec. 2, 2022) (“*Gesture*”), *aff’d*, -- F.4<sup>th</sup> --, No. 2023-1494, 2025 WL 1584286 (Fed. Cir. Jun. 5, 2025) (“Petitioner provides no analysis as to why it is appropriate to have different fields of endeavor all based on the same disclosure.”).

Moreover, the cited portion of the specification cannot support Petitioner’s characterization of the ’673 Patent as “directed to the manufacture of a silicon-based bipolar transistor employing a deep isolation region to isolate the transistor from neighboring transistors.” Pet., 11 (citing ’673 Patent, Field of the Invention). The cited portion says nothing about manufacturing a transistor or “employing” a deep trench isolation region. ’673 Patent, 1:5-10 (“[T]he invention is in the field of isolation region *formation* in semiconductor substrates” (emphasis added)). Ex. 2004, ¶ 50.

Petitioner’s expert tacitly agrees that the field of endeavor for the ’673 Patent is deep trench isolation; his “Technology Background” section focuses on “Deep Isolation Trenches” and provides detail as to how such trenches are formed. Ex. 1003, ¶¶ 44-45. In contrast, his technology background section mentions transistors only once in passing, as an example of components within a semiconductor die. *Id.*, ¶ 47 (“A semiconductor die houses the transistors, such as bipolar junction transistors, that make up the computer logic of the integrated circuit.”). Petitioner’s

own characterization of the '673 Patent's claims leaves out "transistor" entirely. Pet., 1 ("The challenged claims are directed to a semiconductor die with a deep trench isolation region having at least one chamfered corner."); *see also id.*, 1-3 (focusing on trenches and not mentioning transistors); *id.*, 14-18 (mentioning transistors only as an example of the type of device isolated by the invention).

Petitioner's implied field of endeavor for the '673 Patent when analogized with Koshimizu<sup>2</sup> is at the same time too narrow and too broad. It is too narrow because it excludes the key feature of the '673 Patent—manufacture of deep trenches, including those that isolate devices other than bi-polar transistors. It is too broad because it includes the manufacturing of transistors, rather than the manufacture of the trench. Ex. 2004, ¶¶ 50; *see also id.*, ¶¶ 42-52.

This case is very similar to *Gesture*. There, the Petitioner failed to set out a field of endeavor for the patent at issue. *Id.*, 11. Instead, like Petitioner here, the *Gesture* Petitioner merely set out portions of the patent's disclosure and noted some overlap with each of the references. *Id.* Notably, the implicit field of endeavor

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<sup>2</sup> "directed to the manufacture of a silicon-based bipolar transistor employing a deep isolation region to isolate the transistor from neighboring transistors."

varied with the particular reference being analogized. *Id.*, 11-12. The Board found that Petitioner had failed to carry its burden to show that the patent and reference were analogous art. Moreover, the Petitioner’s implied field of endeavor was inconsistent with the patent and its own statements. *Id.*, 12-14. The Petitioner thus failed to carry its burden to show obviousness.

The Federal Circuit recently affirmed the Board’s decision on appeal. -- F.4<sup>th</sup> --, 2025 WL 1584286, No. 2023-1494 (Fed. Cir. Jun. 5, 2025) (“*Gesture IP*”). The Court explained that “the field of invention that a patent is directed to *generally* should not vary based on the prior art reference it is being compared to for purposes of the analogous art inquiry.” *Id.* at \*5.<sup>3</sup> The Court “see[s] no basis for Apple’s attempt to define the field of endeavor differently based on the very same cited disclosures from the patent-in-suit in relation in an attempt to show different prior art references are analogous to the claims.”). *Id.*

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<sup>3</sup> The Court noted that “[t]here may be some situations where a patent might have more than one field of endeavor—for example, where the specification discloses various distinct embodiments and the claims-at-issue are directed to one of them.” *Id.*

The case here is on all fours with *Gesture*. Just as in that case, Petitioner has failed to define a field of endeavor. Indeed, here, Petitioner makes no mention of the field of endeavor at all. Moreover, Petitioner's implicit fields of endeavor are inconsistent, despite citing the same passage in each case. As in *Gesture II*, no exceptions that would allow for a different field exist. Finally, Petitioner's stated field of endeavor for Koshimizu, is, like the *Gesture* field, inconsistent both with the patent and Petitioner's own statements.

Like the Petitioner in *Gesture*, Petitioner here has also waived the use of the "reasonably pertinent" test. In any event, Koshimizu is not reasonably pertinent to the problem faced by the '673 Patent inventors. Ex. 2004, ¶¶ 53-59.

As the '673 Patent explains, the problem faced by the inventors was that the prior art trenches required a thick layer of polysilicon to adequately fill them. *Id.*, ¶¶ 30, 54; '673 Patent, 1:30-34. Utilizing such a thick layer reduces the fill process throughput and requires more frequent deposition furnace cleaning, thus increasing costs. *Id.*, 1:34-38; 3:29-50. The inventors thus set out to design a process that formed a deep trench isolation region, filled by polysilicon, while at the same time reducing the amount of polysilicon required. *Id.*, 1:27-41, 3:29-50, 5:15-41; Ex. 2004, ¶ 54.

A POSITA would not consider Koshimizu to be reasonably pertinent to this problem. Koshimizu does not mention polysilicon at all. Instead, Koshimizu's deep trench is filled with silicon oxide. *Id.*, ¶ 55; Ex. 1005 [0052]. As Mr. Berg explains, silicon dioxide has different stress characteristics and different electrical characteristics. Ex. 2004, ¶¶ 56-57. Petitioner has provided no evidence that a POSITA working to reduce polysilicon thickness would look to a reference describing silicon dioxide. Even if a silicon dioxide reference were pertinent, Koshimizu, with its lack of description of the manufacture and fill of its trench, is not. *Id.*, ¶¶ 55-57.

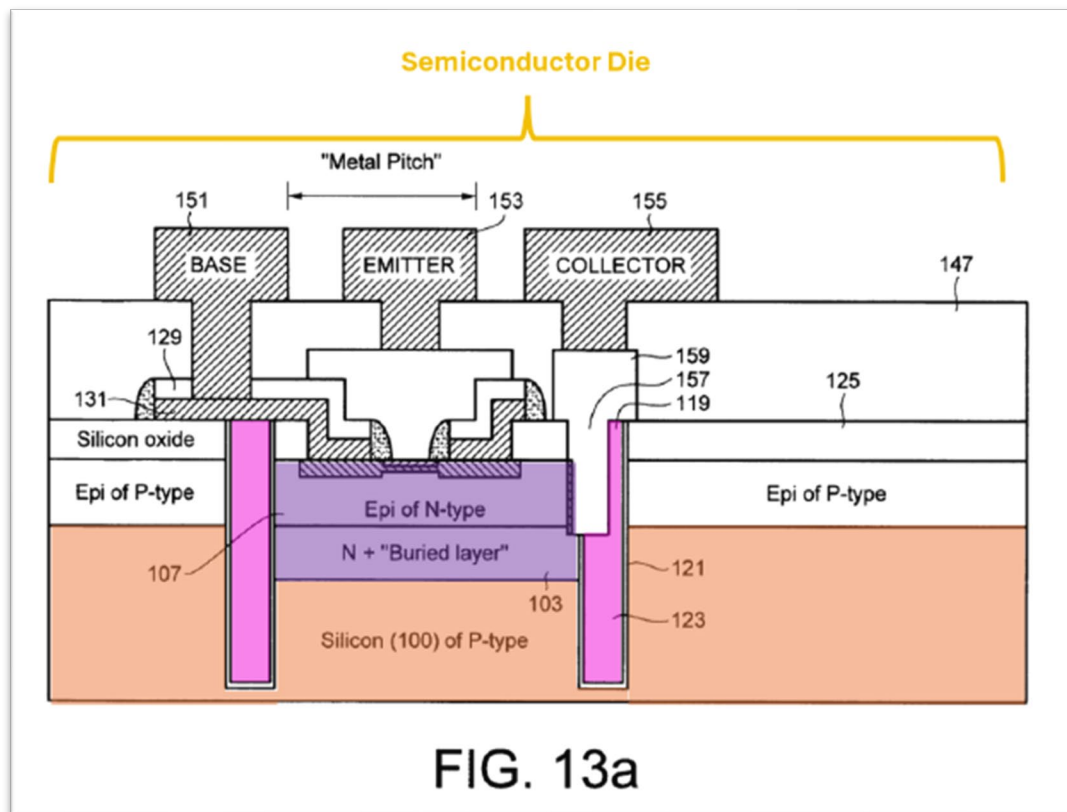
Accordingly, Koshimizu is not analogous art to the '673 Patent. All Petitioner's Ground 1 arguments require Koshimizu; therefore no claims are invalid under Ground 1.

**B. Ground 2: Norström Does Not Anticipate Any Claims Because It Does Not Disclose a Trench that Is Both “Situated in a Substrate” and Has “At Least One Trench Chamfered Corner” as Claimed**

A POSITA would not understand Norström to disclose the claimed trench that is both “situated in a substrate” and has a “trench chamfered corner.” Ex. 2004, ¶ 62. Accordingly, Norström does not anticipate any claims. *Dayco Prods, Inc. v. Total Containment, Inc.*, 329 F.3d 1358, 1368 (Fed. Cir. 2003) (“As this court has

stated, the dispositive question regarding anticipation is whether *one skilled in the art* would reasonably understand or infer from the prior art reference's teaching that every claim element was disclosed in that single reference." (internal quotations and alterations removed)).

Petitioner relies on FIG. 13a as disclosing that a trench is in the substrate. Pet., 62. FIG. 13a shows two trenches, one on either side of the center structure. Petitioner highlights the trenches in magenta.



Pet. 62; Ex. 2004, ¶63.

Norström explains repeatedly that the structures 119 in FIG. 13a are “trenches.” Ex. 1006, FIGS. 3, 8; 7:38-40 (“openings to isolating trenches 119 are lithographically defined. . .”); 7:50-54 (“the openings of the trenches 119”); 7:54-59 (“the openings of the trenches 119”), 7:60-64 (“[a]fter forming the trenches 119. . .”), 9:31-35 (“openings, in which isolating trenches 119 will be formed, are lithographically defined”), 9:36-47 (multiple use of “the trenches 119”), 10:4-9 (“the trench 119 at this side”), 10:14-15 (“The opening of the trench 119 at this side. . .”), 10:34-38 (“the corresponding trench 119”), 10:44-46 (“inner border line of the trenches”) 10:48-56 (trench corresponding with hole 157); 11:35-40 (trench corresponding with contact hole for collector); 11:37-40 (“the trenches 119 may then be filled with silicon dioxide”). Ex. 2004, ¶ 64. Norström always discusses “trenches 119” as a set of multiple trenches. The few times when it uses trench 119 in the singular is when it is referring to a single trench on either: a) the side with the collector contact and corresponding hole 157 (Ex. 1006, 10:48-56; 11:35-40) or b) the side with the emitter (10:14-15, 10:34-38). Ex. 2004, ¶ 65.

Petitioner’s expert, Dr. Thompson, also referred to the 119 structures as trenches, in the plural. Ex. 2010, 22:24-25 (“Q. And then what is 119? A. 119 are

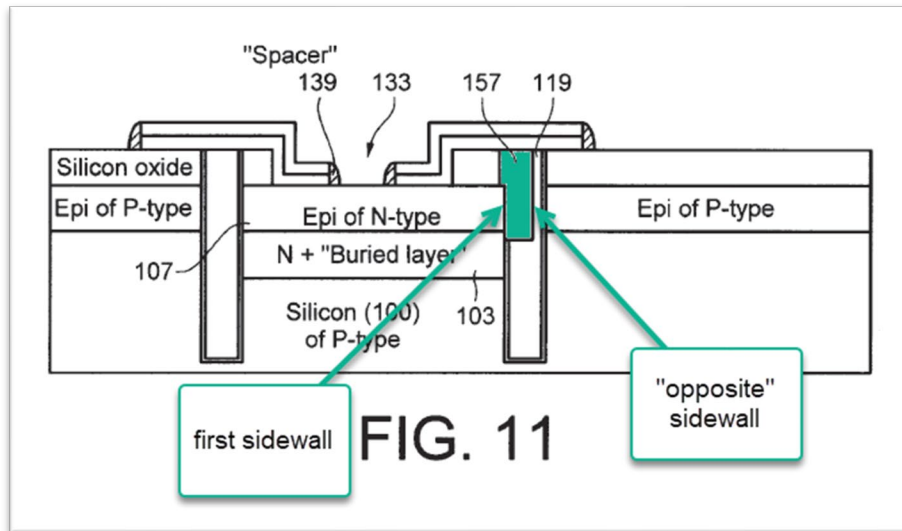
isolating trenches.”); *see also id.*, 23:20-26:19 (discussing individual trenches on either side of Figure 13a).

A POSITA would therefore understand structure 119, as shown in FIG. 13a, to be a set of at least two trenches. Ex. 2004, ¶ 66.

Norström further confirms this understanding. It first explains that, on the left side,<sup>4</sup> a region of layers 129 and 131 is left “so that they extend over the trench 119 at this side for forming a connecting region for the base.” Ex. 1006, 10:4-25. It then explains that the collector contact hole 157 is “self-aligned with the sidewall of the [right side] trench.” *Id.*, 10:32-56; Ex. 2004, ¶ 67. Norström provides a detailed description of how it achieves this alignment. Ex. 1006, 10:32-56. The result is that “[t]he resulting hole 157 will then, is apparent from FIG. 11, have one of its sidewalls in direct contact with the N-doped epitaxial layer 107 and the bottom diffusion 103 and have its *opposite sidewall located against the inner material in the trench.*” *Id.*, 10:48-53, Ex. 2004, ¶ 67 (emphasis added). Annotated FIG. 11 shows this arrangement:

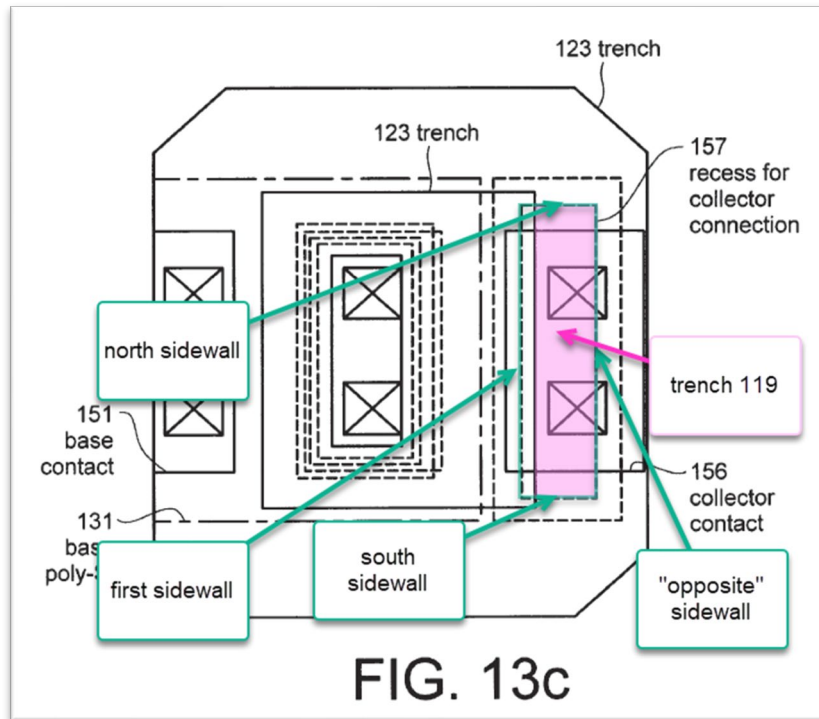
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<sup>4</sup> “At that side of the emitter opening 133, which corresponds to the side of the base-emitter opening 115,” Ex. 1006, 10:4-5.



Ex. 1006, FIG. 11 (annotations added); Ex. 2004, ¶ 67.

FIG. 13a shows the same arrangement, though later in the process. Ex. 1006, 10:57-11:2. The other two sidewalls of the collector hole 157, while not visible in FIGS. 11 or 13a, “will in the normal case be located against the inner material of the trench 119.” *Id.*, 10:53-56; Ex. 2004, ¶ 69. The plan view 13c shows the collector hole, but not the trench 119. Adding the right hand trench 119 as described in Norström 10:32-56 results in:

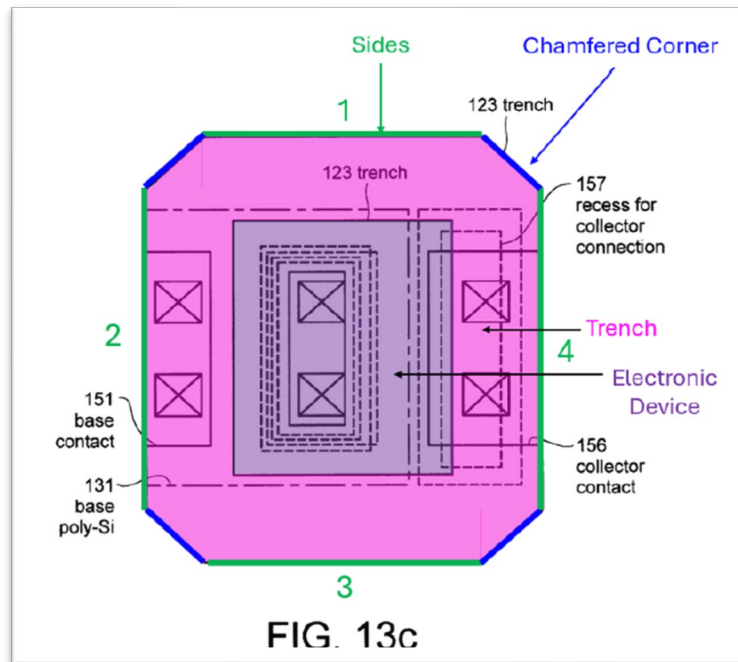


Ex. 2004, FIG. 13c (annotations added), Ex. 2004, ¶69.

The above Figure shows collector hole 157 (outlined in green), with its four sidewalls. The first (left) sidewall is aligned with the epitaxial layer 107. The opposite (right sidewall) is aligned with the right sidewall of the trench, and the north and south sidewalls are “located against the inner material of the trench 119.” Ex. 1006 10:32-56; Ex. 2004, ¶ 70.

In contrast, unannotated FIG. 13c shows a different, singular trench, labeled 123. Petitioner argues that trench 123 discloses the “trench chamfered corner”

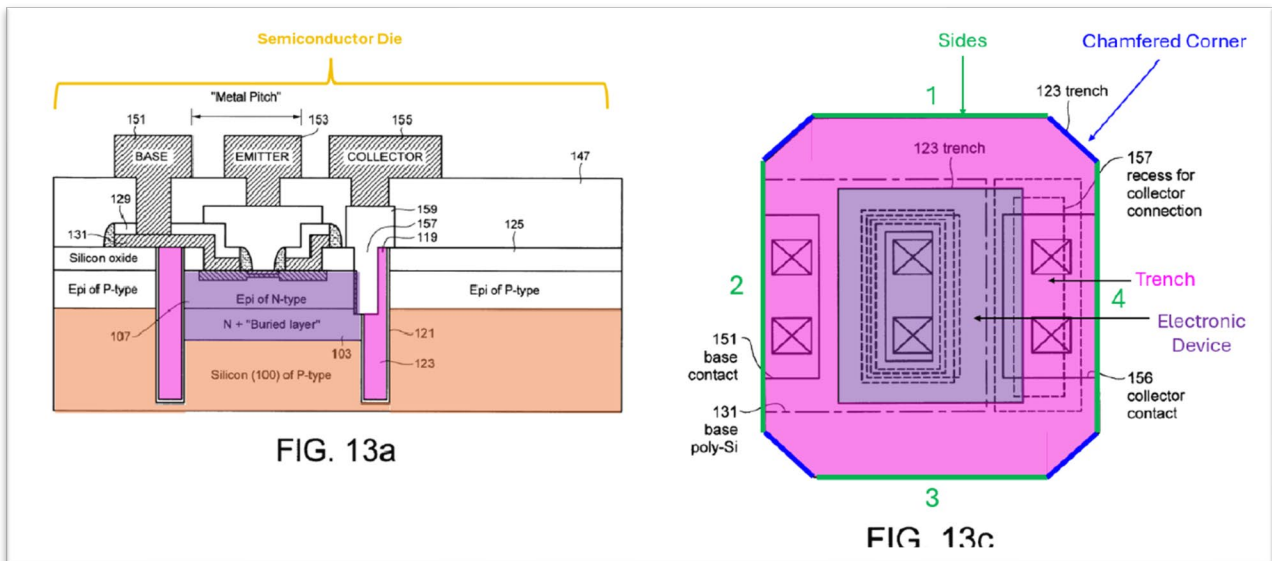
limitation. Pet., 60-63. Petitioner highlights trench 123 in magenta in its annotated FIG. 13c:



Pet., 61; Ex. 2004, ¶ 71. Norström’s specification discusses 123 in reference to any sort of trench only once, and in that case, it refers to trench 123 in the singular. Ex. 1006, 16:39-42 (“the outer sidewalls of the trench 123 shown in FIG. 13c have no right angles...”). 123 is otherwise used to denote “isolating material.” *Id.*, 7:44-50, 9:42-48; Ex. 2004, ¶¶ 71-75.

Aside from the difference in identifier numbering and singular/plural usage, there are numerous other differences between trenches 119 and trench 123.

Comparing FIGS. 13a and 13c (as annotated by Petitioner) side by side illustrates the difference.



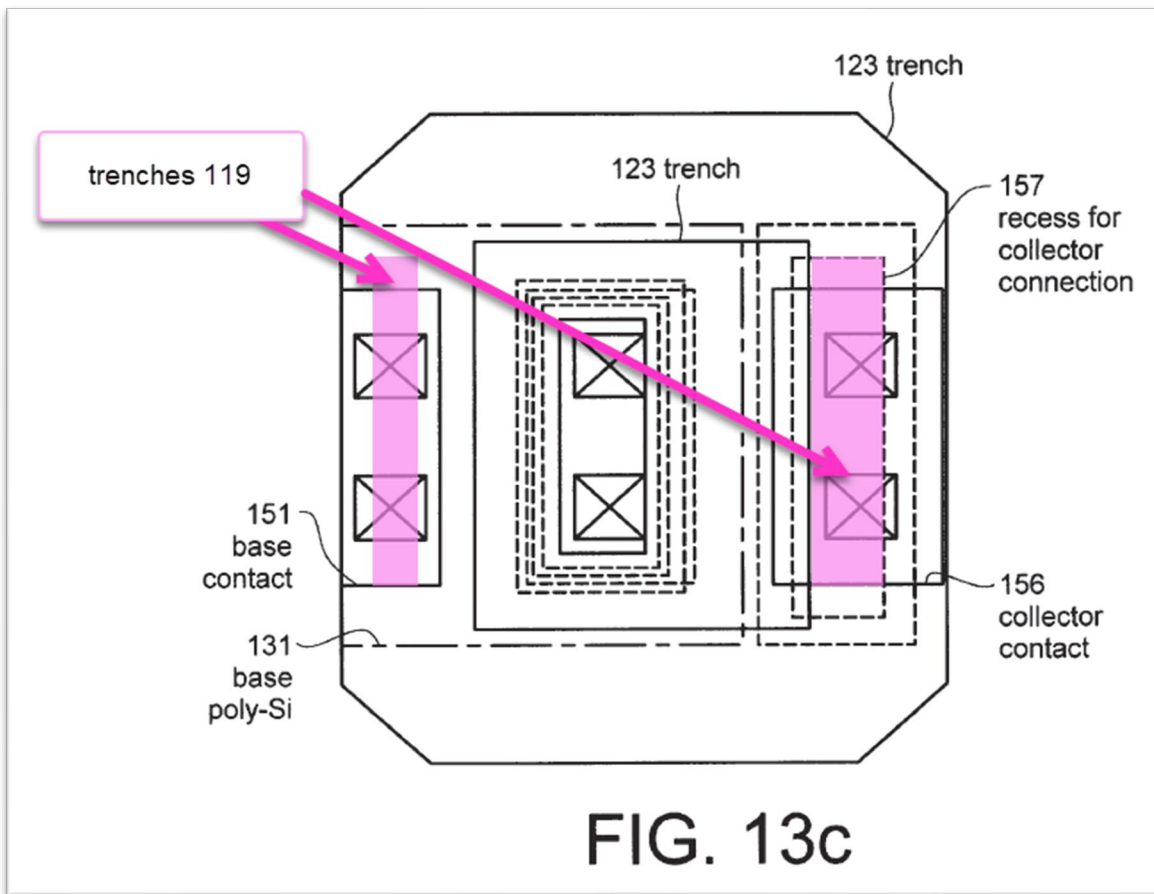
Ex. 2004, ¶ 76 (quoting Pet., 61-62).

As shown above, trenches 119 are both narrow. The leftmost trench is entirely under the base contact 151. The rightmost trench is entirely under the collector contact and the collector contact hole 157. Ex. 2004, ¶ 77. The right sidewall of the collector contact hole 157 abuts the inner material of trench 119. Ex. 1006, 10:32-56. Dr. Thompson agreed with this description of FIG. 13a. Ex. 2010, 24:17-26:19.

Trench 123, as shown in FIG. 13c, is a single trench that entirely envelops base contact 151. Ex. 2004, ¶78.; *see also* Ex. 2010, 31:17-24. Trench 123 further

extends, on the right side, beyond the collector contact hole 157. No portion of trench 123 is shaped in any way like trenches 119. Ex. 2004, ¶ 78.

Mr. Berg added the approximate locations of the trenches 119, as shown in FIG. 13a and described at 10:32-56, to FIG. 13c, illustrating the differences:



Ex. 2004, ¶ 79 (annotated). Trenches 119 are approximately centered under the collector contact, and offset towards the right of the base contact, consistent with

FIG. 13a; Ex. 2004, ¶ 80. Even if trenches 119 extended in a box around the emitter contact, they would not match the geometry of trench 123. *Id.*, ¶ 81

Thus, a detailed reading of Norström shows that trenches 119 and trench 123 are different structures. A POSITA would not consider them to be the same structure, because to do so would require the POSITA to ignore: i) the difference in identifier markings; ii) the difference in singular/plural; iii) the explicit description of the location of trenches 119 in 10:32-56; and iv) the description that the collector hole 157 has four sidewalls, three of which are in contact with the sidewall of right-hand trench 119. A POSITA would not do so. *Id.*, ¶ 82.

In sum, Norström does not disclose that trenches 119 have one or more trench chamfered corner as required. *Id.*, ¶ 83. Norström does not disclose that trench 123 is “in the substrate.” *Id.*, ¶ 84. Norström thus does not disclose the single trench claimed and required in all claims of the ’673 Patent, and therefore does not anticipate any claims.

To the extent the Petition is read to argue that 123’s corners would be applied to the 119 trenches, that argument must fail. “Prior art that must be modified to meet the disputed claim limitation does not anticipate the claim.” *Enplas Display Device Corp. v. Seoul Semiconductor Co.*, 909 F.3d 398, 405 (Fed. Cir. 2008). Anticipation

requires that the prior art must “disclose all elements of the claim within the four corners of the document,” and it must “disclose those elements ‘arranged as in the claim’.” *Net MoneyIn, Inc.*, 545 F.3d at 1369 (quoting *Connell*, 722 F.3d at 1548).

**C. Ground 3 Fails Because It Does Not Cure the Deficiency in Ground 2**

For Ground 3, the Petition argues that dependent Claims 7 and 15 would have been obvious in view of Norström. Pet. at 71-73. The Petition does not make any obviousness arguments with respect to Norström as to any other claims aside from 7 and 15, nor does it argue that it would be obvious to modify Norström to remedy Ground 2’s deficiencies. Accordingly, Ground 3 also fails.

**VII. CONCLUSION**

For the foregoing reasons, Patent Owner respectfully requests that the Board issue a Final Written Decision finding all Challenged Claims not shown to be unpatentable.

Respectfully submitted,

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**CERTIFICATE OF WORD COUNT**

The undersigned hereby certifies that the portions of the above-captioned PATENT OWNER'S RESPONSE specified in 37 C.F.R. § 42.24 has 5,529 words in compliance with the 14,000 word limit set forth in 37 C.F.R. § 42.24. This word count was prepared using Microsoft Word for Office 365.

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