

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

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

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

Title: DEEP TRENCH ISOLATION AND METHOD OF FORMING SAME

PATENT OWNER'S SUR-REPLY

Case No. IPR2024-01403

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LIST OF EXHIBITS

Exhibit No.	Description of Documents
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	https://anysilicon.com/semipedia/deep-trench-isolation-dti/
2010	Deposition transcript of Scott E. Thompson, Ph.D., taken

I. INTRODUCTION

Petitioner's Reply ("Reply") fails to show the Challenged Claims unpatentable. First, Koshimizu is not analogous art. As explained in the POR, and not refuted in the Reply, the '673 Patent is directed to manufacturing deep trenches; Koshimizu, in contrast, is directed to manufacturing transistors. A POSITA would not look to Koshimizu as pertinent to the '673 Patent's problem.

Second, Norstrom does not disclose the required trench. Petitioner ignores or waves away the clear and differing descriptions of trenches 119 and trench 123. A POSITA would not so ignore those differences and thus would not understand Norstrom to disclose a trench that is both "situated in a substrate" and has "at least one trench chamfered corner" as claimed.

The Board should therefore issue a Final Written Decision finding no claims unpatentable.

II. KOSHIMIZU IS NOT ANALOGOUS ART

As explained in the POR, Koshimizu is neither from the same field of endeavor as the '673 Patent, nor reasonably pertinent to the problem the '673 Patent's inventors faced. POR, 13-20.

A. Koshimizu is not from the same field of endeavor

The '673 Patent's field of endeavor is the "formation of deep trench isolation regions." POR, 13; Ex. 2004, ¶ 41.

Petitioner failed to set out any field of endeavor for Koshimizu in the Petition, instead arguing that it was directed to: i) “a semiconductor die with a deep trench isolation region that electrically isolates an electronic device such as a bipolar transistor”; ii) “the manufacture of a silicon-based bipolar transistor employing a deep isolation region to isolate the transistor from neighboring transistors”; and iii) “the manufacture of ‘bipolar semiconductor devices, in particular bipolar transistors and semiconductor diodes, which are electrically isolated or confined by trenches.’” POR, 14-15. The Board preliminarily found that “both the ’673 patent and Koshimizu relate to semiconductor devices (and methods of manufacturing semiconductor devices) with a deep trench for isolating a bipolar device.” Decision Granting Institution of *Inter Partes* Review, Paper 9, 27 (P.T.A.B. Mar. 24, 2025). The Board, however, did explicitly set out a field of endeavor. *Id.*

On Reply, Petitioner still fails to define a field of endeavor for the ’673 Patent, much less pick one of its three fields from the Petition. Reply, 4-8. Instead, it simply provides a heading: “*Koshimizu* Is from the Same Field of Endeavor as the ’673 Patent: Semiconductor Devices with a Deep Isolation Trench.” Reply, 4.

While the ’673 Patent describes a device isolated by a deep trench, it is focused on how to manufacture that trench. ’673 Patent, 1:5-10 (“More particularly,

the invention is in the field of isolation region formation in semiconductor substrates.”), 2:20-23; 1:45-49. Indeed, nearly the entirety of the specification is devoted to providing detailed instructions on manufacturing a deep trench and filling it with polysilicon. Ex. 2004, ¶ 41. ’673 Patent, 5:42-9:3; Figs. 3, 4.

In contrast, Koshimizu is directed to manufacturing transistors. Ex. 1005, [0001] (“The present invention relates . . . particularly to a technique effectively applied to a semiconductor device having a hetero-junction bipolar transistor . . . and to a manufacturing method for the semiconductor device.”). Koshimizu provides no instructions on how to manufacture the trench or fill it with polysilicon. POR, 16-17. By failing to identify any such description, Petitioner tacitly agrees.

Instead, Petitioner simply states that “*Koshimizu* teaches a semiconductor device with a chamfered isolation trench, just like the ’673 Patent.” Reply, 5. But the ground at issue is not anticipation; it is obviousness. Petitioner was required to show that Koshimizu was analogous art; that is, art that an inventor would consider when faced with the problem at issue. An inventor seeking a method to form a deep trench would not look to a reference that does not describe any such method.

Petitioner cites to *Donner Tech., LLC v. Pro Stage Gear, LLC*, 979 F.3d 1353, 1359-60 (Fed. Cir. 2020) in support of its field of endeavor argument. Reply, 5. But

in that case, all parties agreed that the references were not in the same field of endeavor. *Id.* The Federal Circuit remanded because the Board failed to identify the problem to which the patent and reference related. *Id.* at 1360-61. Petitioner's other cited cases are similarly irrelevant. *In re Bigio* considered whether toothbrushes and hairbrushes were analogous art. 381 F.3d 1320, 1324 (Fed. Cir. 2004). The claims at issue there were for a structure with a handle and bristles. *Id.* at 1323. Because hairbrushes and toothbrushes have many structural similarities. *Id.* at 1326. Here, however, the polysilicon of the '673 Patent and the silicon dioxide of Koshimizu have vastly different properties. Ex. 2004, ¶¶ 55-57. *Wyers v. Master Lock Co.*, 616 F.3d 1231, 1237-40 (Fed. Cir. 2010) is distinguishable for the same reason.

B. Koshimizu is not Reasonably Pertinent

As explained in the POR, the problem faced by the inventors was that the prior art trenches required a thick layer of polysilicon to adequately fill them. POR, 22; Ex. 2004, ¶¶ 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

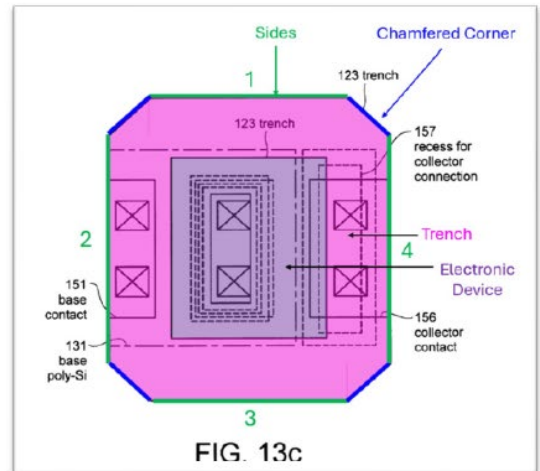
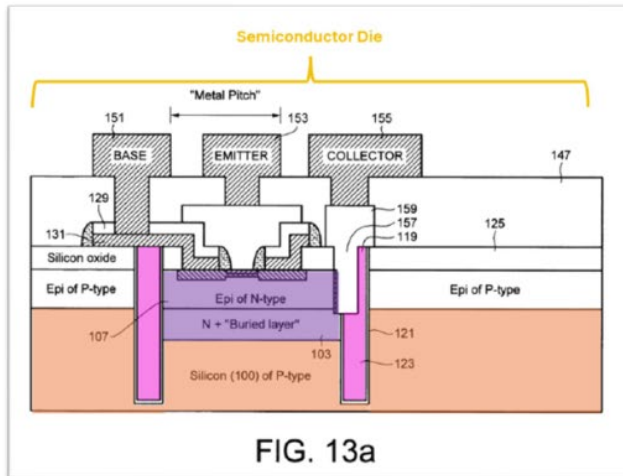
time reducing the amount of polysilicon required. *Id.*, 1:27-41, 3:29-50, 5:15-41; Ex. 2004, ¶ 54.

Even in Reply, Petitioner provides nothing more than conclusory statements to support Koshimizu being reasonably pertinent to the problem faced by the inventors. Reply, 10-11. Neither Petitioner nor its expert deal with the inherent differences between polysilicon and silicon dioxide. Ex. 2004, ¶¶ 54-58. These differences, along with Koshimizu's complete lack of description as to how to manufacture a trench, would lead a POSITA to not look to Koshimizu when seeking to manufacture a polysilicon-filled trench.

III. NORSTRÖM DOES NOT DISCLOSE A TRENCH THAT IS BOTH "SITUATED IN A SUBSTRATE" AND HAS "AT LEAST ONE TRENCH CHAMFERED CORNER" AS CLAIMED

Norstrom does not anticipate because it discloses separate trenches: one with chamfered corners, and a set of two that are in the substrate. The Challenged Claims require a trench with both features.

As explained in the POR, trenches 119 are two separate trenches, located under the base and collector, and shown in FIG. 13a. By contrast, trench 123, shown in FIG. 13c, is a larger trench, not located in the substrate as required. Petitioner's annotated figures show the different geometries.

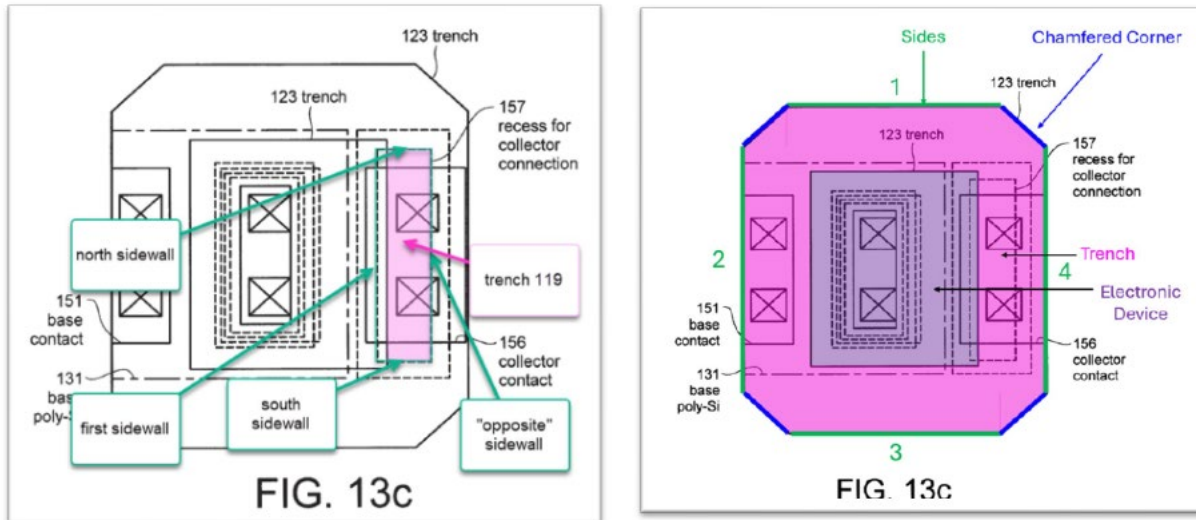


Pet. 61-62.

Petitioner now argues that element 123 of FIG. 13a is the trench of FIG. 13c. Reply, 12-15. Trenches 119 are, somehow, the same thing as element 123, but only before being filled. *Id.*, 13-14 (*Norström* uses element 119 to refer to the empty structure of the isolating trench and element 123 to refer to the isolating filling inside that same trench.”). Indeed, as the POR explained, in FIG. 13a, the trenches are element 119, and the filling within those trenches is element 123. POR, 25-29; Ex. 1006, 7:45-50 (“whereupon the **trenches** are filled with an isolating or semi-isolating material 123. . . .”) (emphasis added); 9:42-48.

Petitioner further incorrectly states that Norstrom “interchangeably refers to element 119 in either the singular or plural form.” Reply, 16. Not so. As explained in the POR, Norstrom *always* refers to the trenches of 119 in the plural, except when explicitly addressing a trench on one side of the device. POR, 25. Petitioner provides no counter-example, nor does its explanation (“the cutaway view of Figure 13a shows two cut sides of the same single trench seen in Figure 13c”) explain Norstrom’s use of the plural “trenches” for element 119.

Petitioner also is unable to explain the incompatibility of: i) the geometry of trenches 119 shown in FIG. 13a and described in the specification; and ii) the geometry of trench 123 shown in FIG. 13c. The POR explained in detail how the wide trench in FIG. 13c cannot be the same trench shown in FIG. 13a, because, e.g., collector-side trench 119 is located in direct contact with the sidewall of the collector contact hole. POR, 26-32. Trench 123 cannot be in such contact.



POR, 28;¹ Pet., 61.

In the figure above to the left, Mr. Berg drew the collector-side trench 119, showing it in contact with the collector hole. On the right is Petitioner's annotated figure showing trench 123. Element 123 cannot be the same trench because it is not in contact with the collector hole. POR, 26-32.

Petitioner ignores *Norstrom*'s explicit description of the location of 119, and cursorily states "HID gripes that the view of the isolating trench appears thinner in

¹ Petitioner quibbles that *Norström* does not use the terms "north sidewall" or "south sidewall." Reply, 18. This is immaterial; Mr. Berg used those terms for clarity in his explanation of the description of the trenches. Ex. 2004, ¶¶ 69-70.

the cutaway view of Figure 13a than the plan view of Figure 13c. See POR, 30. But *Norström* never qualifies its figures as being drawn to scale, and Petitioner never relies on them for being to scale either.” Reply, 17 n.5. But the argument has nothing to do with scale; indeed, HID does not rely on the scaling of the figures. It relies, instead, on the explicit description of the location of the trenches 119, as demonstrated in FIG. 13a and described at 10:32-56. POR, 26-32. Petitioner ignores this entirely.

Petitioner further states that FIG. 13c would show trenches 119 if they were separate from trench 123 because it is a plan view of Fig. 13c. Reply, 17. But FIG. 13a contains numerous structures not shown in FIG. 13c, including, for example, 129 (polysilicon thin film) and 121 (silicon oxide liner). A POSITA would not expect FIG. 13c to show trench 119 just because it is a plan view of FIG. 13a.

In view of the totality of: 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 consider trench 123 and trenches 119 to be the same structure.

Accordingly, Norstrom does not disclose the required trench of the Challenged Claims, and does not anticipate.

IV. NORSTROM DOES NOT RENDER OBVIOUS ANY CLAIMS

The parties agree that Ground 3 stands or falls with Ground 2. Reply, 19.

V. CONCLUSION

The Board should therefore issue a final written decision finding no claims unpatentable.

Respectfully submitted,

Dated: October 20, 2025

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CERTIFICATE OF WORD COUNT

The undersigned hereby certifies that the portions of the above-captioned PATENT OWNER'S SUR-REPLY specified in 37 C.F.R. § 42.24 has 1,714 words in compliance with the 5,600 word limit set forth in 37 C.F.R. § 42.24. This word count was prepared using Microsoft Word for Office 365.

October 20, 2025

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