

Demonstratives of Patent Owner Greenthread, LLC

IPR2024-00263 ('014 patent)
IPR2024-00264 ('481 patent)
IPR2024-00265 ('502 patent)
IPR2024-00266 ('195 patent)

USPTO Patent Trial and Appeal Board

Oral Hearing: May 6, 2025

Overview of Issues

1. Petitioner has presented zero “actual evidence” that the Petitions are timely.
2. The Claims require “movement of carriers” from the “surface layer.
3. The '195 and '502 Claims require “movement of minority carriers” from the “surface layer.”
4. Kawagoe does not disclose “movement of carriers” and “movement of minority carriers” from the “surface layer.”
5. Wieczorek does not disclose “movement of carriers” from the “surface layer.”
6. Payne does not disclose “movement of minority carriers” from the “surface layer.”
7. Petitioner has the burden to identify electric fields that would “aid carrier movement.”
8. Experts confirm that carriers in the “surface layer” are affected by numerous other fields and forces.
9. The “movement of carriers” depends on the sum of all of the fields in the “surface layer.”
10. Dr. Blalock did not analyze any of the fields or force magnitudes in the “surface layer.”
11. Petitioner's prosecution-related arguments are incorrect.
12. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

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1. The Petitions Are Time-Barred

- Petitioner always bears the burden of proving its Petitions are not time-barred.



[1, 2] We largely concur with the burden framework used in *Atlanta Gas Light*. As explained below, we agree that the IPR petitioner bears the burden of persuasion to demonstrate that its petitions are not time-barred under § 315(b) based on a complaint served on a real party in interest more than a year earlier. We also agree that an IPR petitioner's initial identification of the real parties in interest

should be accepted unless and until disputed by a patent owner. And although we disagree with treating this initial acceptance as a "rebuttable presumption" that formally shifts a burden of production to the patent owner, we agree that a patent owner must produce some evidence to support its argument that a particular third party should be named a real party in interest.

Worlds Inc. v. Bungie, Inc., 903 F.3d 1237, 1242 (Fed. Cir. 2018)

1. The Petitions Are Time-Barred

- It is legal error for Petitioner to proceed without producing evidence that the Petitions are not time-barred.



[10] Under the framework we have outlined above, the Board was entitled to rely, at least initially, on Bungie's list of all real parties in interest, which raised no time-bar issues under the facts presented. Here, however, Worlds presented evidence sufficient to put Bungie's identification of itself as the sole real party in interest into dispute. Thus, in this circumstance, the

Board could no longer merely rely upon Bungie's initial identification of the real parties in interest. Instead, the Board was required to make any factual determinations necessary to evaluate whether Bungie had satisfied its burden to demonstrate that its petition was not time-barred based on the complaints served upon Activision, the alleged real party in interest.

Worlds Inc. v. Bungie, Inc., 903 F.3d 1237, 1245-46 (Fed. Cir. 2018)

1. The Petitions Are Time-Barred

- Petitioner is the party with access to the relevant evidence—not Patent Owner.



real parties in interest). Second, an IPR petitioner will usually be in a better position, at least relative to the patent owner, to access evidence relevant to the real-party-in-interest inquiry. See *United States v. N.Y., New Haven & Hartford R.R. Co.*, 355 U.S. 253, 256 n.5, 78 S.Ct. 212, 2 L.Ed.2d 247 (1957) (“The ordinary rule, based on considerations of fairness, does not place the burden upon a litigant of establishing facts peculiarly within the knowledge of his adversary.”).

Moreover, presumptions are usually created based on certain policy considerations, such as correcting an imbalance due to one party’s superior access to sources of proof, or promoting efficiency by presuming a fact to be true where the existence of certain basic facts makes the truth of the presumed fact highly probable. See 2 George E. Dix, et al., *McCormick on Evidence* § 343 (7th ed. 2016). In the real-party-in-interest context, however, we see no particular need to create a formal presumption—especially a presumption that would disfavor the party that likely has inferior access to potential sources of proof.

Worlds Inc. v. Bungie, Inc., 903 F.3d 1237, 1243 (Fed. Cir. 2018)

1. The Petitions Are Time-Barred

- Petitioner knew of its burden under *Worlds* before it filed these Petitions (12/11/23).

Roger,

Thank you for speaking just now. As I explain in the email below and on our call, it is On Semi's burden to show that its petition is not time barred and that it has named all RPIs. You confirmed that tomorrow you will give us On Semi's position on whether it intends to produce evidence sufficient to carry its burden.

Sincerely,
Nick

-00263: Ex. 2014 (Oct. 11, 2023) Email Correspondence

Regardless, the Board need not address any "novel" arguments. Petitioner bears the burden of proof on the timeliness of its petition. The Petition should be denied for the simple reason that Petitioner came forward with **no evidence** regarding an issue on which it bears the burden, even after seeing Patent Owner's supposedly novel arguments in Patent Owner's email correspondence and motion to compel. Allowing a reply and new evidence in these circumstances would be unfair to parties who diligently raise issues and encourage petitioners to sandbag on the timeliness of their petitions, knowing that they can always come forward with cherry-picked evidence after seeing a POPR.

-00263: Ex. 2056 (November 16, 2023) Email Correspondence

1. The Petitions Are Time-Barred

8. For purposes of deciding this case, we need not address the quantum of support required from a patent owner. If it were not framed in terms of a presumption, the standard used in *Atlantic Gas Light*—evidence that “reasonably brings into question the accuracy of a petitioner’s identification of the real parties in interest”—may prove useful. In this case, it suffices to say that, as discussed below, Worlds presented more than enough evidence to sufficiently put this issue into dispute.

IPR2023-01242 (Patent 11,121,222 B2)
IPR2023-01243 (Patent 10,510,842 B2)
IPR2023-01244 (Patent 11,121,222 B2)²

Before COLE MORRIS STEWART, Acting Under Secretary of Commerce for
Intellectual Property and Acting Director of the United States Patent and
Trademark Office.

ORDER

Granting Director Review, Vacating the Final Written
Decision, and Remanding to the Board for Further Proceedings

¹ Texas Instruments Incorporated, which filed a petition in IPR2024-00673, has
been joined as a petitioner in this proceeding. Paper 69.

² This order applies to each of the above-listed proceedings.

Worlds Inc. v. Bungie, Inc.,
903 F.3d 1237, 1244 n.8
(Fed. Cir. 2018)

I agree with Patent Owner that the Board abused its discretion in denying the discovery motions. In the motions, Patent Owner raised more than a mere possibility that discovery would yield useful information on the privity issue given that Petitioner was a supplier of a time-barred party, Intel. *Garmin Int’l, Inc. v. Cuozzo Speed Techs. LLC*, IPR2012-00001, Paper 26 at 6 (PTAB Mar. 5, 2013) (precedential). While Patent Owner’s requested discovery was broad, it was not harassing or abusive. Under these circumstances, the Board either should have allowed whatever narrower discovery was appropriate or made it clear that Patent Owner could amend or resubmit its discovery motions. Instead, the Board denied Patent Owner’s motions and then cited the absence of evidence as a basis not to find a privity relationship.

-01242, 43, 44: Director Review Decision [94] at 3

1. The Petitions Are Time-Barred

- Patent Owner has “presented more than enough evidence to sufficiently put this issue into dispute.”



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Standard Terms and Conditions of Sale

(b) onsemi agrees to defend any claim, suit or proceeding asserted against Buyer based upon a claim that any Product(s) purchased hereunder, excluding Software, directly infringes any patent, mask work right or copyright, effective in the USA and to pay settlements or costs and damages finally awarded in any such suit, provided that onsemi is promptly notified in writing of the claim and given, at onsemi's request and expense, sole control of the defense or response to such claim and all requested reasonable assistance by Buyer for defense of the same. If such a claim has

-00263: Ex. 2010 (Standard T&Cs) at 3

1. The Petitions Are Time-Barred

- Patent Owner has “presented more than enough evidence to sufficiently put this issue into dispute.”

Highly Diversified Customer Base

Customer Needs:

- Best-in-Class Performance
- Reliable suppliers at scale
- Tighter supplier base
- Competitive system cost

onsemi Delivers:

- Industry-leading products
- Vertically integrated supply chain
- Broad portfolio of products
- Solution optimization across BOM

Top 20 customers represent ~35% of revenue

Top 20 customers each buy ~800 products on average

Greenthread Ex. 2003, p. 12
Semiconductor v. Greenthread

onsemi

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Public Information © onsemi 2023

Accelerating the
Towards a Sustainable
May 16, 2023

-00263: Ex. 2003 (OnSemi Customers) at 12

1. The Petitions Are Time-Barred

- Patent Owner has “presented more than enough evidence to sufficiently put this issue into dispute.”

Device	Manufacturer	MPN	IPN
DB200H	On Semiconductor*	NB3L202KMNTXG	J24311-001
DB400H	On Semiconductor*	NB3L204KMNTXG	J24310-001
DB800H	On Semiconductor*	NB3L208KMNTXG	H70432-001

Greenthread Ex. 2004, p. 10
Semiconductor v. Greenthread

Reference Number: 620306

Revision: 1.3

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*Other names and brands may be claimed as the property of others. Copyright © 2020, Intel Corporation.



-00263: Ex. 2004 (Intel Presentation) at 10



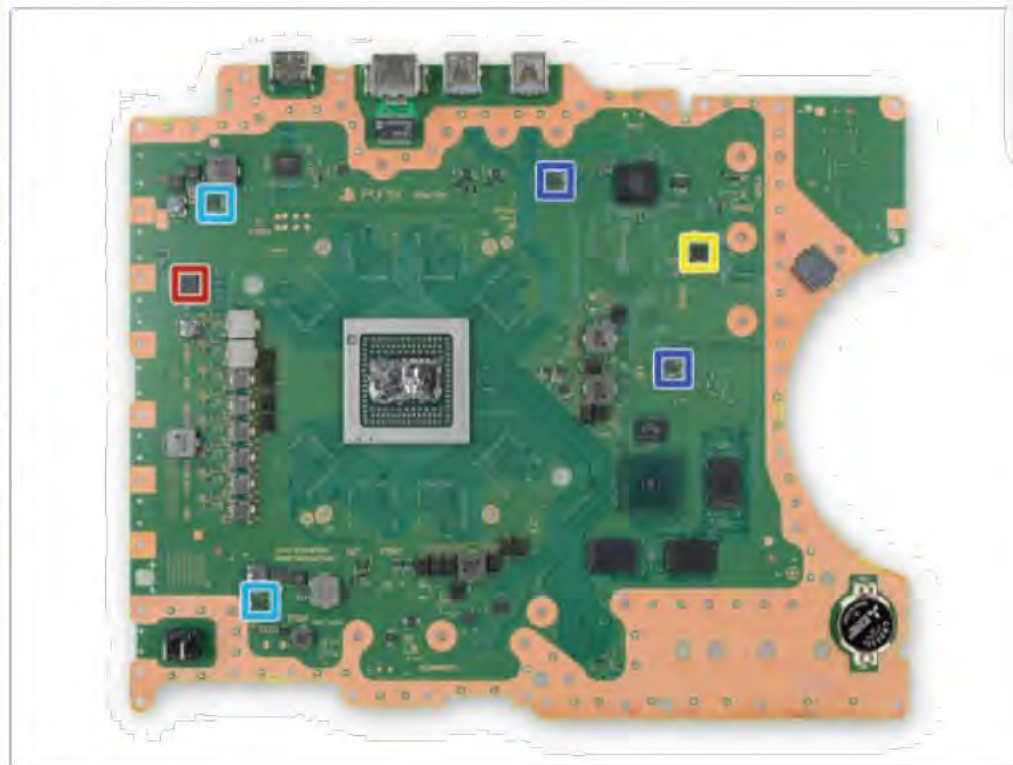
CLOCK DEVICES FOR SERVERS

Intel Corporation
Data Center Platform Applications Engineering
August 2020
Reference Number: 620306
Revision Number: 1.3

1. The Petitions Are Time-Barred

- Patent Owner has “presented more than enough evidence to sufficiently put this issue into dispute.”

Step 9



- What's the point of all of this silicon without a way to deliver the right amount of power to each chip? Here are the equally-important power chips:
- Infineon XDPE14286A 16 Phase PWM Controller (likely)
- ON Semiconductor NCP252160 Power Module
- Richtek RT5126 Power Management (likely)
- Richtek RT5127 Power Management (likely)
- Texas Instruments TPS53219A Synchronous Buck Controller
- Texas Instruments TLV62090 3A Step Down Converter

-00263: Ex. 2036 (Product Teardown) at 11

1. The Petitions Are Time-Barred

- Patent Owner has “presented more than enough evidence to sufficiently put this issue into dispute.”

NCP81248

Three-Rail Controller with Intel Proprietary Interface for IMVP8 CPU Application

The NCP81248 contains a two-phase, and two single-phase buck regulator controller optimized for Intel IMVP8 compatible CPUs. The two-phase controller optimizes the differential voltage, differentially inductor DCR, current sensing, input voltage feedback, and output voltage regulation to provide accurate regulated power for IMVP8 CPUs.

The two single-phase controllers make use of ON Semiconductor's patented high performance EPAT operation. EPAT control enables transient response while allowing smooth transition into discontinuous frequency, reducing operation and continuous mode power operation. The single-phase controller is a low offset and low ripple amplifier with programmable offset compensation for accurate current regulation.

Features Common to All Rails

- V_{IN} Range 4.2 V to 25 V
- Startup and Pre-Biased Load-While-Avoiding False CUV
- Digital Soft-Start Ramp
- Adjustable V_{OUT} (except No-Load)
- Load Regulator Differential Output Voltage Amplifier
- Dynamic Reference Injection
- Programmable Output Voltage (0.5mV Step)
- Dynamic V_{OUT} Post-Forward
- External Control Signal Amplifier (by Each Phase)
- Programmable Adaptive Voltage Positioning (AVP)
- Switching Frequency Range of 200 kHz to 1.2 MHz
- Digitally Stabilized Switching Frequency
- Undervoltage Operation

Two-Phase Rail Features

- Support Intel proprietary interface addresses 00 and 01
- Current Mode Dual Edge Modulation (for Extended Load Response & Transient Response)
- High Performance Operational Error Amplifier
- Adaptive Preload Current Regulation
- Phase-for-Phase Dynamic Control Balancing
- Power Saving Mode Shutdown

Single-Phase Rail Features

- Support Intel proprietary interface addresses 02, 03 and 04
- High Performance EPAT Control System
- Low Offset 250mV Offset
- Zero Delay Capable

Other Features

- 1.5V Input Monitor
- Thermal Monitor in Two Intel proprietary interface addresses
- Three Devices are Pin-Free, Masked Pin BFB Free and are 0.125mm Pitch

Continued Ex. 2913 p. 13
Semiconductor v. GreenThread

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February 2006 - Rev. 3

Publication Order Number: NCP81248G

NCP81248

Three-Rail Controller with Intel Proprietary Interface for IMVP8 CPU Applications

The NCP81248 contains a two-phase, and two single-phase buck regulator controllers optimized for Intel IMVP8 compatible CPUs

The two-phase controller combines true differential voltage



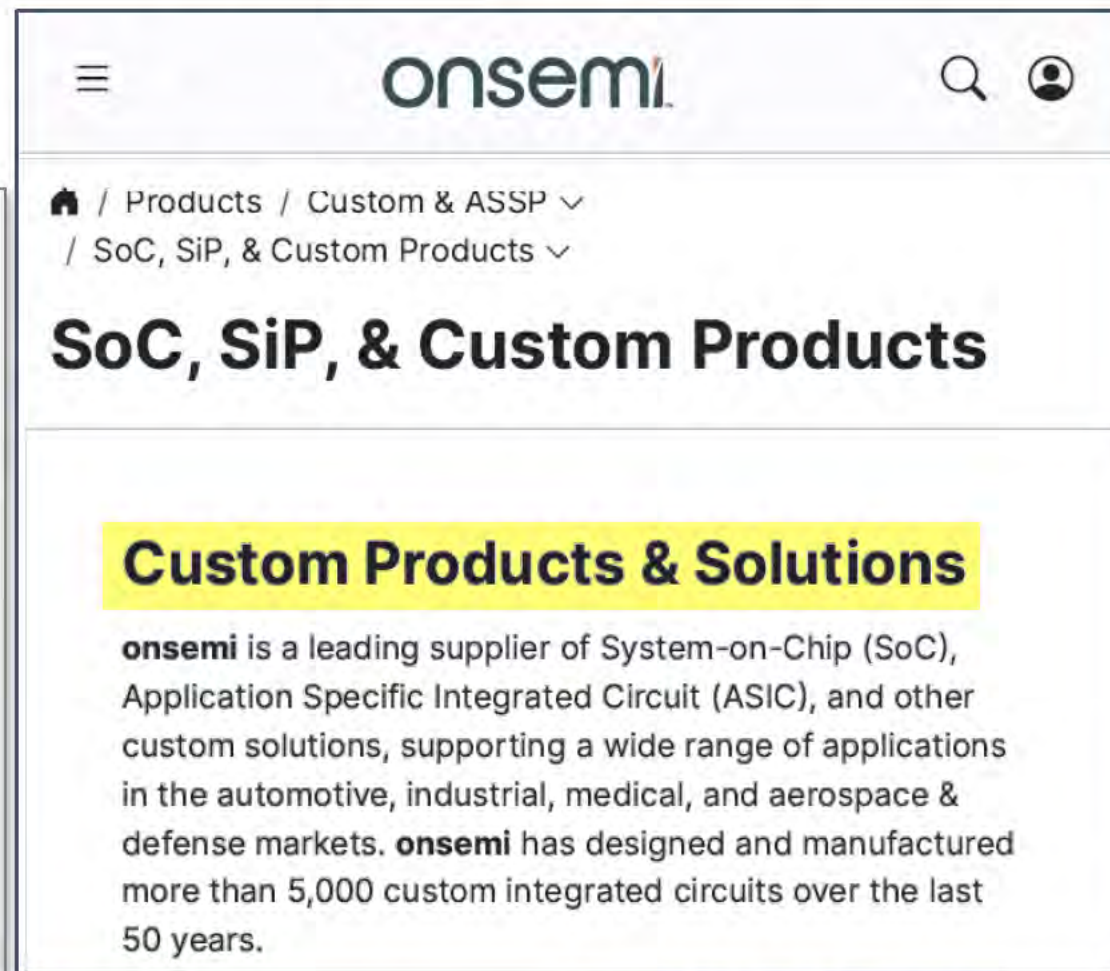
ON Semiconductor®

www.onsemi.com

-00263: Ex. 2006 (OnSemi Data Sheet)

1. The Petitions Are Time-Barred

- Patent Owner has “presented more than enough evidence to sufficiently put this issue into dispute.”



-00263: Ex. 2053 (OnSemi Webpage)

1. The Petitions Are Time-Barred

- Petitioner is one of Intel & [REDACTED] “have made vendors” under its license agreements with time-barred parties.

(c) The sublicense (and release) granted in accordance with Section 1.2(a) and Section 4.3 to any Entity under the Patent License shall be deemed to be a further sublicense (and release) to that Entity's Affiliates (“RPX Licensee Affiliates”), and such RPX Licensees' and RPX Licensee Affiliates' direct and indirect customers, have-made vendors, developers, distributors, dealers, suppliers, manufacturers, original equipment manufacturers (OEMs), original design manufacturers (ODMs), system integrators, other contractors, licensees, and users (including end users) solely to the extent such third parties make, have made, use, purchase, provide, host, sell, lease, distribute, supply, export, import, offer for sale, or otherwise exploit or dispose of any Licensed Product and Service and/or Combined Licensed Product and Service (each, a “Covered Third Party”). Each RPX Licensee shall have the right, consistent with this Section 1.2(c), to grant specific non-sublicensable, non-assignable sublicenses to its Covered Third Parties with respect to such RPX Licensee's or its Affiliates' Licensed Products and Services and/or Combined Licensed Product and Service.

-00263: Ex. 2022 (Intel-[REDACTED] Agreement) at 5

1. The Petitions Are Time-Barred

- The agreement with Intel and [REDACTED] covers each of the Challenged Patents.

Fam ily	Patent No.	Publication No.	Application No.	Title	File Date	Publication Date
1		US20060049464	US10/934915	Semiconductor devices with graded dopant regions	9/3/2004	3/9/2006
1	US8421195		US11/622496	Semiconductor devices with graded dopant regions	1/12/2007	4/16/2013
1	US8106481		US12/549283	Semiconductor devices with graded dopant regions	8/27/2009	1/31/2012
1		US20130221488	US13/854319	Semiconductor devices with graded dopant regions	4/1/2013	8/29/2013
1	US9190502		US14/515584	Semiconductor devices with graded dopant regions	10/16/2014	11/17/2015
1	US9647070		US14/931636	Semiconductor devices with graded dopant regions	11/3/2015	5/9/2017
1	US10510842		US15/590282	Semiconductor devices with graded dopant regions	5/9/2017	12/17/2019
1	US10734481		US16/717950	Semiconductor devices with graded dopant regions	12/17/2019	8/4/2020
1	US11121222		US16/947294	Semiconductor devices with graded dopant regions	7/27/2020	9/14/2021
1	US11316014		US17/371839	Semiconductor devices with graded dopant regions	7/9/2021	4/26/2022
1		US20220246725	US17/728588	Semiconductor devices with graded dopant regions	4/25/2022	8/4/2022

-00263: PO Prelim. Resp. [13] at 18; PO Resp. [31] at 39-42;
PO Sur-Reply [43] at 15

-00263: Ex. 2022 (Intel- [REDACTED] Agreement) at 17

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Greenthread Ex. 2913 p. 16 of 135
Semiconductor v. Greenthread

1. The Petitions Are Time-Barred

- Since Patent Owner has produced “some evidence” to put the RPI issue “into dispute,” the Board can “no longer merely rely upon” Petitioner’s RPI assertions.



[10] Under the framework we have outlined above, the Board was entitled to rely, at least initially, on Bungie’s list of all real parties in interest, which raised no time-bar issues under the facts presented. Here, however, Worlds presented evidence sufficient to put Bungie’s identification of itself as the sole real party in interest into dispute. Thus, in this circumstance, the

Board could no longer merely rely upon Bungie’s initial identification of the real parties in interest. Instead, the Board was required to make any factual determinations necessary to evaluate whether Bungie had satisfied its burden to demonstrate that its petition was not time-barred based on the complaints served upon Activision, the alleged real party in interest.

Worlds Inc. v. Bungie, Inc., 903 F.3d 1237, 1245-46 (Fed. Cir. 2018)

1. The Petitions Are Time-Barred

- “Attorney argument” is not enough to carry Petitioner’s burden
- Petitioner has never provided affidavits, declarations, or other “actual evidence.”



As an aside, we have some concern that the Board may have relied on attorney argument as evidence that Activision was not controlling or funding these IPRs. *See* J.A. 510, 3877, 5095 (citing Bungie’s briefing and stating that “[o]n this record, we accept Petitioner’s express representations that Activision is not controlling or funding this proceeding”); *see also Icon Health & Fitness, Inc. v. Strava, Inc.*, 849 F.3d 1034, 1043 (Fed. Cir. 2017) (“Attorney argument

is not evidence.”). This is particularly concerning given that the Board’s apparent reliance on such statements seemed to outweigh the actual evidence presented by Worlds. Instead of citing evidence to support this factual conclusion, the Board merely cited attorney argument from Bungie’s briefing—attorney argument that itself failed to cite evidence, such as affidavits or declarations. *See* J.A. 510, 3877, 5095 (Institution Decisions); J.A. 409–10, 416 (Bungie’s briefing).

Worlds Inc. v. Bungie, Inc., 903 F.3d 1237, 1246 (Fed. Cir. 2018)

1. The Petitions Are Time-Barred

- Petitioner has never come forward with “supporting evidence,” as the Board ordered.

From the Board –

Petitioner is authorized to file a 10-page preliminary reply to Patent Owner’s Preliminary Response in IPR2024-00263, -00264, -00265, and -00266, and Patent Owner is authorized to file a 10-page preliminary sur-reply in each proceeding. The preliminary reply is due on or before May 31, 2024, and the preliminary sur-reply is due on or before June 11, 2024.

-00263: Ex. 1055 (Authorization Email)

From the Board –

In each of the above-referenced proceedings, Petitioner is authorized to file a preliminary reply and supporting evidence, and Patent Owner is authorized to file a preliminary sur-reply and supporting evidence. The briefs and supporting evidence are limited to the issue of whether the Petition is time-barred. No new testimonial evidence is permitted.

-00263: Ex. 2056 (Prior Authorization Email)

1. The Petitions Are Time-Barred

- Petitioner has only ever offered “attorney argument” to support its theories.
- Petitioner has never denied that there are other indemnification agreements that offer more “generous” terms than its “Standard Terms & Conditions.”

Petition for Inter-Partes Review of U.S. Patent No. 11,316,014

UNITED STATES PATENT AND TRADEMARK OFFICE

Petitioner certifies under Rule 42.104(a) that the '014 Patent is available for IPR and Petitioner is not barred or estopped from requesting IPR of the Challenged Claims on the grounds identified in this Petition.

PETITION FOR INTER PARTES REVIEW
UNDER 35 U.S.C. §312 AND 37 C.F.R. §42.104

-00263: Petition [1] at 5

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

At bottom, Petitioner's standard manufacturer/customer relationship with Intel and Samsung did not provide Petitioner a “full and fair” opportunity to challenge the validity of any patents in any previous matter. Petitioner was a stranger to the Intel and Samsung litigations, and it would be unjust and contrary to precedent to bind Petitioner as a privy to those cases. *Taylor*, 553 U.S. at 893-95; *WesternGeco*, 889 F.3d at 1319-22.

-00263: Pet. Reply to POPR [15] at 10
Pet. Reply [38] at 30-31

-00263: PO Disc. Mot. [8] at 2; PO Prelim. Resp. [13] at 35-36;
PO Resp. [31] at 56-58

DEMONSTRATIVE EXHIBIT – NOT EVIDENCE

Greenthread Ex. 2913 p. 20 of 135
Semiconductor v. Greenthread

20

1. The Petitions Are Time-Barred

- The Board cannot infer that this (lack of) evidence would support Petitioner's theories.



or other alleged discovery misconduct. The lack of evidence, however, regarding the issues that might explain why Seirus paid for the revised exclusivity on the eve of filing the Petitions in these cases cuts against the party bearing the burden of proof on these issues, Ventex. Even if we do not

Ventex Co., Ltd. v. Columbia Sportswear N. Am., Inc., IPR2017-00789, Paper 148 at 14 (PTAB Jan. 24, 2019)

⁴ Volkswagen does not dispute Conti's claims that Volkswagen is completely indemnified by Conti against Patent Owner's claims. We agree with Patent Owner that the fact that Volkswagen has not produced its agreement with Conti may suggest that the agreement does not support Volkswagen in meeting its burden regarding the identification of all real parties in interest. *See Worlds*, 903 F.3d at 1242–43.

Volkswagen Grp. of Am., Inc. v. Arigna Tech. Ltd., IPR2021-01263, Paper 16 at 10-11 (PTAB Jan. 21, 2022)

1. The Petitions Are Time-Barred

- These IPRs present the same facts as *Worlds*—and thus warrant termination because the Petitions are time-barred.

<i>Worlds</i>	<i>OnSemi v. Greenthread</i>
Petitioner knew of its burden of proof?	✓
Board denied discovery on RPI issue?	✓
PO filed preliminary response without RPI discovery?	✓
PO presented evidence that “sufficiently put [the RPI] issue into dispute”?	✓
Petitioner was asked to submit supporting evidence?	✓
Petitioner relied entirely on “attorney argument”?	✓
Board instituted because PO presented “insufficient evidence” on RPI?	✓
Reversible legal error?	✓

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10. Dr. Blalock did not analyze any of the fields or force magnitudes in the “surface layer.”
11. Petitioner's prosecution-related arguments are incorrect.
12. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

2. Movement of Carriers from the Surface Layer

- All of the Challenged Claims require “movement of carriers” from the “active region” or “surface layer.”

US 11,316,014

1. An electronic system, the system comprising:
at least one semiconductor device, the at least one semiconductor device including:
a substrate of a first doping type at a first doping level having a surface;
a first active region disposed adjacent the surface with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first and second active regions towards an area of the substrate where there are no active regions; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface towards the area of the substrate where there are no active regions, wherein at least some of the transistors form digital logic of the semiconductor device.

-00263: Ex. 1001 ('195 pat.)
at 4:49-5:7

US 10,734,481

1. A semiconductor device, comprising:
a substrate of a first doping type at a first doping level having first and second surfaces;
a first active region disposed adjacent the first surface of the substrate with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the first surface to the second surface of the substrate.

-00264: Ex. 1001 ('502 pat.)
at 4:50-5:3

US 9,190,502

7. A semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants generating a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants generating a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00265: Ex. 1001 ('502 pat.)
at 4:52-67

US 8,421,195

1. A CMOS Semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants extending between said surface layer and said substrate, said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00266: Ex. 1001 ('195 pat.)
at 4:13-29

2. Movement of Carriers from the Surface Layer

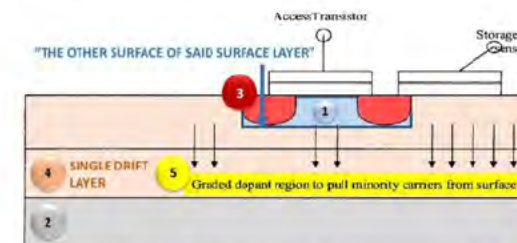
- The “active region” is located in the “surface layer.”

EXEMPLARY CLAIMS 195:1 & 842:1

Term	U.S. Patent No. 8,421,195, Claim 1 (195:1)
1	A CMOS Semiconductor device comprising: a <u>surface layer</u> ;
2	a <u>substrate</u> ;
3	an <u>active region</u> including a source and a drain, disposed on one surface of said surface layer;
4	a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants extending between said surface layer and said substrate, said drift layer further having a first static <u>unidirectional electric drift field</u>
5	<u>to aid the movement of minority carriers from said surface layer to said substrate</u> ; and
6	at least one <u>well region</u> disposed in said single drift layer, said well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00266: Ex. 1030 at 6

Ex. 1, ¶30. The “active region” is a doped region where a transistor can be formed. *Id.*, ¶31; Ex. 2, 1:61-63; 2:18-23; 3:1-3, 30-33. Next, the claim specifies there is a single drift layer disposed between “the other surface of said surface layer” and the substrate. The single drift layer has a graded concentration of dopants. Ex. 1, ¶32.



The graded dopants create an electric field that aids the movement of minority carriers (holes in the example shown in Fig. 5B) from the surface layer to the substrate. Ex. 1, ¶¶32-33; Ex. 2, 3:17-

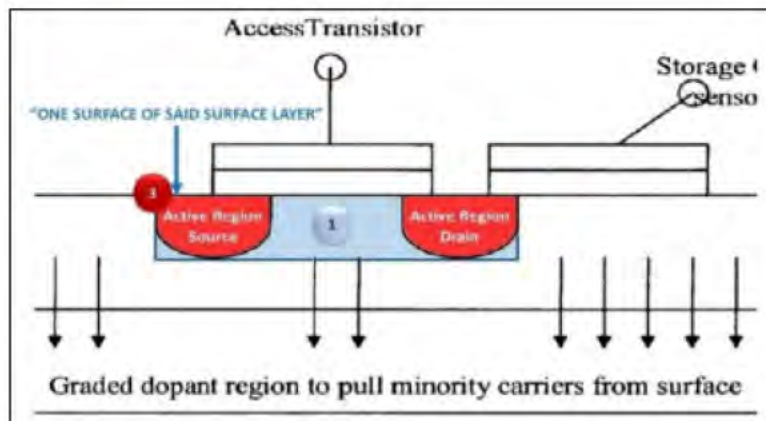
-00266: Ex. 1030 (Claim Constr. Brief) at 16

2. Movement of Carriers from the Surface Layer

- The Petition acknowledges that the “active region” is located in the “surface layer.”

b. Element [1.1]: “a surface layer;”

Payne discloses or renders obvious this element. EX1003, ¶¶73-75. According to Patent Owner (“PO”), a “surface layer” is “a layer at the surface of the silicon” (or “a layer at the surface of the semiconductor device”)—which PO annotated in blue below—“where the active region [(red)] is located.” EX1030, 6, 9, 12, 13; EX1033.

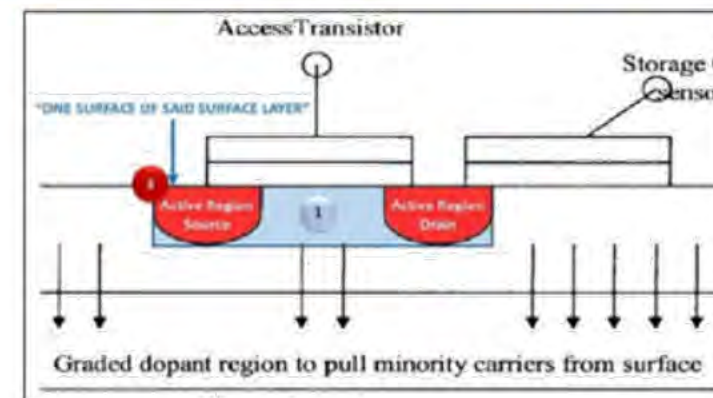


EX1001, FIG. 5(b); EX1030, 7, 12.

-00266: Petition [1] at 14-15

d. Element [1.3]: “an active region including a source and a drain, disposed on one surface of said surface layer;”

Payne discloses or renders obvious this element. EX1003, ¶¶79-84. According to PO, the '195 Patent's Figure 5(b) depicts an active region (red) “disposed on one surface [(top surface)] of said surface layer,” as below:



EX1001, FIG. 5(b). In PO's words: “When the claim says the active region is ‘disposed on one surface of the surface layer,’ it means the active region is located on the ‘ceiling’ of the silicon *inside* the silicon.” EX1030, (emphasis in original), 6-7, 11-12.

-00266: Petition [1] at 17-18

2. Movement of Carriers from the Surface Layer

- The Challenged Claims must be construed to properly reflect the purpose of the invention.



The specification further supports this construction. We have explained that a patent's express purpose of the invention "informs the proper construction of claim terms." *Kaken Pharm. Co. v. Iancu*, 952 F.3d 1346, 1352 (Fed. Cir. 2020). Here, an expressed purpose of the invention is minimizing metadata.⁵ See, e.g., *id.* at col. 1 ll. 10–12, col. 4 ll. 7–10. To achieve this goal, the specification explains that "[t]he present invention constructs a logical volume by using a disk partition as a volume construction unit so the present invention can minimize the size of metadata." *Id.* at col.

Sequoia Tech., LLC v. Dell, Inc.,
66 F.4th 1317, 1326 (Fed. Cir. 2023)

2. Movement of Carriers from the Surface Layer

- The specification explains that “spurious minority carriers” interfere with the “active circuitry at the surface.”

As illustrated in FIGS. 5(a), 5(b), 5(c), donor gradient is also of benefit to very large scale integrated circuits (VLSI)-VLSI logic, DRAM, nonvolatile memory like NAND flash. Spurious minority carriers can be generated by clock switching in digital VLSI logic and memory IC'S. These unwanted carriers can discharge dynamically-held 'actively held high' nodes. Statically held nodes (with V_{cc}) can not be affected, in most cases. Degradation of refresh time in DRAM's is one of the results, because the capacitor holds charge dynamically. Similarly, degradation of CMOS digital images, in digital imaging IC's is another result of the havoc caused by minority carriers. Pixel and color resolution can be significantly enhanced in imaging IC's with the embodiments described here. Creating 'Sub Terrain' recombination centers underneath the wells (gold doping, platinum doping) as is done in some high-voltage diodes is not practical for VLSI circuits. Hence, a novel technique has been described here by creating a drift field to sweep these unwanted minority carriers into the substrate as quickly as possible, from the active circuitry at the surface. In a preferred embodiment, the subterrain n-layer

the surface. In a preferred embodiment, the subterranean n-layer has a graded donor concentration to sweep the minority carriers deep into the substrate. One or more of such layers can also be implemented through wafer to wafer bonding or similar "transfer" mechanisms. This n-layer can be a deeply-implanted layer. It can also be an epitaxial layer. The n-well and p-well also can be graded or retrograded in dopants, as desired, to sweep those carriers away from the surface as well.

-00266: Ex. 1001 ('195 pat.) at 3:33-40

-00266: Ex. 1001 at 3:14-33

2. Movement of Carriers from the Surface Layer

- The specification discloses using a “drift field” to “sweep these unwanted minority carriers from the active circuitry at the surface into the substrate.”



As illustrated in FIGS. 5(a), 5(b), 5(c), donor gradient is also of benefit to very large scale integrated circuits (VLSI)—VLSI logic, DRAM, nonvolatile memory like NAND flash. Spurious minority carriers can be generated by clock switching in digital VLSI logic and memory IC'S. These unwanted carriers can discharge dynamically-held 'actively held high' nodes. Statically held nodes (with V_{cc}) can not be affected, in most cases. Degradation of refresh time in DRAM's is one of the results, because the capacitor holds charge dynamically. Similarly, degradation of CMOS digital images, in digital imaging IC's is another result of the havoc caused by minority carriers. Pixel and color resolution can be significantly enhanced in imaging IC's with the embodiments described here. Creating 'Sub Terrain' recombination centers underneath the wells (gold doping, platinum doping) as is done in some high-voltage diodes is not practical for VLSI circuits. Hence, a novel technique has been described here by creating a drift field to sweep these unwanted minority carriers into the substrate as quickly as possible, from the active circuitry at the surface. In a preferred embodiment, the subterrain n-layer

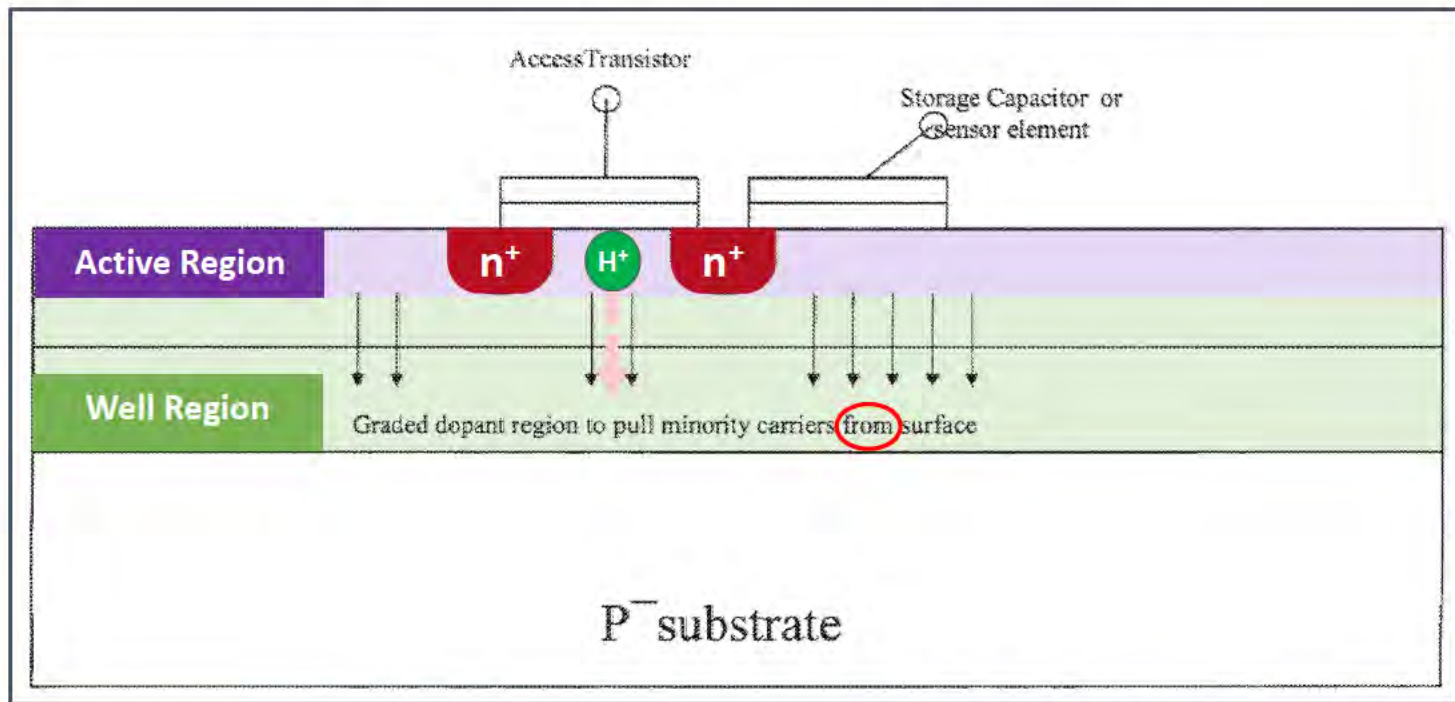
the surface. In a preferred embodiment, the subterrain n-layer has a graded donor concentration to sweep the minority carriers deep into the substrate. One or more of such layers can also be implemented through wafer to wafer bonding or similar "transfer" mechanisms. This n-layer can be a deeply-implanted layer. It can also be an epitaxial layer. The n-well and p-well also can be graded or retrograded in dopants, as desired, to sweep those carriers away from the surface as well.

-00266: Ex. 1001 ('195 pat.) at 3:33-40

-00266: Ex. 1001 at 3:14-33

2. Movement of Carriers from the Surface Layer

- Fig. 5B shows how an electric field moves minority carriers (positively-charged “holes”) from the active region at the surface.
- The positively-charged holes move in the same direction as the electric field.



-00266: Ex. 1001 ('195 pat.) at Fig. 5B

2. Movement of Carriers from the Surface Layer

- The Challenged Claims do not impermissibly mix apparatus and method limitations.

US 11,316,014

1. An electronic system, the system comprising:
at least one semiconductor device, the at least one semiconductor device including:
a substrate of a first doping type at a first doping level having a surface;
a first active region disposed adjacent the surface with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first and second active regions towards an area of the substrate where there are no active regions; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface towards the area of the substrate where there are no active regions, wherein at least some of the transistors form digital logic of the semiconductor device.

-00263: Ex. 1001 ('195 pat.)
at 4:49-5:7

US 10,734,481

1. A semiconductor device, comprising:
a substrate of a first doping type at a first doping level having first and second surfaces;
a first active region disposed adjacent the first surface of the substrate with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the first surface to the second surface of the substrate.

-00264: Ex. 1001 ('502 pat.)
at 4:50-5:3

US 9,190,502

7. A semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants generating a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants generating a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00265: Ex. 1001 ('502 pat.)
at 4:52-67

US 8,421,195

1. A CMOS Semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants extending between said surface layer and said substrate, said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00266: Ex. 1001 ('195 pat.)
at 4:13-29

2. Movement of Carriers from the Surface Layer

- Petitioner argues that, under *ParkerVision*, Greenthread's technical arguments are "irrelevant."

I. INTRODUCTION

Because the challenged apparatus claims do not require an active step of affirmatively moving carriers, Patent Owner's (PO's) arguments about net forces, whether "graded" means "aided," inherency, and calculation of a slope are all irrelevant.¹ "[A]pparatus claims cover what a device *is*, not what a device *does*." *ParkerVision, Inc. v. Qualcomm Inc.*, 903 F.3d 1354, 1361 (Fed. Cir. 2018) (emphasis original) (quoting *Hewlett-Packard Co. v. Bausch & Lomb Inc.*, 909 F.2d 1464, 1468 (Fed. Cir. 1990). "Under *ParkerVision*, the relevant inquiry is whether the graded dopant concentration is capable of performing the claimed limitation, not how likely the claimed limitation is to be performed or occur." IPR2023-01243, Paper 82 (Final Written Decision), 44.

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SEMICONDUCTOR COMPONENTS INDUSTRIES, LLC
Petitioner

v.

GREENTHREAD LLC
Patent Owner

Case IPR2024-01263
U.S. Patent No. 11,316,014

PETITIONER'S REPLY TO PATENT OWNER'S RESPONSE

-00263: Pet. Reply [38] at 1

2. Movement of Carriers from the Surface Layer

- *ParkerVision* is not controlling law here—*INVT* is.



(Fed. Cir. 2002)); see also *ParkerVision, Inc.*, 903 F.3d at 1361 (articulating a distinction between configuration-type and capability-type claims).

Possibly the most straightforward example of this is the common distinction between method claims and apparatus claims. See, e.g., *Finjan*, 626 F.3d at 1203–

Cir. 2009))). Cf. *ParkerVision, Inc.*, 903 F.3d at 1363 (similarly differentiating apparatus claims and method claims in the patent invalidity context).

However, differences exist between apparatus claims as well, depending on the claim language. We have construed some apparatus claims to require an infringing device to actually perform and operate according to the functional terms recited in the claim. The intervenors cite two such cases, *Cross Medical* and *Ball Aerosol*. See Intervenors' Br. 64, 67–68. We have construed other apparatus claims to require only capability, such as in *Finjan* and *Silicon Graphics*.

INVT SPE LLC v. Int'l Trade Comm'n, 46 F.4th 1361, 1371-72 (Fed. Cir. 2022)

2. Movement of Carriers from the Surface Layer

- Treatment of the claim “depend[s] on the claim language,” not the apparatus-or-method inquiry.



(Fed. Cir. 2002)); see also *ParkerVision, Inc.*, 903 F.3d at 1361 (articulating a distinction between configuration-type and capability-type claims).

Possibly the most straightforward example of this is the common distinction between method claims and apparatus claims. See, e.g., *Finjan*, 626 F.3d at 1203–

Cir. 2009))). Cf. *ParkerVision, Inc.*, 903 F.3d at 1363 (similarly differentiating apparatus claims and method claims in the patent invalidity context).

However, differences exist between apparatus claims as well, depending on the claim language. We have construed some apparatus claims to require an infringing device to actually perform and operate according to the functional terms recited in the claim. The intervenors cite two such cases, *Cross Medical* and *Ball Aerosol*. See Intervenors’ Br. 64, 67–68. We have construed other apparatus claims to require only capability, such as in *Finjan* and *Silicon Graphics*.

INVT SPE LLC v. Int’l Trade Comm’n, 46 F.4th 1361, 1371-72 (Fed. Cir. 2022)

2. Movement of Carriers from the Surface Layer

- Mechanical apparatus claims are “configuration-type” claims that require “actual operation.”



Ball Aerosol and *Cross Medical* both involve **mechanical apparatus claims**. According to these two cases, intervenors argue, the '439 claims should be construed to require actual operation of the functions recited in limitations [d] and [e] in order for there to be infringement. *Intervenors'*

In both of those cases, **actual operation** of arranging elements in a particular way was **required** because of the claim language. Neither case involved claim language resembling the language in INVT's claims. *Intervenors emphasize that the*

INVT SPE LLC v. Int'l Trade Comm'n, 46 F.4th 1361, 1372 (Fed. Cir. 2022)

2. Movement of Carriers from the Surface Layer

- The Challenged Claims recite specific structural limitations that require movement from the “surface layer.”

US 11,316,014

1. An electronic system, the system comprising:
at least one semiconductor device, the at least one semiconductor device including:
a substrate of a first doping type at a first doping level having a surface;
a first active region disposed adjacent the surface with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first and second active regions towards an area of the substrate where there are no active regions; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface towards the area of the substrate where there are no active regions, wherein at least some of the transistors form digital logic of the semiconductor device.

-00263: Ex. 1001 ('195 pat.)
at 4:49-5:7

US 10,734,481

1. A semiconductor device, comprising:
a substrate of a first doping type at a first doping level having first and second surfaces;
a first active region disposed adjacent the first surface of the substrate with a second doping type opposite in conductivity to the first doping type and within which transistors can be formed;
a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed;
transistors formed in at least one of the first active region or second active region;
at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the first surface to the second surface of the substrate; and
at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the first surface to the second surface of the substrate.

-00264: Ex. 1001 ('502 pat.)
at 4:50-5:3

US 9,190,502

7. A semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants generating a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants generating a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00265: Ex. 1001 ('502 pat.)
at 4:52-67

US 8,421,195

1. A CMOS Semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants extending between said surface layer and said substrate, said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00266: Ex. 1001 ('195 pat.)
at 4:13-29

2. Movement of Carriers from the Surface Layer

- There is no “different structure” that can “perform the claimed function.”



Here, the apparatus claims are most similar to those in *Ericsson* and are fundamentally dissimilar to those in *Ball Aerosol*. The '940 patent's apparatus claims are drawn to “[a]n apparatus *for frequency up-conversion*” (claim 4) or “[a]n apparatus *for communicating*” (claim 22), all of which comprise “a switch module *to receive*” an oscillating signal and a bias signal, wherein the oscillating signal “*causes* said switch module *to gate* said bias signal and thereby *generate* a periodic signal having a plurality of harmonics.” '940 patent, col. 67, ll. 25–33 (emphases added); *id.* col.

69, ll. 19–32 (emphases added). Accordingly, just as D-Link's products only required a component that was reasonably capable of “arranging information for transmission . . . which identifies a type of payload information . . .,” *Ericsson*, 773 F.3d at 1217, Nozawa's circuit requires only an oscillating signal that is reasonably capable of gating the bias signal in a manner that generates a periodic signal having a plurality of harmonics. And, unlike in *Ball Aerosol*, the claims here recite no structural limitations that would preclude a prior art reference that discloses a different structure from performing the claimed function.

ParkerVision, Inc. v. Qualcomm Inc., 903 F.3d 1254, 1362 (Fed. Cir. 2018)

2. Movement of Carriers from the Surface Layer

- Greenthread's claim language requires "actual operation" and "actual performance" of the claimed limitation in order to be found obvious.

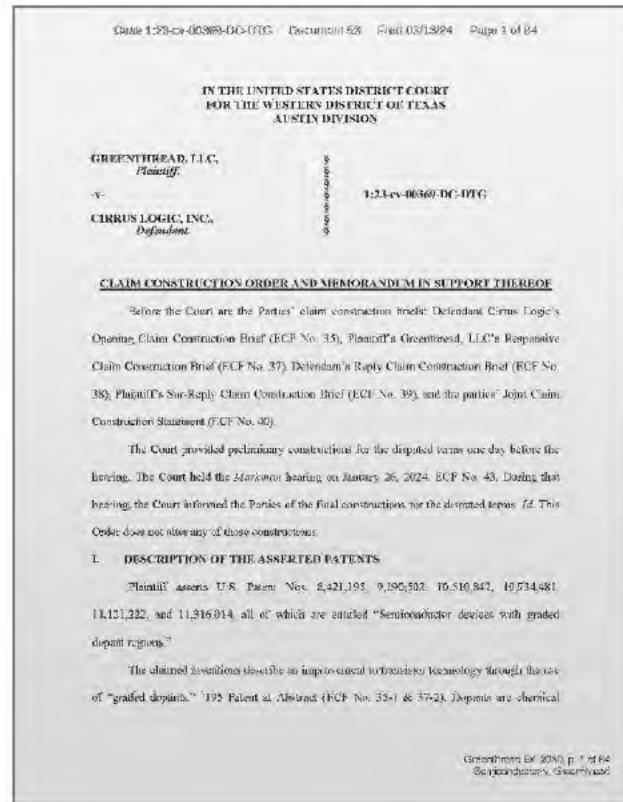


In both of those cases, actual operation of arranging elements in a particular way was required because of the claim language. Neither case involved claim language resembling the language in INVT's claims. Intervenorors emphasize that the

INVT SPE LLC v. Int'l Trade Comm'n, 46 F.4th 1361, 1372 (Fed. Cir. 2022)

2. Movement of Carriers from the Surface Layer

- WDTX ruled that a graded concentration does not necessarily “aid carrier movement.”
- The dopants must be “sufficiently graded” in order to “aid movement.”

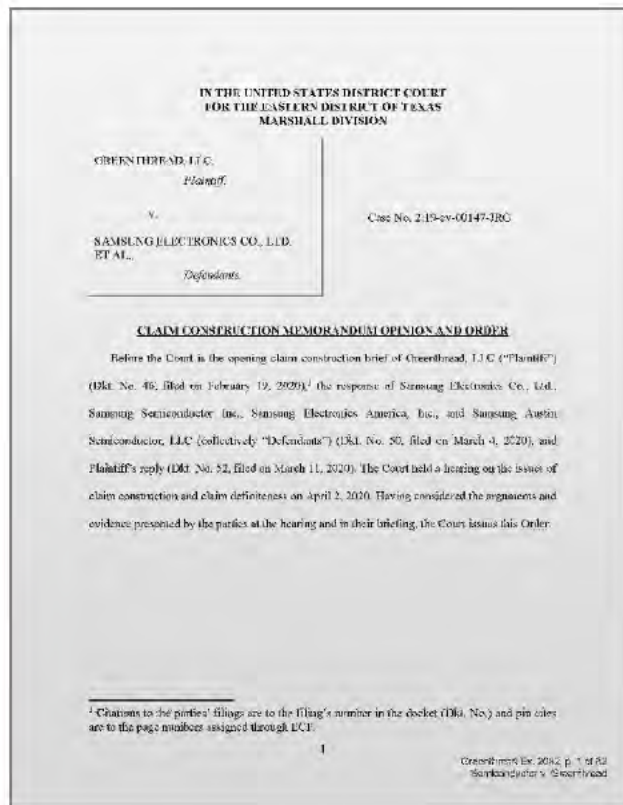


Second, the claim language provides some guidance as to the scope of this term. More specifically, the claim language describes that the graded concentration of dopants creates an electric field. *See, e.g.*, '195 Patent, Claim 1, Limitation [d] (“said drift layer having a graded concentration of dopants ... said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate”). The Court concludes that a person of skill would understand that the graded concentration has to be sufficiently graded to result in a “static unidirectional electric drift field to aid the movement of minority carriers.” This establishes a minimum graded concentration of dopants, *i.e.*, a graded concentration of dopants that is below this minimum will not aid in the movement of minority carriers and thus is not a graded concentration.

-00263: Ex. 2080 (WDTX Order) at 39-40

2. Movement of Carriers from the Surface Layer

- EDTX ruled that carrier movement depends on the direction and magnitude of the slope.



'195 Patent File Wrapper April 17, 2012 Response Pursuant to 37 CFR 1.114 Amendment E at 6–7, Dkt. No. 50-12 at 59–60. Taken in context, that the direction of the electrical field and the carrier movement “depends solely on the slope of the graded concentration of dopant” does not mandate that the slope must be only increasing or only decreasing to maintain a unidirectional drift field. For example, the slope has both a direction and a magnitude and Defendant suggests that the direction of the drift electric field depends solely on *the direction* of the slope of the graded concentration of dopant. This is not justified by the prosecution history statements that Defendant cites. In fact, the *Grove* reference cited by the patentee in the above-quoted statement includes Figure 7.13 (reproduced and annotated below) which depicts a dopant concentration that both increases and decreases in the “graded base region” that provides an “electric field . . . of such direction as to aid the motion of injected holes.” A.S. Grove, *Physics and Technology of Semiconductor Devices* 224–25 (1967), Dkt. No. 50-13 at 22–23. In other words, the patentee cited

-00263: Ex. 2082 (EDTX Order) at 15

2. Movement of Carriers from the Surface Layer

- EDTX already rejected Petitioners' prosecution history argument.

'195 Patent File Wrapper April 17, 2012 Response Pursuant to 37 CFR 1.114 Amendment E at 6–7, Dkt. No. 50–12 at 59–60. Taken in context, that the direction of the electrical field and the carrier movement “depends solely on the slope of the graded concentration of dopant” does not mandate that the slope must be only increasing or only decreasing to maintain a unidirectional drift field. For example, the slope has both a direction and a magnitude and Defendant suggests that the direction of the drift electric field depends solely on *the direction* of the slope of the graded concentration of dopant. This is not justified by the prosecution history statements that Defendant cites. In fact, the *Grove* reference cited by the patentee in the above-quoted statement includes Figure 7.13 (reproduced and annotated below) which depicts a dopant concentration that both increases and decreases in the “graded base region” that provides an “electric field . . . of such direction as to aid the motion of injected holes.” A.S. Grove, *Physics and Technology of Semiconductor Devices* 224–25 (1967), Dkt. No. 50–13 at 22–23. In other words, the patentee cited

* Citations to the parties' filings are to the filing's number in the docket (Dkt. No.) and pin cites are to the page numbers assigned through EDTX.

GreenThread Ex. 2082, p. 1 of 12
Semiconductor v. Greenthread

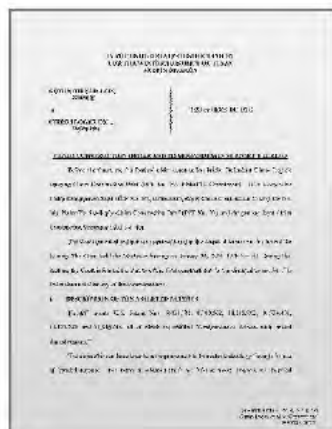
-00263: Ex. 2082
(EDTX Order) at 15

Applicant respectfully disagrees with this position because (as previously argued by Applicant) a unidirectional drift (electric) field necessarily affects all the present minority carriers in the same way – moving all minority carriers in the same direction because of the unidirectional drift due to the existence of the electric field. See “Physics and Technology of Semiconductor Devices,” A.S. Grove, pp. 224–225, John Wiley and Sons, Inc., New York, 1st Edition 1967 (“This same electric field will then be of such direction as to aid the motion of injected holes. Thus the injected minority carriers will now move not only by diffusion but also by drift due to the existence of this electric field.”). Depending on the particular slope of the graded concentration of dopant, all minority carriers are either swept “down” (from the surface layer to the substrate) or “up” (from the substrate to the surface layer). See Applicant’s Figs. 5(b) and 5(c).

-00263: Ex. 1016 ('195 Prosecution History) at 289

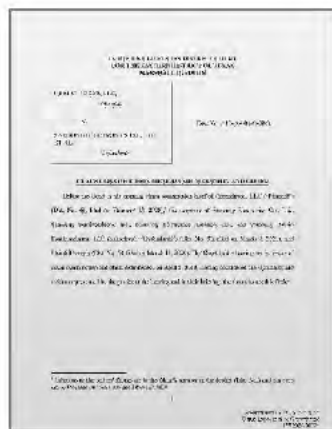
2. Movement of Carriers from the Surface Layer

- WDTX and EDTX agreed that the slope must be sufficiently graded.



The Court concludes that a person of skill would understand that the graded concentration has to be sufficiently graded to result in a “static unidirectional electric drift field to aid the movement of minority carriers.” This establishes a minimum graded concentration of dopants, *i.e.*, a graded concentration of dopants that is below this minimum will not aid in the movement of minority carriers and thus is not a graded concentration.

-00263: Ex. 2080 (WDTX Order) at 39-40



For example, the slope has both a direction and a magnitude and Defendant suggests that the direction of the drift electric field depends solely on *the direction* of the slope of the graded concentration of dopant. This is not justified by the prosecution history statements that Defendant cites. In fact, the *Grove* reference cited by the patentee in the above-quoted statement includes

-00263: Ex. 2082 (EDTX Order) at 15

Overview of Issues

- 1. Petitioner has presented zero “actual evidence” that the Petitions are timely.**
- 2. The Claims require “movement of carriers” from the “surface layer.**
- 3. The '195 and '502 Claims require “movement of minority carriers” from the “surface layer.”**
4. Kawagoe does not disclose “movement of carriers” and “movement of minority carriers” from the “surface layer.”
5. Wieczorek does not disclose “movement of carriers” from the “surface layer.”
6. Payne does not disclose “movement of minority carriers” from the “surface layer.”
7. Petitioner has the burden to identify electric fields that would “aid carrier movement.”
8. Experts confirm that carriers in the “surface layer” are affected by numerous other fields and forces.
9. The “movement of carriers” depends on the sum of all of the fields in the “surface layer.”
10. Dr. Blalock did not analyze any of the fields or force magnitudes in the “surface layer.”
11. Petitioner's prosecution-related arguments are incorrect.
12. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

3. Movement of Minority Carriers from the Surface Layer

- The '195 and '502 claims require “movement of minority carriers.”

US 8,421,195

1. A CMOS Semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants extending between said surface layer and said substrate, said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants and a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00266: Ex. 1001 ('195 pat.) at 4:13-29

US 9,190,502

7. A semiconductor device comprising:
a surface layer;
a substrate;
an active region including a source and a drain, disposed on one surface of said surface layer;
a single drift layer disposed between the other surface of said surface layer and said substrate, said drift layer having a graded concentration of dopants generating a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and
at least one well region disposed in said single drift layer, said well region having a graded concentration of dopants generating a second static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate.

-00265: Ex. 1001 ('502 pat.) at 4:52-67

3. Movement of Minority Carriers from the Surface Layer

- The Challenged Claims **must** be considered in light of the specification.



¶¶12. The claims are directed to the invention that is described in the specification; they do not have meaning removed from the context from which they arose. Thus the claims are construed to state the legal scope of each patented invention, on examination of the language of the claims, the description in the specification, and the prosecution history. See *Renishaw PLC v. Marposs Societa' per Azioni*, 158 F.3d 1243, 1250, 48 USPQ2d 1117, 1122 (Fed. Cir.1998) ("[T]he 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."). Although

Netword LLC v. Centraal Corp.,
242 F.3d 1347, 1352 (Fed. Cir. 2001)

[1-3] "If the intrinsic record fully governs the proper construction of a term, we review the [b]oard's claim construction *de novo*." *Wasica Fin. GmbH v. Cont'l Auto. Sys., Inc.*, 853 F.3d 1272, 1278 (Fed. Cir. 2017). During reexamination, "the PTO must give claims their broadest reasonable construction consistent with the specification." *In re ICON Health & Fitness, Inc.*, 496 F.3d 1374, 1379 (Fed. Cir. 2007). Even under the broadest reasonable construction rubric, however, the board must always "consider the claims in light of the specification and teachings in the underlying patent." *In re CSB-Sys. Int'l, Inc.*, 832 F.3d 1335, 1341 (Fed. Cir. 2016) (citations and internal quotation marks omitted). And there is no reason why this construction could not coincide with that of a court in litigation.

In re Power Integrations,
884 F.3d 1370, 1375 (Fed. Cir. 2018)

Courts must exercise caution lest dictionary definitions, usually the least controversial source of extrinsic evidence, be converted into technical terms of art having legal, not linguistic, significance. The best source for understanding a technical term is the specification from which it arose, informed, as needed, by the prosecution history. The evolution of restrictions in the claims, in the course of examination in the PTO, reveals how those closest to the patenting process—the inventor and the patent examiner—viewed the subject matter. See *Hoechst Celanese Corp. v. BP Chemicals Ltd.*, 78 F.3d 1575, 1578, 38 USPQ2d 1126, 1129 (Fed. Cir. 1996) ("A technical term used in a patent document is interpreted as having the meaning that it would be given by persons experienced in the field of the invention, unless it is apparent from the patent and the prosecution history that the inventor used the term with a different meaning.") When the specification explains and defines a term used in the claims, without ambiguity or incompleteness, there is no need to search further for the meaning of the term.

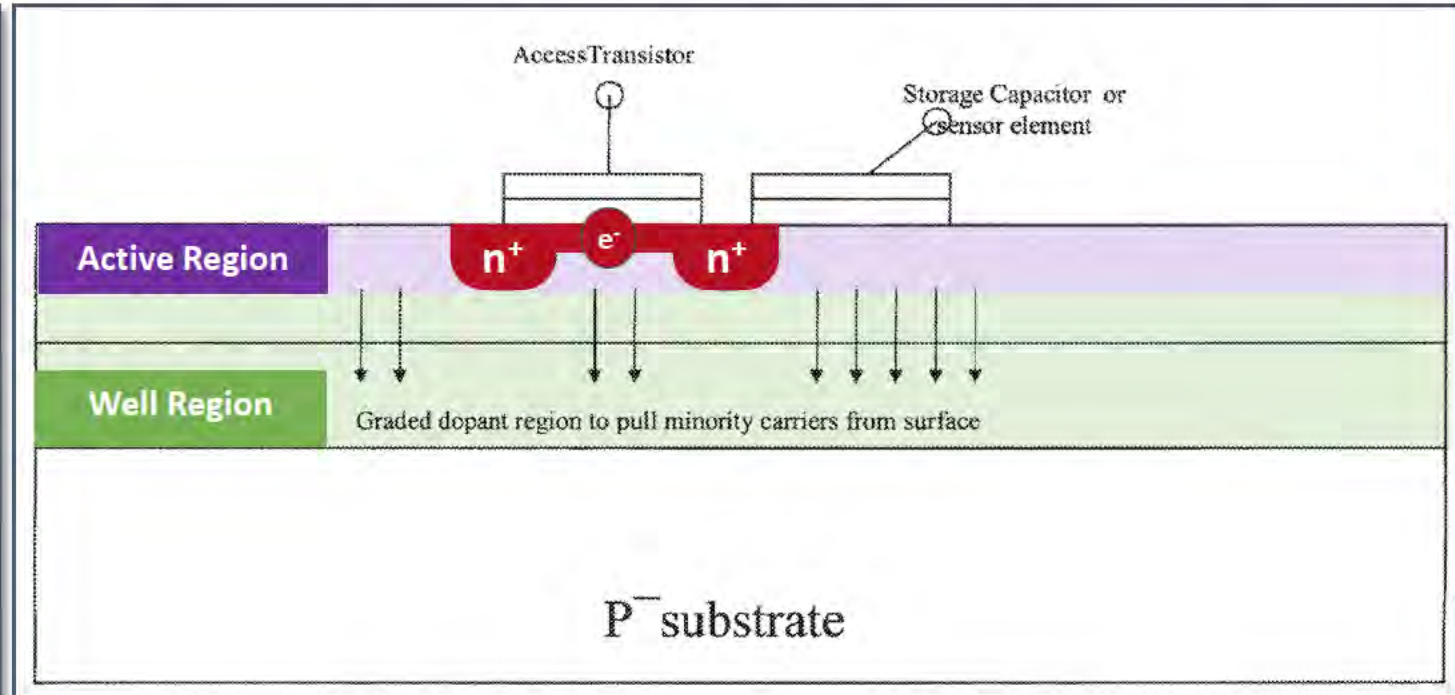
Multiform Desiccants, Inc. v. Medzam, Ltd., 133 F.3d 1473, 1478 (Fed. Cir. 1998)

3. Movement of Minority Carriers from the Surface Layer

- The specification explains the “majority carriers” are the majority carrier in the MOSFET channel.

Bipolar Junction transistors (BJT) are minority carrier devices as the principle device conduction mechanism. However, majority carriers also a small yet finite role in modulating the conductivity in BJTs. Consequently, both carriers (electrons and holes) play a role in the switching performance of BJTs. The maximum frequency of operation in BJTs is limited by the base transit time as well as the quick recombination of the majority carriers when the device is switched off (prior to beginning the next cycle). The dominant carrier mechanism in BJTs is carrier diffusion. Carrier drift current component is fairly small, especially in uniformly doped base BJTs. Efforts have been made in graded base transistors to create an ‘aiding drift field’, to enhance the diffusing minority carrier’s speed from emitter to collector. However, most semiconductor devices, including various power MOSFETs (traditional, DMOS, lateral, vertical and a host of other configurations), IGBT’s (Insulated Gated Base Transistors), still use a uniformly doped drift epitaxial region in the base. FIG. 1 shows the relative doping concentration versus distance in a BJT. FIG. 2 shows the uniformly doped epi region⁴ in a IGBT. In contrast to BJTs, MOS devices are majority carrier devices for conduction. The conduction is channel dominated. The channel can be a surface in one plane in planar devices. The surface can also be on the sidewalls in a vertical device. Other

-00266: Ex. 1001 at 1:23-45



-00266: Ex. 1001 ('195 pat.) at Fig. 5B

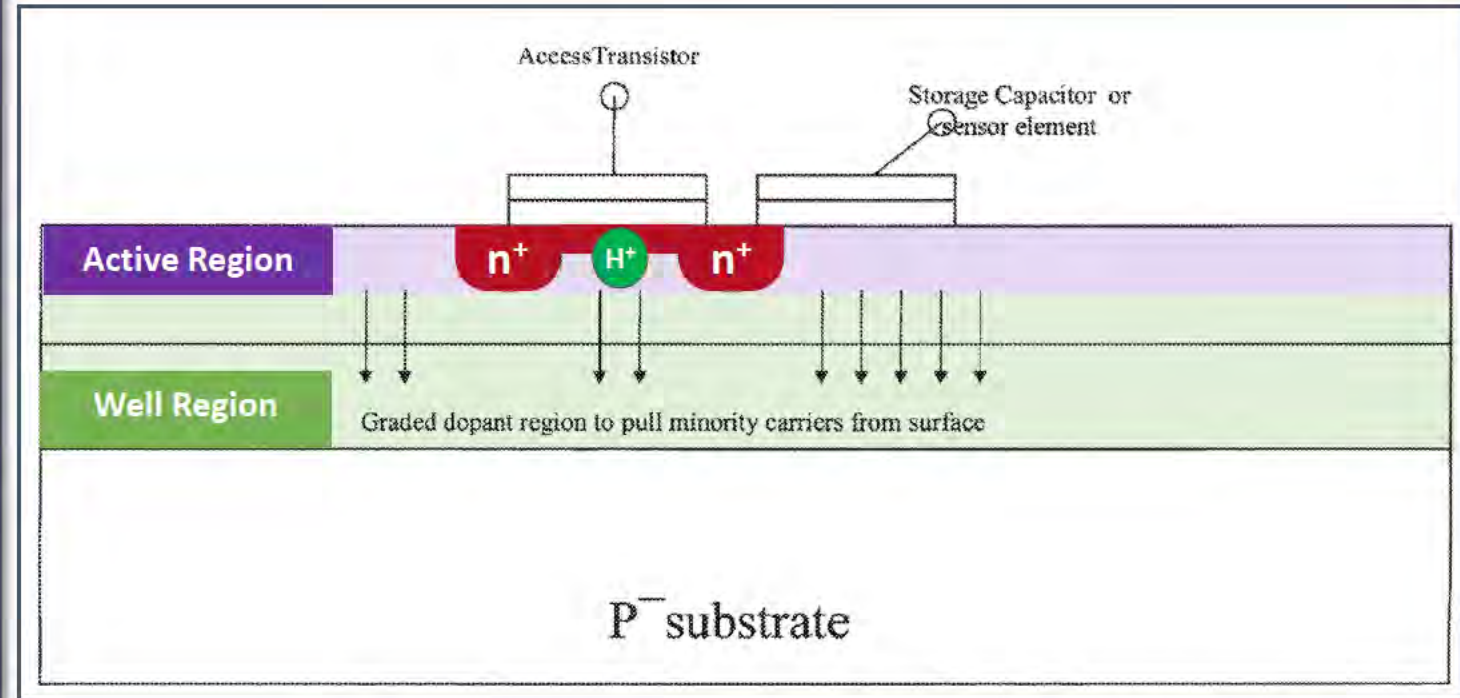
⁴ Because the channel is formed by electrons with a negative charge, the MOSFET is referred to as an n-channel MOSFET, and the “minority carriers” are holes.

-00266: Ex. 2064 (Glew Decl.) at ¶36, n. 4

3. Movement of Minority Carriers from the Surface Layer

- The “spurious minority carriers” interfere with the “active circuitry at the surface.”

As illustrated in FIGS. 5(a), 5(b), 5(c), donor gradient is also of benefit to very large scale integrated circuits (VLSI)—VLSI logic, DRAM, nonvolatile memory like NAND flash. Spurious minority carriers can be generated by clock switching in digital VLSI logic and memory IC'S. These unwanted carriers can discharge dynamically-held 'actively held high' nodes. Statically held nodes (with V_{cc}) can not be affected, in most cases. Degradation of refresh time in DRAM's is one of the results, because the capacitor holds charge dynamically. Similarly, degradation of CMOS digital images, in digital imaging IC's is another result of the havoc caused by minority carriers. Pixel and color resolution can be significantly enhanced in imaging IC's with the embodiments described here. Creating 'Sub Terrain' recombination centers underneath the wells (gold doping, platinum doping) as is done in some high-voltage diodes is not practical for VLSI circuits. Hence, a novel technique has been described here by creating a drift field to sweep these unwanted minority carriers into the substrate as quickly as possible, from the active circuitry at the surface. In a preferred embodiment, the subterrain n-layer has a graded donor concentration to sweep the minority carriers deep into the substrate. One or more of such layers can also be implemented through wafer to wafer bonding or similar “transfer” mechanisms. This n-layer can be a deeply-implanted layer. It can also be an epitaxial layer. The n-well and p-well also can be graded or retrograded in dopants, as desired, to sweep those carriers away from the surface as well.



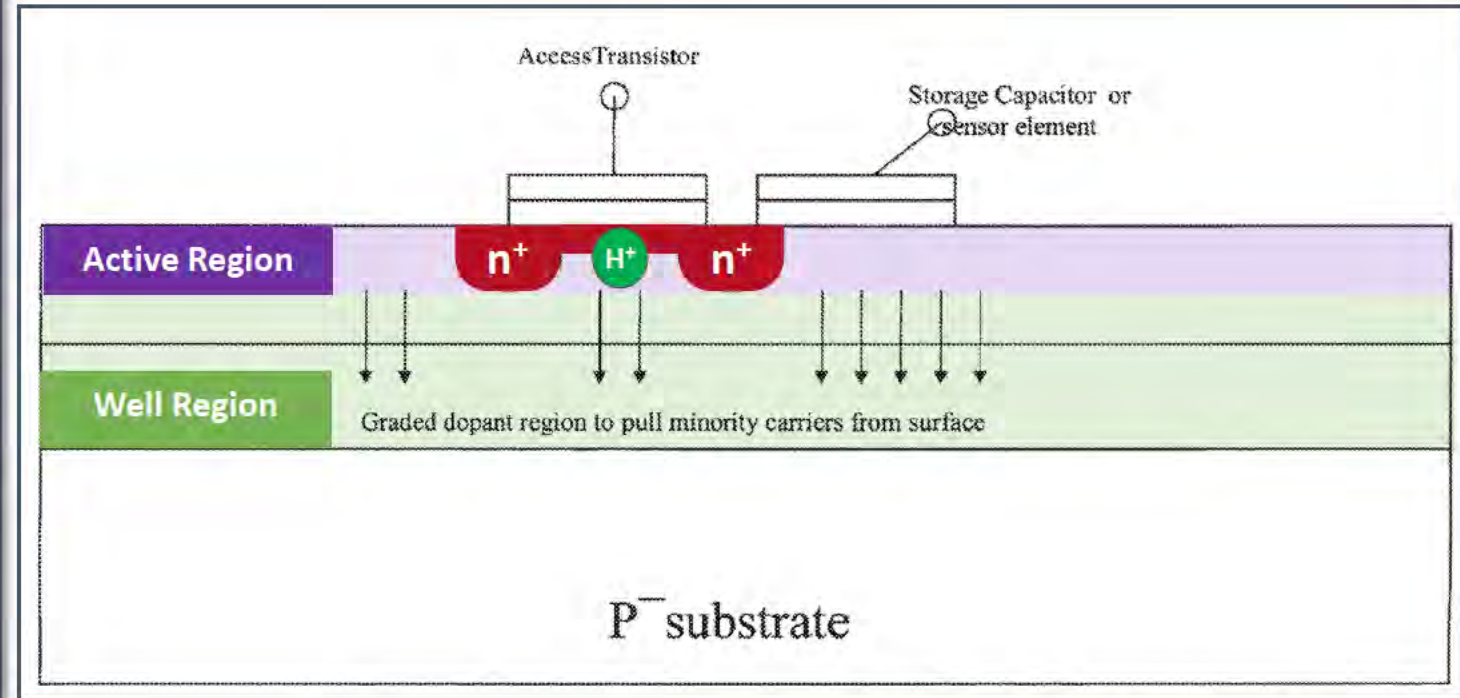
-00266: Ex. 1001 ('195 pat.) at Fig. 5B

-00266: Ex. 1001 ('195 pat.) at 3:14-40

3. Movement of Minority Carriers from the Surface Layer

- The “minority carriers” interfere with the MOSFET’s channel.

As illustrated in FIGS. 5(a), 5(b), 5(c), donor gradient is also of benefit to very large scale integrated circuits (VLSI)– VLSI logic, DRAM, nonvolatile memory like NAND flash. Spurious minority carriers can be generated by clock switching in digital VLSI logic and memory IC’S. These unwanted carriers can discharge dynamically-held ‘actively held high’ nodes. Statically held nodes (with V_{cc}) can not be affected, in most cases. Degradation of refresh time in DRAM’s is one of the results, because the capacitor holds charge dynamically. Similarly, degradation of CMOS digital images, in digital imaging IC’s is another result of the havoc caused by minority carriers. Pixel and color resolution can be significantly enhanced in imaging IC’s with the embodiments described here. Creating ‘Sub Terrain’ recombination centers underneath the wells (gold doping, platinum doping) as is done in some high-voltage diodes is not practical for VLSI circuits. Hence, a novel technique has been described here by creating a drift field to sweep these unwanted minority carriers into the substrate as quickly as possible, from the active circuitry at the surface. In a preferred embodiment, the subterrain n-layer has a graded donor concentration to sweep the minority carriers deep into the substrate. One or more of such layers can also be implemented through wafer to wafer bonding or similar “transfer” mechanisms. This n-layer can be a deeply-implanted layer. It can also be an epitaxial layer. The n-well and p-well also can be graded or retrograded in dopants, as desired, to sweep those carriers away from the surface as well.



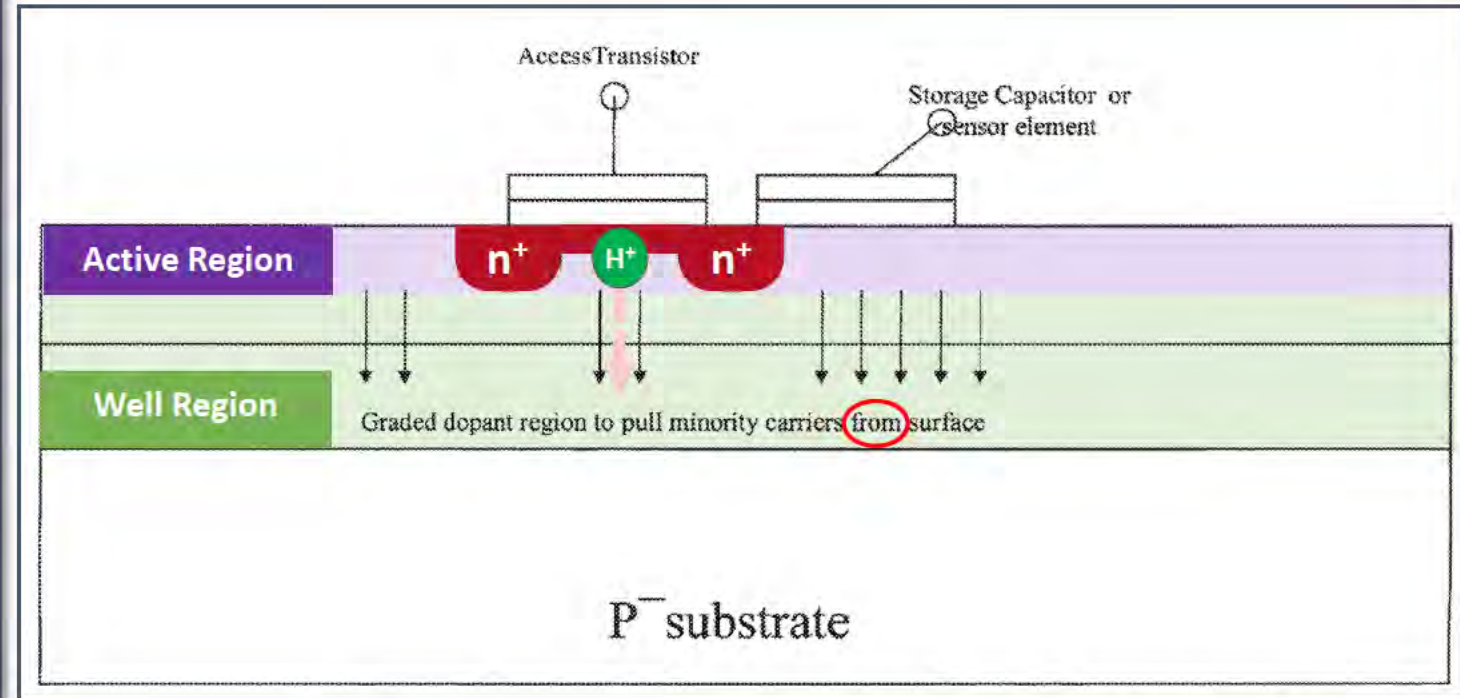
-00266: Ex. 1001 ('195 pat.) at Fig. 5B

-00266: Ex. 1001 ('195 pat.) at 3:14-40

3. Movement of Minority Carriers from the Surface Layer

- A “drift field” with a “graded dopant region” sweeps the minority carriers from the surface.

As illustrated in FIGS. 5(a), 5(b), 5(c), donor gradient is also of benefit to very large scale integrated circuits (VLSI)– VLSI logic, DRAM, nonvolatile memory like NAND flash. Spurious minority carriers can be generated by clock switching in digital VLSI logic and memory IC'S. These unwanted carriers can discharge dynamically-held 'actively held high' nodes. Statically held nodes (with V_{cc}) can not be affected, in most cases. Degradation of refresh time in DRAM's is one of the results, because the capacitor holds charge dynamically. Similarly, degradation of CMOS digital images, in digital imaging IC's is another result of the havoc caused by minority carriers. Pixel and color resolution can be significantly enhanced in imaging IC's with the embodiments described here. Creating 'Sub Terrain' recombination centers underneath the wells (gold doping, platinum doping) as is done in some high-voltage diodes is not practical for VLSI circuits. Hence, a novel technique has been described here by creating a drift field to sweep these unwanted minority carriers into the substrate as quickly as possible, from the active circuitry at the surface. In a preferred embodiment, the subterrain n-layer has a graded donor concentration to sweep the minority carriers deep into the substrate. One or more of such layers can also be implemented through wafer to wafer bonding or similar “transfer” mechanisms. This n-layer can be a deeply-implanted layer. It can also be an epitaxial layer. The n-well and p-well also can be graded or retrograded in dopants, as desired, to sweep those carriers away from the surface as well.



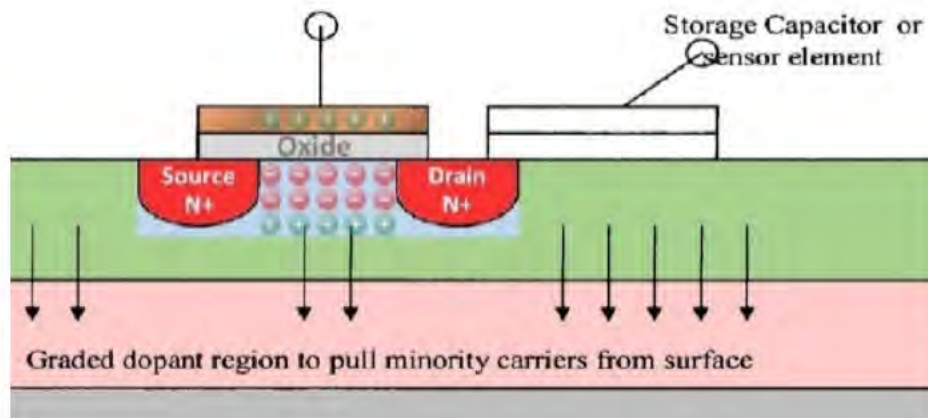
-00266: Ex. 1001 ('195 pat.) at Fig. 5B

-00266: Ex. 1001 ('195 pat.) at 3:14-40

3. Movement of Minority Carriers from the Surface Layer

- Dr. Glew explained that in Fig. 5B, the “minority carriers” are holes.

36. When a positive voltage is applied to the gate, an electric field forms in the oxide. This positive electric field repels the “positive” holes downwards, while When enough electrons have accumulated in the surface layer below the oxide, they form a conductive channel (as annotated in Figure 5B below) of electrons between the source and the drain, and current can begin to flow through the transistor.



'014 Patent, FIG. 5B (annotated).⁴ In order to turn the transistor “off,” the positive voltage is removed from the gate and the channel disappears as the holes return to the surface layer.

⁴ Because the channel is formed by electrons with a negative charge, the MOSFET is referred to as an n-channel MOSFET, and the “minority carriers” are holes.

-00266: Ex. 2064 (Glew Decl.) at ¶136, n. 4

3. Movement of Minority Carriers from the Surface Layer

- Dr. Glew confirmed the same when cross-examined by Petitioner's counsel.

UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD
SEMICONDUCTOR COMPONENTS INDUSTRIES, LLC
v.
GREENTHREAD, LLC,
Patent Owner
Case IPR2024-00266
U.S. Patent 8,421,195
DECLARATION OF ALEXANDER D. GLEW
GreenThread Ex. 2064, p. 1 of 75
Semiconductor v. Greenthread

'014 Patent, FIG. 5B (annotated).⁴ In order to turn the transistor “off,” the positive voltage is removed from the gate and the channel disappears as the holes return to the surface layer.

⁴ Because the channel is formed by electrons with a negative charge, the MOSFET is referred to as an n-channel MOSFET, and the “minority carriers” are holes.

-00266: Ex. 2064 (Glew Decl.) at ¶36, n. 4

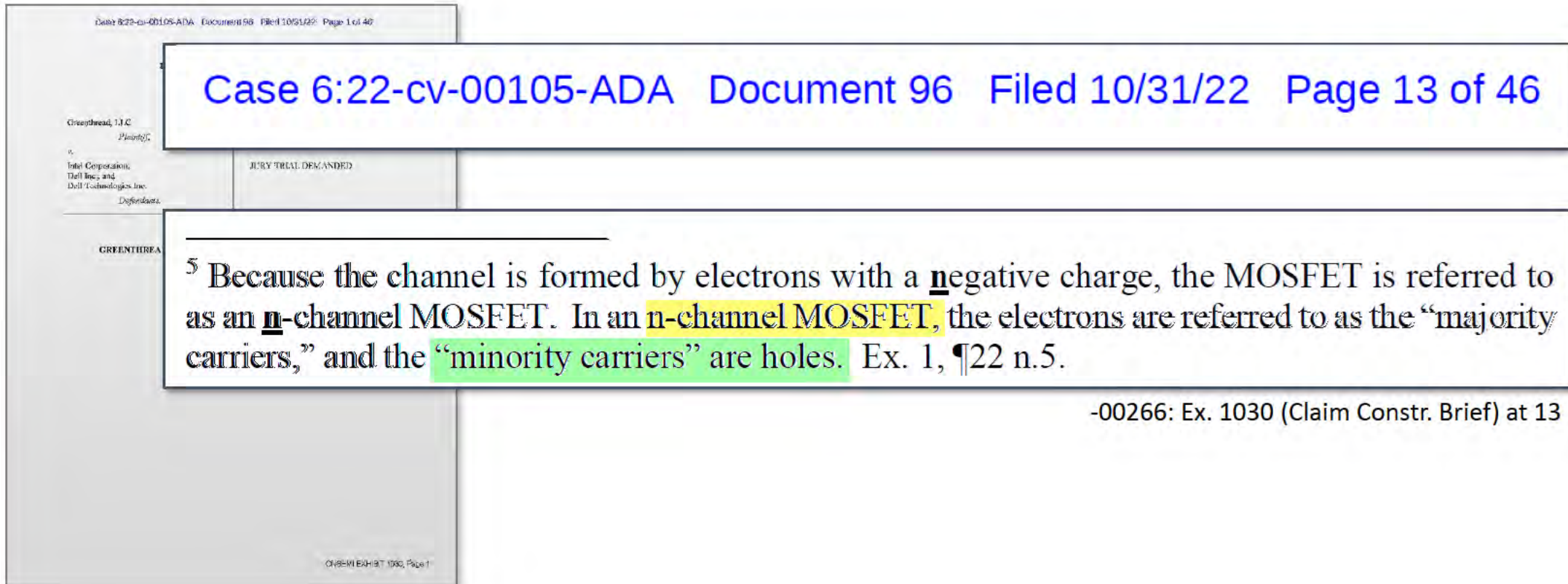
24 Q. And the minority carriers in the
25 annotation you directed me to on page 17, are those
1 holes or electrons?
2 A. In this case, the channel needs to be
3 formed out of N, electrons, so the holes would then
4 be minority carriers. So the majority carriers --
5 majority carrier for an N source drain is an N.

9 GREENTHREAD, LLC,
10 Patent Owner,
11
12 Case IPR2023-01243
13 U.S. Patent No. 11,121,222
Case IPR2023-01243
14 U.S. Patent No. 10,510,842
Case IPR2023-01244
15 U.S. Patent No. 11,121,222
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17 DEPOSITION OF ALEXANDER GLEW, PhD
18 July 16, 2024
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23 Reported by: Dana Peabody, RDR, QDR, CVR No. 6332
24 Pages 1 through 133
25 Job No. KOU 6764721
Page 1
Veritas Legal Solutions
346-291-7000
ON SEMI EXHIBIT 1634, Page 1
Semiconductor Components Industries, LLC v. Greenthread, LLC
IPR2024-00266

-00266: Ex. 1054 (Glew Dep. Tr.) at 74:24-75:5

3. Movement of Minority Carriers from the Surface Layer

- Petitioner was aware of Greenthread's position when it filed its Petitions in December 2023 and cited Greenthread's prior claim construction briefing.



3. Movement of Minority Carriers from the Surface Layer

- Dr. Blalock acknowledged that “minority carrier” is understood in terms of the “surface layer.”

Declaration of Dr. Blalock for *Inter Partes* Review of U.S. Patent No. 8,421,195

UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

SEMICONDUCTOR COMPONENTS INDUSTRIES, LLC,
Petitioner
v.
GREENTHREAD LLC,
Patent Owner

U.S. PATENT NO. 8,421,195
Case IPR2024-00266

DECLARATION OF TRAVIS BLALOCK, Ph.D.

101. During a so-called single event upset (SEU), an α -ray generates millions of carriers, some of which are produced in or near the active regions at the surface of the substrate. EX1013, 431 (“A[n] [α -] particle can induce SEU when it strikes at the *channel region* of an off NMOS transistor or the *drain region* of an off PMOS transistor.”), FIG. 2. As shown in Figure 2, such event generates both types of carriers (holes, denoted “+” and electrons, denoted “-”), one of which will be the minority carrier in any given surface layer.

DEMONSTRATIVE EXHIBIT 1003, Page 1

-00266: Ex. 1003 (Blalock Decl.) at ¶101

3. Movement of Minority Carriers from the Surface Layer

- Dr. Blalock also relies on the doping type within a region/well to define the “minority carrier.”

Declaration of Dr. Blalock, For &

UNITED STATES DISTRICT COURT
BEFORE THE PATENT JUDGE
SEMICONDUCTOR

V.
GREENTHREAD LLC,
Patent Owner

U.S. PATENT NO. 8,421,195
Case IPR2024-00266
DECLARATION OF TRAVIS BLALOCK, Ph.D.

41. Impurities known as “dopants” are added to the active areas and wells to add charge carriers and tailor the electrical properties of these regions such as their conductivity. Charge carriers can be electrons or holes. EX1008C, 86. When a region is doped with p-type dopants, the holes are majority carriers and the electrons are minority carriers. EX1008C, 86. When a region is doped with n-type dopants, the electrons are majority carriers and the holes are minority carriers. EX1008C, 86.

CHSEMI EXHIBIT 1003, Page 1

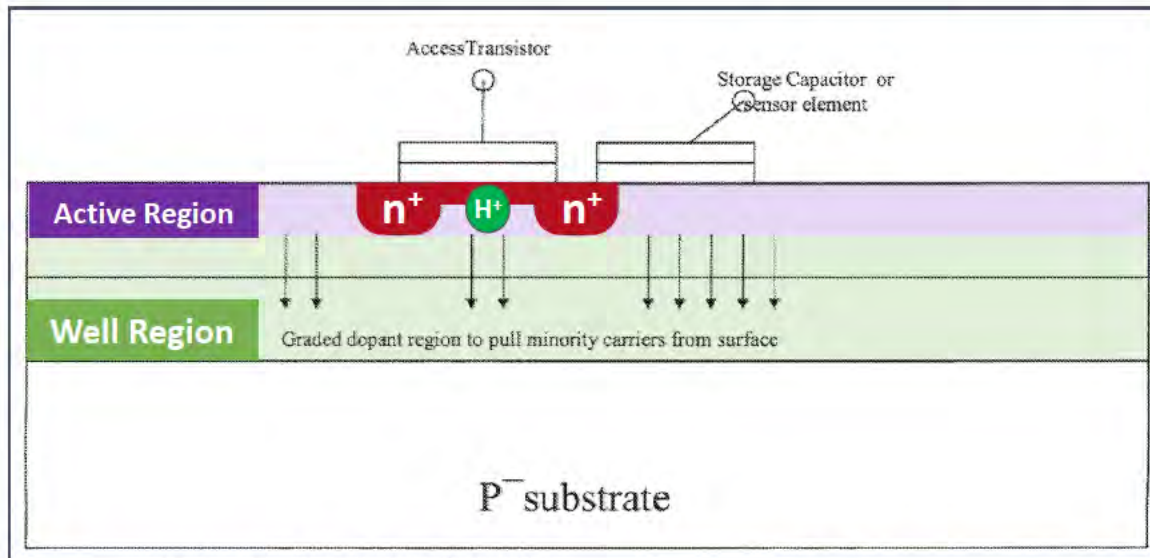
-00266: Ex. 1003 at ¶41

106. In both cases, these electric fields result from the downward-sloping graded concentrations in Payne’s and Sakai’s N-wells and P-wells and aid the movement of minority carriers (holes in N-wells, electrons in P-wells) downward to the substrate. *See also* Sections X.A.1.g, X.B.1.f-g, X.B.2, X.D.1.

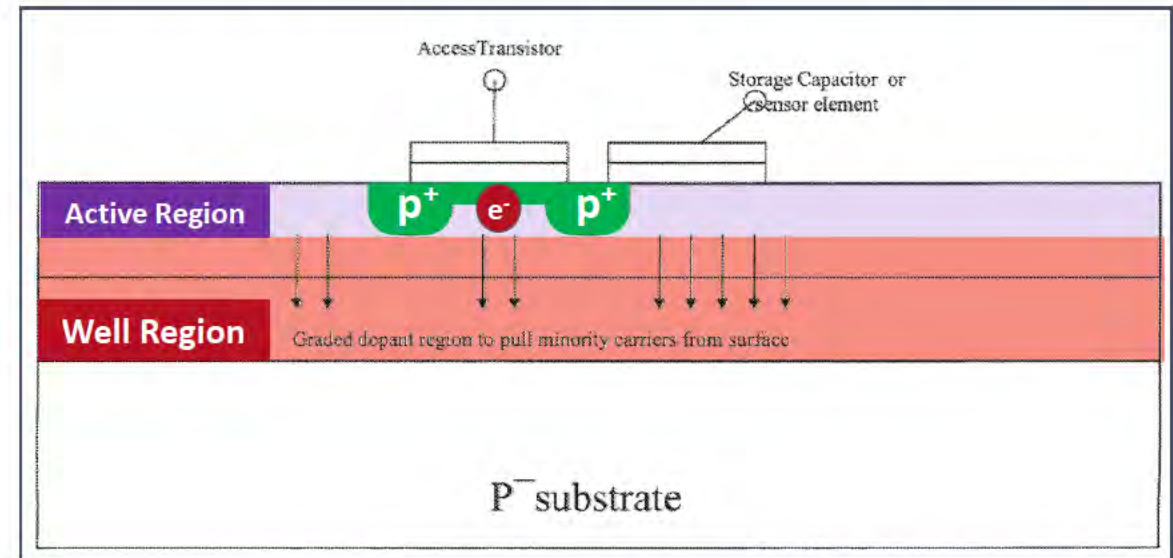
-00266: Ex. 1003 (Blalock Decl.) at ¶106

3. Movement of Minority Carriers from the Surface Layer

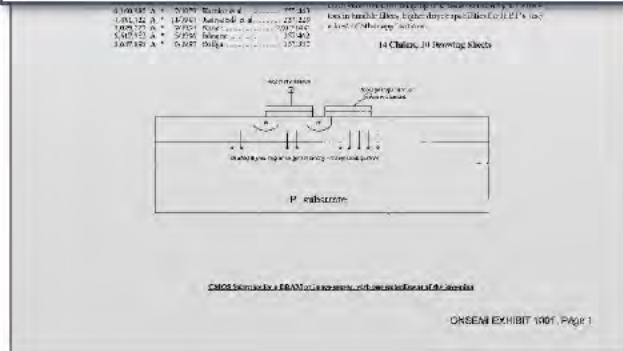
- In an NMOS transistor, the “majority carrier” is an electron, and the “minority carrier” is a hole.
- In an PMOS transistor, the “majority carrier” is a hole, and the “minority carrier” is an electron.



-00266: Ex. 1001 at Fig. 5B

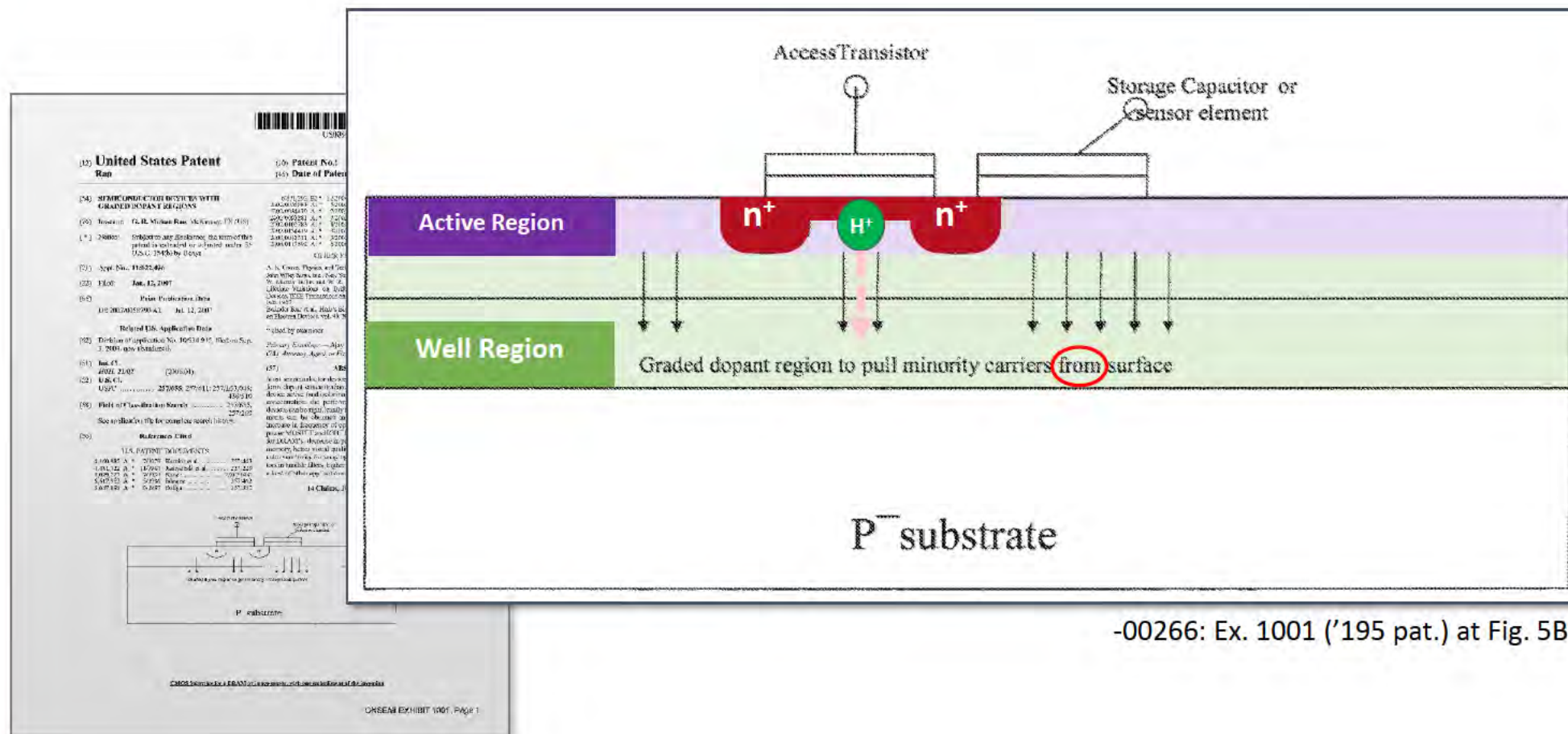


-00266: Ex. 1001 ('195 pat.) at Fig. 5B



3. Movement of Minority Carriers from the Surface Layer

- The only “carrier” that Fig. 5B’s electric field can move from the “surface layer” is a positively-charged hole.



-00266: Ex. 1001 ('195 pat.) at Fig. 5B

3. Movement of Minority Carriers from the Surface Layer

- Dr. Glew explained that it would be impossible for Fig. 5B's electric field to pull a negatively-charged electron from the surface.

70. The basic laws of electronics and physics guarantee that the electric field identified by Petitioner in its demonstratives would not aid carrier movement (move) an electron *from* the active region portion (surface) of the p-well *to* the non-active region portion of the p-well (substrate). This would be impossible. To the extent this electric field moves an electron at all, it would *not* move it from the surface to the substrate. Rather it would move the electron in the *opposite* direction *from the substrate to the surface*. This is because an electron moves in the opposite direction of an electric field towards the source of the electric field, where the positive charge is the greatest.

74. More specifically, in paragraph 36, I explained that when a positive voltage is applied to the gate, an electric field forms in the oxide. Because the positive voltage is greatest at the surface, and it decreases deeper in the substrate, the electric field points *from* the surface *to* the substrate in a *downward* direction. As I explained in Paragraph 36, when holes and electrons encounter an electric field in a downward direction, and they do move due to this electric field, the positively charged holes move in the *same* direction as the electric field in a *downward* direction. The negatively charged electrons move in the *opposite* direction of the electric field in an *upward* direction.

-00266: Ex. 2064 (Glew Decl.) at ¶¶ 70, 74

3. Movement of Minority Carriers from the Surface Layer

- Monolithic's expert agrees that the downward-facing electric field can only move holes.

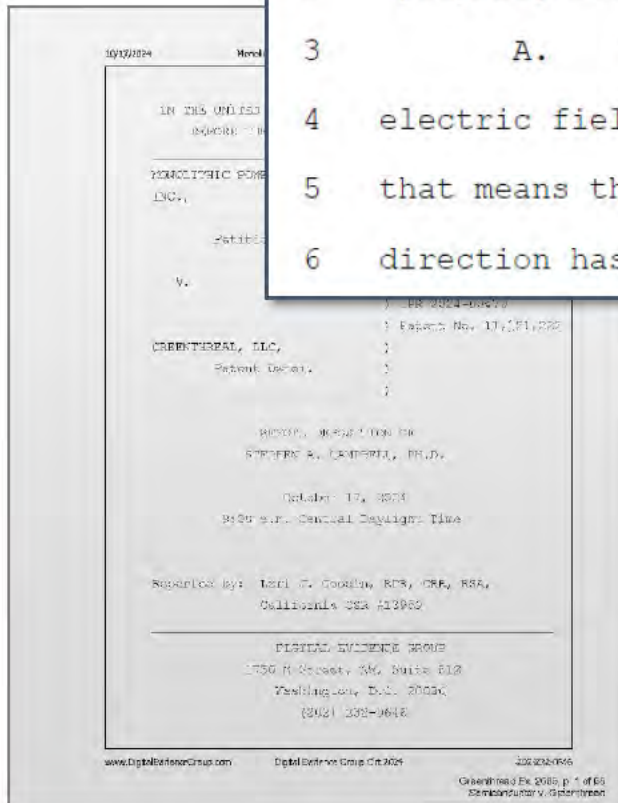
1 Q. What did you mean by
2 "properly constructed"?

3 A. You would have to construct an
4 electric field that moves the carriers away, and
5 that means the electric field has to be, the
6 direction has to be correct.

7 If you're moving poles, then you
8 have to have the electric field that points
9 downward.

10 If you're moving electrons, the
11 electric field has to be pointing upward and you
12 have to have a sufficient electric field
13 intensity to prevent most of the carriers from
14 being collected by the drain.

-00266: Ex. 2085 (Campbell Dep. Tr.) at 34:1-14



3. Movement of Minority Carriers from the Surface Layer

- If the “minority carrier” in an NMOS transistor were an electron, it would exclude the specification’s preferred embodiment.



[17] Moreover, Defendants’ expert admitted that construing the claims such that “employ[ing] the common technique of grounding the system” would cause the converter to be considered non-isolated would prevent the claims from encompassing the preferred embodiment. J.A. at 45070–71. A claim construction that “excludes the preferred embodiment is rarely, if ever, correct and would require highly persuasive evidentiary support.” *Adams Respiratory Therapeutics, Inc. v. Perrigo Co.*, 616 F.3d 1283, 1290 (Fed.Cir.2010). In this case, the specification, including the claims, supports a reading that encompasses the preferred embodiment.

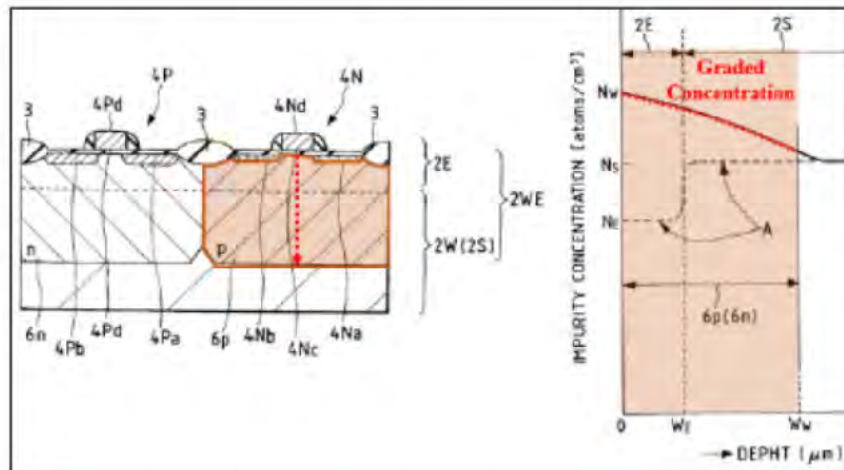
SynQor, Inc. v. Artesyn Techs., Inc.,
709 F.3d 1365, 1378-79 (Fed. Cir. 2013)

3. Movement of Minority Carriers from the Surface Layer

- Kawagoe's graded concentration is only **concerned** with electrons.
- But the Petition says nothing about Payne's effect on "minority carriers" (i.e., holes).

C. Kawagoe

Kawagoe discloses a CMOS device in which wells have graded dopant concentrations that decrease with depth, as illustrated below right. EX1007, 14:46-55, 15:26-40, 15:62-16:40 ("p-well 6p and n-well 6n have their impurity concentrations *gradually lowered* in the depthwise direction ...").³

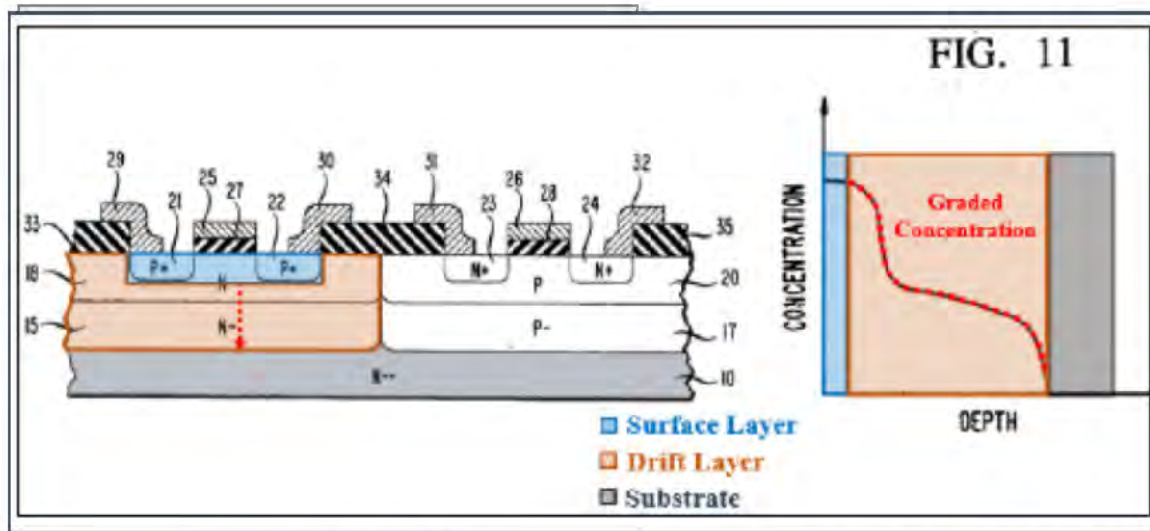


Id., FIGS. 17, 23. The graded dopant concentrations reduce soft errors by sweeping unwanted carriers into the substrate body. *Id.*, 16:2-11 "electrons produced by the α -ray are attracted to the substrate body 2S by that concentration gradient ... so that the soft errors can be reduced ..."); EX1003, ¶68.

-00266: Petition [1] at 12

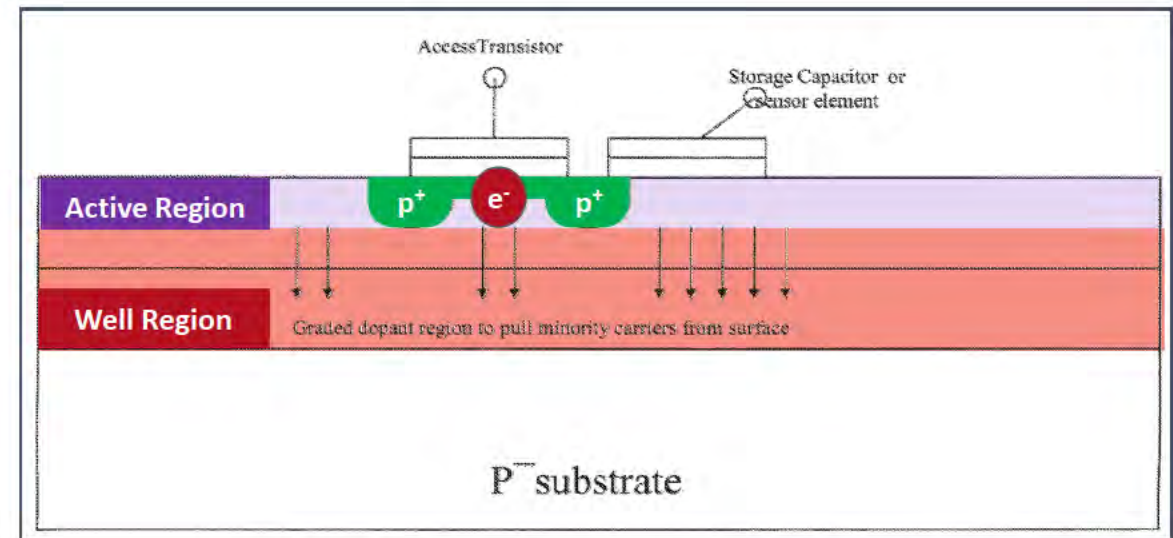
3. Movement of Minority Carriers from the Surface Layer

- Petitioner relies on Payne's PMOS transistor in an N-well whose "minority carrier" is an electron.
- But the Petition says nothing about Payne's effect on "minority carriers" (*i.e.*, holes).



PETITION FOR *INTER PARTES* REVIEW
UNDER 35 U.S.C. §312 AND 37 C.F.R. §42.104

-00266: Petition [1] at 25



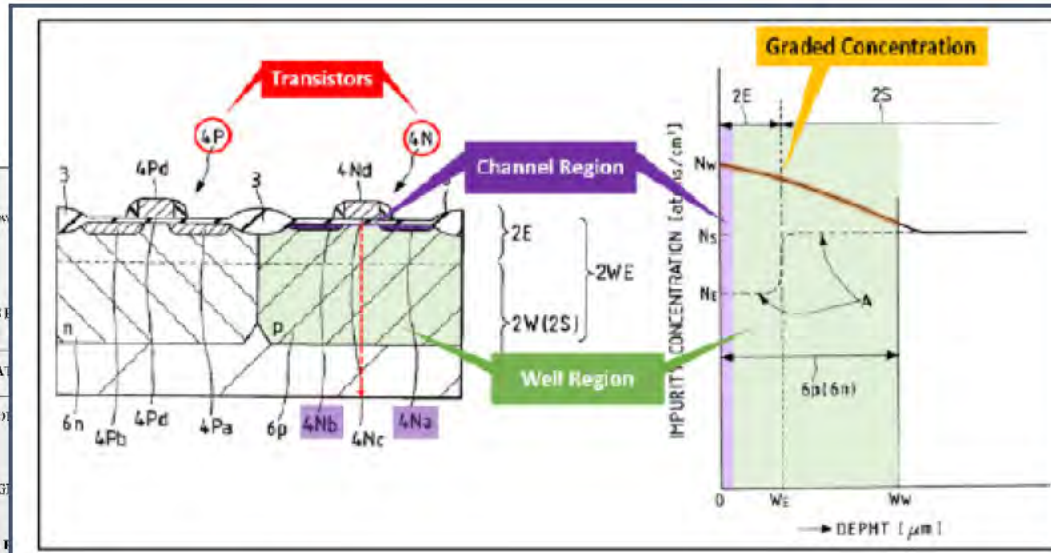
-00266: Ex. 1001 ('195 pat.) at Fig. 5B

Overview of Issues

- 1. Petitioner has presented zero “actual evidence” that the Petitions are timely.**
- 2. The Claims require “movement of carriers” from the “surface layer.**
- 3. The '195 and '502 Claims require “movement of minority carriers” from the “surface layer.”**
- 4. Kawagoe does not disclose “movement of carriers” and “movement of minority carriers” from the “surface layer.”**
5. Wieczorek does not disclose “movement of carriers” from the “surface layer.”
6. Payne does not disclose “movement of minority carriers” from the “surface layer.”
7. Petitioner has the burden to identify electric fields that would “aid carrier movement.”
8. Experts confirm that carriers in the “surface layer” are affected by numerous other fields and forces.
9. The “movement of carriers” depends on the sum of all of the fields in the “surface layer.”
10. Dr. Blalock did not analyze any of the fields or force magnitudes in the “surface layer.”
11. Petitioner's prosecution-related arguments are incorrect.
12. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

4. Kawagoe Does Not Move Carriers from the “Surface Layer”

- Kawagoe does not mention moving carriers from the “surface layer.”



EX1007, FIGS. 17/23.

-00263: Petition [1] at 19

Kawagoe further explains that this downward-sloping graded dopant concentration aids carrier movement from the surface of the epitaxial layer towards/to the area of the substrate where there are no active regions:

[T]he impurity concentration of the p-well 6p is given such a gradient that it is *gradually lowered in the depthwise direction* from the surface of the epitaxial layer 2E, so that the influence to be caused by the carriers (or electrons) due to the α -ray is lowered. Specifically, the *electrons produced by the α -ray are attracted to the substrate body 2S by that concentration gradient* [] so that the soft errors can be reduced in case the MIS memory of the DRAM or the like is formed in the p-well 6p.

-00263: Petition [1] at 21

4. Kawagoe Does Not Move Carriers from the “Surface Layer”

- Petitioner did not identify an electric field, much less an electric field starting at the surface layer.
- Petitioner’s only mention of “field” relates to its erroneous prosecution history arguments.

g. Elements [1.6]/[21.6]: “at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the [first and second active regions/surface] [towards/to] an area of the substrate where there are no active regions; and”

h. Elements [1.7]/[21.7]: “at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface [towards/to] the area of the substrate where there are no active regions,”

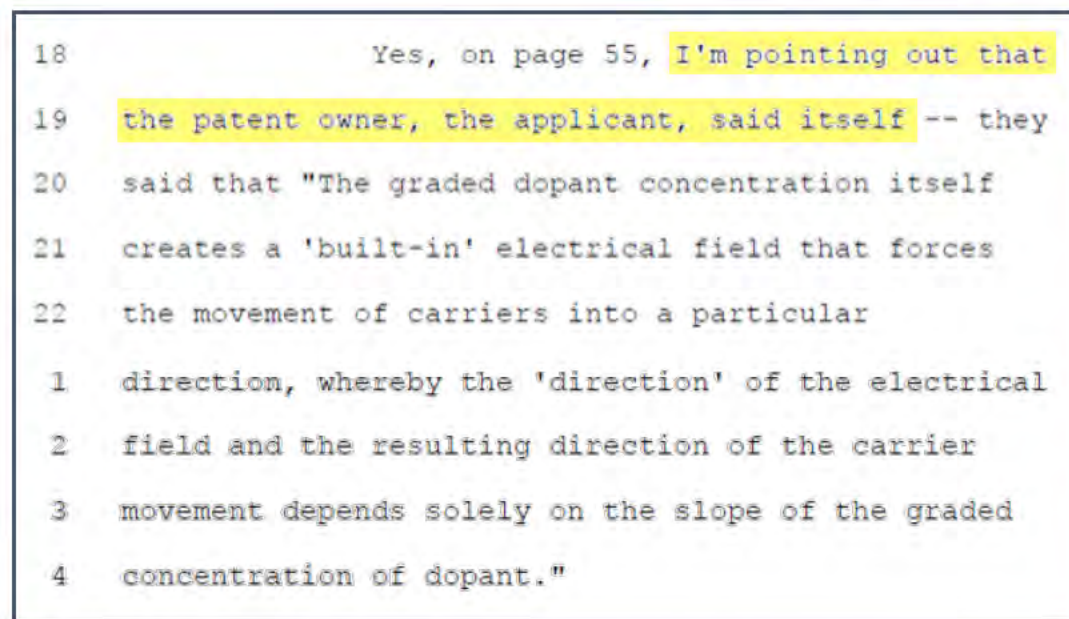
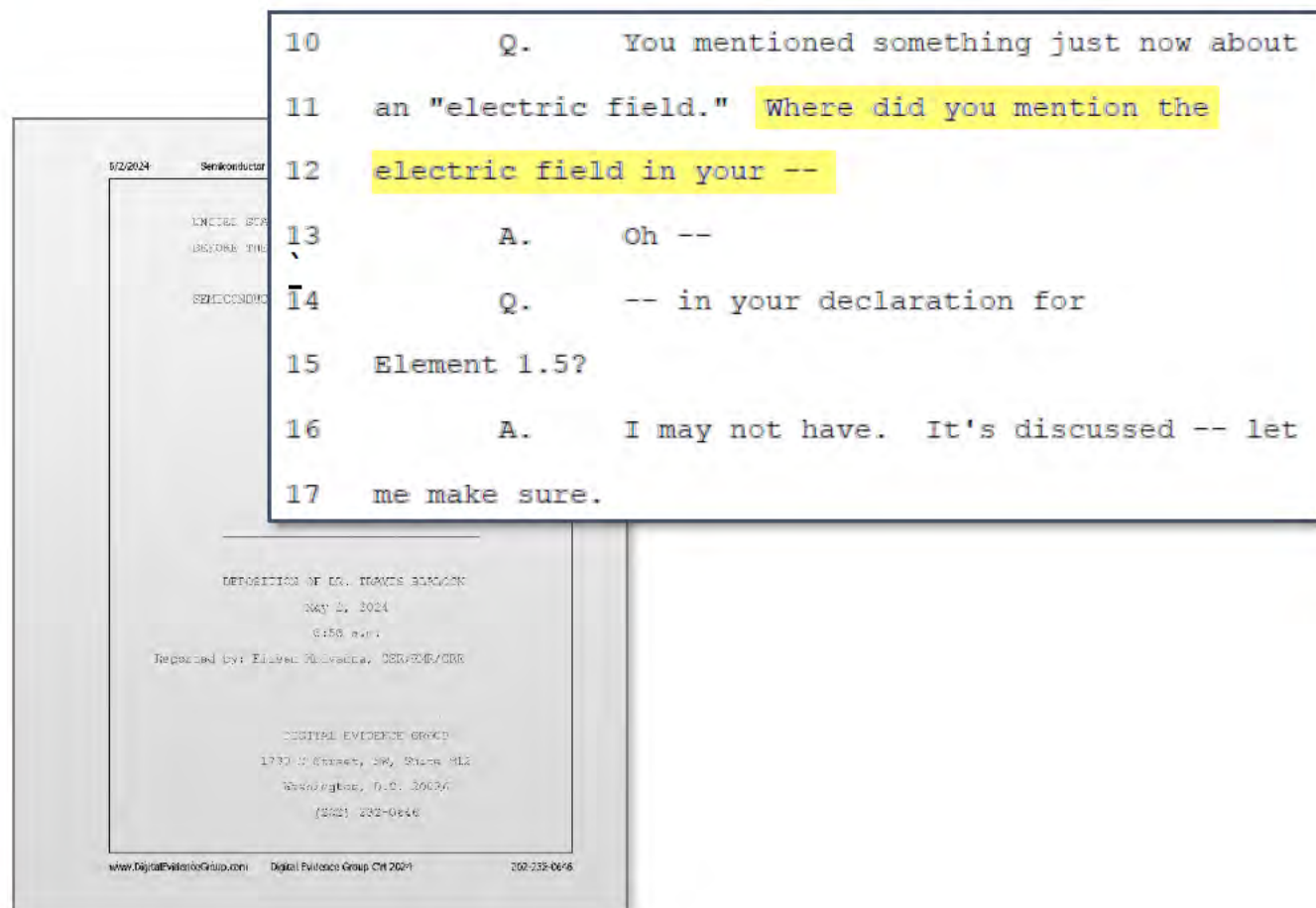
-00263: Petition [1] at 18, 23

Kawagoe also satisfies these claim elements under Intel’s alternative proposed construction that the term means “to sweep the carriers from [the first and second active regions/surface] [towards/to] [an area of the substrate where there are no active regions].” EX1036; EX1001, Cl. 1/21; EX1003, ¶98. Notably, Kawagoe’s Figure 17 illustrates a downward-sloping graded dopant concentration and Applicant represented to Patent Office during prosecution of the parent ‘195 Patent that a downward-sloping graded dopant concentration was known in the prior art to create an “inherent ‘built-in’ unidirectional electric field” that sweeps carriers down into the substrate (where there are no active regions), as detailed below in §VII.A.1.h. EX1016, 289-290; EX1003, ¶98.

-00263: Petition [1] at 22-23

4. Kawagoe Does Not Move Carriers from the “Surface Layer”

- Dr. Blalock's could not explain any generated electric field from the references' “graded concentrations” apart from Applicant's “supposed admissions.”



-00263: Ex. 2058 (Blalock Dep. Tr.) at 72:10-73:4

4. Kawagoe Does Not Move Carriers from the “Surface Layer”

- Because Kawagoe does not expressly teach moving carriers from the “surface layer,” Petitioners had the burden to identify an electric field in the “surface layer.”

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In the absence of any teaching of the claim limitation in the prior art, Petitioners have two options: 1) they can read “aid carrier movement from the first surface” (or active region) out of the claim or 2) they can argue that any “graded dopant concentration” in the active region will “aid carrier movement.” Both options fail.

-00263: PO Response [31] at 2-3

4. Kawagoe Does Not Move Carriers from the “Surface Layer”

- Petitioner admits that the “electrons produced by the β -ray” are created below the wells.

7 Kawagoe states that “electrons produced by the α -ray [are]... prevented from entering the p-well 6p” EX1007, 16:7-9. This refers to electrons produced in the large substrate body below the wells. EX1003, ¶94; EX1009, FIG. 2.

SEMICONDUCTOR COMPONENTS INDUSTRIES, I.L.C.
Petitioner

 γ_{L}

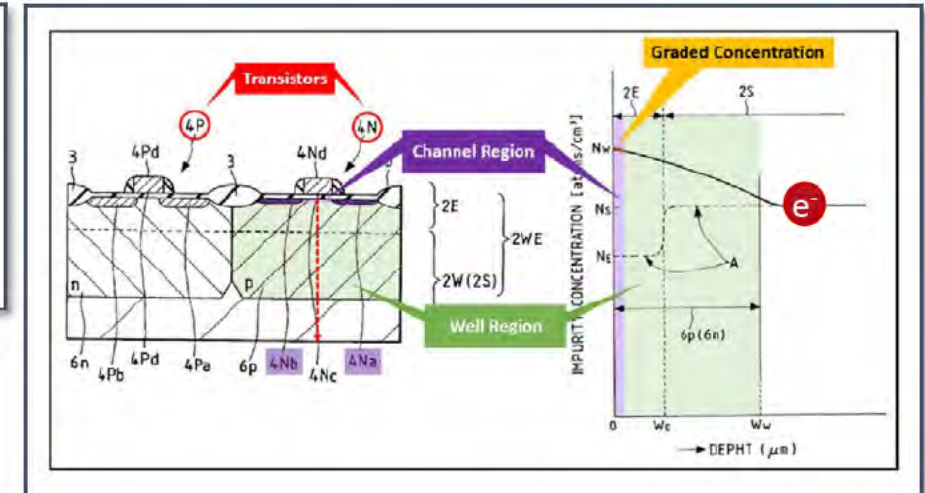
GREENTHREAD LLC,
Patent Owner

U.S. PATENT NO. 11,316,014

Case IPR2023-01263

**PETITION FOR INTER PARTES REVIEW
UNDER 35 U.S.C. §312 AND 37 C.F.R. §42.104**

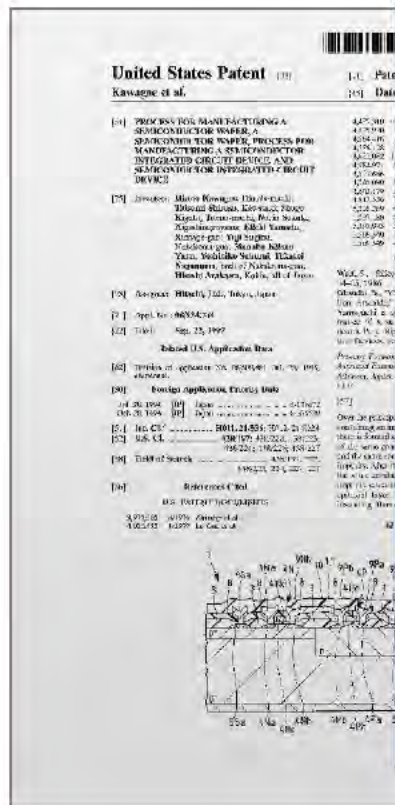
-00263: Petition [1] at 21



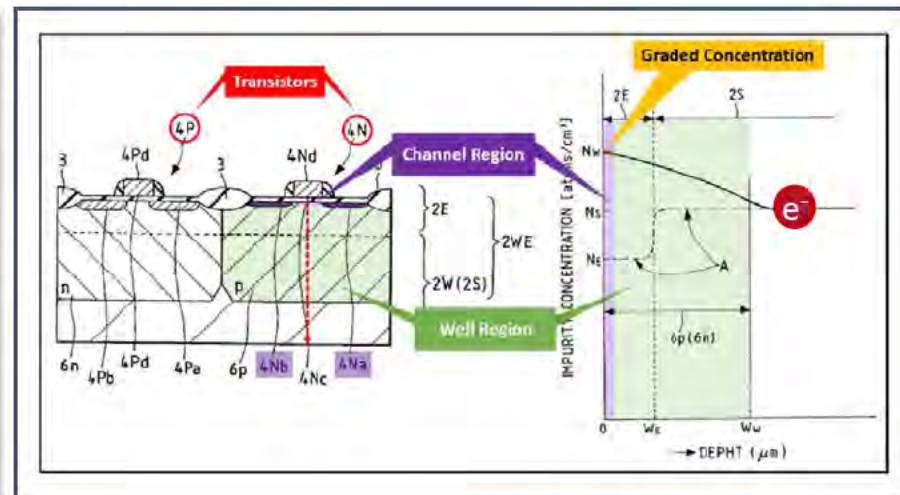
-00263: Petition [1] at 19
(annotations added by PO)

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Kawagoe does not mention moving an electron from the "surface layer."



Incidentally, in the present embodiment 4, the aforementioned p-well 6p and n-well 6n are formed to extend from the surface of the epitaxial layer 2E to the upper portion of the semiconductor substrate body 2S, as shown in FIGS. 16 and 17, and the p-well 6p and n-well 6n have their impurity concentrations gradually lowered in the depthwise direction from the principal surface (having an impurity concentration N_w) of the epitaxial layer 2E. Thus, the impurity concentration of the p-well 6p is given such a gradient that it is gradually lowered in the depthwise direction from the surface of the epitaxial layer 2E, so that the influence to be caused by the carriers (or electrons) due to the α -ray is lowered. Specifically, the electrons produced by the α -ray are attracted to the substrate body 2S by that concentration gradient and prevented from entering the p-well 6p so that the soft errors can be reduced in case the MIS memory of the DRAM or the like is formed in the p-well 6p. The impurity

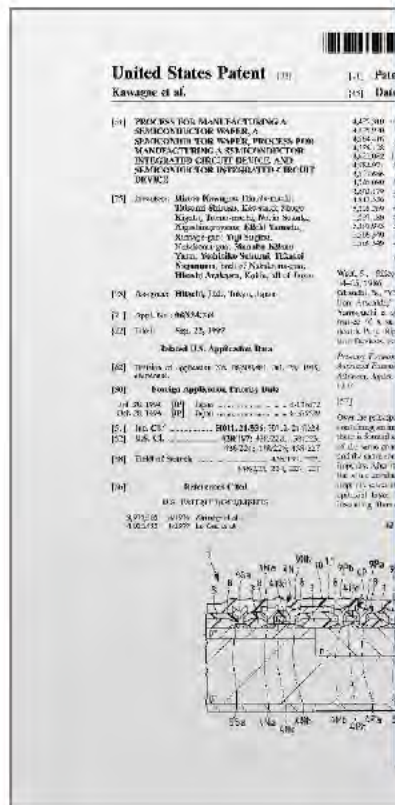


-00263: Petition [1] at 19
annotat ons added by PO

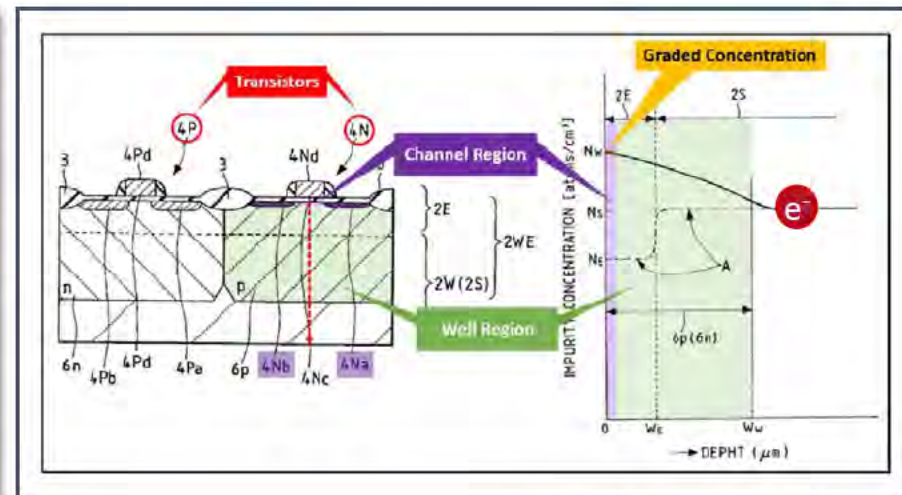
-00263: Ex. 1007 (Kawagoe) at 15:62-16:11

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Kawagoe expressly says it "prevents" the electrons from "entering the p-well 6p."



Incidentally, in the present embodiment 4, the aforementioned p-well 6p and n-well 6n are formed to extend from the surface of the epitaxial layer 2E to the upper portion of the semiconductor substrate body 2S, as shown in FIGS. 16 and 17, and the p-well 6p and n-well 6n have their impurity concentrations gradually lowered in the depthwise direction from the principal surface (having an impurity concentration N_w) of the epitaxial layer 2E. Thus, the impurity concentration of the p-well 6p is given such a gradient that it is gradually lowered in the depthwise direction from the surface of the epitaxial layer 2E, so that the influence to be caused by the carriers (or electrons) due to the α -ray is lowered. Specifically, the electrons produced by the α -ray are attracted to the substrate body 2S by that concentration gradient and prevented from entering the p-well 6p so that the soft errors can be reduced in case the MIS memory of the DRAM or the like is formed in the p-well 6p. The impurity



-00263: Petition [1] at 19
annotat ons added by PO

-00263: Ex. 1007 (Kawagoe) at 15:62-16:11

4. Kawagoe Does Not Move Carriers from the “Surface Layer”

- Dr. Glew confirmed that Kawagoe is not concerned with pushing electrons downward from the surface.

11 Q. And this electric field resulting from the
12 graded dopant concentration of Figure 17 would sweep
13 those electrons from the active region down into the
14 substrate?
15 MR. WHITEHURST: Object to the form.
16 THE WITNESS: It doesn't disclose that it
17 does that.

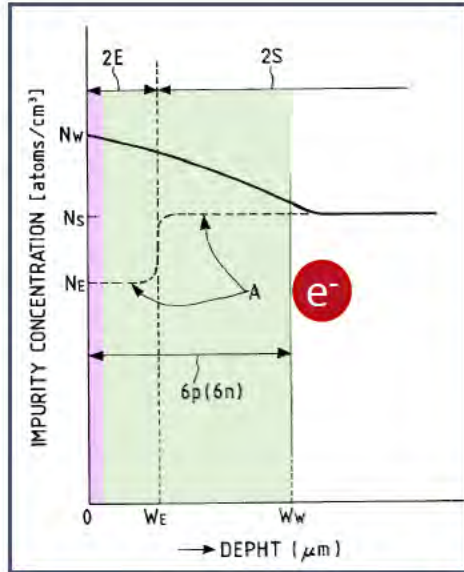
UNITED STATES
DEPARTMENT OF COMMERCE
SEMICONDUCTOR
INDUSTRIES, LLC
Patent
Ver.
GREENTHREAD, LLC,
Patent Owner,
Case IPR2023-01242
U.S. Patent No. 11,121,222
Case IPR2023-01243
U.S. Patent No. 10,510,842
Case IPR2023-01244
U.S. Patent No. 11,121,222
DEPOSITION OF ALEXANDER GLEW, PhD
July 16, 2024
Reported by: Dana Peabody, RWE, CDR, CSR No. 5333
Pages 1 through 193
Job No. HCU 5760791
Page 1
Veritas Legal Solutions
340-293-7000
CASE EXHIBIT 106, Page 1
Semiconductor Components Industries, LLC v. Greenthread, LLC
IPR2023-01243

19 Q. Whether the electrons actually move or
20 not, you would agree that the resulting electric
21 field from this greater dopant concentration exerts
22 a force that would push the electrons in that
23 direction, right?
24 MR. WHITEHURST: Object to form.
25 THE WITNESS: The electric field may not
1 be sufficient to actually move them. The patent --
2 the Kawagoe patent is silent about any effect that
3 this field designated or brought about by the dopant
4 gradient NW as shown in Figure 17 affects anything
5 within the well.
6 The patent only describes that this dopant
7 gradient is able to keep SEU electrons out of the
8 well. It doesn't tell you what's happening in the
9 well.

-00263: Ex. 1056 (Glew Dep. Tr.) at 121:11-122:9

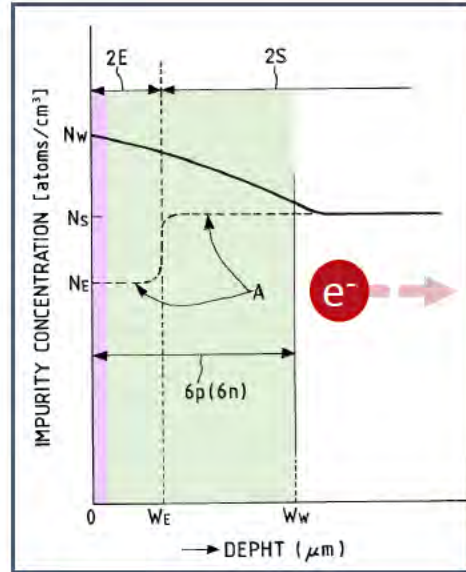
4. Kawagoe Does Not Move Carriers from the “Surface Layer”

- Kawagoe does not disclose “aiding carrier movement” from the surface to the substrate.



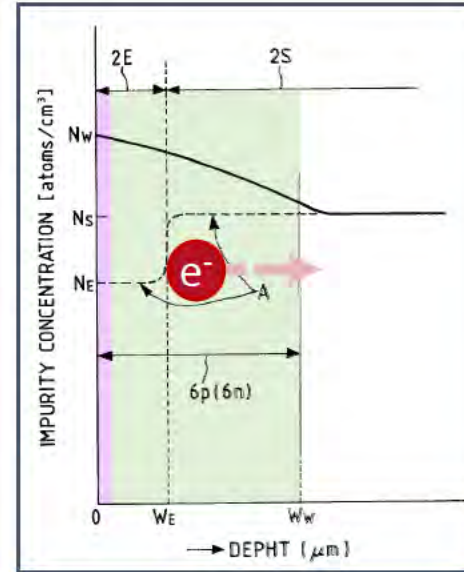
Scenario 1

SEU electron stays in substrate and never enters p-well



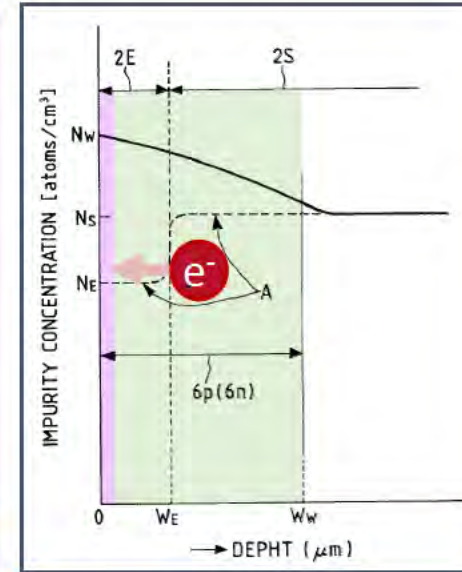
Scenario 2

SEU electron moves deeper into substrate



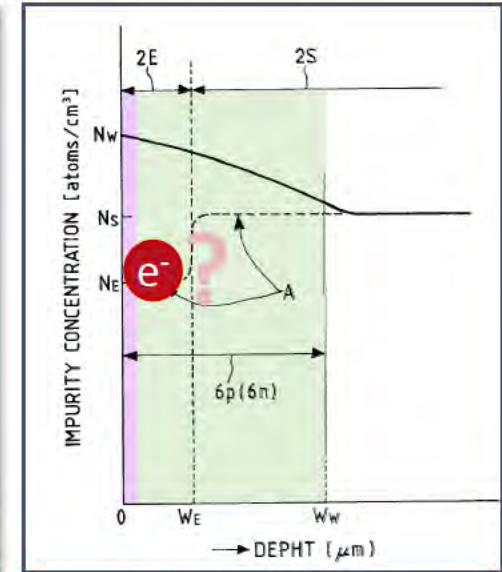
Scenario 3

SEU electron theoretically enters p-well contrary to Kawagoe specification



Scenario 4

SEU electron theoretically enters p-well contrary to Kawagoe specification

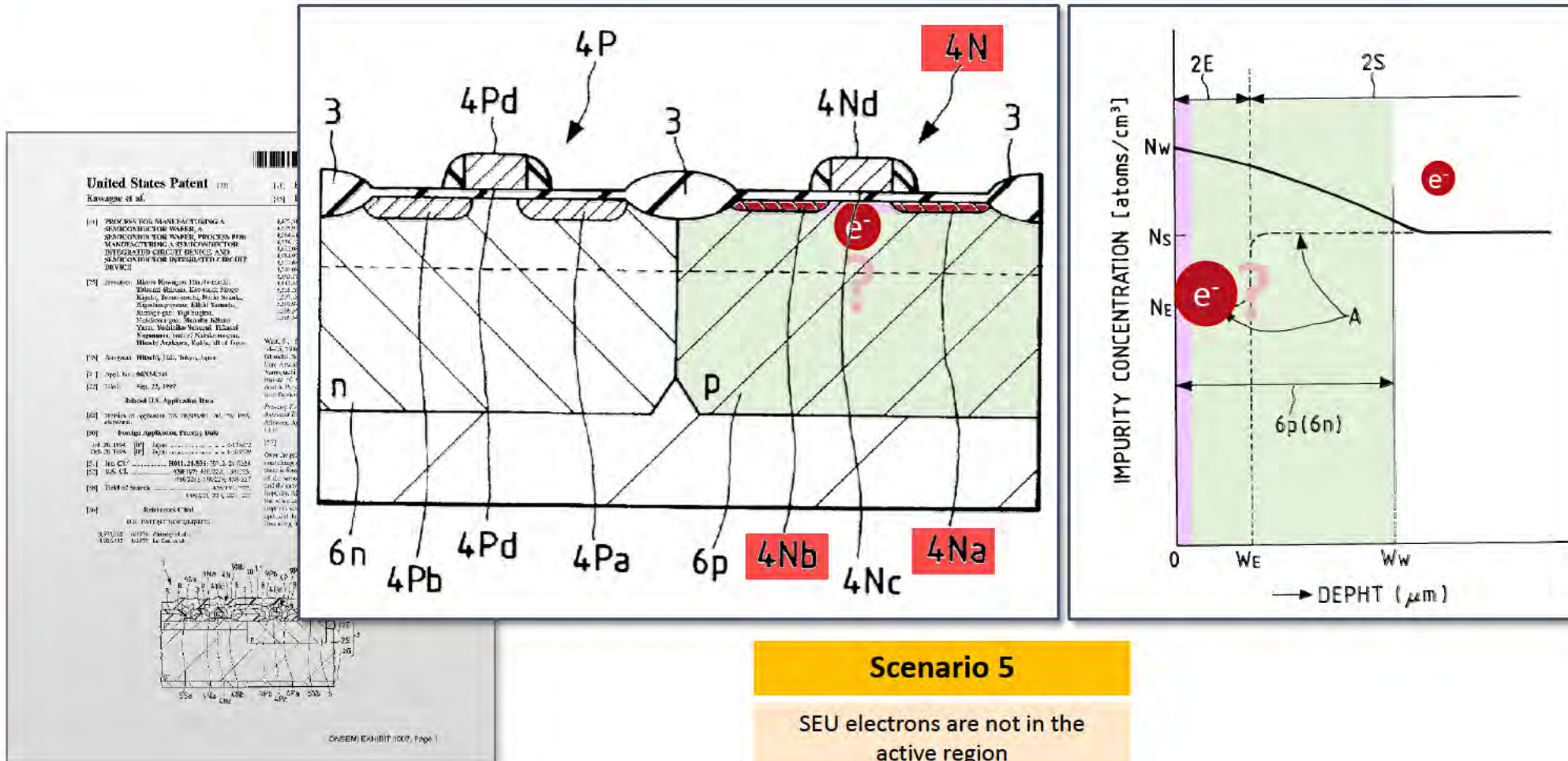


Scenario 5

SEU electrons are not in the active region

4. Kawagoe Does Not Move Carriers from the “Surface Layer”

- Kawagoe does not disclose “aiding carrier movement” from the surface to the substrate.



4. Kawagoe Does Not Move Carriers from the “Surface Layer”

- Kawagoe does not disclose “aiding carrier movement” from the surface to the substrate.

PROTECTIVE ORDER MATERIAL
UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEALS BOARD
SEMICONDUCTOR COMPONENTS INDUSTRIES, INC.
Petitioner,
v.
GREENTHREAD, LLC,
Patent Owner.
Case IPR2024-00263
U.S. Patent 11,316,014
PATENT OWNER'S RESPONSE

“probability of [electrons] ... extremely low” and can be “disregarded.”
Nishizawa, 19:21-34; 20:19-22

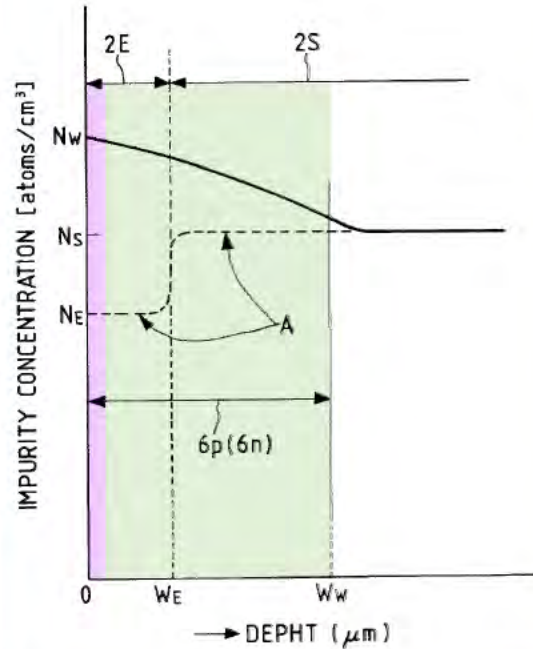
electrons “prevented from entering the p-well 6p”
Ex. 1007 at 16:7-11 .

The diagram is a cross-sectional view of a semiconductor device. It shows a substrate with several layers. At the top, there is a layer labeled '3'. Below it, there are layers labeled '4Pd', '4P', '4Nd', and '4N'. A blue arrow points to the top surface, labeled 'First Surface'. Below these layers, there is a p-well labeled '6p'. A yellow arrow points to this well. Other layers include '6n', '4Pb', '4Pd', '4Pc', '4Nb', '4Nc', and '4Na'. Dimensions are indicated on the right: '2E' for the top layer, '2W(2S)' for the well region, and '2WE' for the entire structure. The text 'Kawagoe's electrons' is written near the '6p' well.

-00263: PO Response [31] at 31

4. Kawagoe Does Not Move Carriers from the "Surface Layer"

- Dr. Blalock admitted that he did not calculate the slope of Kawagoe's concentration gradient.



3 Q. The Kawagoe, Payne and Wieczorek
4 references that we've been talking about, in all
5 three of those, you looked at the existence of a
6 downward-sloping graded dopant concentration; right?

7 A. That's one of the things I looked for,
8 yeah.

9 Q. And in none of those three references
10 did you analyze the particular slope of that
11 gradient; correct?

12 MR. SPEEGLE: Objection, form.

13 THE WITNESS: I did the analysis
14 necessary to show that Kawagoe, Wieczorek or
15 Payne disclosed and gave the information --
16 or combinations thereof -- gave the
17 information necessary to satisfy all the
18 elements of the '222 or '842, whichever the
19 particular case was.

8 Q. And regarding any of these three
9 references, for the mapping of the claim phrase "aid
10 carrier movement," have you looked at any aspect of
11 the gradient other than its being downward sloping?

12 MR. SPEEGLE: Objection, form.

13 THE WITNESS: As I've said, the patent
14 owner tells us that that's sufficient, so
15 that's what I did. I have not done
16 calculations of the slope per se.

-00263: Ex. 2058 (Blalock Dep. Tr.) at 195:8-16

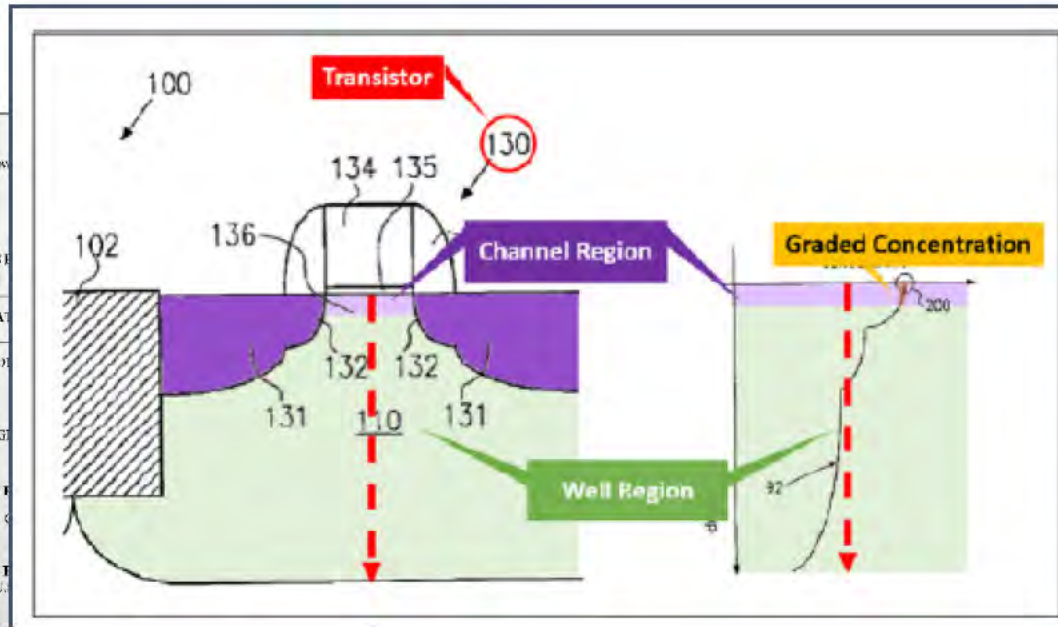
-00263: Ex. 2058 at 190:3-19

Overview of Issues

- 1. Petitioner has presented zero “actual evidence” that the Petitions are timely.**
- 2. The Claims require “movement of carriers” from the “surface layer.**
- 3. The '195 and '502 Claims require “movement of minority carriers” from the “surface layer.”**
- 4. Kawagoe does not disclose “movement of carriers” and “movement of minority carriers” from the “surface layer.”**
- 5. Wieczorek does not disclose “movement of carriers” from the “surface layer.”**
6. Payne does not disclose “movement of minority carriers” from the “surface layer.”
7. Petitioner has the burden to identify electric fields that would “aid carrier movement.”
8. Experts confirm that carriers in the “surface layer” are affected by numerous other fields and forces.
9. The “movement of carriers” depends on the sum of all of the fields in the “surface layer.”
10. Dr. Blalock did not analyze any of the fields or force magnitudes in the “surface layer.”
11. Petitioner's prosecution-related arguments are incorrect.
12. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

5. Wieczorek Does Not Move Carriers from the “Surface Layer”

- Wieczorek does not mention moving carriers from the “surface layer.”



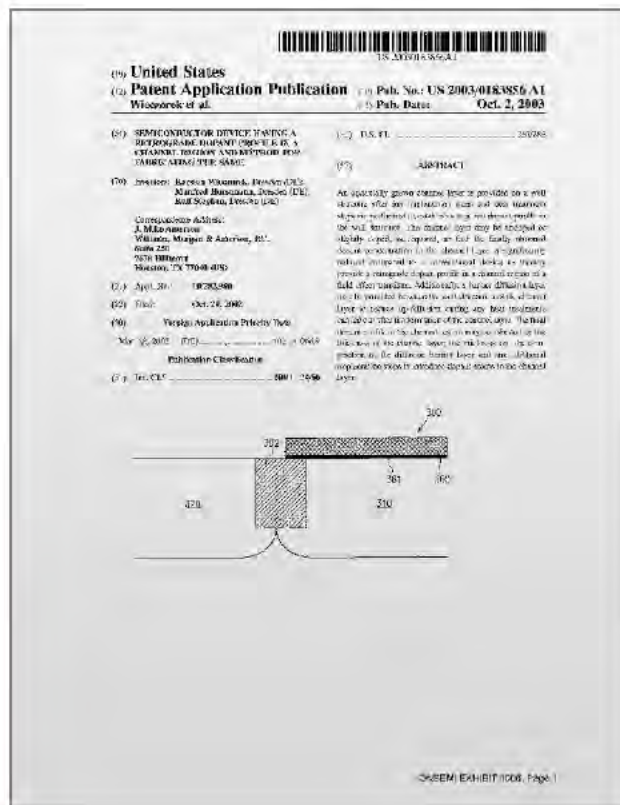
EX1006, FIGS. 1b, 2b. The doping concentration in the channel region is highlighted in brown in the doping profile of Figure 2b (above right), measured for example along the red dotted line in Figure 1b that traverses the channel region. *Id.*, [0011] (“FIG. 2b shows ... a typical dopant profile with respect to the depth of the respective well structure.”), [0013] (“after the plurality of heat treatments, the actual dopant concentration will be represented by the graph shown in FIG. 2b.”), [0009], FIG. 2a.

As Figure 2b shows, the dopant concentration is highest at the surface of the substrate and decreases with depth. EX1003, ¶153. Therefore, channel region 136 has a **graded dopant concentration**. *Id.* And as shown in the figures below, Wieczorek teaches that channel region 146 (light green) of pMOS transistor 140, which is a portion of the second active region, also has a graded dopant concentration

-00263: Petition [1] at 52

5. Wieczorek Does Not Move Carriers from the “Surface Layer”

- Wieczorek does not mentions carriers, much less moving carriers from the surface to the substrate.



-00263: Ex. 1006 at [0009]

-00263: Ex. 1006 at [0011]

[0013] Typically, the N-channel transistor 130 and the P-channel transistor 140 are formed by the following processes. After the heat treatment, the gate insulation layer 135 is formed, wherein the gate insulation layer may be deposited by chemical vapor deposition (CVD), or, if an oxide layer is used, a rapid thermal furnace process or a conventional furnace oxidation process may be used. Since, commonly, elevated temperatures are involved in fabricating the gate insulation layer 135, this process also contributes to a further diffusion of the dopants within the P-well structure 110 and the N-well structure 120. Thereafter, polysilicon is deposited and patterned by sophisticated photolithography techniques to form the gate electrodes 134 and 144. With a first implantation, the extensions 132 and 142 are defined, and, subsequently, the spacer elements 133, 143 are formed and serve as an implantation mask during a subsequent implantation process for defining the source and drain regions 131, 141. Since a further heat treatment is necessary to activate the dopants within the regions 131, 132 and 141, 142 and to cure any crystal damage caused by the preceding implantation steps, the initial dopant concentration, as shown in FIG. 2a, will be even more strongly affected so that, after the plurality of heat treatments, the actual dopant concentration will be represented by the graph shown in FIG. 2b. In particular, it is thus very difficult to obtain or to maintain a retrograde dopant profile in the channel regions 136 and 146, which would be desirable to achieve an improved carrier mobility therein.

-00263: Ex. 1006 (Wieczorek) at [0013]

5. Wieczorek Does Not Move Carriers from the “Surface Layer”

- Petitioner did not identify an electric field, much less an electric field starting at the surface layer.
- Petitioner’s only mention of “field” relates to its erroneous prosecution history arguments.

- g. Elements [1.6]/[21.6]: “at least a portion of at least one of the first and second active regions having at least one graded dopant concentration to aid carrier movement from the [first and second active regions/surface] [towards/to] an area of the substrate where there are no active regions; and”**
- h. Elements [1.7]/[21.7]: “at least one well region adjacent to the first or second active region containing at least one graded dopant region, the graded dopant region to aid carrier movement from the surface [towards/to] the area of the substrate where there are no active regions,”**

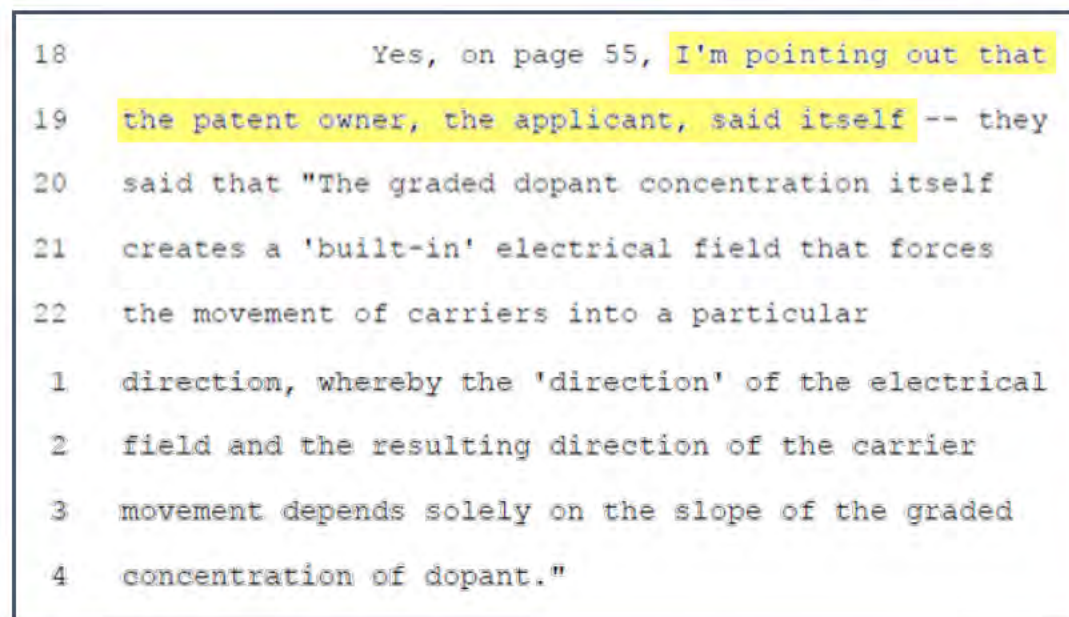
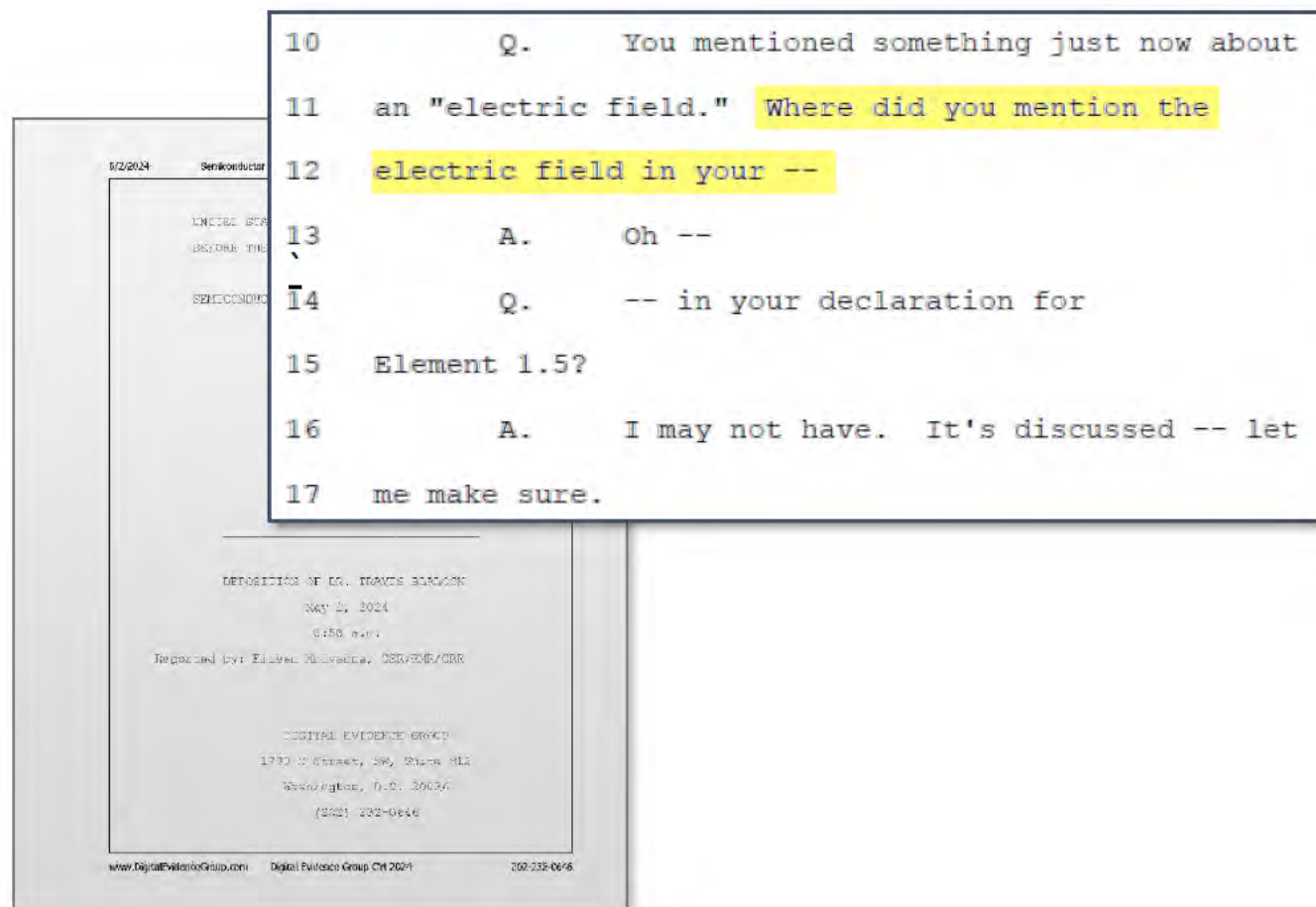
-00263: Petition [1] at 51, 56

Further, Wieczorek’s downward-sloping graded dopant concentrations aid carrier movement from the surface and from the first and second active regions towards/to an area of the substrate where there are no active regions to the same extent to which Applicant relied on the prior art and admitted to the Patent Office that such carrier movement would occur under the same scenario. EX1003, ¶155. As detailed in §VII.A.1.h, during prosecution of the parent ‘195 Patent, Applicant represented to the Patent Office that a downward-sloping graded dopant concentration was known in the prior art to move carriers deep into the substrate. Applicant cited Jastrzebski and Kamins in support. §VII.A.1.h. Notably, according to Jastrzebski, a downward-sloping graded dopant concentration creates an electric drift field that “force[s] most of the charge carriers ... *deep into the substrate*[.]” EX1010, 2:27-32, 5:14-22. EX1003, ¶156, 158.

-00263: Petition [1] at 54

5. Wieczorek Does Not Move Carriers from the “Surface Layer”

- Dr. Blalock's could not explain any generated electric field from the references' “graded concentrations” apart from Applicant's “supposed admissions.”



-00263: Ex. 2058 (Blalock Dep. Tr.) at 72:10-73:4

5. Wieczorek Does Not Move Carriers from the “Surface Layer”

- Because Wieczorek does not expressly teach moving carriers from the “surface layer,” Petitioners had the burden to identify an electric field in the “surface layer.”

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In the absence of any teaching of the claim limitation in the prior art, Petitioners have two options: 1) they can read “aid carrier movement from the first surface” (or active region) out of the claim or 2) they can argue that any “graded dopant concentration” in the active region will “aid carrier movement.” Both options fail.

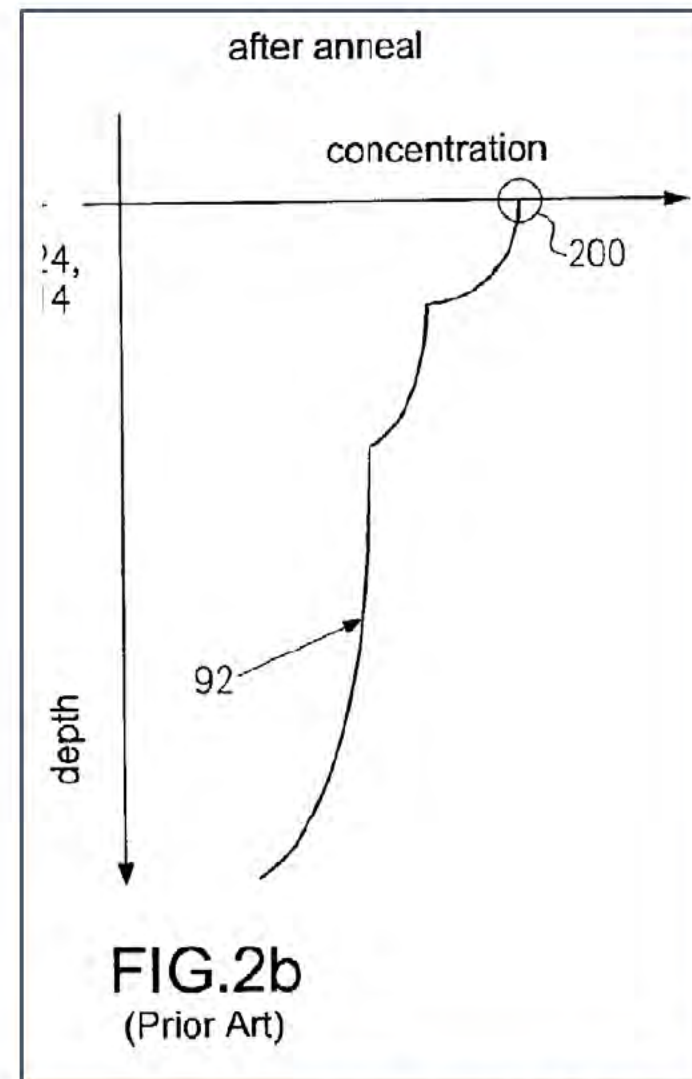
-00263: PO Response [31] at 2-3

5. Wieczorek Does Not Move Carriers from the “Surface Layer”

- There is no generated electric field because Wieczorek says the gradient concentration may be uniform.

[0011] FIG. 2b shows a corresponding graph with a typical dopant profile with respect to the depth of the respective well structure. Due to the up-diffusion of the dopant atoms during the heat treatment, the initially retrograde profile in the vicinity of the surface of the semiconductor device **100**, as indicated by reference number **200**, may have become substantially uniformly distributed.

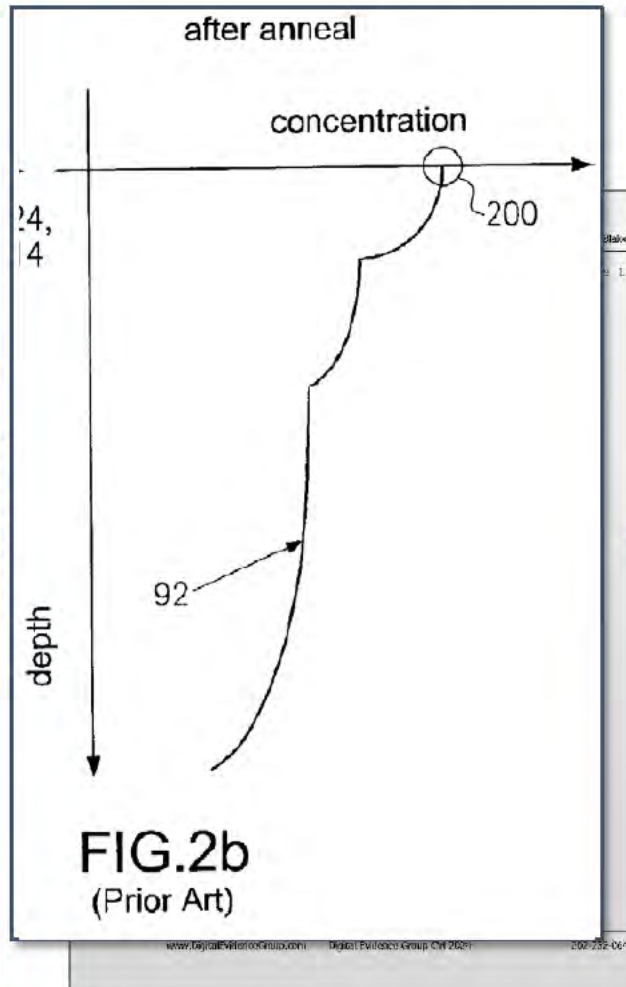
-00263: Ex. 1006 (Wieczorek) at [0011]



-00263: Ex. 1006 at Fig. 2b

5. Wieczorek Does Not Move Carriers from the “Surface Layer”

- Dr. Blalock admitted that he did not calculate the slope of Wieczorek’s concentration gradient.



4 Q. So, Dr. Blalock, in the 1242 and 1243
5 proceedings, Wieczorek is Exhibit 1006; right?

6 A. Yes.

7 Q. And in the 1244 proceeding, there's a
8 different reference that has that exhibit number.

9 A. Okay.

10 Q. Okay. So in the 1242 proceeding, when
11 you analyzed Limitation 1.5 of the '222 patent --

12 A. Which paragraph?

13 Q. Around paragraph 156.

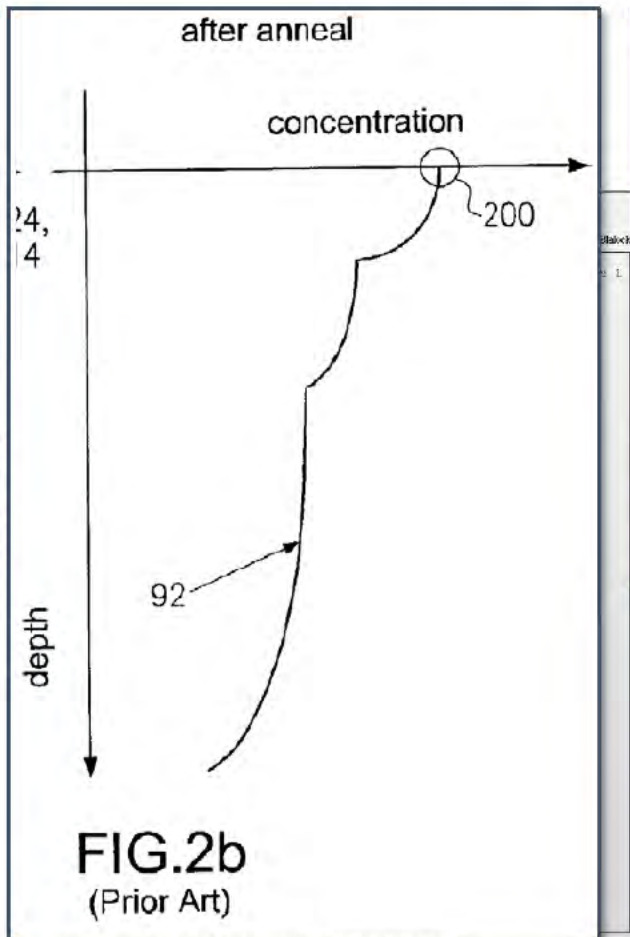
14 At those paragraphs, you did not
15 analyze any particular slope of a concentration
16 curve of Wieczorek; correct?

17 A. I didn't -- I didn't do like a
18 calculation of the slope. I certainly analyzed to
19 ensure that it is downward sloping, and I think
20 there may be some other claims about the nature of
21 that slope, Element 21.7, for instance.

-00263: Ex. 2058 (Blalock Dep. Tr.) at 183:4-21

5. Wieczorek Does Not Move Carriers from the “Surface Layer”

- Dr. Blalock admitted that he **could** not calculate the slope of Wieczorek’s concentration gradient.



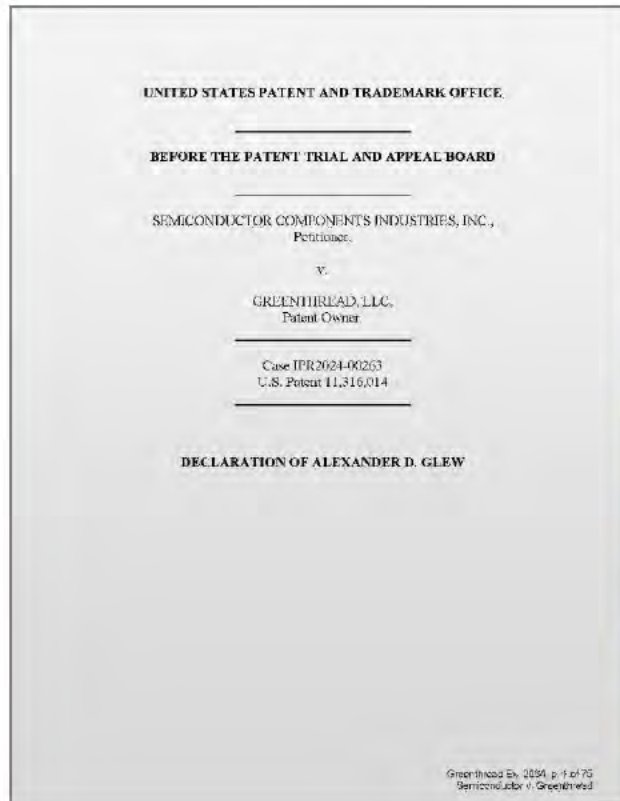
22 Q. You wouldn't have known how to find
3 THE WITNESS: No, of course I would.
5 Q. How would you have found the slope?
6 A. If you have a -- if Wieczorek provided
7 the numbers of the various doping levels, as we saw
8 earlier, then you could -- you know, there's some
9 simple calculations. I don't -- I don't think --
10 I'm trying to remember if Wieczorek gave us any
11 specific numbers. Certainly the figure does not
12 have specific numbers.

13 So I don't remember if we had specific
14 numbers of the final doping levels, but -- I'm not
15 seeing them here. I don't remember every single
16 line. But at least in the figures, if we had a
17 figure with concentrations and dimensions, we could
18 do a calculation -- a specific calculation of the
19 slope.

-00263: Ex. 2058 (Blalock Dep. Tr.) at 183:22-184:19

5. Wieczorek Does Not Move Carriers from the “Surface Layer”

- Dr. Glew recognized that Dr. Blalock could not calculate a slope—and not determine the slope’s effect on a carrier—from FIG. 2b.

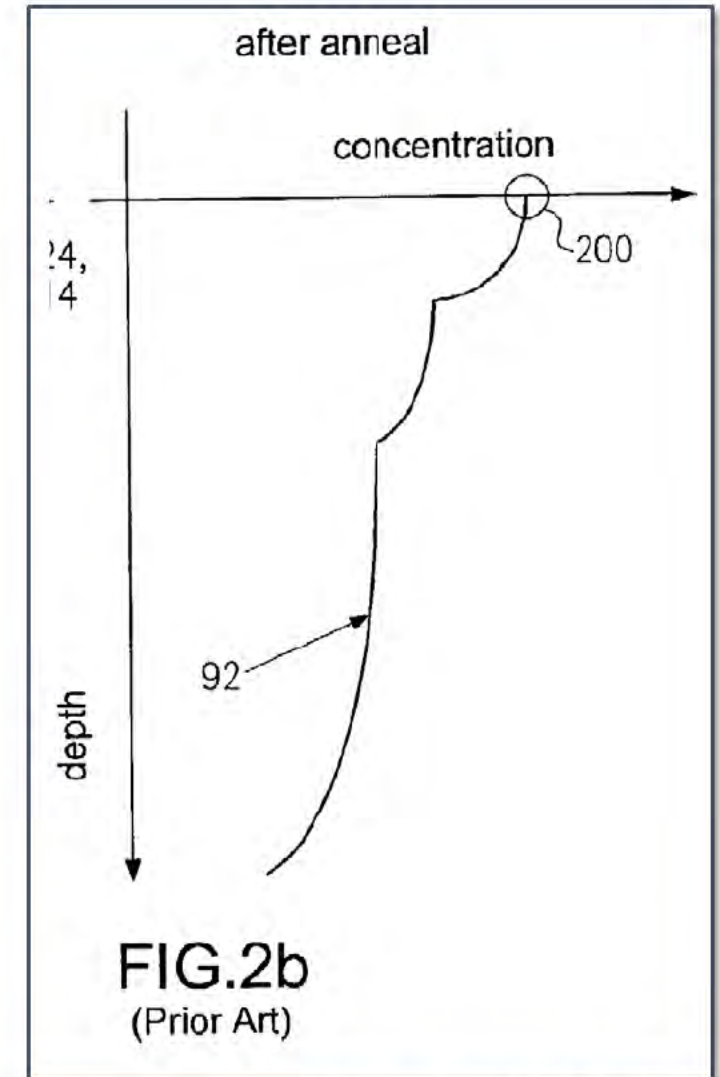
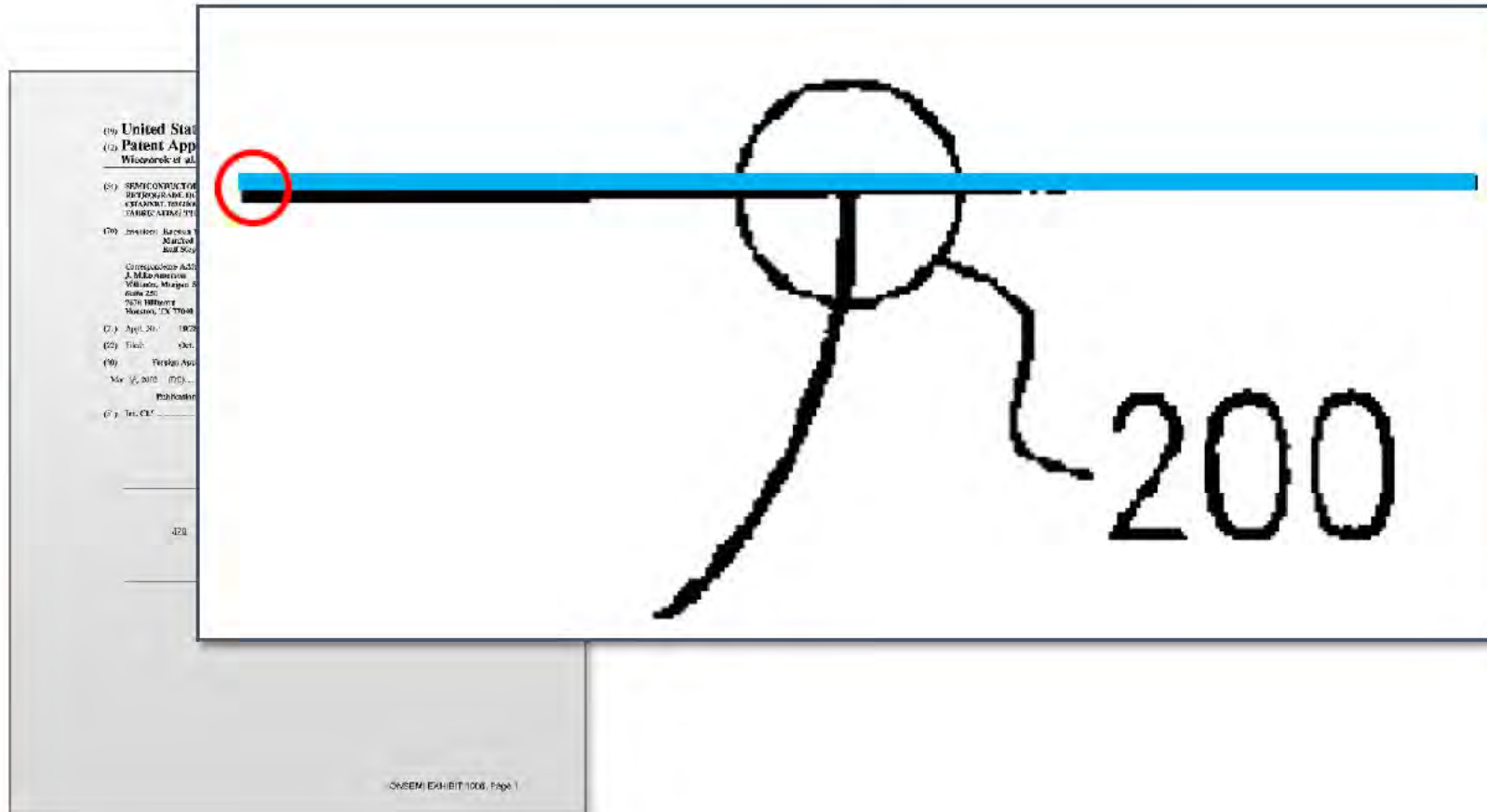


61. Dr. Blalock testified that he did not calculate the slope of the concentration gradient that he said Wieczorek discloses. Ex. 2058, 195 (“Q. And regarding any of these three references [including Wieczorek], for the mapping of the claim phrase ‘aid carrier movement,’ have you looked at any aspect of the gradient other than its being downward sloping? ... THE WITNESS: As I’ve said, the patent owner tells us that that’s sufficient, so [t]hat’s what I did. I have not done calculations of the slope per se.”). It would have been impossible for Dr. Blalock to make such a calculation because the dopant gradient Petitioner points to in Figure 2B (and Wieczorek generally) does not have any values from which one could calculate a slope. In mathematical terms, the slope in each direction (X, Y, and Z) is known formally as the gradient vector. The magnitude of the slope is essential to determine the magnitude of the force the dopant gradient places on the carrier and thus the net force.

-00263: Ex. 2064 (Glew Decl.) at ¶61

5. Wiczorek Does Not Move Carriers from the “Surface Layer”

- Petitioner’s argument that reference 200 “line is not straight” is unfounded.



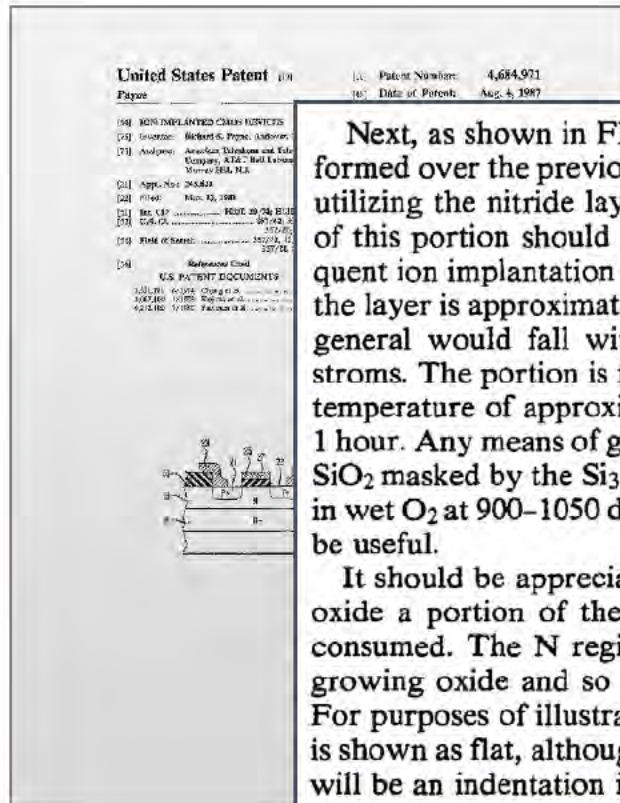
-00263: Ex. 1006 at Fig. 2b

Overview of Issues

- 1. Petitioner has presented zero “actual evidence” that the Petitions are timely.**
- 2. The Claims require “movement of carriers” from the “surface layer.**
- 3. The '195 and '502 Claims require “movement of minority carriers” from the “surface layer.”**
- 4. Kawagoe does not disclose “movement of carriers” and “movement of minority carriers” from the “surface layer.”**
- 5. Wieczorek does not disclose “movement of carriers” from the “surface layer.”**
- 6. Payne does not disclose “movement of minority carriers” from the “surface layer.”**
7. Petitioner has the burden to identify electric fields that would “aid carrier movement.”
8. Experts confirm that carriers in the “surface layer” are affected by numerous other fields and forces.
9. The “movement of carriers” depends on the sum of all of the fields in the “surface layer.”
10. Dr. Blalock did not analyze any of the fields or force magnitudes in the “surface layer.”
11. Petitioner's prosecution-related arguments are incorrect.
12. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

6. Payne Does Not Move “Minority Carriers” from the “Surface Layer”

- Payne never mentions carriers, much less moving minority carriers from the surface.



Next, as shown in FIG. 8, a thick oxide portion 19 is formed over the previously implanted regions 18 and 15 utilizing the nitride layer, 12, as a mask. The thickness of this portion should be sufficient to block the subsequent ion implantation to be described. In this example, the layer is approximately 4000 Angstroms thick, but in general would fall within the range 3000–4500 Angstroms. The portion is formed by heating in wet O₂ at a temperature of approximately 1000 degrees Celsius for 1 hour. Any means of growing the requisite thickness of SiO₂ masked by the Si₃N₄ is suitable. Typically, heating in wet O₂ at 900–1050 degrees Celsius for 1–4 hours will be useful.

It should be appreciated that in the formation of the oxide a portion of the semiconductor surface will be consumed. The N region 18 will diffuse ahead of the growing oxide and so will remain at the new surface. For purposes of illustration, the semiconductor surface is shown as flat, although, as a result of oxidation, there will be an indentation in the area of the N tub.

a separate step is not ordinarily needed. The resulting impurity profile in both tubs thereby has the general shape illustrated in FIG. 11, where the abscissa is depth and the ordinate is impurity concentration.

The oxide layer can then be stripped off, for example, with a solution of dilute HF, and fabrication may proceed in accordance with standard techniques to produce the CMOS device depicted in FIG. 10. The p-channel device includes source and drain regions, 21 and 22, respectively, of P⁺ conductivity type formed with the N surface region, 18. Similarly, the n-channel device includes source and drain regions, 23 and 24, of N⁺ conductivity type formed within the P surface region 20. These source and drain regions would typically have a surface impurity concentration of approximately 10¹⁹–10²⁰ ions/cm³ and a depth of 1 μm. It will be noted, therefore, that the n and p surface regions, 18 and 20, will be present at the surface of their respective devices except for the areas comprising the source and drain. The depth of the surface regions should be at least as great as that of the source and drain regions.

The devices further include gate electrodes, 25 and 26, typically comprising polycrystalline silicon, formed over gate oxide portions 27 and 28. Ohmic contacts to source and drain regions are provided by metal portions, 29–32, typically comprising aluminum, formed over field oxide portions 33–35 and contact windows in said oxide. These features and their method of fabrication are well-known in the art and consequently are not discussed in detail.

It will be appreciated that during the drive-in of the source and drain regions, 21–24, the regions 18, and 20 will also be driven somewhat further into the substrate, while the depth of the tubs 15 and 17 is essentially unaffected. In a typical device, the final depth of surface regions 18 and 20 would be approximately 1–2 μm and the depth of tub regions 15 and 17 would be typically 3–8 μm. The surface impurity concentration of the surface regions is typically 0.5–5 × 10¹⁶ ions/cm³ and that of the tub regions is typically 10¹⁵–10¹⁶ ions/cm³, with the former concentration being at least twice as much as the latter over these ranges.

The major advantage in formation of the high-low implant profile of FIG. 11 is illustrated in FIGS. 12 and

device. In a device fabricated in accordance with the present invention, as illustrated in FIG. 13, the composite profiles remain high and then fall off rapidly at a much closer distance from the boundary. This is due to the high impurity concentration of surface regions 18 and 20 as well as the short diffusion lengths of these regions. On each side of the boundary, therefore, the high impurity concentration of the surface region (e.g., 18) is compensated for only by the low concentration tub region of the adjacent device (17) and substantial overlap is permitted. In a typical device, it is expected

-00266: Ex. 1005 (Payne) at 4:38-59

-00266: Ex. 1005 at 5:14-57

-00266: Ex. 1005 at 6:7-17

6. Payne Does Not Move “Minority Carriers” from the “Surface Layer”

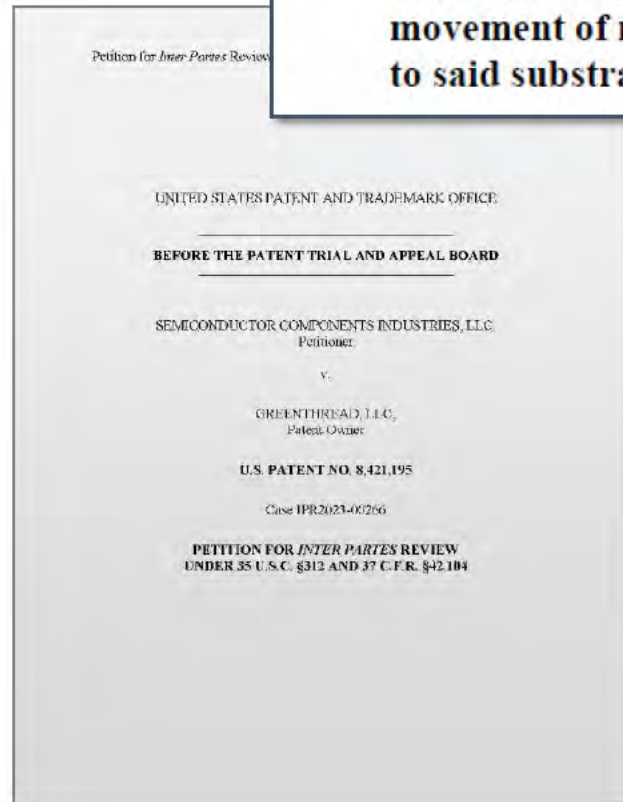
- Petitioner, again, relies on the “prosecution history”—instead of express teachings from Payne.

f. Element [1.5]: “said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate; and”

-00266: Petition [1] at 26

Payne’s downward-sloping graded-dopant concentration aids the movement of minority carriers from the surface layer to the substrate to the same extent to which Applicant relied on the prior art and admitted to the Patent Office that such carrier movement would occur under the same scenario. EX1003, ¶¶95-100. During prosecution, Applicant represented to the Patent Office that a downward-sloping graded-dopant concentration was known in the prior art to create an “inherent ‘built-in’ unidirectional electric field” that moves carriers deep into the substrate (while an upward-sloping concentration, not at issue in Payne, would move those carriers in the opposite direction towards the surface):

-00266: Petition [1] at 27



6. Payne Does Not Move “Minority Carriers” from the “Surface Layer”

- Dr. Blalock’s could not explain any generated electric field from the references’ “graded concentrations” apart from Applicant’s “supposed admissions.”

14 Q. You're looking at what the applicant
15 said, and that's your basis for why Payne meets the
16 "aid the movement of carriers" phrase?

17 MR. SPEEGLE: Same objections.

18 THE WITNESS: Well, I've gone through
19 a lot of discussion, and I have said that
20 the -- let me make sure.

21 So I'm not forming -- I don't need to
22 form a specific definition because the

1 applicant has given us this language already.

2 And the applicant -- so I'm saying "Payne's
3 downward-sloping graded dopant concentration
4 aids the movement of minority carriers...to
5 the same extent to which Applicant relied on
6 the prior art and admitted to the Patent
7 Office that such carrier movement would occur
8 under the same scenario."

9 So, in other words, patent owner's
10 already told us if you have this graded
11 carrier concentration, this claim element is
12 going to be met.

-00263: Ex. 2058 (Blalock Dep. Tr.) at 160:6-161:12

6. Payne Does Not Move “Minority Carriers” from the “Surface Layer”

- Because Payne does not expressly teach moving carriers from the “surface layer,” Petitioners had the burden to identify an electric field in the “surface layer.”

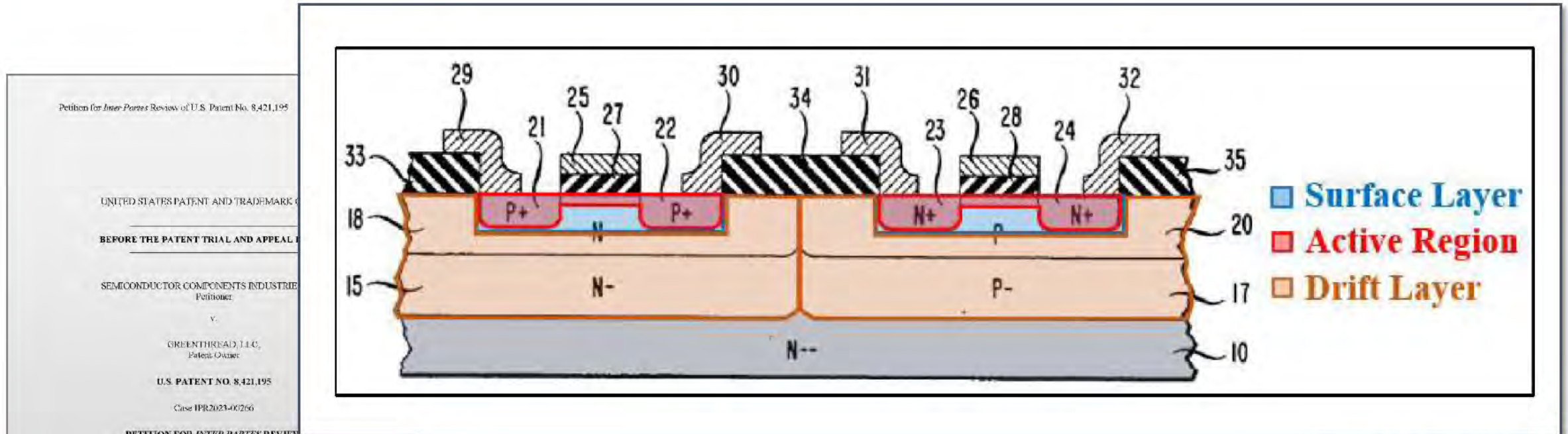
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In the absence of any teaching of the claim limitation in the prior art, Petitioners have two options: 1) they can read “aid the movement of minority carriers from said surface” (or active region) out of the claim or 2) they can argue that any “graded dopant concentration” in the active region will “aid the movement of minority carriers.” Both options fail.

-00266: PO Response [32] at 3

6. Payne Does Not Move “Minority Carriers” from the “Surface Layer”

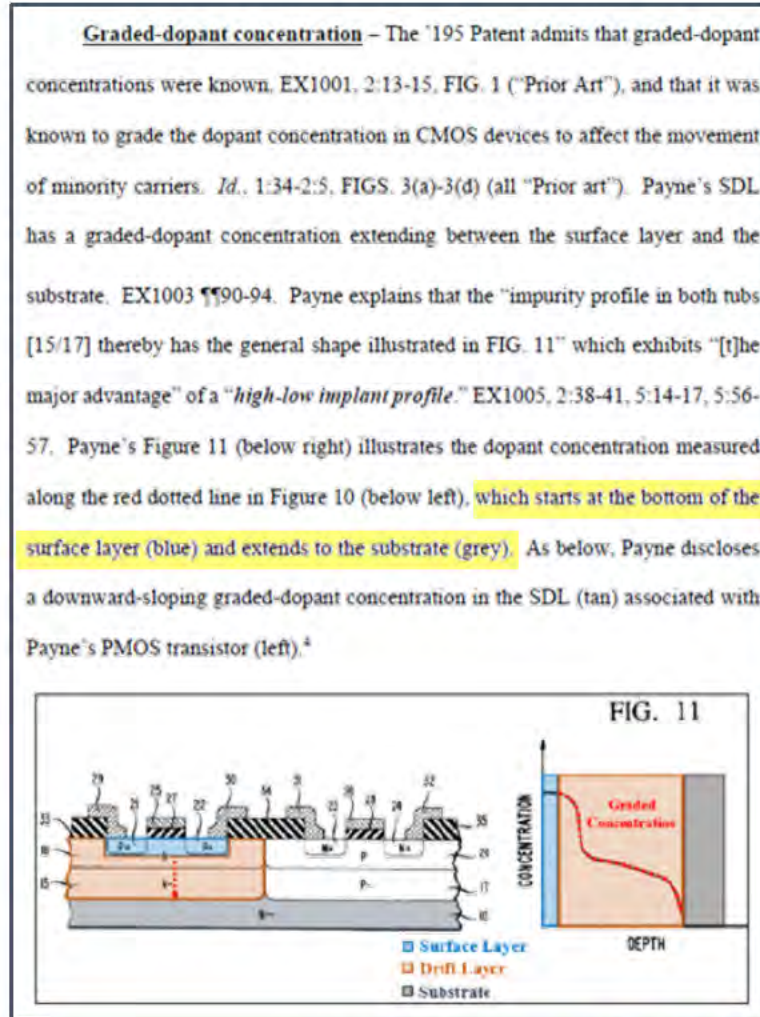
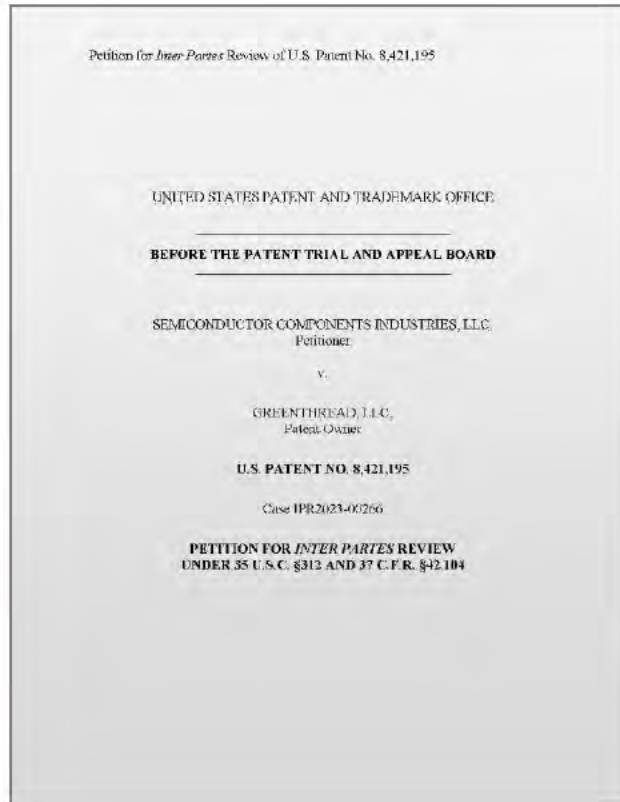
- Petitioner identifies the “active region” in the “surface layer.”



-00266: Petition [1] at 23

6. Payne Does Not Move “Minority Carriers” from the “Surface Layer”

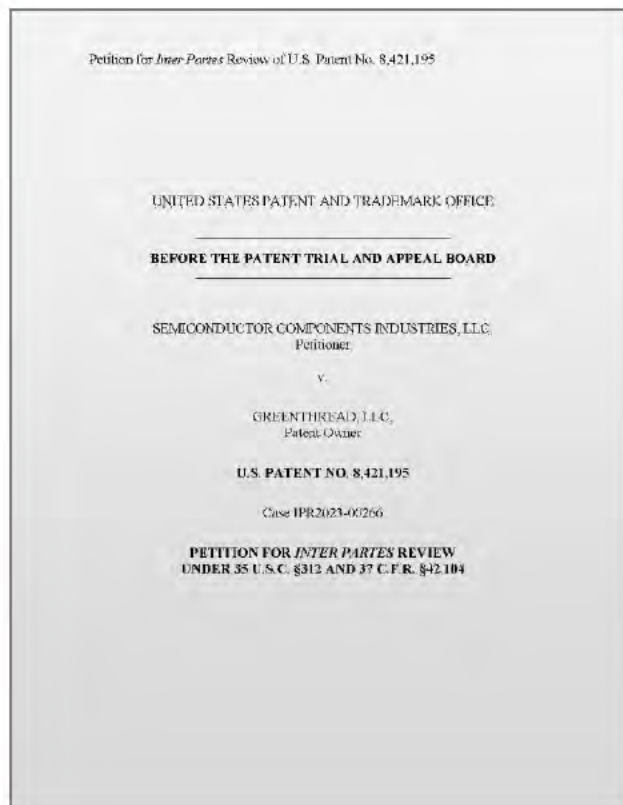
- Petitioner admits the graded dopant concentration “starts at the bottom of the surface layer.”



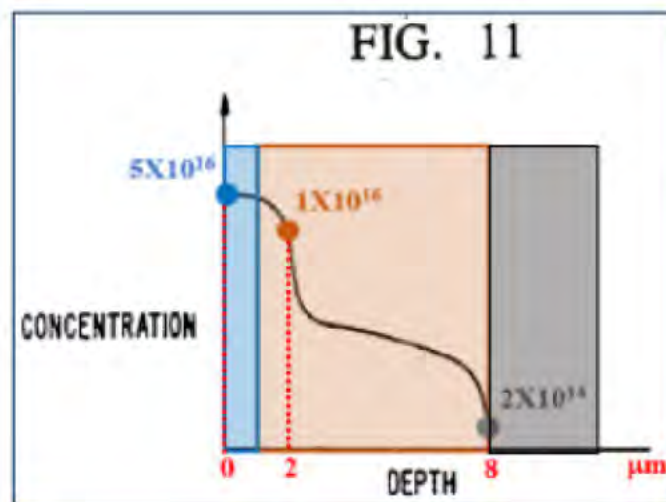
-00266: Petition [1] at 23-24

6. Payne Does Not Move “Minority Carriers” from the “Surface Layer”

- Payne’s added annotations to FIG. 11 does not disclose a graded concentration that would actually aid carrier movement where it is required—**from** the “surface layer.”



EX1005, FIGS. 10-11. Dr. Blalock has annotated Figure 11 to reflect exemplary (maximum) dopant concentrations at various depths disclosed in Payne: (1) 5×10^{16} ions/cm³ at the surface of the shallow wells (depth $0 \mu\text{m}$), (2) 10^{16} ions/cm³ at a depth of $\sim 2 \mu\text{m}$ (boundary of deep and shallow wells), and (3) 2×10^{14} ions/cm³ at a depth of $\sim 8 \mu\text{m}$ (boundary of substrate and deep wells). EX1003, ¶¶90-94.



-00266: Petition [1] at 25

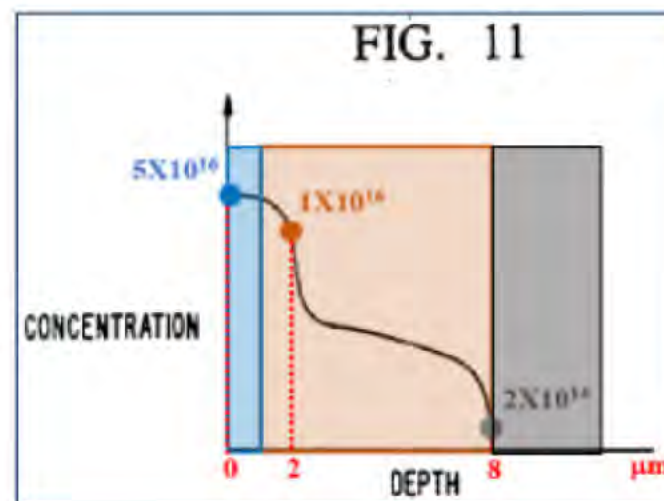
6. Payne Does Not Move “Minority Carriers” from the “Surface Layer”

- Payne discloses only a single impurity concentration for the “surface regions.”
- Payne’s FIG. 11 does not disclose a sloped concentration through the “surface regions.”

The surface impurity concentration of the surface regions is typically $0.5\text{--}5 \times 10^{16}$ ions/cm³ and that of the tub regions is typically $10^{15}\text{--}10^{16}$ ions/cm³, with the former concentration being at least twice as much as the latter over these ranges.

-00266: Ex. 1005 (Payne) at 5:51-55

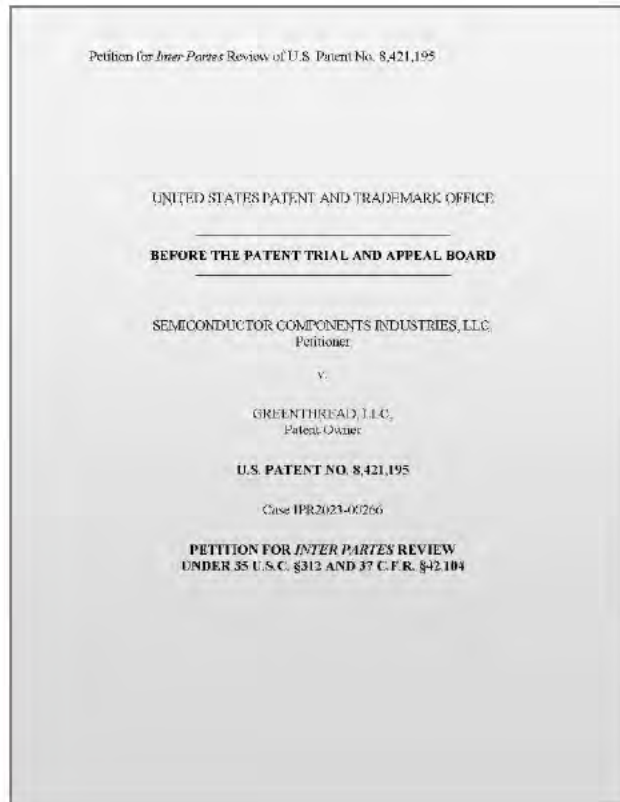
EX1005, FIGS 10-11. Dr. Blalock has annotated Figure 11 to reflect exemplary (maximum) dopant concentrations at various depths disclosed in Payne: (1) 5×10^{16} ions/cm³ at the surface of the shallow wells (depth $0\mu\text{m}$), (2) 10^{16} ions/cm³ at a depth of $\sim 2\mu\text{m}$ (boundary of deep and shallow wells), and (3) 2×10^{14} ions/cm³ at a depth of $\sim 8\mu\text{m}$ (boundary of substrate and deep wells). EX1003, ¶¶90-94.



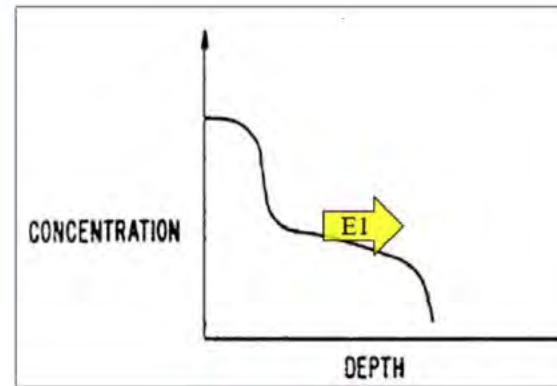
-00266: Petition [1] at 25

6. Payne Does Not Move “Minority Carriers” from the “Surface Layer”

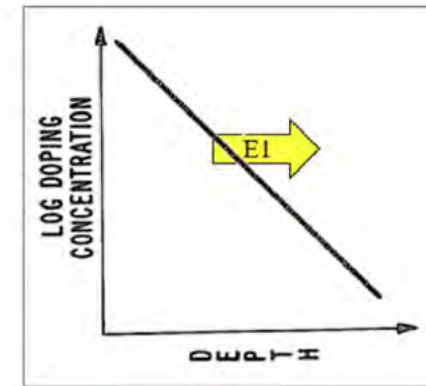
- Petitioner identifies an electric field that does not start in the surface layer.



Thus, according to Jastrzebski, Kamins, Applicant, and PO, Payne’s profile generates a (first) “built-in” static unidirectional electric drift field (illustrated by the yellow arrow labelled “E1” below left) that aids the movement of minority carriers from the surface layer to the substrate.⁵ EX1003, ¶¶95-104.



Ex.1005, FIG. 11



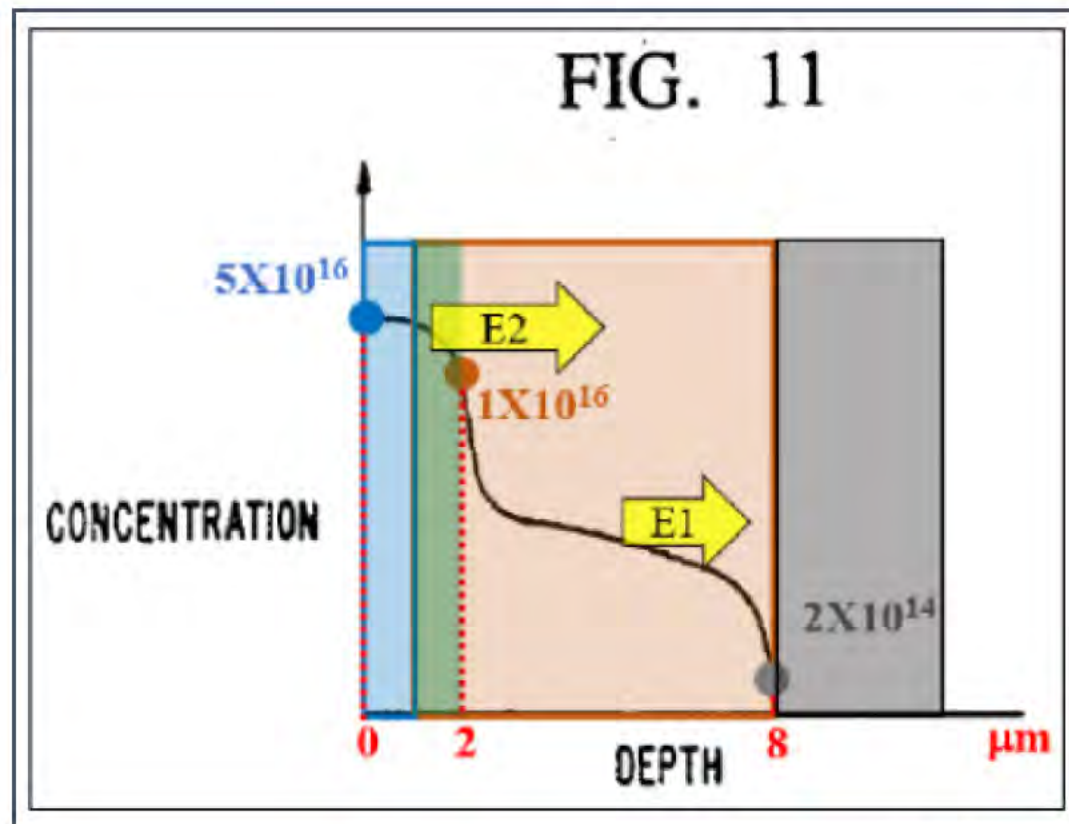
Ex.1010, FIG. 1b

-00266: Petition [1] at 31-32

6. Payne Does Not Move “Minority Carriers” from the “Surface Layer”

- Petitioner later identifies two electric fields that do not start in the surface layer.

Payne’s Figure 11 is further annotated below to show the exemplary first static unidirectional electric drift field (“E1”) present in a deep portion of the SDL (discussed in §IX.A.1.f), and a different, exemplary second static unidirectional electric drift field (“E2”) present in the well region disposed in the SDL. EX1003, ¶¶118-122; *see also* fn.5.

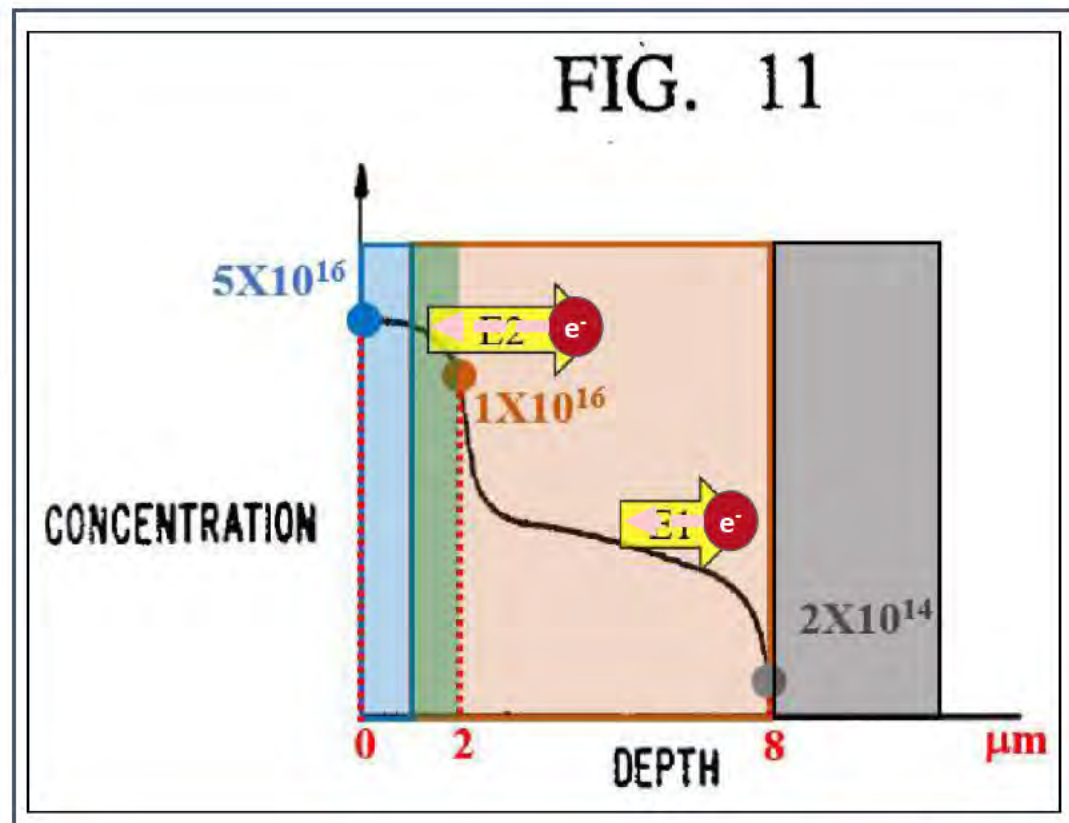


-00266: Petition [1] at 40

6. Payne Does Not Move “Minority Carriers” from the “Surface Layer”

- Petitioner identified two electric fields that will not move electrons from the surface layer.

Payne's Figure 11 is further annotated below to show the exemplary first static unidirectional electric drift field ("E1") present in a deep portion of the SDL (discussed in §IX.A.1.f), and a different, exemplary second static unidirectional electric drift field ("E2") present in the well region disposed in the SDL. EX1003, ¶¶118-122; *see also* fn.5.



-00266: Petition [1] at 40

Overview of Issues

- 1. Petitioner has presented zero “actual evidence” that the Petitions are timely.**
- 2. The Claims require “movement of carriers” from the “surface layer.**
- 3. The '195 and '502 Claims require “movement of minority carriers” from the “surface layer.”**
- 4. Kawagoe does not disclose “movement of carriers” and “movement of minority carriers” from the “surface layer.”**
- 5. Wieczorek does not disclose “movement of carriers” from the “surface layer.”**
- 6. Payne does not disclose “movement of minority carriers” from the “surface layer.”**
- 7. Petitioner has the burden to identify electric fields that would “aid carrier movement.”**
8. Experts confirm that carriers in the “surface layer” are affected by numerous other fields and forces.
9. The “movement of carriers” depends on the sum of all of the fields in the “surface layer.”
10. Dr. Blalock did not analyze any of the fields or force magnitudes in the “surface layer.”
11. Petitioner's prosecution-related arguments are incorrect.
12. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

7. Petitioner Has the Burden to Analyze the Electric Fields



In *Magnum Oil*, we soundly rejected the idea of shifting even the burden of *production* from the petitioner to the patent owner once the Board institutes an IPR where “the patentee’s position is that the patent challenger failed to meet *its* burden of proving obviousness.” 829 F.3d at 1375–76. “Where, as here, the only question presented is whether due consideration of the four *Graham* [obviousness] factors renders a claim or claims obvious, no burden shifts from the patent challeng-

er to the patentee” upon institution. *Id.* at 1376. We therefore reject FanDuel’s suggestion that the patent owner’s failure to put forth rebuttal evidence regarding the substance of the references’ disclosures in any way limited the Board’s ability to decide for itself what the references would teach or suggest to a person of skill in the art. *See Rovalma*, 856 F.3d at 1027 (noting

Fanduel, Inc. v. Interactive Games LLC,
966 F.3d 1334, 1341-42 (Fed. Cir. 2020) (cleaned up)

7. Petitioner Has the Burden to Analyze the Electric Fields

- Because the Prior Art does not expressly teach moving carriers (or minority carriers) from the “surface layer,” Petitioner has the burden to:
 - identify an electric field that is in the correct location (*i.e.*, starts in the “surface layer”)
 - identify an electric field that points in the correct direction
 - analyze the other fields in the “surface layer”

In the absence of any teaching of the claim limitation in the prior art, Petitioners have two options: 1) they can read “aid carrier movement from the first surface” (or active region) out of the claim or 2) they can argue that any “graded dopant concentration” in the active region will “aid carrier movement.” Both options fail.

-00263: PO Response [31] at 2-3

Overview of Issues

1. **Petitioner has presented zero “actual evidence” that the Petitions are timely.**
2. **The Claims require “movement of carriers” from the “surface layer.**
3. **The '195 and '502 Claims require “movement of minority carriers” from the “surface layer.”**
4. **Kawagoe does not disclose “movement of carriers” and “movement of minority carriers” from the “surface layer.”**
5. **Wieczorek does not disclose “movement of carriers” from the “surface layer.”**
6. **Payne does not disclose “movement of minority carriers” from the “surface layer.”**
7. **Petitioner has the burden to identify electric fields that would “aid carrier movement.”**
8. **Experts confirm that carriers in the “surface layer” are affected by numerous other fields and forces.**
9. The “movement of carriers” depends on the sum of all of the fields in the “surface layer.”
10. Dr. Blalock did not analyze any of the fields or force magnitudes in the “surface layer.”
11. Petitioner's prosecution-related arguments are incorrect.
12. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

8. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Blalock testified that “other fields,” including “externally applied voltages” and “environmental effects” can affect carrier movement.

13 Q. I'm saying apart from what the patent
14 owner said and whatever your interpretation of that
15 may be, are you saying that as a matter of physics,
16 such an electric field will definitely be created
17 and will definitely move carriers?

18 MR. SPEEGLE: Objection, form.

19 THE WITNESS: I mean, it depends on --
20 as I said, if there are no other fields --
21 and I guess I should qualify for not an
22 absolute zero temperature, all this stuff,

1 but in normal circumstances, if you have a
2 concentration gradient, it will result in an
3 electric field, which will then act on the
4 carriers.

5 BY MR. JAIRAM:

6 Q. So you mentioned that if there aren't
7 other fields present and the carrier was introduced
8 into that field, you'll move the carrier.

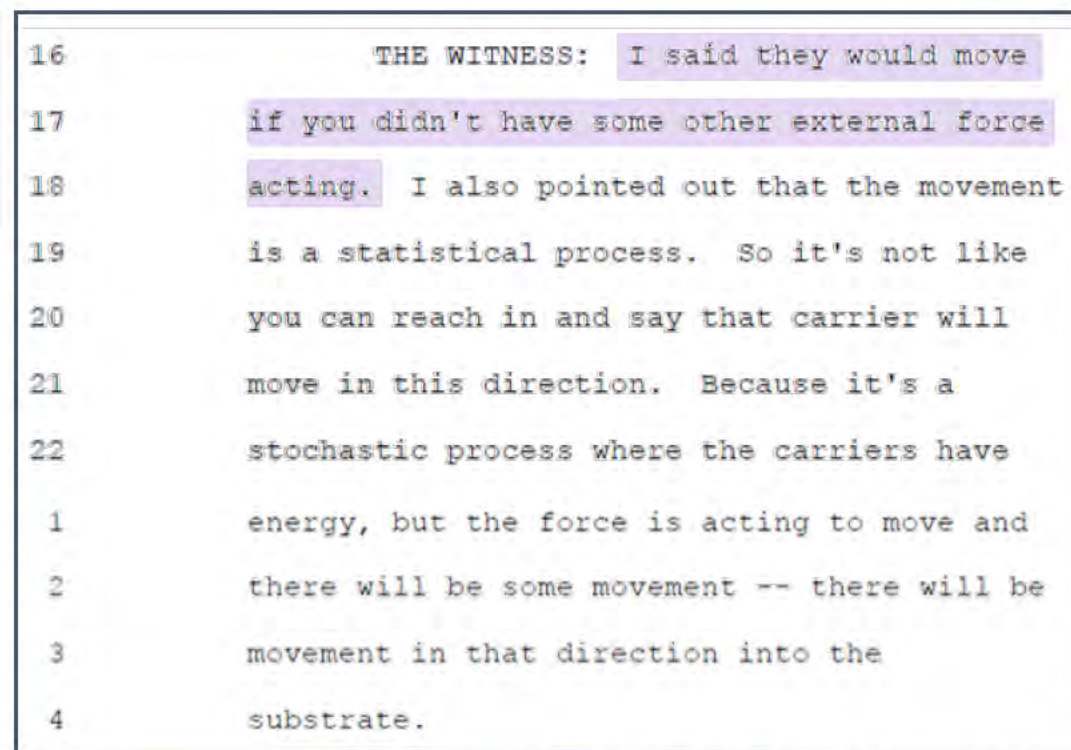
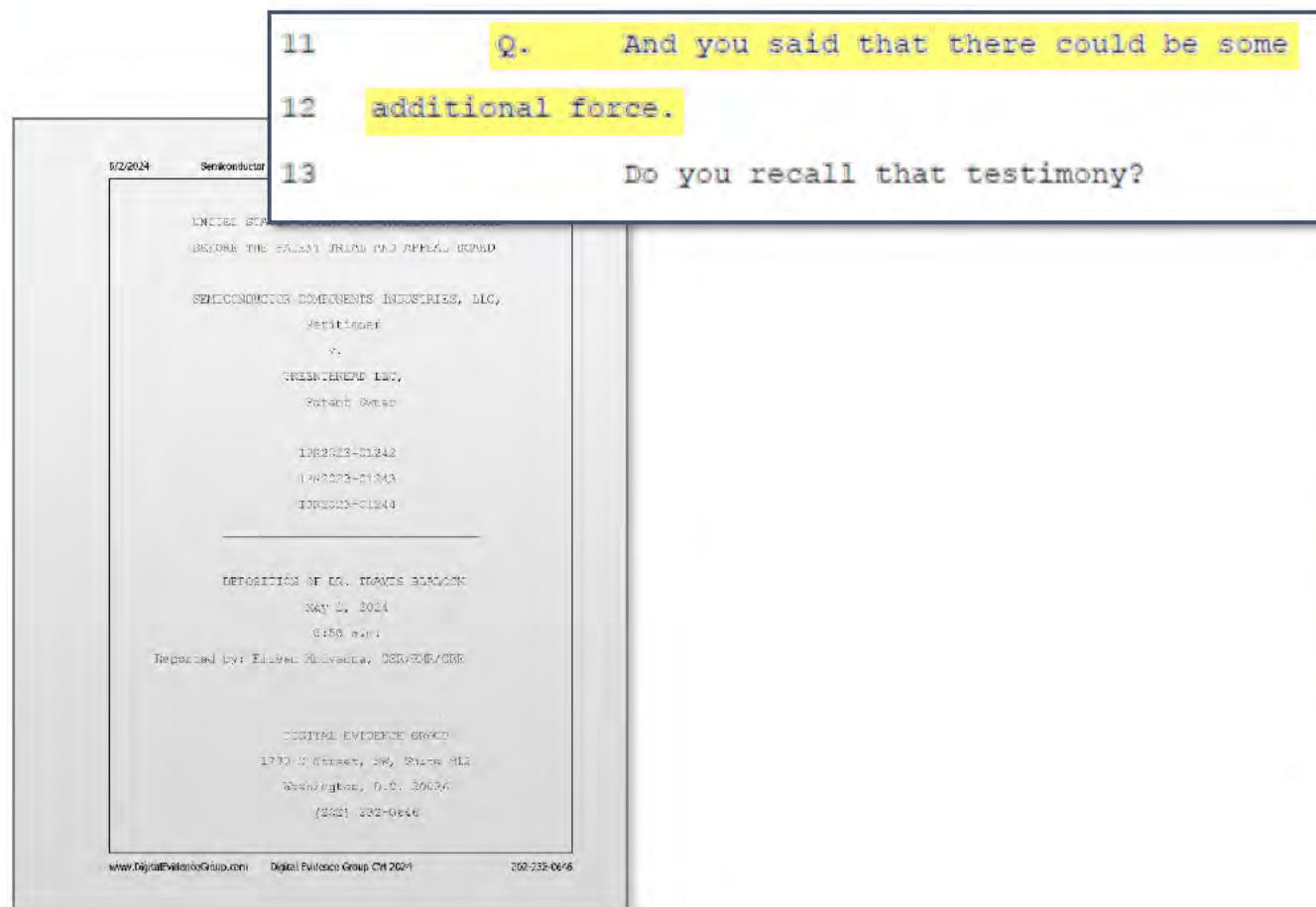
9 Where could other fields come from?

10 A. Externally applied voltages from the
11 circuit, if the structure's in a circuit, things
12 like that. Or I suppose some environmental effect.
13 I don't know.

-00263: Ex. 2058 (Blalock Dep. Tr.) at 131:13-132:13

8. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Blalock confirmed that any “other external force” would affect the carrier movement.



-00263: Ex. 2058 (Blalock Dep. Tr.) at 187:11-188:4

8. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Blalock confirmed that any “other fields” would affect the carrier movement.

21 Q. So does every downward-sloping
22 gradient -- graded dopant concentration create the
1 force that you mentioned?
2 A. Within that -- yeah, locally within
3 that gradient, there's a -- like I said, if you
4 haven't applied some sort of large external voltage
5 or something, it's just the device, and you've got
6 the graded concentration, because of the way the
7 carrier is rearranged, you'll end up with an
8 electric field. And if you then introduce a
9 carrier, you'll have a force on it and that will
10 move. On average. All of these carriers are moving
11 in a stochastic process.

12 Q. And there's no way that they wouldn't
13 move, on average?
14 MR. SPEEGLE: Objection, form.
15 THE WITNESS: If they -- if there
16 aren't any other fields present and the
17 carrier was introduced into that field, it
18 will move so.

-00263: Ex. 2058 (Blalock Dep. Tr.) at 129:21-130:18

8. Carriers in the Surface Layer are Affected by Numerous Fields

- Monolithic's expert explained that other factors affect carrier motion from the surface layer (*i.e.*, temperature, P-N capacitance, crystal imperfections).

15 Q. Okay. Can, does temperature affect
16 the carrier motion?

17 A. In general? Yes. General, the
18 mobility of carriers decreases as the temperature
19 increases.

20 The number of minority carriers, you
21 know, this is not excess minority carriers, this
22 is just the number of minority carriers in an
1 undisturbed sector, increases with temperature.

2 And since the fusion coefficient is
3 proportional to the mobility, as the temperature
4 goes up, both mobility and the diffusion
5 coefficient goes down.

-00263: Ex. 2085 at 187:11-188:4

8 Q. Do imperfections in a silicon
9 crystal affect carrier motion?

10 A. Yes, that's one of the scatter
11 mechanisms. So, it reduces mobility or it
12 reduces diffusivity.

-00263: Ex. 2085 (Campbell Dep. Tr.) at 39:8-12

8. Carriers in the Surface Layer are Affected by Numerous Fields

- Monolithic's expert explained that other factors affect carrier motion from the surface layer (*i.e.*, temperature, P-N capacitance, crystal imperfections).

19 Q. What -- so, what about the
20 capacitant created a PN junction?

21 A. Okay. Now we're talking.

22 Q. Okay. Does the capacitance created
1 at a PN junction affect carrier motion?

2 A. Yes. It creates a fairly
3 substantial electric field in the depletion
4 region.

5 There's a region near the junction
6 where the carriers are, annihilate each other.
7 They come across the boundary and recombine them
8 creating a region where there are a few carriers.

9 This is called the depletion region.
10 And you're left with positive and
11 negatively-charged ions on the two sides of the
12 junction.

13 And, that creates a capacitance.

14 Thus, and that also creates an electric field.

-00263: Ex. 2085 (Campbell Dep. Tr.)
at 35:19-36:14

8. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Glew explained that a semiconductor's gate voltage creates an electric field and that the device's internal resistance affects carrier movement.

97. I disagree with OnSemi's assertion that external forces are "hypothetical," and that prior art does not have any external forces. In all of the prior art references, there will be external forces. For example, as I described in paragraphs 36 and 37 of my declaration, there will be a force due to a voltage applied to a gate of the transistor. In the example, in my declaration, the voltage applied to the gate will create an electric field that points in a downward direction. Similarly, the graded dopant region in Fig. 5B will create an electric field that points in the downward direction. In this example, the electric field created by the graded dopant region may aid carrier movement of holes from the surface to the substrate because they point in the same downward direction. If, however, the electric field pointed in the upward direction, the electric field would not aid carrier movement of holes from the surface to the substrate, and the question of whether the holes moved at all would depend on the net effect of the two fields.

54. In my opinion, a POSITA would have known that if two forces are acting on an object in opposite directions, both forces cannot aid its movement. Either the opposing forces are equal—and there is no movement—or the two forces are not equal and the object moves in the direction of the force having larger magnitude, albeit diminished by the counter force. The smaller force does not "aid" the movement of the object, because it is pushing *against* the movement. The magnitude of the concentration gradient plays a substantial role, because a small gradient may not be sufficient to overcome the resistance of the material in which the gradient exists.

-00263: Ex. 2064 (Glew Decl.) at ¶ 54

-00263: Ex. 2064 (Glew Decl.) at ¶ 97

8. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Glew confirmed some of the forces and affects explained by Petitioners' experts.

14 Q. Is that what's creating the downward force
15 we talked about in Figure 5B?
16 A. That's part of it. Mainly, what we talk
17 about, there is a diffusion, diffusional force too.
18 But, you know, if you think of a drop of ink in a
19 pool, you put it a corner, it doesn't stay there.
20 It will eventually diffuse out.

1 UNITED STATES
2 BEFORE THE
3 SEMICONDUCTOR
4 INDUSTRIES, LLC
5
6 Petitioner
7
8 Vs.
9 GREENTHREAD, LLC,
10
11 Patent Owner.
12
13 Case IPR2023-01242
U.S. Patent No. 11,121,222
Case IPR2023-01243
U.S. Patent No. 10,510,842
Case IPR2023-01244
U.S. Patent No. 11,121,222
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17 DEPOSITION OF ALEXANDER GLEW, PhD
18 July 16, 2024
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23 Reported by: Dana Peabody, RDE, CDE, CSR No. 5333
24 Page 1 through 193
25 Job No. HCU 5760791
Page 1
Veritas Legal Solutions
340-293-7000
CASEM EXHIBIT 1906, Page 1
Semiconductor Components Industries, LLC v. GreenThread, LLC
IPR2023-01243

21 If I had a pile of electrons or holes in
22 one area, and I didn't have them -- I had a dearth
23 next to it, then there's a little bit of diffusional
24 driving force to get them to move. Usually they
25 don't move, really, on their own without some other
1 force, like a little bit of a temperature to
2 activate or a little bit of voltage, but there is a
3 diffusional force also.
4 There's other -- there's other forces that
5 cause things to happen that we're not discussing
6 here: Stress, energy. Any form of energy can cause
7 things to happen, potentially.

-00263: Ex. 1056 (Glew Dep. Tr.) at 87:14-88:7

8. Carriers in the Surface Layer are Affected by Numerous Fields

- Dr. Glew confirmed on cross-examination that a semiconductor's resistance affects carrier movement.

1 UNITED STATES PATENT AND TRADEMARK OFFICE
2 BEFORE THE PATENT TRIAL AND APPEAL BOARD
3
4 SEMICONDUCTOR COMPONENTS
5 INDUSTRIES, LLC,
6
7 Petitioner,
8
9 Vs.
10
11 GREENTHREAD, LLC,
12
13 Patent Owner.
14
15 Case IPR2023-01242
16 U.S. Patent No. 11,121,222
17 Case IPR2023-01243
18 U.S. Patent No. 10,510,842
19 Case IPR2023-01244
20 U.S. Patent No. 11,111,222
21
22 DEPOSITION OF ALEXANDRE GLEW,
23 July 16, 2024
24
25 Reported by: Dana Peabody, RUL, CDR, CSR No. 5334
Page 1 through 193
Job No. HCU 5750791

12 Q. And you didn't identify any contrary
13 forces that would act opposite of the graded dopant
14 concentration in Payne?
15 MR. WHITEHURST: Object to form.
16 THE WITNESS: One with skill in the art
17 would understand these are semiconductors, so
18 there's always some resistance to a semiconductor.

-00263: Ex. 1056 (Glew Dep. Tr.) at 87:14-88:7

Page 1
Veritas Legal Solutions
340-293-7800
CASEM EXHIBIT 1906, Page 1
Semiconductor Components Industries, LLC v. Greenthread, LLC
IPR2023-01243

Overview of Issues

1. Petitioner has presented zero “actual evidence” that the Petitions are timely.
2. The Claims require “movement of carriers” from the “surface layer.
3. The '195 and '502 Claims require “movement of minority carriers” from the “surface layer.”
4. Kawagoe does not disclose “movement of carriers” and “movement of minority carriers” from the “surface layer.”
5. Wieczorek does not disclose “movement of carriers” from the “surface layer.”
6. Payne does not disclose “movement of minority carriers” from the “surface layer.”
7. Petitioner has the burden to identify electric fields that would “aid carrier movement.”
8. Experts confirm that carriers in the “surface layer” are affected by numerous other fields and forces.
9. The “movement of carriers” depends on the sum of all of the fields in the “surface layer.”
10. Dr. Blalock did not analyze any of the fields or force magnitudes in the “surface layer.”
11. Petitioner's prosecution-related arguments are incorrect.
12. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

9. Movement of Carriers Depends on the Net Field

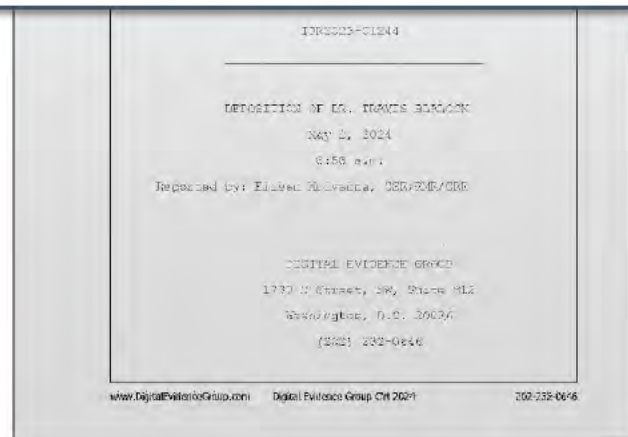
- Dr. Blalock testified that it is the **net** field/force that affects carrier movement.

6 Q. Suppose there are two forces pushing
7 on the carrier in opposite directions. Do both of
8 those forces aid the movement of the carrier?
9 MR. SPEEGLE: Object to form.
10 THE WITNESS: The net field will exert
11 a force which -- it will have some direction
12 depending on what the field directions were,
13 but we can calculate the net force. And it
14 will have -- it will act to move the carrier.

16 Q. When you talk about "the net force,"
17 are you saying even if there's a first force and
18 then some second additional force, the net effect is
19 that movement of the carrier will still be aided?
20 MR. SPEEGLE: Objection, incomplete
21 hypothetical.
22 THE WITNESS: I said the net force --
1 you know, if there is some other imaginary
2 second force, which is not what we're talking
3 about here, but if somehow someone created
4 some second force, those two forces -- those
5 two fields -- at the location of the carrier,
6 there would be some summation of those
7 fields.

8 And the net summation of those fields
9 and their directions will create a force that
10 tends to move the carrier unless the force
11 is -- I suppose if this hypothetical field
12 somehow exactly canceled out the other, maybe
13 there would be no movement; but, otherwise,
14 as long as there's some net force, it will
15 tend to move the carrier in the direction of
16 the force.

-00263: Ex. 2058 (Blalock Dep. Tr.) at 188:6-189:16



9. Movement of Carriers Depends on the Net Field

- Dr. Blalock explained that other forces “might be larger than the force created by the gradient.”

17 Q. Is there a gradient that would be so
18 steep or so shallow, that it would not aid carrier
19 movements?

22 THE WITNESS: It will create a force.
1 A shallow or a steep one will create a force.
2 As I said a few moments ago, as I've already
3 answered, if there are -- through some other
4 imagined, who knows, means, someone creates
5 an additional force, that might be larger
6 than the force created by the gradient.

-00263: Ex. 2058 (Blalock Dep. Tr.) at 137:17-138:6

1/2/2024 Semiconductor

19 movements?

UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

SEMICONDUCTOR COMPONENTS INDUSTRIES, LLC,
Petitioner
v.
FREINTREX LLC,
Patent Owner

1922023-01242
1922023-01243
1922023-01244

DEPOSITION OF DR. THOMAS BOGARD
MAY 2, 2024
8:50 AM

Reported by: Eileen McQuade, DEPT/EMC/CRB

DIGITAL EVIDENCE GROUP
1770 W Street, SW, Suite 412
Washington, D.C. 20036
(202) 232-0646

www.DigitalEvidenceGroup.com Digital Evidence Group CM 2024 202-232-0646

9. Movement of Carriers Depends on the Net Field

- Dr. Blalock explained that the magnitude of the GDC-generated force depends on the particular slope of the gradient.

3 Q. How do you know the magnitude of the
4 force a dopant concentration puts on carriers?
5 A. Well, as the patent owner discussed --
6 I have references to it, but it's -- I don't know.
7 Anyway, it's related to the -- the steepness of the
8 gradient, the slope of the concentration gradient.
9 And that was also well known by a POSITA as well,
10 which the patent owner pointed out also.

DEPOSITION OF DR. TRAVIS BLALOCK
May 21, 2024
6:50 a.m.
Reported by: Elvira Rodriguez, CDR/236/CBB

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-00263: Ex. 2058 (Blalock Dep. Tr.) at 89:3-10

20 Q. And can you explain how the
21 statistical recombination rate would potentially
22 impact the extent to which carriers would move in
1 response to an electric field resulting from the
2 gradient dopant concentration in Kawagoe?
3 A. Well, the strength of the field will
4 accelerate carriers and move them in a particular
5 direction, in this case deeper into the substrate.
6 And the steeper the slope, the stronger that field
7 so the faster they would move.

-00263: Ex. 2058 (Blalock Dep. Tr.) at 213:20-214:7

9. Movement of Carriers Depends on the Net Field

- Dr. Blalock testified that there would be instances where a “downward-sloping graded dopant concentration” does not aid carrier movement.

1 Q. Are you able to tell me any example of
2 a situation in which there would be a
3 downward-sloping graded dopant concentration, but it
4 somehow doesn't aid carrier movement?

UNITED STATES PATENT AND TRADEOFFICE
BEFORE THE PATENT TRIALS AND APPEALS BOARD

SEMICONDUCTOR COMPONENTS INDUSTRIES, LLC,

Plaintiff,

v.

GREENTHREAD LTD.,

Defendant.

1002023-01242

1002023-01343

1002023-01344

DEPOSITION OF DR. FRANK BLALOCK

MAY 21, 2024

8:50 a.m.

Reported by: Elvira Rodriguez, 0004205/000

DIGITAL EVIDENCE GROUP

1730 P Street, NW, Suite 412

Washington, D.C. 20036

(202) 242-0646

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Digital Evidence Group, Inc. 2024

202-232-0646

7 THE WITNESS: Again, you know, I'm not
8 trying to define the limits of "aid." What I
9 can tell you, if you do have a
10 downward-sloping gradient, it will create an
11 electric field and it will create a force.

12 To the extent that is sufficient to
13 define the word "aid," but I'm not -- I'm not
14 saying -- I'm not trying to say the complete
15 definition of "aid" and how big something has
16 to be or small or whatever. I'm just saying
17 if you have a gradient, you'll get a force
18 and it will tend to move carriers. I'm
19 trying to find prior art that maps to the
20 structure sufficiently.

22 Q. And you just said, "if you have a
1 gradient, you'll get a force and it will tend to
2 move carriers."

3 Will it move carriers or -- what do
4 you mean "tend to move carriers"?

5 A. Well, it creates a force on the
6 carriers. All other things being equal, they'll
7 move. I mean, you could have, I suppose -- I don't
8 want to theorize. I'm not -- I mean, again, the
9 point of this declaration is are the teachings of
10 Kawagoe disclosing what's in the '222 and '042?

11 And I find that they're right on track
12 with what's appearing in '042, but that doesn't mean
13 I've tried to define the full scope of the word
14 "aid."

-00263: Ex. 2058 (Blalock Dep. Tr.) at 126:1-127:14

9. Movement of Carriers Depends on the Net Field

- Monolithic's expert explained that a "properly constructed" electric field must have "sufficient" "intensity."

14 Q. So, about the middle of the page
15 there's a sentence that you say, "As will be
16 discussed these charged species move in response
17 to an electric field, and so, an electric field
18 that is properly constructed will push the
19 minority carriers away from the surface, making
20 their collection much less probable."
21 Do you see that sentence?
22 A. Yes, I do.

10/10/2014 Mon
IN THE UNITED
STATES OF AMERICA
MONOLITHIC POWER
INC.,
Petitioner,
vs.
GREENTHREAD, INC.
Respondent.
Case No. 1:13-cv-00263
Reported by: LEEI W. GORDON, RGS, ORF, RSA,
California USA #12962
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Washington, D.C. 20006
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www.DigitalEvidenceGroup.com Digital Evidence Group, Inc. 2014
Greenthread Ex. 2013, p. 1 of 66
Semiconductor v. Greenthread

-00263: Ex. 2085 (Campbell Dep. Tr.)
at 33:14-34:14

1 Q. What did you mean by
2 "properly constructed"?
3 A. You would have to construct an
4 electric field that moves the carriers away, and
5 that means the electric field has to be, the
6 direction has to be correct.
7 If you're moving poles, then you
8 have to have the electric field that points
9 downward.
10 If you're moving electrons, the
11 electric field has to be pointing upward and you
12 have to have a sufficient electric field
13 intensity to prevent most of the carriers from
14 being collected by the drain.

9. Movement of Carriers Depends on the Net Field

- Dr. Glew also recognized that the net force is that matters to aiding carrier movement.

54. In my opinion, a POSITA would have known that if two forces are acting on an object in opposite directions, both forces cannot aid its movement. Either the opposing forces are equal—and there is no movement—or the two forces are not equal and the object moves in the direction of the force having larger magnitude, albeit diminished by the counter force. The smaller force does not “aid” the movement of the object, because it is pushing *against* the movement. The magnitude of the concentration gradient plays a substantial role, because a small gradient may not be sufficient to overcome the resistance of the material in which the gradient exists.

-00263: Ex. 2064 (Glew Decl.) at ¶ 54

55. I see that in response to the question “have you looked at any aspect of the gradient other than its being downward sloping?” Dr. Blalock replied: “As I’ve said, the patent owner tells us that that’s sufficient, so *[t]hat’s what I did. I have not done calculations of the slope per se.*” Ex. 2058, 195 (emphasis added). And in response to the question: “Do you need to know the magnitude of the force on carriers to know if their movement is being aided?” Dr. Blalock said: “Well, the patent owner -- the patent hasn’t given us a threshold for aiding. ... *when I look at the prior art, when I find a concentration gradient, ... if there was a gradient, then it was producing that force and aiding the movement.*” Ex. 2058, 91-92 (emphasis added). Since the mere direction of the gradient is *not* sufficient to determine whether there is a “net force”—the premise of Dr. Blalock’s analysis is incorrect.

-00263: Ex. 2064 (Glew Decl.) at ¶ 55

GreenThread Ex. 2064 p. 1 of 75
Semiconductor v. GreenThread

Overview of Issues

1. Petitioner has presented zero “actual evidence” that the Petitions are timely.
2. The Claims require “movement of carriers” from the “surface layer.
3. The '195 and '502 Claims require “movement of minority carriers” from the “surface layer.”
4. Kawagoe does not disclose “movement of carriers” and “movement of minority carriers” from the “surface layer.”
5. Wieczorek does not disclose “movement of carriers” from the “surface layer.”
6. Payne does not disclose “movement of minority carriers” from the “surface layer.”
7. Petitioner has the burden to identify electric fields that would “aid carrier movement.”
8. Experts confirm that carriers in the “surface layer” are affected by numerous other fields and forces.
9. The “movement of carriers” depends on the sum of all of the fields in the “surface layer.”
10. Dr. Blalock did not analyze any of the fields or force magnitudes in the “surface layer.”
11. Petitioner's prosecution-related arguments are incorrect.
12. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

10. Dr. Blalock Did Not Perform the Required Analysis

- Dr. Blalock testified that he did not calculate the slope of the concentration gradients for any of the asserted references.

8 Q. And regarding any of these three

9 references, for the mapping of the claim phrase "aid

10 carrier movement," have you looked at any aspect of

11 the gradient other than its being downward sloping?

12 MR. SPEEGLE: Objection, form.

13 THE WITNESS: As I've said, the patent

14 owner tells us that that's sufficient, so

15 that's what I did. I have not done

16 calculations of the slope per se.

5/2/2024 Semiconductor Components Industries, LLC v. Greenthread, LLC

UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE PATENT TRIAL AND APPEAL BOARD

SEMICONDUCTOR COMPONENTS INDUSTRIES, LLC
Petitioner

v.

GREENTHREAD LLC,
Patent Owner

1082023-01242
1082023-01343
1082023-01344

DEPOSITION OF DR. FRANCIS BLALOCK
May 2, 2024
9:50 a.m.

Reported by: Elvira Rodriguez, CDR/PTB/COR

DIGITAL EVIDENCE GROUP
1732 P Street, NW, Suite 412
Washington, D.C. 20036
(202) 232-0646

www.DigitalEvidenceGroup.com Digital Evidence Group CDR 2024 202-232-0646

-00263: Ex. 2058 (Blalock Dep. Tr.) at 195:8-16

10. Dr. Blalock Did Not Perform the Required Analysis

- Dr. Blalock could not testify to any analysis he conducted besides observing that the references' concentration gradients were downward-sloping.

10 Apart from calculation of slope, which
11 you said you didn't do, apart from sloping being
12 downward, which you said you have observed, is there
13 anything else about the concentration gradients of
14 Kawagoe, Wieczorek or Payne that you analyzed for
15 your opinion regarding the phrase "aid carrier
16 movement" of the independent claim?

17 A. I mean, I'm -- also, of course,
18 depending on the -- I mean, my own understanding
19 that a gradient -- a downward-sloping gradient will
20 create a field that will create a force that will
21 act on the carrier, as I've said many times today.

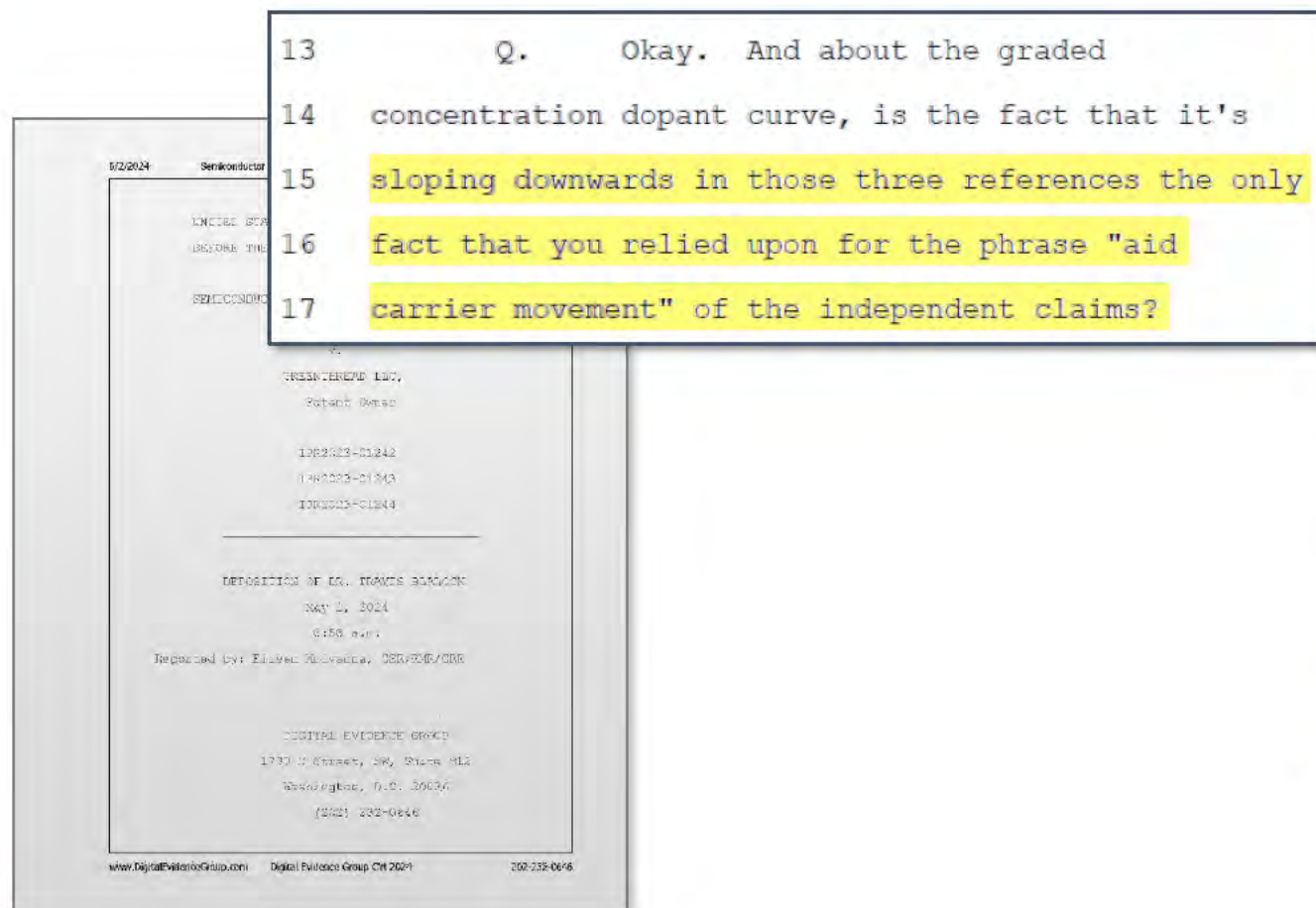
22 Q. That's, again, the property of being
1 downward sloping. I'm asking if there's anything
2 else at all about the concentration curve that's
3 relevant to your analysis, either that you did in
4 your analysis or that you think maybe you didn't do
5 it, but would still be relevant.

6 A. As long as we're -- I mean, I
7 certainly analyzed where the gradient was, the
8 structure, all that stuff. Right. I understand --
9 in other words, I don't want to be left being
10 interpreted as all that matters is the gradient.
11 What also matters is the structure and the location
12 of active regions and all of those things as well.

-00263: Ex. 2058 (Blalock Dep. Tr.) at 196:10-197:12

10. Dr. Blalock Did Not Perform the Required Analysis

- Dr. Blalock could not testify to any analysis he conducted besides observing that the references' concentration gradients were downward-sloping.



20 THE WITNESS: The claims only refer to
21 a graded concentration. And they don't
22 specify any specific thresholds, so I didn't
1 do that analysis because it wasn't necessary.
2 But I -- as I've said before, the -- I
3 understand those forces act. That's just
4 from basic physics of how these things
5 operate. And the fact that that force is
6 there is apparently, according to the patent
7 owner, sufficient. So that was adequate to
8 map the claim.

-00263: Ex. 2058 (Blalock Dep. Tr.) at 197:13-198:8

Overview of Issues

1. Petitioner has presented zero “actual evidence” that the Petitions are timely.
2. The Claims require “movement of carriers” from the “surface layer.
3. The '195 and '502 Claims require “movement of minority carriers” from the “surface layer.”
4. Kawagoe does not disclose “movement of carriers” and “movement of minority carriers” from the “surface layer.”
5. Wieczorek does not disclose “movement of carriers” from the “surface layer.”
6. Payne does not disclose “movement of minority carriers” from the “surface layer.”
7. Petitioner has the burden to identify electric fields that would “aid carrier movement.”
8. Experts confirm that carriers in the “surface layer” are affected by numerous other fields and forces.
9. The “movement of carriers” depends on the sum of all of the fields in the “surface layer.”
10. Dr. Blalock did not analyze any of the fields or force magnitudes in the “surface layer.”
11. Petitioner's prosecution-related arguments are incorrect.
12. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

11. Petitioners' Prosecution-Related Arguments are Incorrect

- Petitioner relies entirely on a misreading of the prosecution history to make up for Kawagoe's lack of express disclosure "aiding carrier movement" from the surface.

Petition for Inter Partes Review

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SEMICONDUCTOR DEVICE

GREEN THREAD EX. 2913

PETITION UNDER 35 U.S.C. § 31

Id., 16:2-11. Kawagoe's teaching is consistent with Applicant's representation to the Patent Office during prosecution of the parent '195 Patent that a downward-sloping graded dopant concentration was known in the prior art to create an "inherent 'built-in' unidirectional electric field" that moves carriers deep into the substrate (while an upward-sloping concentration, not at issue in Kawagoe, would move carriers in the opposite direction towards the surface):

[T]he graded dopant concentration itself creates a 'built-in' electrical field that forces the movement of carriers into a particular direction, whereby the "direction" of the electrical field and the resulting direction of the carrier movement depends solely on the slope of the graded concentration of dopant.

Amended Petition (08/19/2012)

EX1016, 289-290 (underlining in original); see also EX1003, ¶¶101-102. Applicant also represented that "a unidirectional drift (electric) field necessarily affects *all* the present minority carriers in the same way.... Depending on the particular slope of the graded concentration of dopant, *all* minority carriers are either swept "down" ... or "up."^{xxx} EX1016, 289. Applicant cited Jastrzebski in support. *Id.*, 290. In Jastrzebski, the doping concentration is "decreasing with depth" from the top surface 11 (purple) of the substrate 10, as shown in Figure 1b below. EX1010, 5:14-22. Jastrzebski teaches that this downward-sloping graded dopant concentration creates an electric drift field that "force[s] most of the charge carriers ... *deep into the substrate[.]*" *Id.*, 2:27-32, 5:14-22.

-00263: Petition [1] at 25-26

11. Petitioners' Prosecution-Related Arguments are Incorrect

- Petitioner relies entirely on a misreading of the prosecution history to make up for Wieczorek's lack of express disclosure "aiding carrier movement" from the surface.

Petition for *Inter Partes* Review of U.S. Patent No. 11,316,014

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SEMICONDUCTOR COMPONENTS INDUSTRIES, I.L.C.
Petitioner,

v.

GREENTHREAD LLC,
Patent Owner

U.S. PATENT NO. 11,316,014
Case IPR2023-00263

PETITION FOR INTER PARTES REVIEW
UNDER 35 U.S.C. §312 AND 37 C.F.R. §42.104

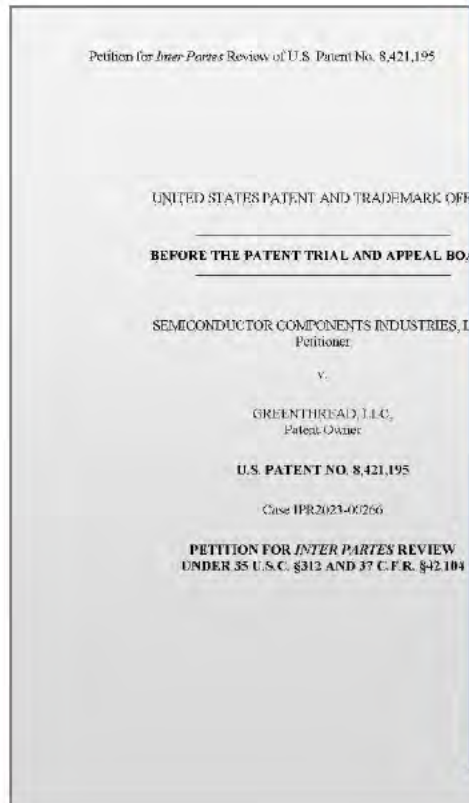
Acme (08/10/2023)

Further, Wieczorek's downward-sloping graded dopant concentrations aid carrier movement from the surface and from the first and second active regions towards/to an area of the substrate where there are no active regions to the same extent to which Applicant relied on the prior art and admitted to the Patent Office that such carrier movement would occur under the same scenario. EX1003, ¶155. As detailed in §VII.A.1.h, during prosecution of the parent '195 Patent, Applicant represented to the Patent Office that a downward-sloping graded dopant concentration was known in the prior art to move carriers deep into the substrate. Applicant cited Jastrzebski and Kamins in support. §VII.A.1.h. Notably, according to Jastrzebski, a downward-sloping graded dopant concentration creates an electric drift field that "force[s] most of the charge carriers ... *deep into the substrate[.]*" EX1010, 2:27-32, 5:14-22. EX1003, ¶156, 158.

-00263: Petition [1] at 54

11. Petitioners' Prosecution-Related Arguments are Incorrect

- Petitioner relies entirely on a misreading of the prosecution history to make up for Payne's lack of express disclosure "aiding carrier movement" from the surface.



Payne's downward-sloping graded-dopant concentration aids the movement of minority carriers from the surface layer to the substrate to the same extent to which Applicant relied on the prior art and admitted to the Patent Office that such carrier movement would occur under the same scenario. EX1003, ¶¶95-100. During prosecution, Applicant represented to the Patent Office that a downward-sloping graded-dopant concentration was known in the prior art to create an "inherent 'built-in' unidirectional electric field" that moves carriers deep into the substrate (while an upward-sloping concentration, not at issue in Payne, would move those carriers in the opposite direction towards the surface):

-00266: Petition [1] at 27

11. Petitioners' Prosecution-Related Arguments are Incorrect

- Dr. Blalock admitted that his entire analysis was based on his—and Petitioner's—understanding of the prosecution history.

14 Q. If patent owner hadn't allegedly said
15 that, then would you reach the same conclusion that
16 the claim element is met?

17 MR. SPEEGLE: Objection to form.

18 THE WITNESS: Well, I would have
19 written this report differently.

20 BY MR. JAIRAM:

21 Q. What do you mean --

22 A. I suppose. Well, I couldn't refer --

1 I obviously couldn't refer to the applicant.

02/2024 Semiconductor
ONCE THE
BEFORE THE
SEMICONDUCTOR
Referred by E
DIGITAL EVIDENCE GROUP
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Washington, D.C. 20036
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www.DigitalEvidenceGroup.com Digital Evidence Group, Inc 2024 202-232-0616

2 Q. What would you have written
3 differently?

4 A. I don't know. I'd have to go back and
5 work through that. But that's not the situation.
6 My opinion is that the applicant has told us these
7 things. The applicant represented, in '96, "a
8 unidirectional drift field necessarily affects all
9 the present minority carriers in the same
10 way...depending on the particular slope of the
11 graded concentration of dopant, all minority
12 carriers are either swept 'down' or 'up.'"

-00263: Ex. 2058 (Blalock Dep. Tr.) at 161:14-162:12

11. Petitioners' Prosecution-Related Arguments are Incorrect

- Greenthread did not say: all “graded dopant concentrations” will move carriers from the “surface layer.”
- Greenthread said: the electric field must move the carriers from the surface layer.

ATTORNEY DOCKET
1288-03

SEMICONDUCTOR

CROSS-REFERENCE

[0001] This application is a continuation of U.S. patent application Ser. No. 10/000,000, filed September 3, 2004, which is hereby incorporated by reference.

FIELD OF INVENTION

[0002] This invention relates to semiconductor devices, and more particularly to a method of manufacturing a semiconductor device.

BACKGROUND OF THE INVENTION

[0003] Bipolar junction transistors (BJTs) are widely used in analog and digital integrated circuits. In a BJT, the carrier transport is controlled by the electric field of the base-emitter junction. The electric field is created by the applied bias voltage. The electric field is also affected by the graded dopant concentration of the base region. The electric field is used to enhance the carrier transport in the base region.

Applicant respectfully disagrees with this position because (as previously argued by Applicant) a unidirectional drift (electric) field necessarily affects all the present minority carriers in the same way — moving all minority carriers in the same direction because of the unidirectional drift due to the existence of the electric field. *See* “Physics and Technology of Semiconductor Devices,” A.S. Grove, pp. 224-225, John Wiley and Sons, Inc., New York, 1st Edition 1967 (“This same electric field will then be of such direction as to aid the motion of injected holes. Thus the injected minority carriers will now move not only by diffusion but also by drift due to the existence of this electric field.”). Depending on the particular slope of the graded concentration of dopant, all minority carriers are either swept “down” (from the surface layer to the substrate) or “up” (from the substrate to the surface layer). *See* Applicant’s Figs. 5(b) and 5(c).

The Office Action also states that “such a unidirectional drift field may attempt to apply a force on all minority carriers in a specific direction, it does not appear to ensure (without knowing other parameters of the device) that it will draw ‘all’ minority carriers...” Yet, this argument appears to not consider that the graded dopant concentration itself creates a “built-in”

electrical field that forces the movement of carriers into a particular direction, whereby the “direction” of the electrical field and the resulting direction of the carrier movement depends solely on the slope of the graded concentration of dopant. With regard to the existence of a “built-in” electric field created by a graded dopant density, *see, e.g.,* Jastrzebski (US 4,481,522) col. 5, lines 11-13 (cited in Office Action). Applicant respectfully submits that this inherent “built-in” unidirectional electric field is the additional parameter for ensuring that all minority carriers are being moved in one direction and which parameter the Office Action deemed to be missing from the disclosure.

-00263: Ex. 1016 ('195 Prosecution History) at 289-290

11. Petitioners' Prosecution-Related Arguments are Incorrect

- Greenthread did not say: all “graded dopant concentrations” will move carriers from the “surface layer.”
- Greenthread said: the electric field must move the carriers from the surface layer.

ATTORNEY DOCKET NO.
1288-03

PATENT

SEMICONDUCTOR DEVICES WITH GRADED DOPANT CONCENTRATIONS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application is a Divisional of U.S. application Ser. No. 10/987,654, filed September 3, 2004, which application is incorporated herein by reference.

FIELD OF INVENTION

[0002] This present invention relates to all semiconductor devices. Particularly, it applies to diodes, avalanche diodes, Schottky diodes, JFETs, IGFETs, bipolar transistors, IGBTs (Insulated Gate Bipolar Transistors), mixed signal circuits and sensor devices, including Charge Coupled Devices (CCDs) as well as CMOS technologies.

BACKGROUND OF INVENTION

[0003] Bipolar Junction Transistors (BJTs) are minority carrier devices. Their operation is based on the injection of minority carriers into a region of high conductivity. However, minority carriers also modulate the conductivity in BJTs. Consequently, bulk carriers play a significant role in the switching performance of BJTs. The maximum frequency of operation of BJTs is limited by the base transit time as well as the carrier recombination time. The device is switched off (prior to beginning the next cycle). The dominant carrier mechanism in BJTs is carrier diffusion. Carrier drift current component is fairly small, especially in uniformly doped base BJTs. Efforts have been made in graded base transistors to create an “aiding drift field” to enhance the diffusing minority carrier’s speed from emitter to collector. However, most semiconductor devices, including various power MOSFETs (traditional, DMOS, lateral, vertical),

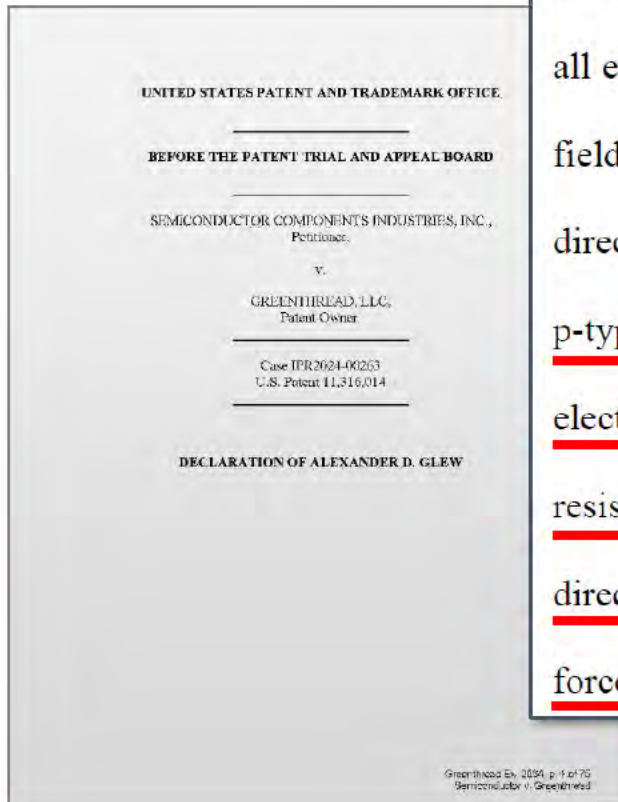
knowing other parameters of the device) that it will draw ‘all’ minority carriers...’ Yet, this argument appears to not consider that the graded dopant concentration itself creates a “built-in” electrical field that forces the movement of carriers into a particular direction, whereby the “direction” of the electrical field and the resulting direction of the carrier movement depends solely on the slope of the graded concentration of dopant. With regard to the existence of a

DNSEMI EXHIBIT 1315, Page 1

-00263: Ex. 1016 ('195 Prosecution History) at 289-290

11. Petitioners' Prosecution-Related Arguments are Incorrect

- Dr. Glew confirmed that whether the resulting direction of carrier movement is “up” or “down”—if there is movement at all—depends on a number of factors.



In this slide, OnSemi has taken my testimony out of context to wrongly imply that all electric fields will aid carrier movement. This is not true. Whether an electric field from a graded dopant concentration will aid carrier movement in a particular direction depends on numerous factors. For example, (1) are the dopants n-type or p-type?; (2) are the dopants increasing or decreasing?; (3) is the carrier a hole or an electron?; (4) is the electric field generating a force that is sufficient to overcome the resistance of the semiconductor?; (5) is the force in the same direction or the opposite direction of another force?; and (6) is the force greater than or less than the other force. To take my testimony and wrongly imply that all graded dopant concentrations

-00263: Ex. 2064 (Glew Decl.) at ¶ 90

11. Movement of Carriers from the Surface Layer

- EDTX already rejected Petitioners' prosecution history argument.

'195 Patent File Wrapper April 17, 2012 Response Pursuant to 37 CFR 1.114 Amendment E at 6–7, Dkt. No. 50–12 at 59–60. Taken in context, that the direction of the electrical field and the carrier movement “depends solely on the slope of the graded concentration of dopant” does not mandate that the slope must be only increasing or only decreasing to maintain a unidirectional drift field. For example, the slope has both a direction and a magnitude and Defendant suggests that the direction of the drift electric field depends solely on *the direction* of the slope of the graded concentration of dopant. This is not justified by the prosecution history statements that Defendant cites. In fact, the *Grove* reference cited by the patentee in the above-quoted statement includes Figure 7.13 (reproduced and annotated below) which depicts a dopant concentration that both increases and decreases in the “graded base region” that provides an “electric field . . . of such direction as to aid the motion of injected holes.” A.S. Grove, *Physics and Technology of Semiconductor Devices* 224–25 (1967), Dkt. No. 50–13 at 22–23. In other words, the patentee cited

* Citations to the parties' filings are to the filing's number in the docket (Dkt. No.) and pin cites are to the page numbers assigned through EDTX.

Greenthread Ex. 2012, p. 1 of 12
Semiconductor v. Greenthread

-00263: Ex. 2082 (EDTX Order)
at 15

Applicant respectfully disagrees with this position because (as previously argued by Applicant) a unidirectional drift (electric) field necessarily affects all the present minority carriers in the same way – moving all minority carriers in the same direction because of the unidirectional drift due to the existence of the electric field. *See* “Physics and Technology of Semiconductor Devices,” A.S. Grove, pp. 224–225, John Wiley and Sons, Inc., New York, 1st Edition 1967 (“This same electric field will then be of such direction as to aid the motion of injected holes. Thus the injected minority carriers will now move not only by diffusion but also by drift due to the existence of this electric field.”). Depending on the particular slope of the graded concentration of dopant, all minority carriers are either swept “down” (from the surface layer to the substrate) or “up” (from the substrate to the surface layer). *See* Applicant’s Figs. 5(b) and 5(c).

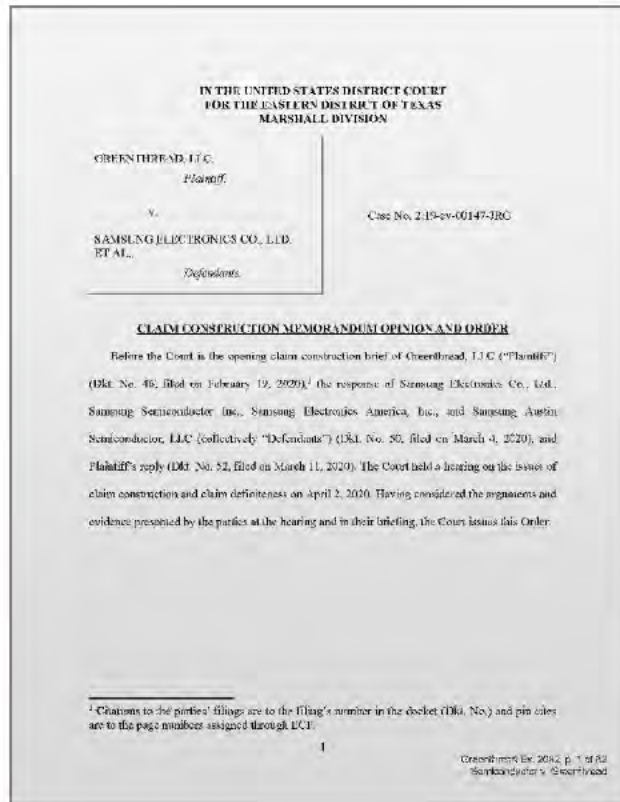
semiconductor devices, including various power MOSFETs (traditional, DMOS, lateral, vertical)

ONSEMI EXHIBIT 1215 Page 1

-00263: Ex. 1016 ('195 Prosecution History) at 289

11. Movement of Carriers from the Surface Layer

- EDTX ruled that carrier movement depends on the direction and magnitude of the slope.



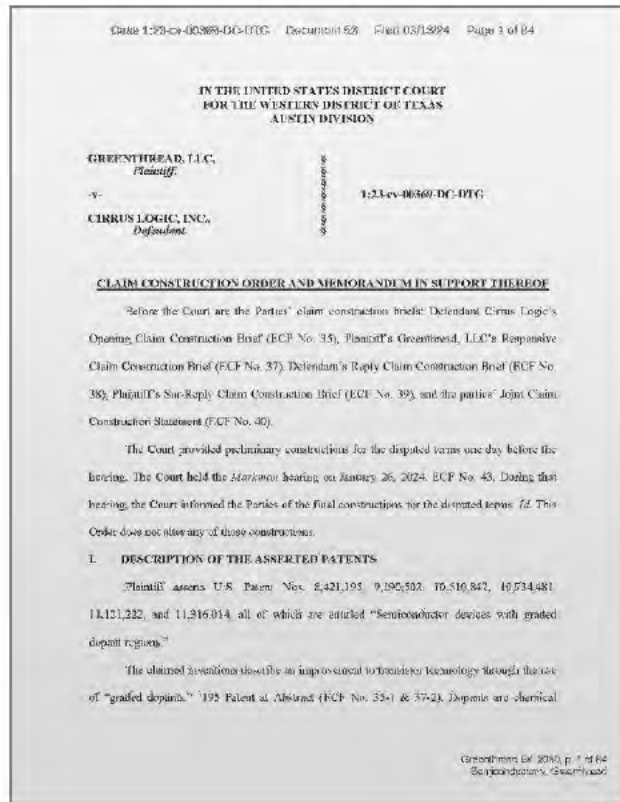
'195 Patent File Wrapper April 17, 2012 Response Pursuant to 37 CFR 1.114 Amendment E at 6–7, Dkt. No. 50-12 at 59–60. Taken in context, that the direction of the electrical field and the carrier movement “depends solely on the slope of the graded concentration of dopant” does not mandate that the slope must be only increasing or only decreasing to maintain a unidirectional drift field. For example, the slope has both a direction and a magnitude and Defendant suggests that the direction of the drift electric field depends solely on *the direction* of the slope of the graded concentration of dopant. This is not justified by the prosecution history statements that Defendant cites. In fact, the *Grove* reference cited by the patentee in the above-quoted statement includes Figure 7.13 (reproduced and annotated below) which depicts a dopant concentration that both increases and decreases in the “graded base region” that provides an “electric field . . . of such direction as to aid the motion of injected holes.” A.S. Grove, *Physics and Technology of Semiconductor Devices* 224–25 (1967), Dkt. No. 50-13 at 22–23. In other words, the patentee cited

-00263: Ex. 2082 (EDTX Order) at 15

11. Movement of Carriers from the Surface Layer

- WDTX ruled that a graded concentration does not necessarily “aid carrier movement.”
- The dopants must be “sufficiently graded” in order to “aid movement.”

Second, the claim language provides some guidance as to the scope of this term. More specifically, the claim language describes that the graded concentration of dopants creates an electric field. *See, e.g.*, '195 Patent, Claim 1, Limitation [d] (“said drift layer having a graded concentration of dopants ... said drift layer further having a first static unidirectional electric drift field to aid the movement of minority carriers from said surface layer to said substrate”). The Court concludes that a person of skill would understand that the graded concentration has to be **sufficiently graded** to result in a “static unidirectional electric drift field to **aid the movement of minority carriers.**” This establishes a minimum graded concentration of dopants, *i.e.*, a graded concentration of dopants that is below this minimum will not aid in the movement of minority carriers and thus is not a graded concentration.



-00263: Ex. 2080 (WDTX Order) at 39-40

Overview of Issues

1. Petitioner has presented zero “actual evidence” that the Petitions are timely.
2. The Claims require “movement of carriers” from the “surface layer.
3. The '195 and '502 Claims require “movement of minority carriers” from the “surface layer.”
4. Kawagoe does not disclose “movement of carriers” and “movement of minority carriers” from the “surface layer.”
5. Wieczorek does not disclose “movement of carriers” from the “surface layer.”
6. Payne does not disclose “movement of minority carriers” from the “surface layer.”
7. Petitioner has the burden to identify electric fields that would “aid carrier movement.”
8. Experts confirm that carriers in the “surface layer” are affected by numerous other fields and forces.
9. The “movement of carriers” depends on the sum of all of the fields in the “surface layer.”
10. Dr. Blalock did not analyze any of the fields or force magnitudes in the “surface layer.”
11. Petitioner's prosecution-related arguments are incorrect.
12. Greenthread's licensing agreements provide substantial evidence of objective indicia of non-obviousness.

12. Objective Indicia of Non-Obviousness



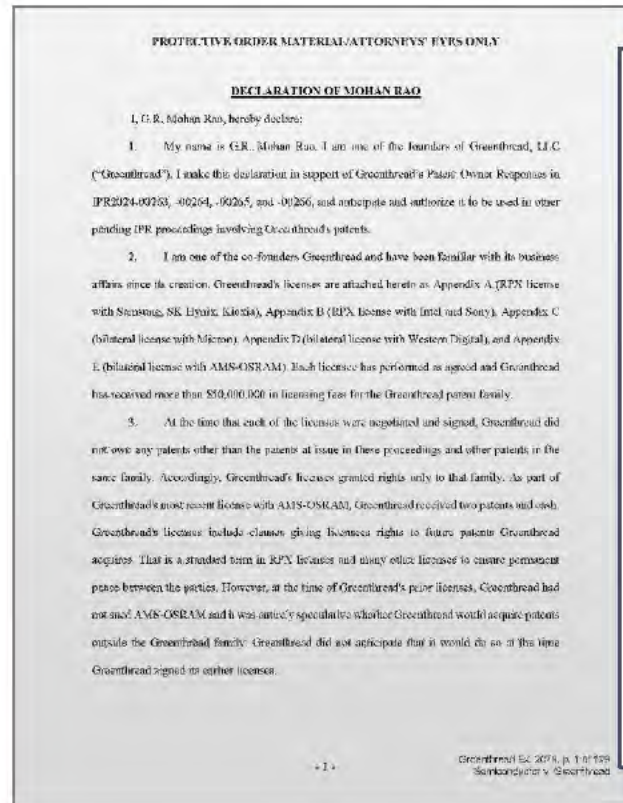
(Fed.Cir.1983). Objective evidence of non-obviousness is an important component of the obviousness inquiry because “evidence of secondary considerations may often be the most probative and cogent evidence in the record.” It may often establish that an invention appearing to have been obvious in light of the prior art was not.” *Id.* This objective evidence must be “considered as part of all the evidence, not just when the decisionmaker remains in doubt after reviewing the art.” *Id.* at 1538–39. Thus, in

We conclude that Transocean presented sufficient evidence for the jury to find that Transocean’s licensing supports nonobviousness. From Transocean’s testimony regarding the value of the licenses relative to litigation costs and regarding licenses with companies under no apparent threat of litigation, a reasonable jury could have found that the licenses reflect the value of the claimed invention and are not solely attributable to litigation. As a result, the district court erred by holding that the jury lacked substantial evidence to support its finding regarding licensing.

Transocean Offshore Deepwater Drilling, Inc. v. Maersk Drilling USA, Inc.,
699 F.3d 1340, 1349, 1353 (Fed. Cir. 2012)

12. Objective Indicia of Non-Obviousness

- Two semiconductor companies took licenses without any threat of litigation.
- There is no evidence that these companies took a license to save litigation costs.
- The license was for the entire patent family related to graded dopant concentrations.



-000263: Ex. 2078 (Dr. Rao Decl.) at 2

12. Objective Indicia of Non-Obviousness

- Intel, [REDACTED] Micron, and Western Digital also licensed the patents.

EXHIBIT E

LICENSEE NULLITY PROCEEDINGS AND LICENSOR LITIGATIONS

Greenthread, LLC v. Intel Corporation, 22-cv-02001-IR (D. Or.)

[REDACTED]

Intel Corp. v. Greenthread LLC, IPR2023-00260
Intel Corp. v. Greenthread LLC, IPR2023-00308
Intel Corp. v. Greenthread LLC, IPR2023-00386
Intel Corp. v. Greenthread LLC, IPR2023-00420
Intel Corp. v. Greenthread LLC, IPR2023-00541
Intel Corp. v. Greenthread LLC, IPR2023-00548
Intel Corp. v. Greenthread LLC, IPR2023-00552

[REDACTED]

outside the Greenthread family. Greenthread did not anticipate that it would do so at this time.
Greenthread signed its earlier license.

-000263: Ex. 2078 at 55

EXHIBIT D – LITIGATION

Greenthread, LLC v. Micron Technology, Inc. et al., 23-cv-00333 (D. Del.)

-000263: Ex. 2078 at 81

EXHIBIT D – LITIGATION

Greenthread, LLC v. Western Digital Corporation et al., 1:23-cv-00326-RGA (D. Del.)

-000263: Ex. 2078 at 101

GREENTHREAD-AMS-OSRAM SETTLEMENT

EXHIBIT D – LITIGATION and IPRs

Greenthread, LLC v. OSRAM GmbH et al., 2:23-cv-00179-JRG (E.D. Tex.)

IPR2024-00001, IPR2024-00016, IPR2024-00017, IPR2024-00018, IPR2024-00019, IPR2024-00020, IPR2024-00021 and all other proceedings challenging the validity of a Licensed Patent.

-000263: Ex. 2078 (Dr. Rao Decl.) at 122