IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

AUTHORIZATION TO COMMUNICATE VIA THE INTERNET AND EMAIL

Recognizing that Internet communications are not secure, I hereby authorize the USPTO to communicate with the undersigned and practitioners in accordance with 37 CFR 1.33 and 37 CFR 1.34 concerning any subject matter of this application by video conferencing or electronic mail. I understand that a copy of these communications will be made of record in the application file.

Respectfully submitted,

/Bill R. Naifeh, Reg. No. 44,962/

Bill R. Naifeh
Registration No. 44,962

Bill R. Naifeh
Law Office of Bill Naifeh
P.O. Box 803423
Dallas, TX 75380
972-726-9500
214-550-2542 (fax)

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

AFFIRMATIVE RECESSION OF PREVIOUS DISCLAIMER

This Application is a continuation or continuation-in-part of previous applications and patents.

Except as explicitly set forth in the prosecution of this application, to the extent any amendments, characterizations, or other assertions made (in this or in any related patent applications or patents, including any parent, sibling, or child) with respect to any art, prior or otherwise, could be construed as a disclaimer of any subject matter supported by the present disclosure of this application, Applicant hereby rescinds and retracts such disclaimer. Applicant also respectfully submits that any prior art considered in any related patent applications or patents, including any parent, sibling, or child, may need to be re-visited.

New claims in this Application may be broader than the claims previously allowed in parent or related applications.

Respectfully submitted,

/Bill R. Naifeh, Reg. No. 44,962/

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Registration No. 44,962

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P.O. Box 803423
Dallas, TX 75380
972-726-9500
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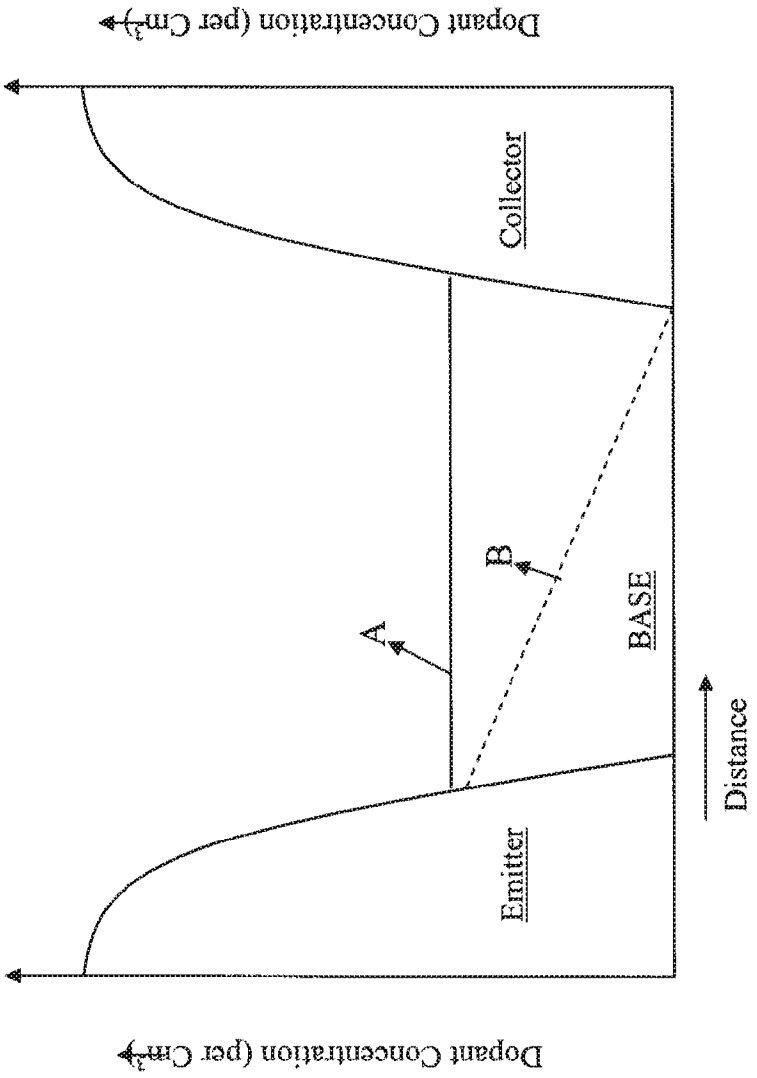


Figure 1 Prior Art

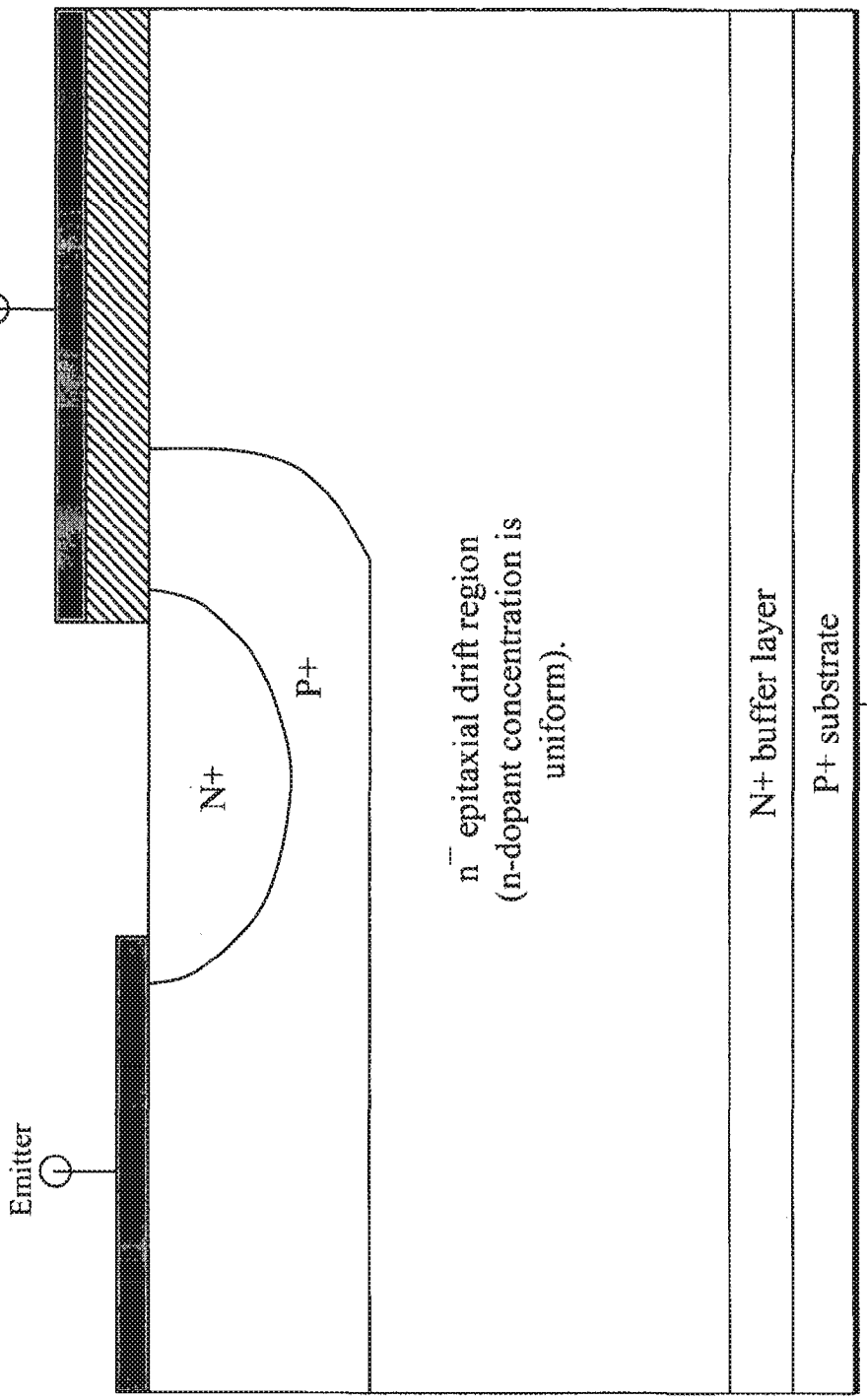


FIGURE 2 Prior art

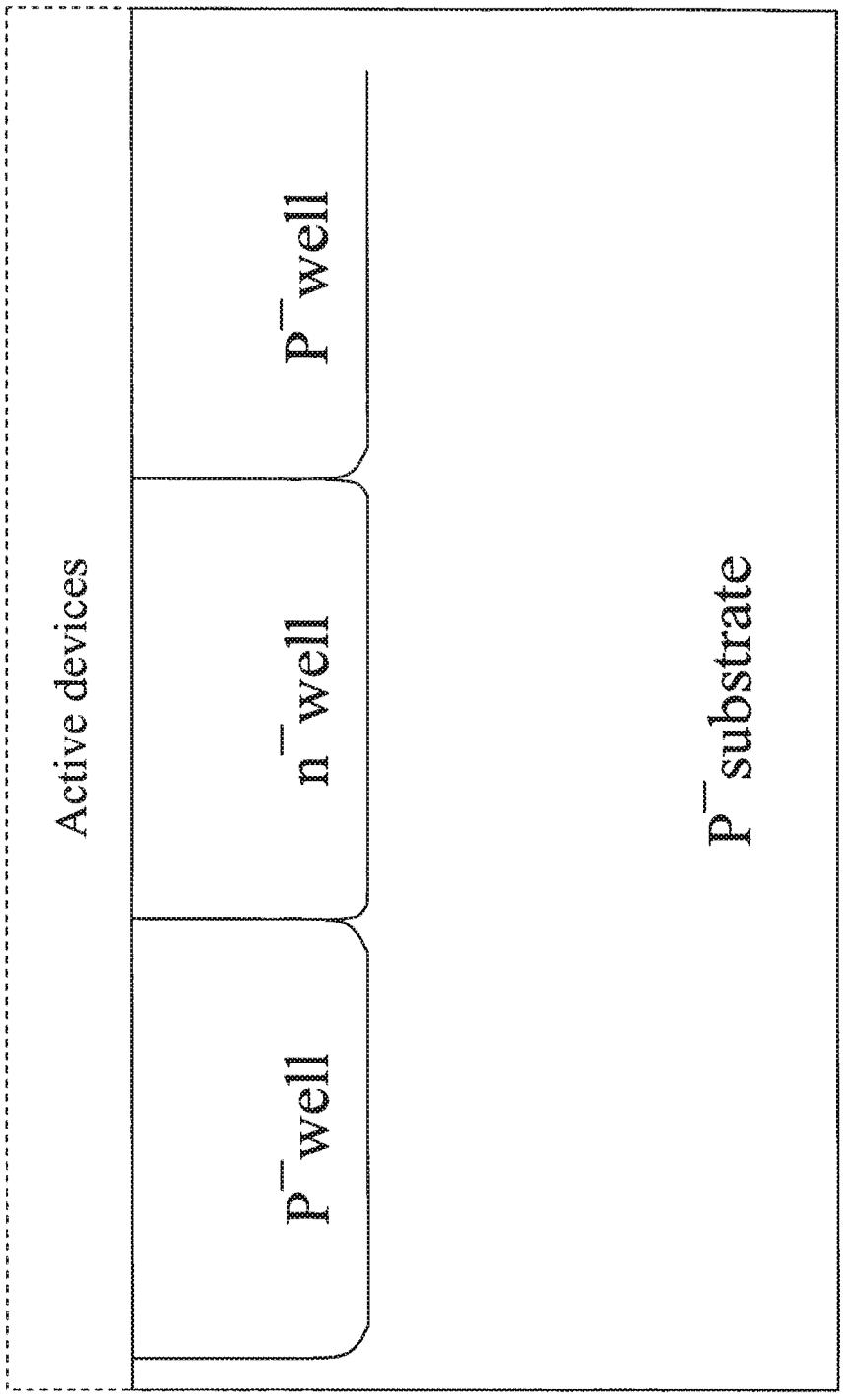


FIGURE 3A Prior art (Twin well CMOS) for a CMOS integrated circuit

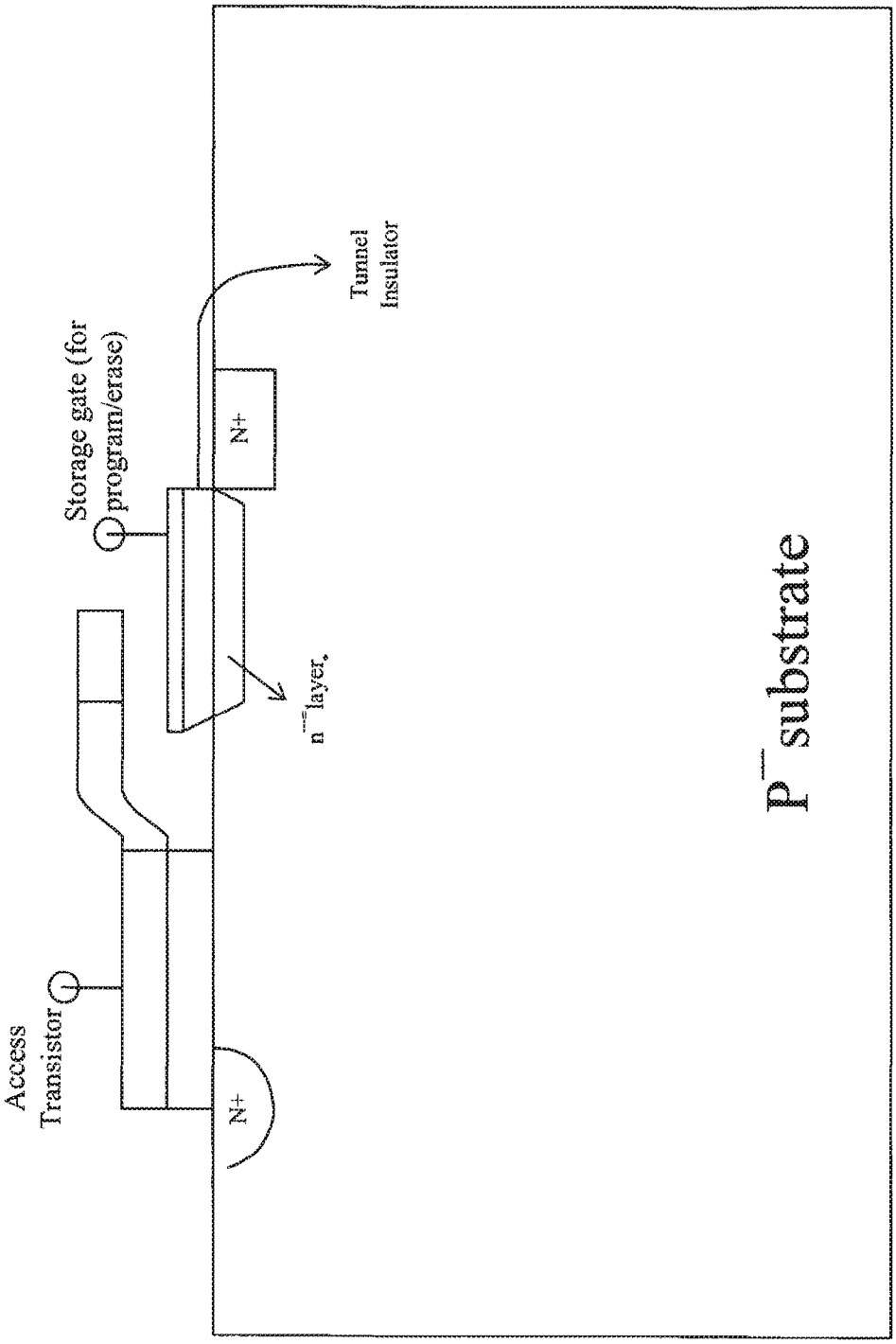


FIGURE 3B Prior art for a two-device EEPROM memory cell

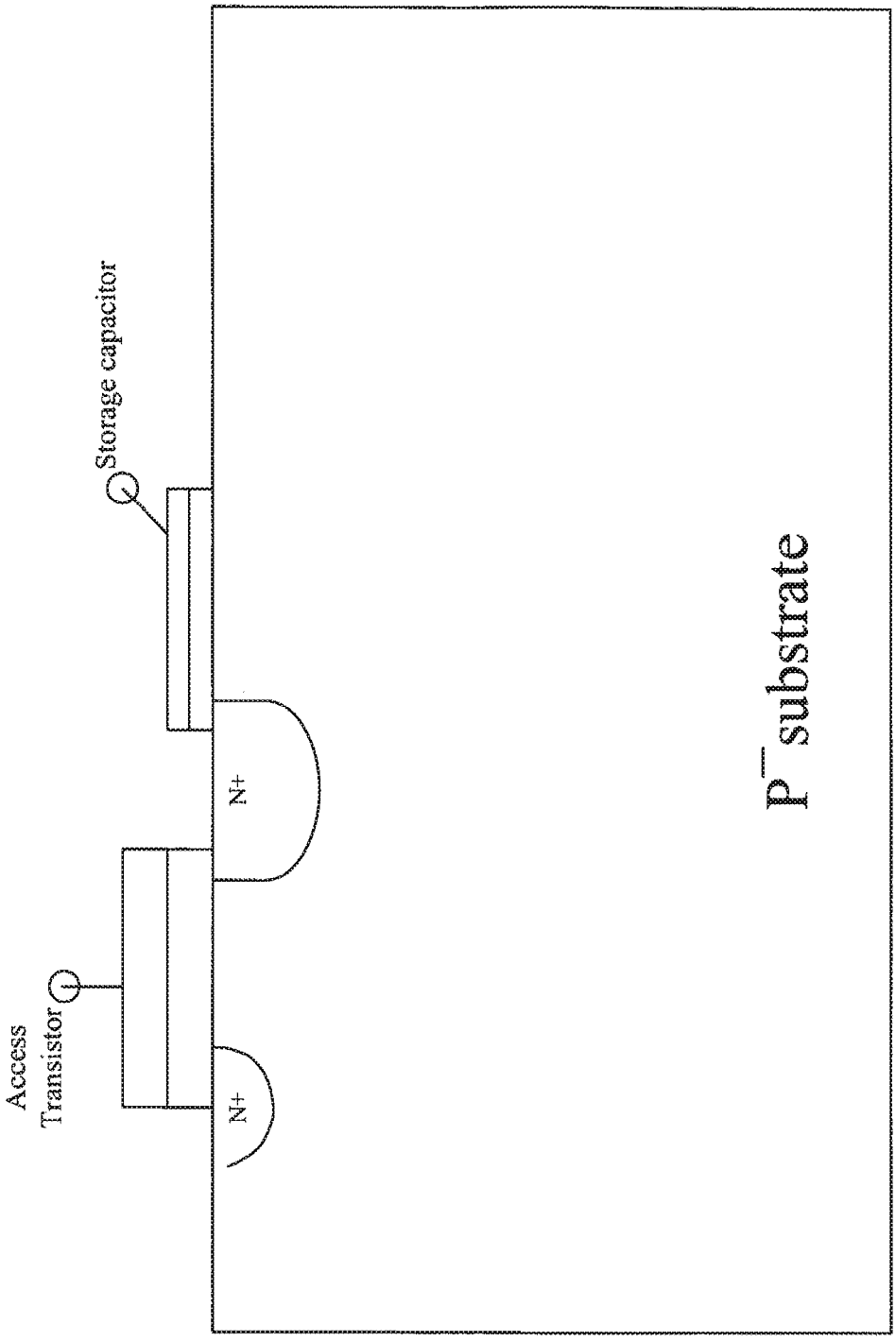


FIGURE 3C Prior art for a 1T-1C DRAM memory cell

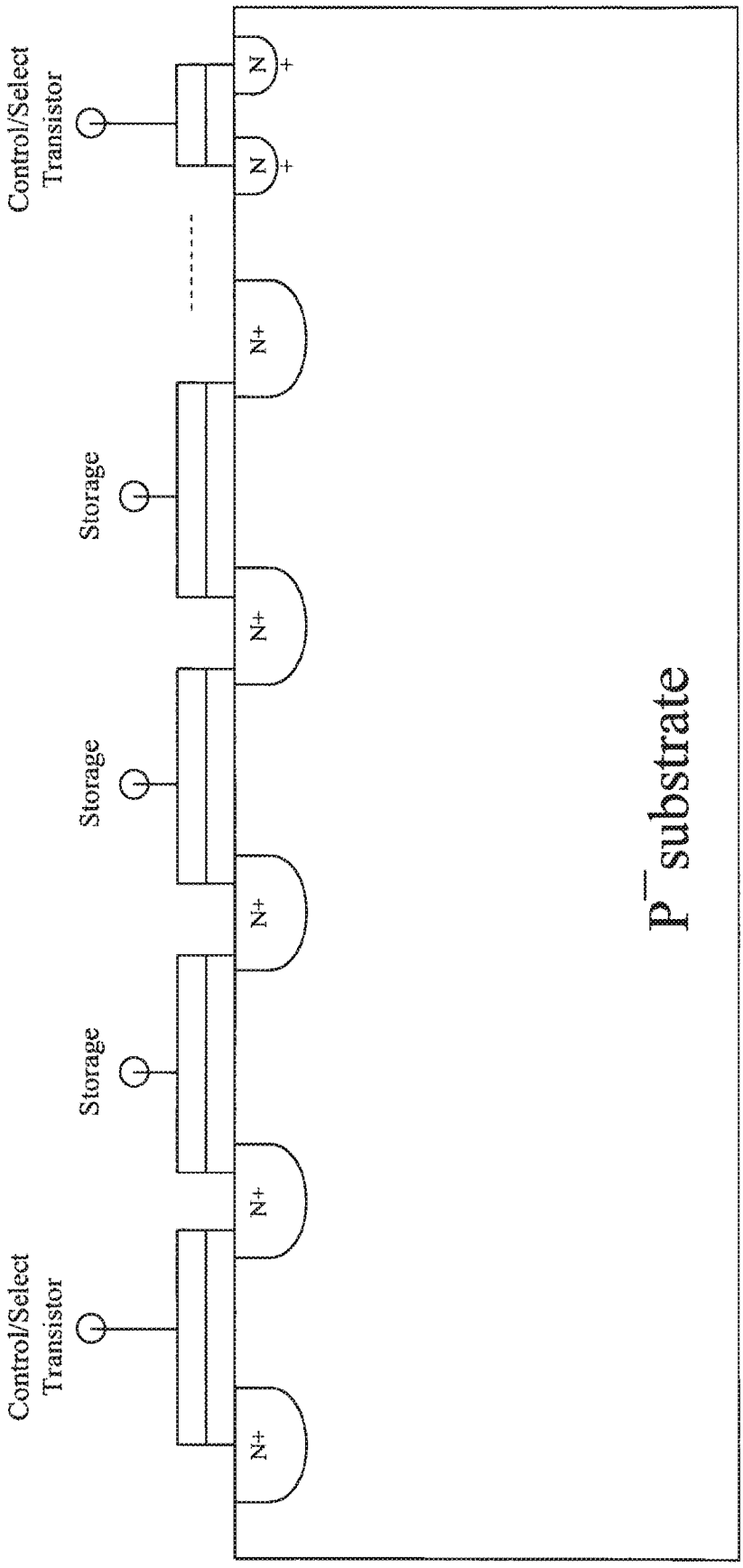


FIGURE 3D Prior art for a NAND flash memory cell

Note: Control/ Sect transistors have a single insulator - traditional MOS transistor.

Storage nodes have a stacked gate structure, typically with a floating gate and control gate comprising the stack.

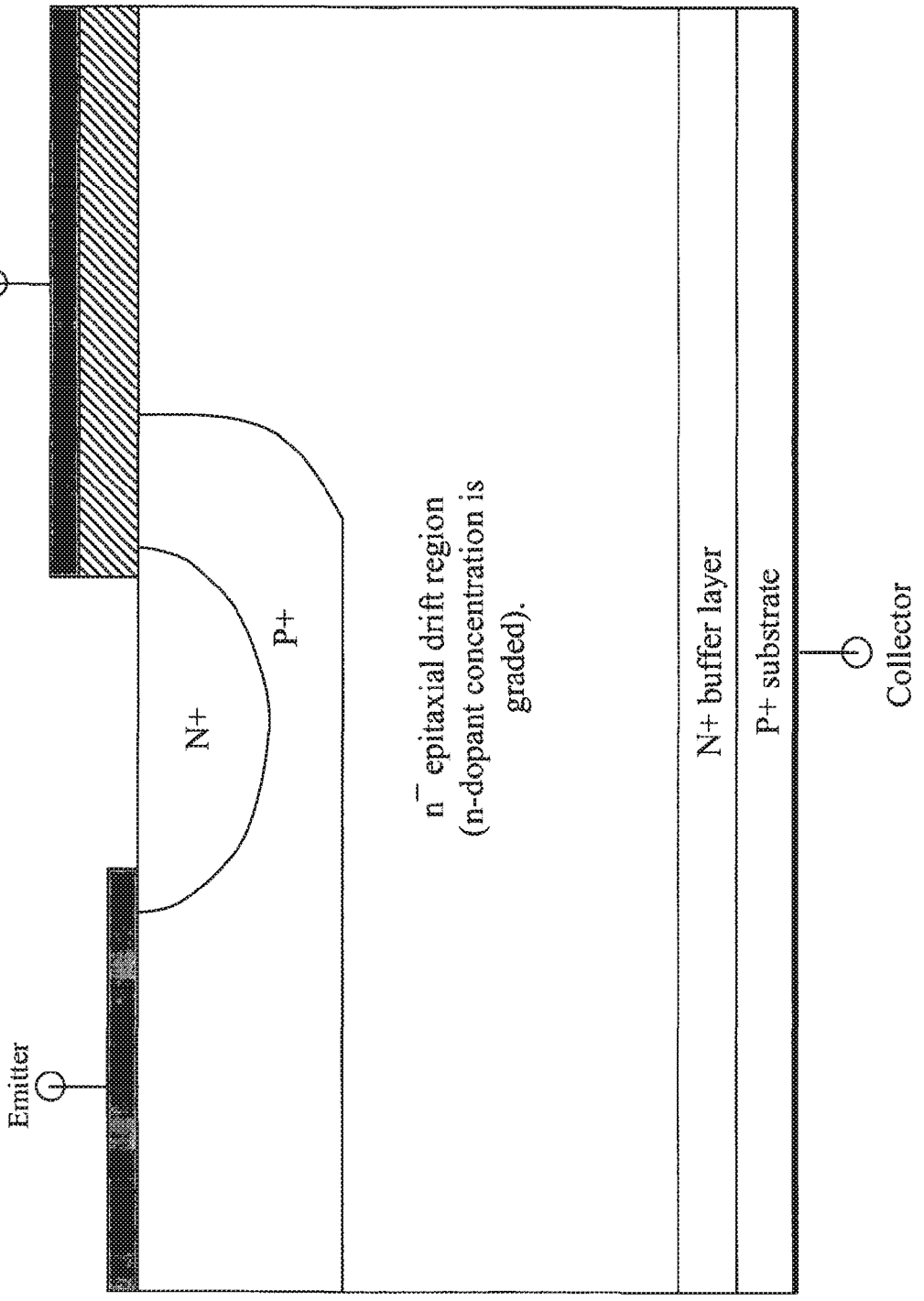


FIGURE 4 A dopant - concentration grinded drift region in a IGBT

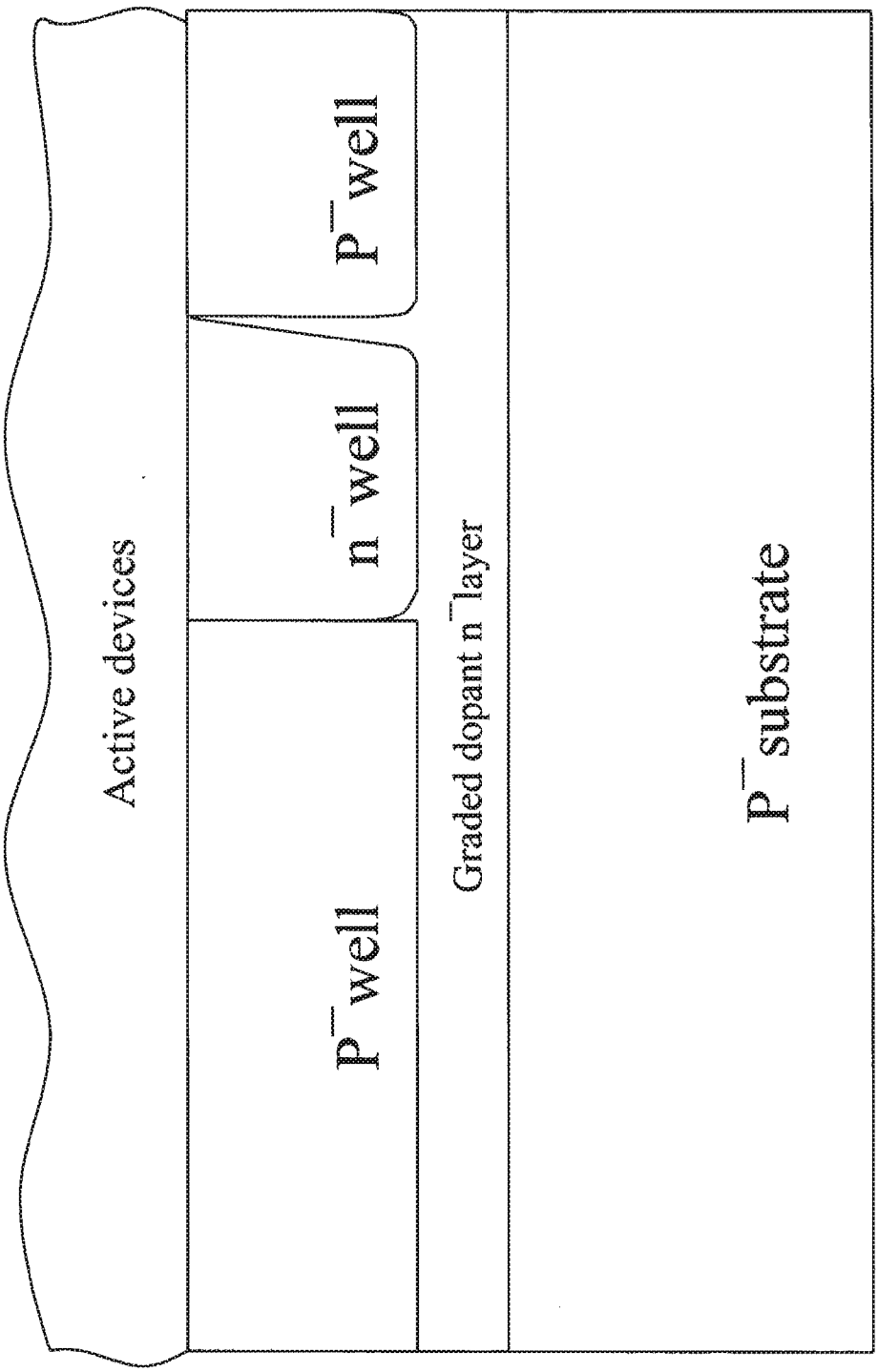


FIGURE 5A A CMOS Substrate for digital, mixed, signal, and senors IC's

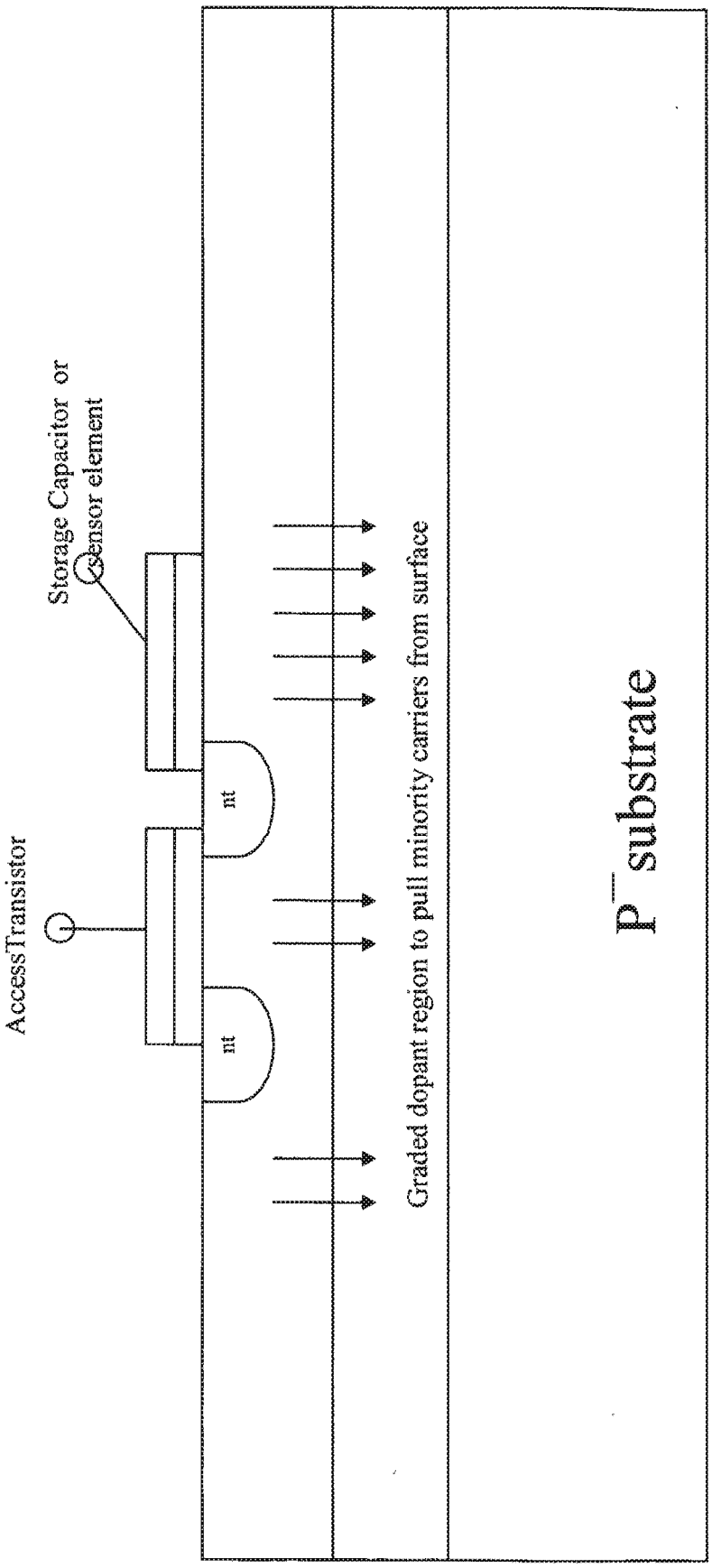


FIGURE 5B CMOS Substrate for a DRAM or image sensor, with one embodiment of the invention

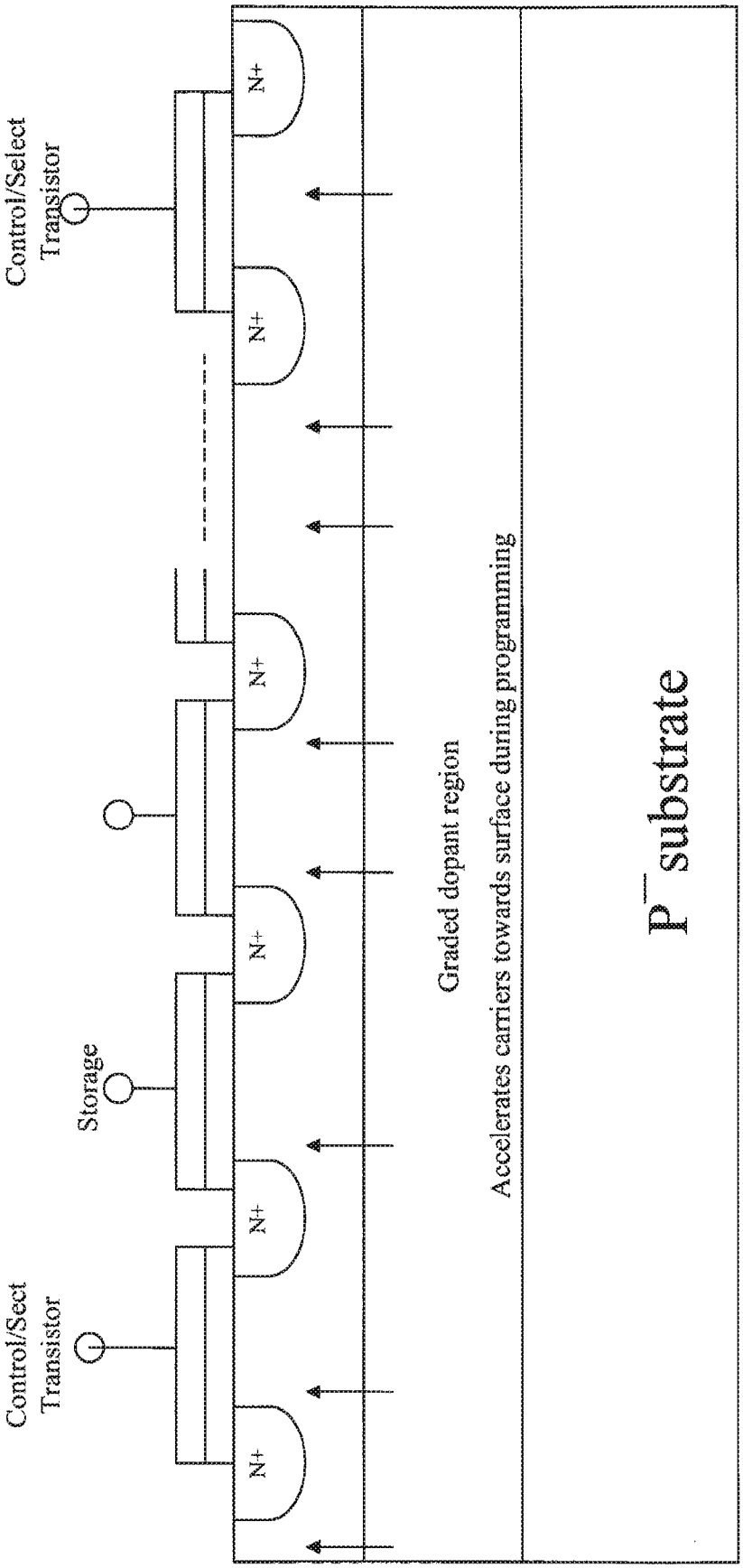


FIGURE 5C CMOS Substrate for a NAND flash device to improve programming times

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS
First Named Inventor/Applicant Name:	G.R. Mohan Rao
Filer:	Bill Naifeh/April Reasoner
Attorney Docket Number:	GRTD.01.01.DV6

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY FILING FEE (ELECTRONIC FILING)	4011	1	75	75
UTILITY SEARCH FEE	2111	1	330	330
UTILITY EXAMINATION FEE	2311	1	380	380
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**785**

Electronic Acknowledgement Receipt

EFS ID:	38062583
Application Number:	16717950
International Application Number:	
Confirmation Number:	5519
Title of Invention:	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS
First Named Inventor/Applicant Name:	G.R. Mohan Rao
Customer Number:	40672
Filer:	Bill Naifeh/April Reasoner
Filer Authorized By:	Bill Naifeh
Attorney Docket Number:	GRTD.01.01.DV6
Receipt Date:	17-DEC-2019
Filing Date:	
Time Stamp:	18:54:09
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$785
RAM confirmation Number	E2019BGI54309861
Deposit Account	
Authorized User	

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	01_ADS.pdf	1256470 8e730ddd811fbab6a29252ca95593c0306f704af	no	9
Warnings:					
Information:					
2		02_ContinuationApp.pdf	55332 59627a5ff61886b2e5831c18766807a3826882e9	yes	11

Multipart Description/PDF files in .zip description

Document Description	Start	End
Abstract	11	11
Claims	8	10
Specification	1	7

Warnings:					
Information:					
3	Oath or Declaration filed	04_Declaration.pdf	102840 657df698e088c5b8077d08d11f4c84dc03a479dc	no	1
Warnings:					
Information:					
4	Internet Communications Authorized	05_Email_Authorization.pdf	21660 bfe2be1f1bd817991c381cbb5bc7e547219eead2	no	1
Warnings:					
Information:					
5	Miscellaneous Incoming Letter	06_AffirmativeRecessionDisclaimer.pdf	14648 984ed6d914f7a2a1af5e8f505464f0835414427b	no	1

Warnings:					
Information:					
6	Drawings-other than black and white line drawings	03_Drawings.pdf	491140 01bac4c726779b544a5b9d15fc160cbbc90f bd30	no	10
Warnings:					
Information:					
7	Fee Worksheet (SB06)	fee-info.pdf	35143 1bfda9a587b8cb57d5dc02353cf44f03c019 1cce	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1977233		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	GRTD.01.01.DV6
	Application Number	
Title of Invention	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 — Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	G.R. Mohan		Rao	

Residence Information (Select One) ● US Residency Non US Residency Active US Military Service

City	Allen	State/Province	TX	Country of Residence	US

Mailing Address of Inventor:

Address 1	1611 Willingham Drive
Address 2	

City	Allen	State/Province	TX
Postal Code	72013	**Country**	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. — Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence Information of this application.**

Customer Number	40672		
Email Address	patents@naifeh.com	Add Email	Remove Email

Application Information:

Title of the Invention	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS		
Attorney Docket Number	GRTD.01.01.DV6	**Small Entity Status Claimed**	☒
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	10	**Suggested Figure for Publication (if any)**	

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	GRTD.01.01.DV6
	Application Number	
Title of Invention	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS	

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

Representative Information:

Representative information should be provided for all practitioners having a power of attorney in the application. Providing this information in the Application Data Sheet does not constitute a power of attorney in the application (see 37 CFR 1.32).
Either enter Customer Number or complete the Representative Name section below. If both sections are completed the customer Number will be used for the Representative Information during processing.

Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	40672		

Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	15590282	2017-05-09

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	GRTD.01.01.DV6
	Application Number	
Title of Invention	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS	

Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15590282	Continuation of	14931636	2015-11-03	9647070	2017-05-09
Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14931636	Continuation of	14515584	2014-10-16	9190502	2015-11-17
Prior Application Status	Abandoned				Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
14515584	Continuation of	13854319	2013-04-01		
Prior Application Status	Patented				Remove
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
13854319	Continuation of	11622496	2007-01-12	8421195	2013-04-16
Prior Application Status	Abandoned				Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
11622496	Division of	10934915	2004-09-03		
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button.					Add

Foreign Priority Information:

This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

			Remove
Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)
Additional Foreign Priority Data may be generated within this form by selecting the **Add** button.			Add

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	GRTD.01.01.DV6
	Application Number	
Title of Invention	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS	

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	GRTD.01.01.DV6
	Application Number	
Title of Invention	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS	

Authorization or Opt-Out of Authorization to Permit Access:

When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

NOTE: This section of the Application Data Sheet is **ONLY** reviewed and processed with the **INITIAL** filing of an application. After the initial filing of an application, an Application Data Sheet cannot be used to provide or rescind authorization for access by a foreign IP office(s). Instead, Form PTO/SB/39 or PTO/SB/69 must be used as appropriate.

1. Authorization to Permit Access by a Foreign Intellectual Property Office(s)

A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

2. Opt-Out of Authorizations to Permit Access by a Foreign Intellectual Property Office(s)

☐ A. Applicant **DOES NOT** authorize the USPTO to permit a participating foreign IP office access to the instant application-as-filed. If this box is checked, the USPTO will not be providing a participating foreign IP office with any documents and information identified in subsection 1A above.

☐ B. Applicant **DOES NOT** authorize the USPTO to transmit to the EPO any search results from the instant patent application. If this box is checked, the USPTO will not be providing the EPO with search results from the instant application.

NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	GRTD.01.01.DV6
	Application Number	
Title of Invention	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS	

Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	GREENTHREAD, LLC		
Mailing Address Information For Applicant:			
Address 1	4544 Harrys Lane		
Address 2			
City	Dallas	**State/Province**	TX
Country	US	Postal Code	75229
Phone Number		Fax Number	
Email Address			

Additional Applicant Data may be generated within this form by selecting the Add button. Add

Assignee Information including Non-Applicant Assignee Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	GRTD.01.01.DV6
	Application Number	
Title of Invention	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS	

Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

Remove

If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

Prefix	**Given Name**	Middle Name	**Family Name**	Suffix

Mailing Address Information For Assignee including Non-Applicant Assignee:

Address 1			
Address 2			
City		**State/Province**	
Country i		Postal Code	
Phone Number		Fax Number	
Email Address			

Additional Assignee or Non-Applicant Assignee Data may be generated within this form by selecting the Add button. Add

Signature:

Remove

NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). **However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).**

This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/Bill R. Naifeh, Reg No. 44962/			Date (YYYY-MM-DD)	2019-12-17
First Name	Bill R.	Last Name	Naifeh	Registration Number	44962

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	GRTD.01.01.DV6
	Application Number	
Title of Invention	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS	

This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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ABSTRACT

Most semiconductor devices manufactured today, have uniform dopant concentration, either in the lateral or vertical device active (and isolation) regions. By grading the dopant concentration, the performance in various semiconductor devices can be significantly improved. Performance improvements can be obtained in application specific areas like increase in frequency of operation for digital logic, various power MOSFET and IGBT ICs, improvement in refresh time for DRAMs, decrease in programming time for nonvolatile memory, better visual quality including pixel resolution and color sensitivity for imaging ICs, better sensitivity for varactors in tunable filters, higher drive capabilities for JFETs, and a host of other applications.

ONSEMI EXHIBIT 1002, Page 27

WHAT IS CLAIMED IS:

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;

a second active region separate from the first active region disposed adjacent to the first active region;

circuitry formed in at least one of the first active region or second active region; and

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.

2. The semiconductor device of Claim 1, wherein the substrate is a p-type substrate.

3. The semiconductor device of Claim 1, wherein the substrate is an n-type substrate.

4. The semiconductor device of Claim 1, wherein the substrate has epitaxial silicon on top of a nonepitaxial substrate.

5. The semiconductor device of Claim 1, wherein the first active region and second active region contain p-channel and n-channel devices.

6. The semiconductor device of Claim 1, wherein the first active region and second active region contain either p-channel or n-channel devices.

7. The semiconductor device of Claim 1, wherein the first active region and second active region are each separated by at least one isolation region.

8. The semiconductor device of Claim 1, wherein the graded dopant is fabricated with an ion implantation process.

9. 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;

a second active region separate from the first active region disposed adjacent to the first active region;

circuitry formed in at least one of the first active region or second active region; and

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 surface to the substrate.

10. The semiconductor device of Claim 9, wherein the substrate is a p-type substrate.

11. The semiconductor device of Claim 9, wherein the substrate is an n-type substrate.

12. The semiconductor device of Claim 9, wherein the substrate has epitaxial silicon on top of a nonepitaxial substrate.

13. The semiconductor device of Claim 9, wherein the first active region and second active region contain p-channel and n-channel devices.

14. The semiconductor device of Claim 9, wherein the first active region and second active region contain either p-channel or n-channel devices.

15. The semiconductor device of Claim 9, wherein the first active region and second active region are each separated by at least one isolation region.

16. The semiconductor device of Claim 9, wherein the graded dopant is fabricated with an ion implantation process.

SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a Continuation of U.S. Patent Application No. 15/590,282, filed May 9, 2017, published on August 24, 2017, as U.S. Publication No. 2017-0243876. Application No. 15/590,282 is a continuation of U.S. Patent Application No. 14/931,636, filed November 3, 2015, published on June 16, 2016 as U.S. Publication No. 2016-0172447, now U.S. Patent No. 9,647,070, issued on May 9, 2017. Application No. 14/931,636 is a continuation of U.S. Patent Application No. 14/515,584, filed October 16, 2014, published on February 5, 2015, as U.S. Publication No. 2015-0035004, now U.S. Patent No. 9,190,502, issued on November 17, 2015, (GRTD-32613). Application No. 14/515,584 is a Continuation of U.S. Patent Application No. 13/854,319 filed April 1, 2013, published on August 29, 2013, as U.S. Publication No. 2013-0221488 (GRTD-32626). Application No. 13/854,319 is a Continuation of 11/622,496, filed January 12, 2007, published on July 12, 2007, as Publication No. 2007-0158790, now U.S. Patent No. 8,421,195, issued on April 16, 2013 (GRTD-32611). Application No. 11/622,496, is a Division of U.S. Patent Application No. 10/934,915, filed September 3, 2004, published on March 9, 2006, as U.S. Publication No. 2006-0049464 (GRTD-32625). Patent Nos. 9,647,070, 9,190,502, and 8,421,195, and Patent Application Publication Nos. 2017-0243876, 2016-0172447, 2015-0035004, 2013-0221488, 2007-0158790, and 2006-0049464, are incorporated herein by reference in their entirety.

TECHNICAL FIELD

[0002] This present invention relates to all semiconductor devices and systems. Particularly it applies to diffused diodes, avalanche diodes, Schottky devices, power MOS transistors, JFET's, RF bipolar transistors, IGBTs (Insulated Gate Bipolar Transistors), varactors, digital VLSI, mixed signal circuits and sensor devices including camera ICs employing CCD (Charge Coupled Device) as well as CMOS technologies.

BACKGROUND

[0003] Bipolar Junction Transistors (BJT) are classified as minority carrier devices because minority carriers are the principle device conduction mechanism. However, majority carriers also play a small but 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. The 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 region in an 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 device architectures to combine planar and vertical conductions are also possible. The maximum frequency of operation is dictated primarily by source-drain separation distance. Most MOS devices use a uniformly doped substrate (or a well region). When a MOSFET is optimally integrated with a BJT in a monolithic fashion, an IGBT results. The IGBT inherits the advantages of both MOSFET and BJT. It also brings new challenges because the required characteristics (electron transit and hole recombination as fast as possible in n-channel IGBT) necessitate different dopant gradients either in the same layer at different positions, or at the interfaces of similar or dissimilar layers.

[0004] Retrograde wells have been attempted, with little success, to help improve soft error immunity in SRAMs and visual quality in imaging circuits. FIG. 3A shows a typical CMOS VLSI device employing a twin well substrate, on which active devices are

subsequently fabricated. FIGS. 3B, 3C, and 3D illustrate device cross sections, as practiced today. Retrograde and halo wells have also been attempted to improve refresh time in DRAMs (dynamic random-access memories), as well as, reducing dark current (background noise) and enhance RGB (Red, Green, Blue) color resolution in digital camera ICs. Most of these techniques either divert the minority carriers away from the active regions of critical charge storage nodes at the surface, or, increase minority carrier density locally as the particular application requires.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] For a more complete understanding of the present invention, and the advantages thereof, reference is now made to the following descriptions taken in conjunction with the accompanying drawings, in which:

[0006] FIG. 1 illustrates the relative doping profiles of emitter, base and collector for the two most popular bipolar junction transistors: namely, uniform base ("A") and graded base ("B");

[0007] FIG. 2 illustrates the cross section of a commercial IGBT with a uniform epitaxial drift region (base);

[0008] FIGS. 3A, 3B, 3C, and 3D illustrate cross sections of commonly used prior art CMOS silicon substrates; FIG. 3A showing a typical prior art IC with two wells (one n^- well in which p-channel transistors are subsequently fabricated and one p^-well in which n-channel transistors are subsequently fabricated); FIG 3B showing a prior art EEPROM (Electronically Erasable Programmable Read-Only Memory) memory cell having a tunnel insulator; FIG. 3C showing a prior art DRAM memory cell; and FIG. 3D showing a prior art NAND flash memory cell;

[0009] FIG. 4 illustrates the cross section of an IGBT, using one embodiment of the invention described here, where the dopant is optimally graded in the epitaxial drift region; and

[0010] FIGS. 5A, 5B, and 5C illustrate the cross sections of a CMOS silicon substrate with two wells and an underlying layer using embodiments of the invention to improve performance in each application—VLSI logic, DRAM/image IC, nonvolatile memory IC.

DETAILED DESCRIPTION

[0011] The relative doping concentrations of emitter and collector regions varies from 10^{18} to $10^{20}/cm^3$, whereas the base region is 10^{14} to $10^{16}/cm^3$ depending on the desired characteristics of the BJT. In graded base p-n-p transistors, the donor dopant concentration may be 10 to 100× at the emitter-base junction, relative to the base-collector junction (1×). The gradient can be linear, quasi linear, exponential or complimentary error function. The relative slope of the donor concentration throughout the base creates a suitable aiding drift electric field, to help the holes (p-n-p transistor) transverse from emitter to collector. Since the aiding drift electric field helps hole conduction, the current gain at a given frequency is enhanced, relative to a uniformly-doped (base) BJT. The improvement in cut-off frequency (or, frequency at unity gain, f_T) can be as large as 2×-5×. Similar performance improvements are also applicable to n-p-n transistors.

[0012] As illustrated in FIG. 4, in one embodiment according to the invention, a donor gradient is established from the emitter-drift epitaxial base region junction of the punch-through IGBT, to the drift epitaxial base region—n^+ buffer layer boundary (electrons in this case are accelerated in their transit from emitter to collector). The "average" base resistance is optimized so that conductivity modulation and lifetime (for minority carriers) in the base region are not compromised. By sweeping the carriers towards the n^+ buffer region a number of advantages are obtained. First, the frequency of operation (combination of t_{on} and t_{off} as is known in the IGBT commercial nomenclature) can be enhanced. Second, and maybe more importantly, during t_{off}, holes can be recombined much quicker at the n^+ buffer layer, compared to the uniformly doped n^-epitaxial drift region by establishing a different dopant gradient near the n^+ buffer layer. It should be noted that the drift region can also be a non-epitaxial silicon substrate. Although epitaxy enhances lifetime, it is not mandatory. Different layers of dopant regions can be transferred through wafer to wafer bonding (or other similar transfer mechanisms) for eventual device fabrication. The "reverse recovery time" for an IGBT is significantly improved due to the optimized graded dopant in the so called "drift region" as well as at the interfaces of the drift region. Graded dopants can also be implemented in the n^+ buffer

layer as well as other regions adjacent to the respective layers. Two important performance enhancements are the result of dopant gradients. For example, in an n-channel IGBT, electrons can be swept from source to drain rapidly, while at the same time holes can be recombined closer to the n^+ buffer layer. This can improve t_{on} and t_{off} in the same device.

[0013] As illustrated in FIGS. 5A, 5B, and 5C, 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 ICs. These unwanted carriers can discharge dynamically-held "actively held high" nodes. In most cases, statically-held nodes (with V_{cc}) cannot be affected. Degradation of refresh time in DRAMs is one of the results, because the capacitor holds charge dynamically. Similarly, degradation of CMOS digital images in digital imaging ICs is another result of the havoc caused by minority carriers. Pixel and color resolution can be significantly enhanced in imaging ICs with the embodiments described herein. Creating "subterranean" 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 is described herein which creates a drift field to sweep these unwanted minority carriers from the active circuitry at the surface into the substrate in a monolithic die as quickly as possible. 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. As desired, the n^-well and p^-wells can also be graded or retrograded in dopants to sweep those carriers away from the surface as well. The graded dopant can also be implemented in surface channel MOS devices to accelerate majority carriers towards the drain. To decrease programming time in nonvolatile memory devices, carriers should be accelerated towards the surface when programming of memory cells is executed. The graded dopant can also be used to fabricate superior Junction Field-Effect transistors where the "channel pinch-off" is controlled by a graded channel instead of a uniformly doped channel (as practiced in the prior art).

[0014] One of ordinary skill and familiarity in the art will recognize that the concepts taught herein can be customized and tailored to a particular application in many advantageous ways. For instance, minority carriers can be channeled to the surface to aid programming in nonvolatile memory devices (NOR, NAND, multivalued-cell). Moreover, single-well, and triple-well CMOS fabrication techniques can also be optimized to incorporate these embodiments individually and collectively. Any modifications of such embodiments (described here) fall within the spirit and scope of the invention. Hence, they fall within the scope of the claims described below.

[0015] Although the invention has been described with reference to specific embodiments, these descriptions are not meant to be construed in a limiting sense. Various modifications of the disclosed embodiments, as well as alternative embodiments of the invention will become apparent to persons skilled in the art upon reference to the description of the invention. It should be appreciated by those skilled in the art that the conception and the specific embodiment disclosed may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present invention. It should also be realized by those skilled in the art that such equivalent constructions do not depart from the spirit and scope of the invention as set forth in the appended claims.

[0016] It is therefore, contemplated that the claims will cover any such modifications or embodiments that fall within the true scope of the invention.

PTO/AIA/01 (06-12)
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DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS

As the below named inventor, I hereby declare that:

This declaration is directed to:

☑ The attached application, or

☐ United States application or PCT international application number _____

filed on _____.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

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LEGAL NAME OF INVENTOR

Inventor: G.R. Mohan Rao Date (Optional): Sept 30, 2015

Signature: G R Mohan Rao

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16/717,950	12/17/2019	2811	785	GRTD.01.01.DV6	16	2

CONFIRMATION NO. 5519

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Inventor(s)

G.R. Mohan Rao, Allen, TX;

Applicant(s)

GREENTHREAD, LLC, Dallas, TX;

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 15/590,282 05/09/2017 PAT 10510842
which is a CON of 14/931,636 11/03/2015 PAT 9647070
which is a CON of 14/515,584 10/16/2014 PAT 9190502
which is a CON of 13/854,319 04/01/2013 ABN
which is a CON of 11/622,496 01/12/2007 PAT 8421195
which is a DIV of 10/934,915 09/03/2004 ABN

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

Permission to Access Application via Priority Document Exchange: Yes

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The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/717,950**

Projected Publication Date: 04/23/2020

Non-Publication Request: No

Early Publication Request: No

**** SMALL ENTITY ****

Title

SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS

Preliminary Class

257

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/717,950

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A	75		N/A	
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A	330		N/A	
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A	380		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	16 minus 20 =	*	x 50 =	0.00	OR		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*	x 230 =	0.00			
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).			0.00			
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))				0.00			
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL	785		TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	G.R. Mohan Roa	§	Conf. No.:	5519
		§		
Serial No:	16/717,950	§	Group Art Unit:	2892
		§		
Filed:	December 17, 2019	§	Examiner:	Arora, Ajay
		§		

For: SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS

Via EFS

Mail Stop NON-FEE AMENDMENT
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313.1450

PRELIMINARY AMENDMENT

Please amend the application as follows prior to the substantive examination thereof:

Amendments to the Claims are reflected in the listing of claims which begins on page 2 of this paper.

Remarks begin on page 7 of this paper.

AMENDMENTS TO THE CLAIMS

The listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims

1-16. **(Canceled)**

17. **(New)** 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.

18. **(New)** The semiconductor device of Claim 17, wherein the substrate is a p-type substrate.

19. **(New)** The semiconductor device of Claim 17, wherein the substrate has epitaxial silicon on top of a nonepitaxial substrate.

20. **(New)** The semiconductor device of Claim 17, wherein the first active region and second active region contain one of either p-channel and n-channel devices.

21. **(New)** The semiconductor device of Claim 17, wherein the first active region and second active region contain either p-channel or n-channel devices in n-wells or p-wells, respectively, and each well has at least one graded dopant.

22. **(New)** The semiconductor device of Claim 17, wherein the first active region and second active region are each separated by at least one isolation region.

23. **(New)** The semiconductor device of Claim 17, wherein the graded dopant is fabricated with an ion implantation process.

24. **(New)** The semiconductor device of Claim 17, wherein the first and second active regions are formed adjacent the first surface of the substrate.

25. **(New)** The semiconductor device of Claim 17, wherein dopants of the graded dopant concentration in the first active region or the second active region are either p-type or n-type.

26. **(New)** The semiconductor device of Claim 17, wherein dopants of the graded dopant concentration in the first active region are both p-type and n-type.

27. **(New)** The semiconductor device of Claim 17, wherein dopants of the graded dopant concentration in the second active region are both p-type and n-type.

28. **(New)** The semiconductor device of Claim 17, wherein dopants of the graded dopant region in the well region are both p-type and n-type.

29. **(New)** The semiconductor device of claim 17, wherein the transistors which can be formed in the first and second active regions are CMOS transistors requiring at least a source, a drain, a gate and a channel.

30. **(New)** The semiconductor device of Claim 17, wherein the device is a dynamic random access memory (DRAM).

31. **(New)** The semiconductor device of Claim 17, wherein the device is a complementary metal oxide semiconductor (CMOS) with a nonepitaxial substrate.

32. **(New)** The semiconductor device of Claim 17, wherein the device is a flash memory.

33. **(New)** The semiconductor device of Claim 17, wherein the device is a logic device.

34. **(New)** The semiconductor device of Claim 33, wherein the device is central processing unit.

35. **(New)** The semiconductor device of claim 17, wherein the device is an image sensor.

36. **(New)** 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 in the surface thereof;

a second active region separate from the first active region disposed adjacent to the first active region and within which transistors can be formed in the surface thereof;

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 surface to 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.

37. **(New)** The semiconductor device of Claim 36, wherein the substrate is an n-type substrate.

38. **(New)** The semiconductor device of Claim 36, wherein the substrate is a p-type substrate.

39. **(New)** The semiconductor device of Claim 36, wherein the substrate has epitaxial silicon on top of a nonepitaxial substrate.

40. **(New)** The semiconductor device of Claim 36, wherein the first active region and second active region contain at least one of either p-channel and n-channel devices.

41. **(New)** The semiconductor device of Claim 36, wherein the first active region and second active region contain either p-channel or n-channel devices in n-wells or p-wells, respectively, and each well has at least one graded dopant.

42. **(New)** The semiconductor device of Claim 36, wherein the first active region and second active region are each separated by at least one isolation region.

43. **(New)** The semiconductor device of Claim 36, wherein dopants of the graded dopant concentration in the first active region or the second active region are either p-type or n-type.

44. **(New)** The semiconductor device of Claim 36, wherein dopants of the graded dopant concentration in the first active region are both p-type and n-type.

45. **(New)** The semiconductor device of Claim 36, wherein dopants of the graded dopant concentration in the second active region are both p-type and n-type.

46. **(New)** The semiconductor device of Claim 36, wherein dopants of the graded dopant region in the well region are both p-type and n-type.

47. **(New)** The semiconductor device of Claim 36, wherein the graded dopant is fabricated with an ion implantation process.

48. **(New)** The semiconductor device of Claim 36, wherein the substrate is a complementary metal oxide semiconductor (CMOS) device.

49. **(New)** The semiconductor device of Claim 36, wherein the device is a flash memory.

50. **(New)** The semiconductor device of Claim 36, wherein the device is a logic device.

51. **(New)** The semiconductor device of Claim 50, wherein the device is central processing unit.

52. **(New)** The semiconductor device of claim 36, wherein the device is an image sensor.

REMARKS

The Applicant has canceled original claims 1-16 and added new claims 17-52. Accordingly, claims 17-52 are pending in the application.

The new claims are not made for any reason related to any statutory requirements of patentability. The new claims have been made to more completely claim that to which the Applicant is entitled and to conform to the personal preferences of the current patent attorney. Therefore no amendments have been made to narrow the scope of the claims or to create any sort of estoppel. Favorable consideration of the pending claims is respectfully requested.

Respectfully submitted,

/Bill R. Naifeh, Reg. No. 44,962/

Registration No. 44,962

Bill R. Naifeh
Law Office of Bill Naifeh
15303 Dallas Parkway
Suite 700
Addison, TX 7540
972-726-9500
214-550-2542 (fax)

Electronic Patent Application Fee Transmittal

Application Number:	16717950
Filing Date:	17-Dec-2019
Title of Invention:	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS
First Named Inventor/Applicant Name:	G.R. Mohan Rao
Filer:	Bill Naifeh/April Reasoner
Attorney Docket Number:	GRTD.01.01.DV6

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	2202	16	50	800
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**800**

Electronic Acknowledgement Receipt

EFS ID:	38925122
Application Number:	16717950
International Application Number:	
Confirmation Number:	5519
Title of Invention:	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS
First Named Inventor/Applicant Name:	G.R. Mohan Rao
Customer Number:	40672
Filer:	Bill Naifeh/April Reasoner
Filer Authorized By:	Bill Naifeh
Attorney Docket Number:	GRTD.01.01.DV6
Receipt Date:	20-MAR-2020
Filing Date:	17-DEC-2019
Time Stamp:	13:45:52
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$800
RAM confirmation Number	E20203JD46246547
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		GRTD-DV6_PrelimAmd.pdf	40282 3dbe2328ec5f519f4cf436fc3db131fa9485d8e4	yes	7

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Preliminary Amendment	1	1
	Claims	2	6
	Applicant Arguments/Remarks Made in an Amendment	7	7

Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30514 e57276a87bb93a743099dd4085bbc6480435b73c	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	70796		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/717,950	Filing Date 12/17/2019	☐ To be Mailed

ENTITY: ☐ LARGE ☑ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $50 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $230 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	03/20/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 36	Minus	** 20	= 16		x $50 =	800
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $230 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	800

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/VINCENT S BUTLER/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Doc Code: PA..
Document Description: Power of Attorney

PTO/AIA/82B (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

[X] I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: **40672**

OR

[ ] I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

[X] The address associated with the above-mentioned Customer Number

OR

[ ] The address associated with Customer Number:

OR

[ ] Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

GREENTHREAD, LLC

[ ] Inventor or Joint Inventor (title not required below)

[ ] Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

[X] Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

[ ] Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature	/Philip W. John, Jr./	Date (Optional)	3/21/2022
Name	Philip W. John, Jr.		
Title	President		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

[ ] Total of forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

Electronic Acknowledgement Receipt

EFS ID:	38951349
Application Number:	16717950
International Application Number:	
Confirmation Number:	5519
Title of Invention:	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS
First Named Inventor/Applicant Name:	G.R. Mohan Rao
Customer Number:	40672
Filer:	Bill Naifeh/April Reasoner
Filer Authorized By:	Bill Naifeh
Attorney Docket Number:	GRTD.01.01.DV6
Receipt Date:	24-MAR-2020
Filing Date:	17-DEC-2019
Time Stamp:	13:03:28
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	POA-Greenthread.pdf	2989622 cc0a7855f517b7200d9e1467395b0ebd3ec396b7	no	1

Warnings:

Information:	
Total Files Size (in bytes):	2989622

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/717,950	12/17/2019	G.R. Mohan Rao	GRTD.01.01.DV6

CONFIRMATION NO. 5519

POA ACCEPTANCE LETTER

40672
BILL R. NAIFEH
PO BOX 803423
DALLAS, TX 75380

OC000000115730168

Date Mailed: 03/27/2020

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 03/24/2020.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/zretta/

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16717950
Filing Date	2019-12-17
First Named Inventor	G.R. Mohan Rao
Art Unit	2892
Examiner Name	Arora, Ajay
Attorney Docket Number	GRTD.01.01.DV6

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4001864	A	1997-01-04	Gibbons	
	2	4160985	A	1979-07-10	Kamins et al.	
	3	4347654	A	1982-09-07	Allen et al.	
	4	4481522	A	1984-11-06	Jastrzebski et al.	
	5	4866000	A	1989-09-12	Okita	
	6	5029277	A	1991-07-02	Kane	
	7	5130262	A	1992-07-14	Masquelier et al.	
	8	5213988	A	1993-05-25	Yamauchi et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16717950
	Filing Date	2019-12-17
	First Named Inventor	G.R. Mohan Rao
	Art Unit	2892
	Examiner Name	Arora, Ajay
	Attorney Docket Number	GRTD.01.01.DV6

	9	5262345	A	1993-11-16	Nasser et al.	
	10	5329144	A	1994-07-12	Luryi	
	11	5448087	A	1995-09-05	Streit et al.	
	12	5480816	A	1996-01-02	Uga et al.	
	13	5496746	A	1996-03-05	Matthews	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16717950
	Filing Date	2019-12-17
	First Named Inventor	G.R. Mohan Rao
	Art Unit	2892
	Examiner Name	Arora, Ajay
	Attorney Docket Number	GRTD.01.01.DV6

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	Art Unit	2892
	Examiner Name	Arora, Ajay
	Attorney Docket Number	GRTD.01.01.DV6

	31	6713813	B2	2004-03-30	Marchant	
	32	6720622	B1	2004-04-13	Yu	
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	35	6747883	B2	2004-06-08	Yasumura	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	First Named Inventor	G.R. Mohan Rao
	Art Unit	2892
	Examiner Name	Arora, Ajay
	Attorney Docket Number	GRTD.01.01.DV6

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	First Named Inventor	G.R. Mohan Rao
	Art Unit	2892
	Examiner Name	Arora, Ajay
	Attorney Docket Number	GRTD.01.01.DV6

	53	10510842	B2	2019-12-17	Rao	

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20010040622	A1	2001-11-15	Maruyama	
	2	20020056883	A1	2002-05-16	Baliga	
	3	20020074585	A1	2002-06-20	Tsang et al.	
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	8	20030026126	A1	2003-02-06	Uemura	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Art Unit	2892
	Examiner Name	Arora, Ajay
	Attorney Docket Number	GRTD.01.01.DV6

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16717950
	Filing Date	2019-12-17
	First Named Inventor	G.R. Mohan Rao
	Art Unit	2892
	Examiner Name	Arora, Ajay
	Attorney Docket Number	GRTD.01.01.DV6

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T5
	1	P.D. Moor, Advanced CMOS-based pixel sensors, https://indico.cern.ch/event/122027/contributions/88236/attachments/69340/99377/FEEimecPdM.pdf, 2011, 41 pages	
	2	E. Parton, CMOS Sensors, Laser Focus World, http://www.laserfocusworld.com/articles/print/volume-49/issue-10/features/cmos-sensors-cmos-based-specialty-imagers-reach-new-performance-levels.html, Oct. 14, 2013, 5 pages	
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	4	M. Tanenbaum, BSTJ: Diffused Emitter and Base Silicon Transisters, The Bell System Technical Journal, Jan. 1956, 22 pages, vol. XXXV, https://archive.org/details/bstj35-1-1	
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	8	Berinder Brar et al., Herb's Bipolar Transistors, IEEE Transactions on Electron Devices, vol. 48, No. 11, Nov. 2001	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16717950
	Filing Date	2019-12-17
	First Named Inventor	G.R. Mohan Rao
	Art Unit	2892
	Examiner Name	Arora, Ajay
	Attorney Docket Number	GRTD.01.01.DV6

EXAMINER SIGNATURE			
Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16717950
	Filing Date	2019-12-17
	First Named Inventor	G.R. Mohan Rao
	Art Unit	2892
	Examiner Name	Arora, Ajay
	Attorney Docket Number	GRTD.01.01.DV6

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Bill R. Naifeh, Reg. No. 44962/	Date (YYYY-MM-DD)	2020-04-06
Name/Print	Bill R. Naifeh	Registration Number	44962

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

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5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

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9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	39078594
Application Number:	16717950
International Application Number:	
Confirmation Number:	5519
Title of Invention:	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS
First Named Inventor/Applicant Name:	G.R. Mohan Rao
Customer Number:	40672
Filer:	Bill Naifeh/April Reasoner
Filer Authorized By:	Bill Naifeh
Attorney Docket Number:	GRTD.01.01.DV6
Receipt Date:	06-APR-2020
Filing Date:	17-DEC-2019
Time Stamp:	20:19:32
Application Type:	Utility under 35 USC 111(a)

Payment information:

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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Information Disclosure Statement (IDS) Form (SB08)	IDS.pdf	1037047 ec4ef80f3ffd4ae3871f222f5f0e1d53ebc973e7	no	11

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

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If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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NOTICE OF ALLOWANCE AND FEE(S) DUE

40672 7590 04/07/2020

BILL R. NAIFEH
PO BOX 803423
DALLAS, TX 75380

EXAMINER
ARORA, AJAY

ART UNIT	PAPER NUMBER
2892	

DATE MAILED: 04/07/2020

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/717,950	12/17/2019	G.R. Mohan Rao	GRTD.01.01.DV6	5519

TITLE OF INVENTION: SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	07/07/2020

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

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40672 7590 04/07/2020

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(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/717,950	12/17/2019	G.R. Mohan Rao	GRTD.01.01.DV6	5519

TITLE OF INVENTION: SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	07/07/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
ARORA, AJAY	2892	257-025000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

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5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

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Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/717,950	12/17/2019	G.R. Mohan Rao	GRTD.01.01.DV6	5519

40672 7590 04/07/2020

BILL R. NAIFEH
PO BOX 803423
DALLAS, TX 75380

EXAMINER	
ARORA, AJAY	
ART UNIT	**PAPER NUMBER**
2892	

DATE MAILED: 04/07/2020

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)

(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

ONSEMI EXHIBIT 1002, Page 78

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 16/717,950	Applicant(s) Rao, G.R. Mohan	
	Examiner AJAY ARORA	Art Unit 2892	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 3/20/2020.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 17-52 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☑ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/AJAY ARORA/
Primary Examiner, Art Unit 2892

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Reasons for Allowance

2. Claims 17-52 are allowed. The following is an examiner's statement of reasons for allowance:

3. Claims 17-35 are allowed because the prior art of record does not teach or suggest, singularly or in combination, at least the limitations of the base claim 17 that requires "a first active region" within which "transistors can be formed" (see lines 4-6) and "a second active region separate from the first active region" within which "transistors can be formed" (see lines 7-8) in conjunction with "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" (see last 2 lines).

The closest reference is Hong (US 2007/0045682), hereinafter Hong. More specifically, regarding claim 17, Hong (refer to Figures 4A-4D and 5A-5C) teaches a semiconductor device, comprising:

a substrate (312 – see para 29) of a first doping type (i.e. parts 312 and 21 of the substrate have n-type doping, see para 29) at a first doping level having first and second surfaces;

a first region (311, which includes wells such as 21, 22, 5, 2) disposed adjacent the first surface,

a second region (such as source/drain region 2, see para 40; or 2 or 5 or 22 of pixel cell formed in an adjacent region separated by shallow trench isolation 37 – see para 30) separate from the first region disposed adjacent to the first active region;

at least a portion of at least one of the first and second regions having at least one graded dopant concentration (350 – see para 24, last 3 sentences; also see Figure 5C and para 29) to aid carrier movement (para 26).

Although Hong does not specifically state that the aiding of carrier movement is "from the first surface to the second surface of the substrate", such directional movement by doping gradient is known in the art. However, the "first region" and "second region" described above are not "active" regions and hence transistor cannot be formed in any of these regions (only parts of a transistor such as source or drain are shown formed, not a transistor). Further, it is not obvious to modify Hong as changing first region and second region as above would change the intended function of the device.

4. Similarly, claims 36-52 are allowed because the prior art of record does not teach or suggest, singularly or in combination, at least the limitations of the base claim 36 that similarly requires "a first active region" within which "transistors can be formed in the surface thereof" (se lines 4-6) and "a second active region separate from the first active region" within which "transistors can be formed in the surface thereof" (see lines 7-9) in

conjunction with “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" (see last 2 lines). In this case also, the closest reference is Hong.

5. Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled “Comments on Statement of Reasons for Allowance.”

Conclusion

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to AJAY ARORA whose telephone number is (571)272-8347. The examiner can normally be reached on 9 AM - 5 PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner’s supervisor, Thao X. Le can be reached on 5712721708. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only.

For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/AJAY ARORA/
Primary Examiner, Art Unit 2892

Notice of References Cited	Application/Control No. 16/717,950	Applicant(s)/Patent Under Reexamination Rao, G.R. Mohan	
	Examiner AJAY ARORA	Art Unit 2892	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20070045682-A1	03-2007	Hong; Sungkwon C.	H01L27/14601	257/292
*	B	US-20030030488-A1	02-2003	Hueting, Raymond J.E.	H01L29/0821	330/57
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/717,950	Rao, G.R. Mohan
	Examiner	Art Unit
	AJAY ARORA	2892

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original									
-	1									
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-	3									
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-	5									
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24	40									
25	41									
26	42									

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/717,950	Rao, G.R. Mohan
	Examiner	**Art Unit**
	AJAY ARORA	2892

CLAIM		DATE								
Final	Original									
27	43									
28	44									
29	45									
30	46									
31	47									
32	48									
33	49									
34	50									
35	51									
36	52									

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/717,950	Rao, G.R. Mohan
	Examiner	Art Unit
	AJAY ARORA	2892

CPC - Searched*		
Symbol	Date	Examiner
H01L 29/1095	03/28/2020	AKA

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner
257	25		AKA

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
All references of parent applications considered	03/30/2020	AKA
Inventor search	03/28/2020	AKA
Assignee search	03/28/2020	AKA
.clm. interference search	03/28/2020	AKA
EAST search history report	03/30/2020	AKA

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H01L	29/1095	03/28/2020	AKA
257	25	03/28/2020	AKA

/A.A/ Primary Examiner, Art Unit 2892	

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/717,950	Rao, G.R. Mohan
	Examiner	**Art Unit**
	AJAY ARORA	2892

CPC								
Symbol							**Type**	**Version**
H01L	/	29	/	1095			F	2013-01-01
H01L	/	29	/	36			I	2013-01-01
H01L	/	29	/	7395			I	2013-01-01
H01L	/	27	/	14643			I	2013-01-01
H01L	/	27	/	11524			I	2013-01-01
H01L	/	27	/	11521			I	2013-01-01
H01L	/	27	/	0214			A	2013-01-01
H01L	/	27	/	10844			A	2013-01-01

CPC Combination Sets								
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	36	
/AJAY ARORA/ Primary Examiner, Art Unit 2892	30 March 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	5B

U.S. Patent and Trademark Office — Part of Paper No.: 20200330

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/717,950	Rao, G.R. Mohan
	Examiner	**Art Unit**
	AJAY ARORA	2892

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H01L	/	29	/	06

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**
257	25

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	36	
/AJAY ARORA/ Primary Examiner, Art Unit 2892	30 March 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	5B

U.S. Patent and Trademark Office — Part of Paper No.: 20200330

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/717,950	Rao, G.R. Mohan
	Examiner	**Art Unit**
	AJAY ARORA	2892

☑ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
1	17	10	26	19	35	28	44								
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4	20	13	29	22	38	31	47								
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6	22	15	31	24	40	33	49								
7	23	16	32	25	41	34	50								
8	24	17	33	26	42	35	51								
9	25	18	34	27	43	36	52								

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	36	
/AJAY ARORA/ Primary Examiner, Art Unit 2892	30 March 2020	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	5B

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	10	("20010040622" | "20030030488" | "4160985").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/30 19:48
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L8	222	l1 l2 L7	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/30 19:51
L9	202035	(source drain source/drain) and drift ((gradient graded) near2 concentration near2 dop$3) and well	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/30 19:51
L10	33	L9 and l8	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/30 19:51
L11	18	L7 and (((gradient graded) near2 concentration near2 dop$3) and well)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/30 19:51
L12	18	L11 and l8	US-PGPUB; USPAT;	OR	OFF	2020/03/30 19:51

			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S1	0	"16717950"	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:09
S2	6	14/515,584	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:09
S3	27	("5448087" | "5888857" | "20030030488" | "6720622" | "20030026126" | "5973575" | "5262345" | "20040027753").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:10
S4	44	("20020056883" | "20020084430" | "20020102783" | "20030042511" | "4160985" | "5637898" | "5517052" | "4481522" | "6831292" | "20020093281" | "5029277" | "20060113592" | "20020134419").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:10
S5	96	("20020074585" | "5496746" | "6683343" | "6696314" | "6452086" | "6472715" | "6747883" | "5797999" | "6670544" | "20040063288" | "4347654" | "4866000" | "6744117" | "6754093" | "5213988" | "5569612" | "RE37441" | "4001864" | "6756616" | "5130262" | "5329144" | "6706550" | "6753202" | "5480816" | "6713813" | "6737722" | "5575862" | "6211028").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:10
S6	220	("20020102783" | "20030026126" | "20030030488" | "6211028" | "6310366" | "6753202" | "7115925" | "8164124" | "6878603" | "20020056883" | "20020093281" | "20150200314" | "4347654" | "5496746" | "6452086" | "6737722" | "6747883" | "6780713" | "20030042511" | "5029277" | "5888857" | "6670544" | "6706550" | "6713813" | "6921943" | "7504692" | "20040027753" | "4160985" | "5448087" | "6472715" | "6683343" | "6831292" | "7307327" | "5569612" | "5575862" | "5637898" | "6720622" | "6744117" | "20070045682" | "20020134419" | "20060113592" | "20130001661" | "4481522" | "5262345" | "6756616" | "6933215" | "7233044" | "20010040622" | "20020074585" | "5130262" | "5213988" | "5329144" |	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:11

		"6465862" | "6696314" | "RE37441" | "20020084430" | "4001864" | "4866000" | "5480816" | "5517052" | "5797999" | "5973575" | "6754093" | "7064385" | "20120048462").PN.				
S7	222	S3 S4 S5 S6	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:12
S8	1003	((Mohan) near2 (Rao)).INV.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:13
S9	8	S8 and drift	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:13
S10	202035	(source drain source/drain) and drift ((gradient graded) near2 concentration near2 dop$3) and well	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:13
S11	25808	H01L29/1095.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:14
S12	662	(257/25).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:14
S13	24026	H01L27/11521.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/03/28 18:15
S14	11555	H01L27/11524.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/03/28 18:15

S15	25088	H01L27/14643.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/03/28 18:15
S16	9892	H01L29/36.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/03/28 18:16
S17	11614	H01L29/7395.cpc.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/03/28 18:16
S18	0	((source drain "source/drain") and drift and ((gradient graded) near2 concentration near2 dop$3) and well and unidirectional).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:18
S19	2	((source drain "source/drain") and drift and (((gradient graded) near2 concentration near2 dop$3) SAME well)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:19
S20	6	S8 and (((gradient graded) near2 concentration near2 dop$3) and well)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:19
S21	18	S7 and (((gradient graded) near2 concentration near2 dop$3) and well)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:19
S22	1150	(257/655).CCLS.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2020/03/28 18:19
S23	12	(US-20030030488-$ or US-20040027753-$ or US-20030026126-$ or US-20140034997-$ or US-20060049464-$ or US-20130234201-$ or US-20070181927-$).did. or (US-5448087-$	US-PGPUB; USPAT	OR	ON	2020/03/28 18:20

		or US-5262345-$ or US-5973575-$ or US-6720622-$ or US-5888857-$).did.				

3/30/2020 8:51:58 PM
C:\Users\aarora\Documents\EAST\Workspaces\16717950.wsp

Bibliographic Data

Application No: 16/717,950

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /AJAY ARORA/ Examiner's Signature | Initials

Title: SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
12/17/2019	257	2892	GRTD.01.01.DV6
RULE			

APPLICANTS

GREENTHREAD, LLC, Dallas, TX, UNITED STATES

INVENTORS

G.R. Mohan Rao Allen, TX, UNITED STATES

CONTINUING DATA

This application is a CON of 15590282 05/09/2017 PAT 10510842

15590282 is a CON of 14931636 11/03/2015 PAT 9647070

14931636 is a CON of 14515584 10/16/2014 PAT 9190502

14515584 is a CON of 13854319 04/01/2013ABN

13854319 is a CON of 11622496 01/12/2007 PAT 8421195

11622496 is a DIV of 10934915 09/03/2004ABN

FOREIGN APPLICATIONS

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Courtesy Reminder for
Application Serial No: 16/717,950

Attorney Docket No: GRTD.01.01.DV6
Customer Number: 40672
Date of Electronic Notification: 04/07/2020

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/717,950	12/17/2019	G.R. Mohan Rao	GRTD.01.01.DV6

CONFIRMATION NO. 5519

40672
BILL R. NAIFEH
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DALLAS, TX 75380

PUBLICATION NOTICE

OC000000116475555

Title:SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS

Publication No.US-2020-0127095-A1
Publication Date:04/23/2020

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/717,950	12/17/2019	G.R. Mohan Rao	GRTD.01.01.DV6	5519

40672 7590 06/19/2020

BILL R. NAIFEH
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DALLAS, TX 75380

EXAMINER	
ARORA, AJAY	

ART UNIT	PAPER NUMBER
2892	

NOTIFICATION DATE	DELIVERY MODE
06/19/2020	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

patents@naifeh.com

Corrected ***Notice of Allowability***	**Application No.** 16/717,950	**Applicant(s)** Rao, G.R. Mohan	
	Examiner AJAY ARORA	**Art Unit** 2892	**AIA (FITF) Status** No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 4/6/2020.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are 17-52 . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some *c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☑ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date 4/6/2020.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☐ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☐ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/AJAY ARORA/
Primary Examiner, Art Unit 2892

Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16717950
Filing Date	2019-12-17
First Named Inventor	G.R. Mohan Rao
Art Unit	2892
Examiner Name	Arora, Ajay
Attorney Docket Number	GRTD.01.01.DV6

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Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	4001864	A	1997-01-04	Gibbons	
	2	4160985	A	1979-07-10	Kamins et al.	
	3	4347654	A	1982-09-07	Allen et al.	
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	7	5130262	A	1992-07-14	Masquelier et al.	
	8	5213988	A	1993-05-25	Yamauchi et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.A/

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First Named Inventor	G.R. Mohan Rao
Art Unit	2892
Examiner Name	Arora, Ajay
Attorney Docket Number	GRTD.01.01.DV6

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	16	5575862	A	1996-11-19	Nishida	
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	18	5797999	A	1998-08-25	Sannomiya et al.	
	19	5888857	A	1999-03-30	Zhang et al.	

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	Examiner Name	Arora, Ajay
	Attorney Docket Number	GRTD.01.01.DV6

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	21	6211028	B1	2001-04-03	Tsai et al.	
	22	6310366	B1	2001-10-30	Rhodes et al.	
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	24	6452086	B1	2002-09-17	Muller	
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	Examiner Name	Arora, Ajay
	Attorney Docket Number	GRTD.01.01.DV6

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	32	6720622	B1	2004-04-13	Yu	
	33	6737722	B2	2004-05-18	Yamamoto et al.	
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(Not for submission under 37 CFR 1.99)

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First Named Inventor	G.R. Mohan Rao
Art Unit	2892
Examiner Name	Arora, Ajay
Attorney Docket Number	GRTD.01.01.DV6

	42	6921946	B2	2005-07-26	Kenney et al.	
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	44	7064385	B2	2006-06-20	Dudek et al.	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
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	Filing Date	2019-12-17
	First Named Inventor	G.R. Mohan Rao
	Art Unit	2892
	Examiner Name	Arora, Ajay
	Attorney Docket Number	GRTD.01.01.DV6

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Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
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	3	20020074585	A1	2002-06-20	Tsang et al.	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	16717950
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	First Named Inventor	G.R. Mohan Rao
	Art Unit	2892
	Examiner Name	Arora, Ajay
	Attorney Docket Number	GRTD.01.01.DV6

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	10	20030042511	A1	2003-03-06	Rhodes	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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	1	P.D. Moor, Advanced CMOS-based pixel sensors, https://indico.cern.ch/event/122027/contributions/88236/attachments/69340/99377/FEEimecPdM.pdf, 2011, 41 pages	
	2	E. Parton, CMOS Sensors, Laser Focus World, http://www.laserfocusworld.com/articles/print/volume-49/issue-10/features/cmos-sensors-cmos-based-specialty-imagers-reach-new-performance-levels.html, Oct. 14, 2013, 5 pages	
	3	Z. Cao, Design of Pixel for High Speed CMOS Image Sensors, http://www.imagesensors.org/Past%20Workshops/2013%20Workshop/2013%20Papers/07-11_072-Cao_papers.pdf, 4 pages	
	4	M. Tanenbaum, BSTJ: Diffused Emitter and Base Silicon Transisters, The Bell System Technical Journal, Jan. 1956, 22 pages, vol. XXXV, https://archive.org/details/bstj35-1-1	
	5	IMEC Image Sensors and Vision Systems, http:www2.imec.be/content/user/File/Brochures/cmos%20imagers%20brochure-april26.pdf, Apr. 2014, 2 pages	
	6	A.S. Grove, Physics and Technology of Semiconductor Devices, John Wiley Sons, Inc., New York, Nov. 1967.	
	7	W. Murray Bullis and W. R. Runyan, Influence of Mobility and Lifetime Variations on Drift-Field Effects in Silicon-Junction Devices, IEEE Transactions on Electron Devices, vol. Ed-14, No. 2, Feb. 1967	
	8	Berinder Brar et al., Herb's Bipolar Transistors, IEEE Transactions on Electron Devices, vol. 48, No. 11, Nov. 2001	

If you wish to add additional non-patent literature document citation information please click the Add button Add

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.A/

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (**Not for submission under 37 CFR 1.99)**	Application Number	16717950
	Filing Date	2019-12-17
	First Named Inventor	G.R. Mohan Rao
	Art Unit	2892
	Examiner Name	Arora, Ajay
	Attorney Docket Number	GRTD.01.01.DV6

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /A.A/

EXAMINER SIGNATURE			
Examiner Signature	/AJAY ARORA/	Date Considered	06/16/2020

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	16717950
Filing Date	2019-12-17
First Named Inventor	G.R. Mohan Rao
Art Unit	2892
Examiner Name	Arora, Ajay
Attorney Docket Number	GRTD.01.01.DV6

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/Bill R. Naifeh, Reg. No. 44962/	Date (YYYY-MM-DD)	2020-04-06
Name/Print	Bill R. Naifeh	Registration Number	44962

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these record s.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

40672 7590 04/07/2020

BILL R. NAIFEH
PO BOX 803423
DALLAS, TX 75380

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/717,950	12/17/2019	G.R. Mohan Rao	GRTD.01.01.DV6	5519

TITLE OF INVENTION: SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	SMALL	$500	$0.00	$0.00	$500	07/07/2020

EXAMINER	ART UNIT	CLASS-SUBCLASS
ARORA, AJAY	2892	257-025000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Bill R. Naifeh
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: Greenthread, LLC

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Dallas, Texas

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ☒ Corporation or other private group entity ❑ Government

4a. Fees submitted: ☒ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /Bill R. Naifeh, Reg No. 44962/ Date 2020-06-19

Typed or printed name Bill R. Naifeh Registration No. 44,962

Electronic Patent Application Fee Transmittal

Application Number:	16717950
Filing Date:	17-Dec-2019
Title of Invention:	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS
First Named Inventor/Applicant Name:	G.R. Mohan Rao
Filer:	Bill Naifeh/April Reasoner
Attorney Docket Number:	GRTD.01.01.DV6

Filed as Small Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	2501	1	500	500

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**500**

Electronic Acknowledgement Receipt

EFS ID:	39774893
Application Number:	16717950
International Application Number:	
Confirmation Number:	5519
Title of Invention:	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS
First Named Inventor/Applicant Name:	G.R. Mohan Rao
Customer Number:	40672
Filer:	Bill Naifeh/April Reasoner
Filer Authorized By:	Bill Naifeh
Attorney Docket Number:	GRTD.01.01.DV6
Receipt Date:	19-JUN-2020
Filing Date:	17-DEC-2019
Time Stamp:	15:00:05
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$500
RAM confirmation Number	E20206IF00323136
Deposit Account	
Authorized User	

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	GRTDDV6_IssueFeeTrans.pdf	80366 2daa2ccb217ed4d7f410ccf6a13da505fd54b255	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30214 8a27da1d75a283a5d5fa506b4f8cc17f24169c55	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	110580		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
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Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/717,950	08/04/2020	10734481	GRTD.01.01.DV6	5519

40672 7590 07/15/2020

BILL R. NAIFEH
PO BOX 803423
DALLAS, TX 75380

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

GREENTHREAD, LLC, Dallas, TX;
G.R. Mohan Rao, Allen, TX;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY.DOCKET NO./TITLE	REQUEST ID
16/717,950	12/17/2019	GREENTHREAD, LLC	GRTD.01.01.DV6	121973

Acknowledgement of Loss of Entitlement to Entity Status Discount

The entity status change request below filed through Private PAIR on 09/28/2020 has been accepted.

CERTIFICATIONS:

Change of Entity Status:

X Applicant changing to regular undiscounted fee status.

NOTE: Checking this box will be taken to be notification of loss of entitlement to small or micro entity status, as applicable.

This portion must be completed by the signatory or signatories making the entity status change in accordance with 37 CFR 1.4(d)(4).

Signature:	/Bill R. Naifeh, Reg. No. 44962/
Name:	Bill R. Naifeh
Registration Number:	44962

PTO/AIA/81A (02-15)
Approved for use through 03/31/2021. OMB 0651-0035
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT - POWER OF ATTORNEY OR REVOCATION OF POWER OF ATTORNEY WITH A NEW POWER OF ATTORNEY AND CHANGE OF CORRESPONDENCE ADDRESS

Patent Number	10,734,481
Issue Date	08-04-2020
First Named Inventor	G.R. Mohan RAO
Title	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS
Attorney Docket No.	GRTD60-35377

I hereby revoke all previous powers of attorney given in the above-identified patent.

☐ A Power of Attorney is submitted herewith.

OR

☉ I hereby appoint Practitioner(s) associated with the Customer Number identified in the box at right as my/our attorney(s) or agent(s) with respect to the patent identified above, and to transact all business in the United States Patent and Trademark Office connected therewith: 25883

OR

☐ I hereby appoint Practitioner(s) named below as my/our attorney(s) or agent(s) with respect to the patent identified above, and to transact all business in the United States Patent and Trademark Office connected therewith:

Practitioner(s) Name	Registration Number

Please recognize or change the correspondence address for the above-identified patent to:

☐ The address associated with the above-identified Customer Number.

OR

☉ The address associated with the Customer Number identified in the box at right: 25883

OR

☐ Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the:

☐ Applicant.

OR

☒ Patent owner.

Statement under 37 CFR 3.73(c) (Form PTO/AIA/96) submitted herewith or filed on _____.

SIGNATURE of Applicant or Patent Owner

Signature	Phillip John	Date	7/30/21
Name	Phillip John	Telephone	214-732-6244
Title and Company	Manager Greenthread, LLC		

NOTE: Signatures of all the applicants or patent owners of the entire interest or their representative(s) are required. If more than one signature is required, submit multiple forms, check the box below, and identify the total number of forms submitted in the blank below.

☐ A total of _____ forms are submitted.

This collection of information is required by 37 CFR 1.31, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public, which is to update (and by the USPTO to process) the file of a patent or reexamination proceeding. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

PTO/AIA/96 (08-12)
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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

STATEMENT UNDER 37 CFR 3.73(c)

Applicant/Patent Owner: Greenthread, LLC

Application No./Patent No.: 10,734,481 Filed/Issue Date: 08-04-2020

Titled: SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS

Greenthread, LLC, a Limited Liability Company

(Name of Assignee) (Type of Assignee, e.g., corporation, partnership, university, government agency, etc.)

states that, for the patent application/patent identified above, it is (choose **one** of options 1, 2, 3 or 4 below):

1. [x] The assignee of the entire right, title, and interest.

2. [ ] An assignee of less than the entire right, title, and interest (check applicable box):

   [ ] The extent (by percentage) of its ownership interest is _____%. Additional Statement(s) by the owners holding the balance of the interest must be submitted to account for 100% of the ownership interest.

   [ ] There are unspecified percentages of ownership. The other parties, including inventors, who together own the entire right, title and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

3. [ ] The assignee of an undivided interest in the entirety (a complete assignment from one of the joint inventors was made). The other parties, including inventors, who together own the entire right, title, and interest are:

   Additional Statement(s) by the owner(s) holding the balance of the interest must be submitted to account for the entire right, title, and interest.

4. [ ] The recipient, via a court proceeding or the like (*e.g.*, bankruptcy, probate), of an undivided interest in the entirety (a complete transfer of ownership interest was made). The certified document(s) showing the transfer is attached.

The interest identified in option 1, 2 or 3 above (not option 4) is evidenced by either (choose **one** of options A or B below):

A. [✓] An assignment from the inventor(s) of the patent application/patent identified above. The assignment was recorded in the United States Patent and Trademark Office at Reel 051843, Frame 0078, or for which a copy thereof is attached.

B. [ ] A chain of title from the inventor(s), of the patent application/patent identified above, to the current assignee as follows:

   1. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

   2. From: _____ To: _____

      The document was recorded in the United States Patent and Trademark Office at

      Reel _____, Frame _____, or for which a copy thereof is attached.

This collection of information is required by 37 CFR 3.73(b). The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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STATEMENT UNDER 37 CFR 3.73(c)

3. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

4. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

5. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

6. From: _____ To: _____

The document was recorded in the United States Patent and Trademark Office at

Reel _____, Frame _____, or for which a copy thereof is attached.

☐ Additional documents in the chain of title are listed on a supplemental sheet(s).

☑ As required by 37 CFR 3.73(c)(1)(i), the documentary evidence of the chain of title from the original owner to the assignee was, or concurrently is being, submitted for recordation pursuant to 37 CFR 3.11.

[NOTE: A separate copy (i.e., a true copy of the original assignment document(s)) must be submitted to Assignment Division in accordance with 37 CFR Part 3, to record the assignment in the records of the USPTO. See MPEP 302.08]

The undersigned (whose title is supplied below) is authorized to act on behalf of the assignee.

/Gregory M. Howison, Reg. #30646/	October 5, 2021
Signature	Date
Gregory M. Howison	30,646
Printed or Typed Name	Title or Registration Number

Privacy Act Statement

The **Privacy Act of 1974 (P.L. 93-579)** requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (*i.e.*, GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Acknowledgement Receipt

EFS ID:	43954987
Application Number:	16717950
International Application Number:	
Confirmation Number:	5519
Title of Invention:	SEMICONDUCTOR DEVICES WITH GRADED DOPANT REGIONS
First Named Inventor/Applicant Name:	G.R. Mohan Rao
Customer Number:	40672
Filer:	Gregory Michael Howison
Filer Authorized By:	
Attorney Docket Number:	GRTD.01.01.DV6
Receipt Date:	07-OCT-2021
Filing Date:	17-DEC-2019
Time Stamp:	11:45:31
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	GRT35377POACHANGEADDRESSEXE.pdf	1029309 3acfebd46ef481052c4e2a13c086408631a9b159	no	1

Warnings:

Information:					
2	Assignee showing of ownership per 37 CFR 3.73	GRT35377373STMT.pdf	120456 2cfd5990a1bfac2c5318d20fd7dee2abab650b07	no	3
Warnings:					
Information:					
			Total Files Size (in bytes):	1149765	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/717,950	12/17/2019	G.R. Mohan Rao	GRTD60-35377

CONFIRMATION NO. 5519

POA ACCEPTANCE LETTER

25883
MUNCK WILSON MANDALA L.L.P
P.O. Drawer 800889
DALLAS, TX 75380

OC00000012911218 7

Date Mailed: 10/15/2021

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 10/07/2021.

The Power of Attorney in this application is accepted. Correspondence in this application will be mailed to the above address as provided by 37 CFR 1.33.

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/atesfai/

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/717,950	12/17/2019	G.R. Mohan Rao	GRTD.01.01.DV6

CONFIRMATION NO. 5519

POWER OF ATTORNEY NOTICE

40672
LAW OFFICE OF BILL NAIFEH
PO BOX 803423
DALLAS, TX 75380

OC000000129112151

Date Mailed: 10/15/2021

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 10/07/2021.

- The Power of Attorney to you in this application has been revoked by the applicant. Future correspondence will be mailed to the new address of record(37 CFR 1.33).

Questions about the contents of this notice and the requirements it sets forth should be directed to the Office of Data Management, Application Assistance Unit, at **(571) 272-4000** or **(571) 272-4200** or **1-888-786-0101**.

/atesfai/

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Western District of Texas, Waco Division on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
6:22-cv-00105	1/27/2022	Western District of Texas, Waco Division

PLAINTIFF	DEFENDANT
GREENTHREAD, LLC	INTEL CORPORATION, DELL INC., AND DELL TECHNOLOGIES INC.,

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	8,421,195	4/16/2013	GREENTHREAD, LLC
2	9,190,502	11/17/2015	GREENTHREAD, LLC
3	10,510,842	12/17/2019	GREENTHREAD, LLC
4	10,734,481	8/4/2020	GREENTHREAD, LLC
5	11,121,222	9/14/2021	GREENTHREAD, LLC

In the above---entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1		
2		
3		
4		
5		

In the above---entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1---Upon initiation of action, mail this copy to Director Copy 3---Upon termination of action, mail this copy to Director
Copy 2---Upon filing document adding patent(s), mail this copy to Director Copy 4---Case file copy

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Western District of Texas, Waco Division on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
6:22-cv-00105	1/27/2022	Western District of Texas, Waco Division

PLAINTIFF	DEFENDANT
GREENTHREAD, LLC	INTEL CORPORATION, DELL INC., AND DELL TECHNOLOGIES INC.,

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	8,421,195	4/16/2013	GREENTHREAD, LLC
2	9,190,502	11/17/2015	GREENTHREAD, LLC
3	10,510,842	12/17/2019	GREENTHREAD, LLC
4	10,734,481	8/4/2020	GREENTHREAD, LLC
5	11,121,222	9/14/2021	GREENTHREAD, LLC

In the above---entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☑ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading		
	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	11,316,014	4/26/2022	GREENTHREAD, LLC
2			
3			
4			
5			

In the above---entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE

Copy 1---Upon initiation of action, mail this copy to Director Copy 3---Upon termination of action, mail this copy to Director
Copy 2---Upon filing document adding patent(s), mail this copy to Director Copy 4---Case file copy

Trials@uspto.gov
Tel: 571-272-7822

Paper 10
Date: May 17, 2023

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DELL TECHNOLOGIES INC. AND DELL INC.,
Petitioner,

v.

GREENTHREAD LLC,
Patent Owner.

IPR2023-00506 (Patent No. 10,510,842 B2)
IPR2023-00507 (Patent No. 10,734,481 B2)
IPR2023-00509 (Patent No. 11,121,222 B2)
IPR2023-00510 (Patent No. 11,316,014 B2)[1]

Before CHRISTOPHER L. CRUMBLEY, CHRISTOPHER M. KAISER, and KRISTI L. R. SAWERT, *Administrative Patent Judges*.

Per Curiam.

DECISION
Settlement Prior to Institution of Trial
37 C.F.R. § 42.74

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[1] This Order addresses issues that are the same in the above-captioned proceedings. The parties are not authorized to use a multi-case caption.

I. INTRODUCTION

On May 2, 2023, after email authorization by the Board, Petitioner and Patent Owner (collectively "the Parties") filed a Joint Motion to Terminate *Inter Partes* Review in the above-identified proceeding. Paper 9 ("Joint Motion").[2] In support of the Joint Motion, the Parties filed copies of Confidential Settlement-Related Agreements (Exs. 2001, 2002 ("Settlement Agreements")), as well as a Joint Request to Keep Separate Pursuant to 35 U.S.C. § 317(b) and 37 C.F.R. § 42.74(c) (Paper 10 ("Joint Request")).

II. DISCUSSION

In the Joint Motion, "[t]he Parties jointly request that the Board terminate this *inter partes* review of the Patent-in-Suit, Case No. IPR2023-00506, in its entirety." Paper 9, 2. The Parties represent that the filed Settlement Agreements are true copies and "together form the complete agreement resolving the disputes in the *inter partes* review between the Parties" and that "[t]here are no other collateral agreements between the Parties made in connection with, or in contemplation of, the termination sought." *Id.* at 1. The Parties further represent that a "joint motion to dismiss the lawsuit between" the Parties "involving the Patent-in-Suit was filed on April 24, 2023." *Id.* at 2.

The Parties also filed a Joint Request that the Settlement Agreements be treated as business confidential information and be kept separate from the file of the patent involved in this *inter partes* proceeding and the files of this

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[2] For purposes of expediency, we cite to papers and exhibits filed in IPR2023-00506, unless otherwise noted. The Parties filed similar papers and exhibits in each of the above-identified proceedings.

proceeding. Paper 10, 1. As the filing party for confidential Exhibit 2001, Patent Owner represents that it "is not permitted to share certain portions . . . with any party other than the Board and its staff." Paper 9, 1. Patent Owner further represents that "Exhibit 2001, to which Dell is not a party, is to be filed such that it is available to the Board and Patent Owner only" and that "the Parties are in agreement with this procedure." *Id.*

This proceeding is in its preliminary phase. Petitioner filed its Petition on January 27, 2022, and Patent Owner has not filed a Preliminary Response. Paper 9, 2. Accordingly, we have not yet entered a decision on institution. In view of the early stage of the proceeding and the settlement between the Parties, we determine that good cause exists to terminate the proceeding with respect to the Parties.

After reviewing each of the Settlement Agreements, we find that the Settlement Agreements contain confidential business information regarding the terms of settlement. We determine that good cause exists to treat the Settlement Agreements as business confidential information pursuant to 35 U.S.C. § 317(b) and 37 C.F.R. § 42.74(c) and kept separate from the files of the challenged patent. On the other hand, as to the Parties' request that the Board keep the Settlement Agreements "separate from the files of this proceeding," Paper 10, 1, our regulations do not require us to do so. Therefore, we decline to issue an order to keep the Settlement Agreements separate from the file of this *inter partes* proceeding.

The Parties further request that "the Board inform them if anyone seeks production of the agreements and afford them an opportunity to address whether such request is supported by good cause." Paper 10, 1. We

have no such procedure to serve upon the Parties a request for access to the Settlement Agreements, and, further, our regulations do not require us to do so. Therefore, we decline to issue an order regarding any request for access to the Settlement Agreements.

This Order does not constitute a final written decision pursuant to 35 U.S.C. § 318(a).

Accordingly, for the reasons discussed above, it is:

III. ORDER

ORDERED that the Joint Motion to Terminate is *granted*;

FURTHER ORDERED that the Joint Request to Keep Separate Pursuant to 35 U.S.C. § 317(b) and 37 C.F.R. § 42.74(c) is *granted-in-part* and *denied-in-part*,

FURTHER ORDERED that Exhibits 2001 and 2002 shall remain business confidential information, and

FURTHER ORDERED that the Petition is *dismissed*.

IPR2023-00506 (Patent No. 10,510,842 B2)
IPR2023-00507 (Patent No. 10,734,481 B2)
IPR2023-00509 (Patent No. 11,121,222 B2)
IPR2023-00510 (Patent No. 11,316,014 B2)

FOR PETITIONER:

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Lauren N. Griffin
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FOR PATENT OWNER:

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nmatich@mckoolsmith.com
smccommas@mckoolsmith.com

Trials@uspto.gov
Tel: 571-272-7822

Paper 10
Entered: May 18, 2023

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

SONY GROUP CORPORATION,
Petitioner,

v.

GREENTHREAD LLC
Patent Owner.

IPR2023-00324 (Patent No. 11,121,222 B2)
IPR2023-00325 (Patent No. 11,316,014 B2)
IPR2023-00375 (Patent No. 10,734,481 B2)
IPR2023-00376 (Patent No. 10,510,842 B2)[1]

Before GRACE KARAFFA OBERMANN, CHRISTOPHER L. CRUMBLEY, and CHRISTOPHER M. KAISER, *Administrative Patent Judges*.

Per Curiam.

DECISION
Settlement Prior to Institution of Trial
37 C.F.R. § 42.74

---

[1] This Order addresses issues that are the same in the above-captioned proceedings. The parties are not authorized to use a multi-case caption.

I. INTRODUCTION

On May 3, 2023, after email authorization by the Board, Petitioner and Patent Owner (collectively "the Parties") filed a Joint Motion to Terminate *Inter Partes* Review in the above-identified proceeding. Paper 8 ("Joint Motion").[2] In support of the Joint Motion, the Parties filed copies of Confidential Settlement-Related Agreements (Exs. 2001, 2002 ("Settlement Agreements")), as well as a Joint Request that Agreements be Treated as Business Confidential Information and be Kept Separate Pursuant to 35 U.S.C. § 317(b) and 37 C.F.R. § 42.74 (Paper 9 ("Joint Request")).

II. DISCUSSION

In the Joint Motion, "[t]he Parties jointly request that the Board terminate this *inter partes* review in its entirety." Paper 8, 2. The Parties represent that the filed Settlement Agreements are true copies and "together form the complete agreement resolving the disputes in the *inter partes* review between the Parties" and that "[t]here are no other collateral agreements between the Parties made in connection with, or in contemplation of, the termination sought." *Id.* at 1. The Parties further represent that the District Court proceedings between the Parties involving the above-identified patent at issue was dismissed on April 27, 2023. *Id.* at 2.

The Parties also filed a Joint Request that the Settlement Agreements be treated as business confidential information and be kept separate from the

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[2] For purposes of expediency, we cite to papers and exhibits filed in IPR2023-00324, unless otherwise noted. The Parties filed similar papers and exhibits in each of the above-identified proceedings.

file of the patent involved in this *inter partes* proceeding. Paper 9, 1. As the filing party for confidential Exhibit 2001, Patent Owner represents that it "is not permitted to share certain portions . . . with any party other than the Board and its staff." Paper 8, 1. Patent Owner further represents that "Exhibit 2001, to which Sony is not a party, is to be filed such that it is available to the Board and Patent Owner only" and that "the Parties are in agreement with this procedure." *Id.*

This proceeding is in its preliminary phase. Petitioner filed its Petition on December 12, 2022, and Patent Owner has not filed a Preliminary Response, which was due May 12, 2023. Paper 5, 1; Ex. 3002, 1. Accordingly, we have not yet entered a decision on institution. In view of the early stage of the proceeding and the settlement between the Parties, we determine that good cause exists to terminate the proceeding with respect to the Parties.

After reviewing each of the Settlement Agreements, we find that the Settlement Agreements contain confidential business information regarding the terms of settlement. We determine that good cause exists to treat the Settlement Agreements as business confidential information pursuant to 35 U.S.C. § 317(b) and 37 C.F.R. § 42.74(c) and kept separate from the files of the challenged patent.

The Parties further request that "the Board inform them if anyone seeks production of the agreements and afford them an opportunity to address whether such request is supported by good cause." Paper 9, 1. We have no such procedure to serve upon the Parties a request for access to the Settlement Agreements, and, further, our regulations do not require us to do

so. Therefore, we decline to issue an order regarding any request for access to the Settlement Agreements.

This Order does not constitute a final written decision pursuant to 35 U.S.C. § 318(a).

Accordingly, for the reasons discussed above, it is:

III. ORDER

ORDERED that the Joint Motion to Terminate is *granted*;

FURTHER ORDERED that the Joint Request that Agreements be Treated as Business Confidential Information and be Kept Separate Pursuant to 35 U.S.C. § 317(b) and 37 C.F.R. § 42.74 is *granted*,

FURTHER ORDERED that Exhibits 2001 and 2002 shall remain business confidential information, and

FURTHER ORDERED that the Petition is *dismissed.*

IPR2023-00324 (Patent No. 11,121,222 B2)
IPR2023-00325 (Patent No. 11,316,014 B2)
IPR2023-00375 (Patent No. 10,734,481 B2)
IPR2023-00376 (Patent No. 10,510,842 B2)

For PETITIONER:

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Andrew S. Baluch
SMITH BALUCH LLP
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baluch@smithbaluch.com

For PATENT OWNER:

Alan Whitehurst
Nicholas T. Matich
Arvind Jairam
Stuart McCommas
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nmatich@mckoolsmith.com
ajairam@mckoolsmith.com
smccommas@mckoolsmith.com
nozarkar@mckoolsmith.com

AO 120 (Rev. 08/10)

TO:	REPORT ON THE FILING OR DETERMINATION OF AN ACTION REGARDING A PATENT OR TRADEMARK
Mail Stop 8 Director of the U.S. Patent and Trademark Office P.O. Box 1450 Alexandria, VA 22313-1450	

In Compliance with 35 U.S.C. § 290 and/or 15 U.S.C. § 1116 you are hereby advised that a court action has been filed in the U.S. District Court Western District of Texas, Austin Division on the following

☐ Trademarks or ☑ Patents. (☐ the patent action involves 35 U.S.C. § 292.):

DOCKET NO.	DATE FILED	U.S. DISTRICT COURT
1:23-cv-00369	3/31/2023	Western District of Texas, Austin Division

PLAINTIFF	DEFENDANT
GREENTHREAD, LLC	CIRRUS LOGIC, INC.

	PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1	8,421,195	4/16/2013	GREENTHREAD, LLC
2	9,190,502	11/17/2015	GREENTHREAD, LLC
3	10,510,842	12/17/2019	GREENTHREAD, LLC
4	10,734,481	8/4/2020	GREENTHREAD, LLC
5	11,121,222	9/14/2021	GREENTHREAD, LLC

In the above—entitled case, the following patent(s)/ trademark(s) have been included:

DATE INCLUDED	INCLUDED BY ☐ Amendment ☐ Answer ☐ Cross Bill ☐ Other Pleading	
PATENT OR TRADEMARK NO.	DATE OF PATENT OR TRADEMARK	HOLDER OF PATENT OR TRADEMARK
1 11,316,014	4/26/2022	GREENTHREAD, LLC
2		
3		
4		
5		

In the above—entitled case, the following decision has been rendered or judgement issued:

DECISION/JUDGEMENT

CLERK	(BY) DEPUTY CLERK	DATE
PHILIP J. DEVLIN		04/04/2023

Copy 1—Upon initiation of action, mail this copy to Director **Copy 3—Upon termination of action, mail this copy to Director**
Copy 2—Upon filing document adding patent(s), mail this copy to Director **Copy 4—Case file copy**