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UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/216,244	07/21/2016	Martin U. Pralle	143705.000333

CONFIRMATION NO. 5052

POA ACCEPTANCE LETTER

11951
Troutman Pepper Hamilton Sanders LLP (Rochester)
70 Linden Oaks
Suite 210
Rochester, NY 14625

OC000000136285898

Date Mailed: 09/16/2022

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/01/2022.

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**.

/hsarwari/

IPR2025-00845
Apple-Sony EX1002 Page 1

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/216,244	07/21/2016	Martin U. Pralle	143705.05221

CONFIRMATION NO. 5052

POWER OF ATTORNEY NOTICE

136549
Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736

OC000000136285881

Date Mailed: 09/16/2022

NOTICE REGARDING CHANGE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 09/01/2022.

- The Power of Attorney to you in this application has been revoked by the applicant.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**.

/hsarwari/

IPR2025-00845
Apple-Sony EX1002 Page 2

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

PTO/AIA/82A (07-13)
Approved for use through 03/31/2021. OMB 0651-0035
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.

TRANSMITTAL FOR POWER OF ATTORNEY TO ONE OR MORE REGISTERED PRACTITIONERS

NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	15/216,244
Filing Date	21-Jul-2016
First Named Inventor	Martin U. PRALLE
Title	PIXEL ISOLATION ELEMENTS, DEVICES, AND ASSOCIATED METHODS
Art Unit	
Examiner Name	
Attorney Docket Number	143705.000333

SIGNATURE of Applicant or Patent Practitioner

Signature	/Gunnar G. Leinberg/	Date (Optional)	2022-09-01
Name	Gunnar G. Leinberg	Registration Number	35,584
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

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

☑ *Total of 1 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.

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
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

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.)

☑ 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: 11951

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:

☑ 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):

SiOnyx, LLC

☐ Inventor or Joint Inventor (title not required below)

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

☑ 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		Date (Optional)	
Name	Steven D. Saylor		
Title	President and CEO		

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 1 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:	46533426
Application Number:	15216244
International Application Number:	
Confirmation Number:	5052
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Customer Number:	136549
Filer:	Gunnar G. Leinberg/Mary Frances Heeks
Filer Authorized By:	Gunnar G. Leinberg
Attorney Docket Number:	143705.05221
Receipt Date:	01-SEP-2022
Filing Date:	21-JUL-2016
Time Stamp:	11:37:41
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	20220901_Corrected_POA_with_Transmittal_143705_000333.pdf	328413 ba00e26ae497a77188fac64ce06b19f33302a034	no	2

Warnings:

IPR2025-00845
Apple-Sony EX1002 Page 5

Information:	
Total Files Size (in bytes):	328413

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

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United States Patent and Trademark Office
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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/216,244	03/05/2019	10224359	143705.05221	5052

136549 7590 02/13/2019

Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736

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):

Martin U. Pralle, Wayland, MA;
SiOnyx, LLC., Beverly, MA;
Jeffrey McKee, Tualatin, OR;
Jason Sickler, Arlington, MA;

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.

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

PTO/SB/08a (03-15)
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	15216244
Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

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	5236863		1993-08-17	Iranmesh	
	2	5410168		1995-04-25	Hisa	
	3	8076746		2011-12-13	McCarten et al.	
	4	9419159		2016-08-16	Sakamoto et al.	
Change(s) applied to document, /D.W./ 12/1/2018	5	9673250		2017-06-06	Haddad et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

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	20040256561		2004-12-23	Beuhler et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /L.P./

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15216244
	Filing Date	2016-07-21
	First Named Inventor	Martin U. Pralle
	Art Unit	2814
	Examiner Name	Long Pham
	Attorney Docket Number	143705.05221

	9	7897942		2011-03-01	Bereket	
	10	9184204		2015-11-10	Hu	
	11	9369641		2016-06-14	Hu	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

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	20010044266		2001-11-22	Katsuoka	
	2	20050088634		2005-04-28	Kosugi	
Change(s) applied to document, /K.B./ 12/5/2018	3	20090093100		04/2009 ~~2005-05-06~~	Xia, et al. ~~Chen~~	
	4	20080173620		2008-07-24	Grek	
	5	20090027640		2009-01-29	Shibazaki	
	6	20090114630		2009-05-07	Hawryluk	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Change(s) applied to document,

Application Number	15216244
Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	PHAM, LONG
Attorney Docket Number	143705.05221

/K.B./ 12/5/2018	9	7728274		2010-06-01	Pilla et al	
	10	8268403		09/2012 ~~2007-04-30~~	Akiyama et al	
	11	8445950		2013-05-21	Iida et al	
	12	8445985		2013-05-21	Hiyama et al	
	13	8530264		2013-09-10	De Munck et al	
	14	8604405		2013-12-10	Liu et al	
	15	8729678		2014-05-20	Shim et al	
	16	8928784		2015-01-06	Watanabe et al	
	17	9064762		2015-06-23	Yamaguchi	
	18	9478572		2016-10-25	Miyanami	
	19	9659984		2017-05-23	Ohkubo et al	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /K.B./

IPR2025-00845
Apple-Sony EX1002 Page 10

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)

136549 7590 10/24/2018
Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736

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.
15/216,244	07/21/2016	Martin U. Pralle	143705.05221	5052

TITLE OF INVENTION: Pixel Isolation Elements, Devices and Associated Methods

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	01/24/2019

EXAMINER	ART UNIT	CLASS-SUBCLASS
PHAM, LONG	2814	257-432000

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 Thomas J. Engellenner
2 Reza Mollaaghababa
3 Pepper Hamilton LLP

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: SiOnyx, LLC

(B) RESIDENCE: (CITY and STATE OR COUNTRY): Beverly, MA

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. 500436

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 /Andrew W. Schultz/ Date January 22, 2019

Typed or printed name Andrew W. Schultz Registration No. 66869

IPR2025-00845
Apple-Sony EX1002 Page 11

Electronic Patent Application Fee Transmittal

Application Number:	15216244
Filing Date:	21-Jul-2016
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Filer:	Andrew W. Schultz/Irene Gommerstadt
Attorney Docket Number:	143705.05221

Filed as Large 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	1501	1	1000	1000

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1000**

Electronic Acknowledgement Receipt

EFS ID:	34916852
Application Number:	15216244
International Application Number:	
Confirmation Number:	5052
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Customer Number:	136549
Filer:	Andrew W. Schultz/Irene Gommerstadt
Filer Authorized By:	Andrew W. Schultz
Attorney Docket Number:	143705.05221
Receipt Date:	22-JAN-2019
Filing Date:	21-JUL-2016
Time Stamp:	11:39:43
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1000
RAM confirmation Number	012219INTEFSW11414000
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)	Issue_Fee.pdf	90126 5a0d93900d9a98b5d461aea7d1225b99f8c7b132	no	1
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30144 7b838dfda5629299099370965621 1d7787b875c0	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	120270		

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

NOTICE OF ALLOWANCE AND FEE(S) DUE

136549 7590 10/24/2018

Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736

EXAMINER	
PHAM, LONG	
ART UNIT	PAPER NUMBER
2814	

DATE MAILED: 10/24/2018

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/216,244	07/21/2016	Martin U. Pralle	143705.05221	5052

TITLE OF INVENTION: Pixel Isolation Elements, Devices and Associated Methods

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	01/24/2019

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.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

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)

136549 7590 10/24/2018
Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736

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.
15/216,244	07/21/2016	Martin U. Pralle	143705.05221	5052

TITLE OF INVENTION: Pixel Isolation Elements, Devices and Associated Methods

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1000	$0.00	$0.00	$1000	01/24/2019

EXAMINER	ART UNIT	CLASS-SUBCLASS
PHAM, LONG	2814	257-432000

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 _____

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 _____ Date _____

Typed or printed name _____ Registration No. _____

IPR2025-00845
Apple-Sony EX1002 Page 17

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 NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/216,244	07/21/2016	Martin U. Pralle	143705.05221	5052

136549 7590 10/24/2018

Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736

EXAMINER	
PHAM, LONG	

ART UNIT	PAPER NUMBER
2814	

DATE MAILED: 10/24/2018

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.

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.

IPR2025-00845
Apple-Sony EX1002 Page 19

Notice of Allowability	Application No. 15/216,244	Applicant(s) Pralle et al.	
	Examiner LONG PHAM	Art Unit 2814	AIA 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 AMENDMENT DATED 8/1/2018.
   ☐ 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 34,36-52,54-61,63-64 and 67-121 . 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 areply 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 8/1/2018.
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 _____.

/LONG PHAM/
Primary Examiner, Art Unit 2814

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/216,244	Pralle et al.
	Examiner	Art Unit
	LONG PHAM	2814

CPC - Searched*		
Symbol	Date	Examiner
SEE ISSUE CLASSIFICATION	09/25/2018	LP

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* 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
UPDATED TEXT AND INTERFERENCE SEARCHES	09/25/2018	LP

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
H01L	27/1463	09/25/2018	LP

IPR2025-00845
Apple-Sony EX1002 Page 21

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/216,244	Pralle et al.
	Examiner	**Art Unit**
	LONG PHAM	2814

CPC								
Symbol							**Type**	**Version**
H01L	/	27	/	1463			F	2013-01-01
H01L	/	27	/	14627			I	2013-01-01
H01L	/	27	/	14629			I	2013-01-01
H01L	/	27	/	14685			I	2013-01-01
H01L	/	27	/	14625			I	2013-01-01
H01L	/	27	/	1462			I	2013-01-01
H01L	/	27	/	14607			I	2013-01-01
H01L	/	27	/	14645			I	2013-01-01
H01L	/	27	/	14689			I	2013-01-01

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

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	83	
/LONG PHAM/ Primary Examiner, Art Unit 2814	25 September 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4,6

U.S. Patent and Trademark Office — Part of Paper No.: 20180925

IPR2025-00845
Apple-Sony EX1002 Page 22

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/216,244	Pralle et al.
	Examiner	**Art Unit**
	LONG PHAM	2814

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H01L	/	27	/	146

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

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

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	83	
/LONG PHAM/ Primary Examiner, Art Unit 2814	25 September 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4,6

U.S. Patent and Trademark Office

Part of Paper No.: 20180925

IPR2025-00845
Apple-Sony EX1002 Page 23

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/216,244	Pralle et al.
	Examiner	**Art Unit**
	LONG PHAM	2814

☐ 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	34	12	46	23	58	34	72	45	83	56	94	67	105	78	116
2	36	13	47	24	59	35	73	46	84	57	95	68	106	79	117
3	37	14	48	25	60	36	74	47	85	58	96	69	107	80	118
4	38	15	49	26	61	37	75	48	86	59	97	70	108	81	119
5	39	16	50	27	63	38	76	49	87	60	98	71	109	82	120
6	40	17	51	28	64	39	77	50	88	61	99	72	110	83	121
7	41	18	52	29	67	40	78	51	89	62	100	73	111		
8	42	19	54	30	68	41	79	52	90	63	101	74	112		
9	43	20	55	31	69	42	80	53	91	64	102	75	113		
10	44	21	56	32	70	43	81	54	92	65	103	76	114		
11	45	22	57	33	71	44	82	55	93	66	104	77	115		

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	83	
/LONG PHAM/ Primary Examiner, Art Unit 2814	25 September 2018	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	4,6

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/216,244	Pralle et al.
	Examiner	Art Unit
	LONG PHAM	2814

✓	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	09/07/2016	02/06/2017	06/10/2017	02/15/2018	09/25/2018				
	34	÷	✓	✓	✓	=				
	35	÷	✓	✓	O	-				
	36	÷	✓	✓	✓	=				
	37	÷	✓	✓	✓	=				
	38	÷	✓	✓	O	=				
	39	÷	✓	✓	✓	=				
	40	÷	✓	✓	✓	=				
	41	÷	✓	✓	✓	=				
	42	÷	✓	✓	✓	=				
	43	÷	✓	✓	✓	=				
	44	÷	✓	✓	✓	=				
	45	÷	✓	✓	✓	=				
	46	÷	✓	✓	✓	=				
	47	÷	✓	✓	✓	=				
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	53	÷	✓	✓	✓	-				
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	62		O	-		-				
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	64		✓	✓	✓	=				
	65		O	-		-				
	66			✓	-	-				
	67				✓	=				
	68					=				
	69					=				
	70					=				
	71					=				
	72					=				
	73					=				
	74					=				
	75					=				

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15/216,244	Pralle et al.
	Examiner	Art Unit
	LONG PHAM	2814

CLAIM		DATE								
Final	Original	09/07/2016	02/06/2017	06/10/2017	02/15/2018	09/25/2018				
	76					=				
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	116					=				
	117					=				
	118					=				
	119					=				
	120					=				
	121					=				

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	45	("0969984" | "20050184291" | "20050184353" | "20080191296" | "20080303932" | "20090090988" | "20090096049" | "20090200625" | "20090278967" | "20100108864" | "20100128161" | "20100201834" | "20110241148" | "20110241152" | "20120025199" | "20120049306" | "20120147241" | "20120153127" | "20120153128" | "20120188431" | "20120217602" | "20120228473" | "20130020468" | "20130207212" | "20140054662" | "20140374868" | "20170244920" | "4546945" | "5583704" | "5802091" | "6131511" | "6131512" | "6479093" | "6690968" | "7315014" | "7728274" | "8268403" | "8445950" | "8445985" | "8530264" | "8604405" | "8729678" | "8928784" | "9064762" | "9478572").PN.	US-PGPUB; USPAT	OR	ON	2018/09/25 13:45
L2	1	("20160329366").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2018/09/25 13:57
L3	9556	H01L27/1463.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/09/25 14:06
L5	0	H01L27/14637.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/09/25 14:06
L6	17402	H01L27/14627.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/09/25 14:06
L7	4188	H01L27/14629.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/09/25 14:06

L8	12683	H01L27/14685.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/09/25 14:06
L9	12130	H01L27/14625.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/09/25 14:06
L10	4452	H01L27/1462.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/09/25 14:06
L11	2461	H01L27/14607.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/09/25 14:06
L12	7967	H01L27/14645.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/09/25 14:07
L13	11554	H01L27/14689.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/09/25 14:07
S2	84	US-3035052-$.DID. OR US-20030029495-$.DID. OR US-20040222187-$.DID. OR US-20050127401-$.DID. OR US-20050227390-$.DID. OR US-20060011955-$.DID. OR US-20060079062-$.DID. OR US-20060118781-$.DID. OR US-20060180885-$.DID. OR US-20060231914-$.DID. OR US-20070145505-$.DID. OR US-20080026550-$.DID. OR US-20080036022-$.DID. OR US-20080044943-$.DID. OR US-20080076240-$.DID. OR US-20080099804-$.DID. OR US-20080178932-$.DID. OR US-20080258604-$.DID. OR US-20090065051-$.DID. OR US-20090142879-$.DID. OR US-	US-PGPUB; USPAT; USOCR; JPO; IBM_TDB	OR	ON	2014/06/25 14:14

		20090160983-$.DID. OR US-20090194671-$.DID. OR US-20090200586-$.DID. OR US-20090213883-$.DID. OR US-3487223-$.DID. OR US-4277793-$.DID. OR US-4419533-$.DID. OR US-4493942-$.DID. OR US-4514582-$.DID. OR US-4536608-$.DID. OR US-4663188-$.DID. OR US-4829013-$.DID. OR US-5080725-$.DID. OR US-5081049-$.DID. OR US-5100478-$.DID. OR US-5114876-$.DID. OR US-5164324-$.DID. OR US-5322988-$.DID. OR US-5346850-$.DID. OR US-5597621-$.DID. OR US-5714404-$.DID. OR US-5731213-$.DID. OR US-5792280-$.DID. OR US-6147297-$.DID. OR US-6498336-$.DID. OR US-6580053-$.DID. OR US-6583936-$.DID. OR US-6667528-$.DID. OR US-6759262-$.DID. OR US-6800541-$.DID. OR US-7057256-$.DID. OR US-7091411-$.DID. OR US-7109517-$.DID. OR US-7247527-$.DID. OR US-7314832-$.DID. OR US-7354792-$.DID. OR US-7390689-$.DID. OR US-7442629-$.DID. OR US-7456452-$.DID. OR US-7482532-$.DID. OR US-7498650-$.DID. OR US-7504325-$.DID. OR US-7504702-$.DID. OR US-7511750-$.DID. OR US-7745901-$.DID. OR US-7781856-$.DID. OR US-7816220-$.DID. OR US-7847253-$.DID. OR US-7884439-$.DID. OR US-7884446-$.DID. OR US-8030726-$.DID. OR US-8058615-$.DID. OR US-8207051-$.DID. OR US-8476681-$.DID. OR US-3666484-$.DID. OR US-2030766-$.DID. OR JP-07173484-$.DID. OR JP-071734840721-$.DID. OR JP-2008187003-$.DID. OR JP-2011091128-$.DID. OR JP-2152226-$.DID. OR JP-63116421-$.DID. OR JP-9298308-$.DID. OR KR-20010061058-$.DID. OR KR-20100118864-$.DID. OR WO-2006086014-$.DID. OR WO-2009100023-$.DID. OR WO-2011035188-$.DID. OR WO-2011119618-$.DID.				
S3	7768	(light adj2 (trapping or trapped))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 14:16
S4	11	S2 and S3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 14:16

S5	2251	(reflector or Bragg) and S3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:40
S6	14	(reflector or Bragg) and S2	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:41
S7	888	(reflector or Bragg) near3 backside	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:55
S8	51623	(reflector or Bragg) near3 (side or sidewall or edge or wall)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:55
S9	112640	pixel near5 (side or sidewall or edge or wall)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:56
S10	143	S7 same S8	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:56
S11	2	S9 same4 S10	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:56
S12	3	S9 and S10	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:57
S13	1	S12 not S11	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2014/06/25 15:57

			DERWENT; IBM_TDB			
S14	179	S7 same4 S8	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:58
S15	145	S14 and (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:59
S16	129	S14 same10 (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:59
S17	128	S14 same8 (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:59
S18	1204	(reflector or Bragg) near5 backside	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:09
S19	71202	(reflector or Bragg) near5 (side or sidewall or edge or wall)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:09
S20	280	S18 same4 S19	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:09
S21	195	S20 same4 (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:09
S22	7	S18 same2 S9	US-PGPUB; USPAT; USOCR;	OR	ON	2014/06/25 16:10

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S23	7	S22 same4 (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:10
S24	217	S18 same S19	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:13
S25	0	(light adj2 sensitive adj2 pixel) same4 S24	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:14
S26	0	(light adj2 sensitive adj2 pixel) and S24	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:14
S27	14	pixel same4 S24	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:14
S28	7	S27 and index	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:18
S29	26925	(high adj2 index) near3 (layer or film)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:48
S30	27823	(low adj2 index) near3 (layer or film)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:48
S31	12802	S29 near10 S30	US-PGPUB;	OR	ON	2014/06/26

			USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			12:48
S32	1170	(reflector or Bragg) same S31	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:49
S33	611	(reflector or Bragg) near10 S31	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:49
S34	4200	S30 near5 ("between")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:49
S35	1972	S34 near10 S29	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:50
S36	81	(reflector or Bragg) near10 S35	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:50
S37	188	S29 near5 (polysilicon or polycrystalline or poly or (amorphous adj2 silicon) or germanium)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:53
S38	2500	S30 near5 (oxide or nitride or oxynitride or oxynitrides)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:53
S39	14	S37 near20 S38	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	2014/06/26 12:53

			IBM_TDB			
S40	0	(reflector or Bragg) same S39	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:54
S41	0	S39 near20 ("between")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:54
S42	51	backside near6 (textured near2 (layer or film))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 13:12
S43	10	S42 AND ((H01L21/02686 OR H01L27/1214 OR H01L21/02532 OR H01L21/02595 OR H01L31/0236 OR H01L21/0237 OR H01L21/02403 OR H01L21/0243 OR H01L21/02472 OR H01L21/02483 OR H01L21/02494 OR H01L21/02554 OR H01L21/02565 OR H01L21/02573 OR H01L21/02587 OR H01L21/02609 OR H01L21/0262 OR H01L21/365 OR H01L2224/16 OR H01L27/14625 OR H01L27/14627 OR H01L27/14629 OR H01L27/1463 OR H01L27/14685 OR H01L31/02168 OR H01L31/022425 OR H01L31/02363 OR H01L31/042 OR H01L31/0527 OR H01L31/0682 OR H01L31/18 OR H01L31/1804 OR H01L33/0087 OR H01L33/22 OR H01L33/24 OR H01L33/28 OR H01L33/385 OR H01L33/405 OR H01L33/483 OR H01L33/60 OR H01L33/62).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 13:25
S44	5	S39 AND ((H01L21/02686 OR H01L27/1214 OR H01L21/02532 OR H01L21/02595 OR H01L31/0236 OR H01L21/0237 OR H01L21/02403 OR H01L21/0243 OR H01L21/02472 OR H01L21/02483 OR H01L21/02494 OR H01L21/02554 OR H01L21/02565 OR H01L21/02573 OR H01L21/02587 OR H01L21/02609 OR H01L21/0262 OR H01L21/365 OR H01L2224/16 OR H01L27/14625 OR H01L27/14627 OR H01L27/14629 OR H01L27/1463 OR H01L27/14685 OR H01L31/02168 OR H01L31/022425 OR H01L31/02363 OR H01L31/042 OR H01L31/0527 OR H01L31/0682 OR H01L31/18 OR H01L31/1804 OR H01L33/0087 OR H01L33/22 OR H01L33/24 OR H01L33/28 OR H01L33/385 OR	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 13:25

		H01L33/405 OR H01L33/483 OR H01L33/60 OR H01L33/62).CPC.)				
S45	2	S36 AND ((H01L21/02686 OR H01L27/1214 OR H01L21/02532 OR H01L21/02595 OR H01L31/0236 OR H01L21/0237 OR H01L21/02403 OR H01L21/0243 OR H01L21/02472 OR H01L21/02483 OR H01L21/02494 OR H01L21/02554 OR H01L21/02565 OR H01L21/02573 OR H01L21/02587 OR H01L21/02609 OR H01L21/0262 OR H01L21/365 OR H01L2224/16 OR H01L27/14625 OR H01L27/14627 OR H01L27/14629 OR H01L27/1463 OR H01L27/14685 OR H01L31/02168 OR H01L31/022425 OR H01L31/02363 OR H01L31/042 OR H01L31/0527 OR H01L31/0682 OR H01L31/18 OR H01L31/1804 OR H01L33/0087 OR H01L33/22 OR H01L33/24 OR H01L33/28 OR H01L33/385 OR H01L33/405 OR H01L33/483 OR H01L33/60 OR H01L33/62).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 13:25
S46	1	("20140138785").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2015/01/05 11:26
S47	3930	(257/432).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2015/01/05 11:54
S48	218	(257/228).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2015/01/05 11:54
S50	1	("9373732").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2016/07/13 15:10
S51	1	("9373732").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2016/07/15 10:13
S52	395	reflective near3 (aluminum adj oxide)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/07/15 13:07
S53	35214	(rough or textured) near2 (layer or film)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:24
S54	44833	light adj2 incident adj2 surface	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:24
S55	38	S53 same S54	US-PGPUB;	OR	ON	2017/02/06

			USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			01:25
S56	10	S55 same efficiency	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:25
S57	0	S55 same ((silicon adj oxide) or "SiO" or (silicon adj nitride) or "SiN")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:29
S58	0	S55 same ((silicon adj oxide) or "SiO" or (silicon adj nitride) or "SiN")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:30
S59	3	S55 same (metal or polysilicon or amorphous)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:30
S60	1864	S53 same efficiency	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:32
S61	42	S60 same ((silicon adj oxide) or "SiO" or (silicon adj nitride) or "SiN")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:32
S62	351	S60 same ((silicon adj oxide) or "SiO" or (silicon adj nitride) or "SiN" or metal or polysilicon or amorphous)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:32
S63	85	S62 same4 incident	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	2017/02/06 01:33

			IBM_TDB			
S64	228102	(reflective near2 (material or layer or film))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:11
S65	530599	("AlO" or (aluminum adj oxide)) or ("HfO" or (hafnium adj oxide))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:12
S66	403	S64 near3 S65	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:12
S67	2	S66 near4 (benefit or beneficial or advantages or advantageous or advantegeously)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:13
S68	2	S66 near10 (benefit or beneficial or advantages or advantageous or advantegeously)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:13
S69	31128	(anti or non) near2 S64	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:20
S70	121	S65 near4 S69	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:20
S71	2	S70 same (benefit or beneficial or advantages or advantageous or advantegeously)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:20
S72	2	(dope or doping or implanting or implant or implants implantation or dopes) near2 (light adj incident adj surface)	US-PGPUB; USPAT; USOCR; FPRS;	OR	ON	2017/02/06 12:04

			EPO; JPO; DERWENT; IBM_TDB			
S73	6	(dope or doping or implanting or implant or implants implantation or dopes) near2 (light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:05
S74	13	(dope or doping or implanting or implant or implants implantation or dopes) near4 (light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:05
S75	167141	(doped or implanted) adj2 (region or section or portion or part)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:13
S76	1	S75 near4 (light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:13
S77	26	S75 near10 (light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:15
S78	25	S77 not S76	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:15
S79	1	("9064764").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2017/02/06 12:20
S80	44833	(light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:49
S81	167141	(doped or implanted) adj2 (region or section or portion or part)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	2017/02/06 17:49

			IBM_TDB			
S82	9	S80 near6 S81	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:49
S83	364064	(light adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:50
S84	54	S83 near4 S81	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:50
S85	53	S84 not S82	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:50
S86	21	("20030214595" | "20030228883" | "20050093100" | "20060086956" | "20060128087" | "20070189583" | "20070237504" | "20080158398" | "20080192133" | "20080284884" | "20100200658" | "20110194100" | "20110292380" | "20140198240" | "5101260" | "5600130" | "5626687" | "5635089" | "6082858" | "6204506" | "6907135").PN.	US-PGPUB; USPAT	OR	ON	2017/02/07 07:43
S87	21	("20030214595" | "20030228883" | "20050093100" | "20060086956" | "20060128087" | "20070189583" | "20070237504" | "20080158398" | "20080192133" | "20080284884" | "20100200658" | "20110194100" | "20110292380" | "20140198240" | "5101260" | "5600130" | "5626687" | "5635089" | "6082858" | "6204506" | "6907135").PN.	US-PGPUB; USPAT	OR	ON	2017/02/07 07:44
S88	20	("20010044266" | "20050088634" | "20080173620" | "20090027640" | "20090093100" | "20090114630" | "20090308457" | "20100140768" | "20130135439" | "4886958" | "5351446" | "5641969" | "5727096" | "6327022" | "6331885" | "6340281" | "7800684" | "7897942" | "9184204" | "9369641").PN.	US-PGPUB; USPAT	OR	ON	2017/06/01 13:32
S89	20	("20040256561" | "20070063219" | "20070103580" | "20070125951" | "20080142686" | "20090009596" |	US-PGPUB; USPAT	OR	ON	2018/02/15 10:41

		"20090174026" | "20090242019" | "20100102366" | "20110003424" | "20110019050" | "20120080733" | "20120274744" | "20140352779" | "20150076468" | "5236863" | "5410168" | "8076746" | "9419159" | "9673250").PN.				
S90	24107	(layer or film) near3 (different near2 (refractive or refraction or refracting))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:45
S91	18	S90 near4 isolation	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:45
S92	5	S91 same4 (pixel or pixels)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:45
S93	13	S91 not S92	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:47
S94	22683	bragg adj2 (reflective or reflector)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:51
S95	58	S94 near4 isolation	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:52
S96	6	S95 same4 (pixel or pixels)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:52
S97	52	S95 not S96	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2018/02/15 10:55

			DERWENT; IBM_TDB			
S98	29452	(isolation or isolating or insulation or insulating) near2 (multi-layer or multiple)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:57
S99	19	S98 near10 (different near2 (refractive or refraction or refracting))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:58
S100	48	S98 near3 (silicon adj2 dioxide)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 13:05
S101	1	S100 same4 (pixel or pixels)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 13:05
S102	19531	(isolation or isolating or insulation or insulating) near2 (silicon adj2 dioxide)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 13:08
S103	53	S102 near4 (benefit or advantage or beneficial or advantageous)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 13:08
S104	4006	(isolation or isolating or insulation or insulating) near2 ("Al.sub.2O.sub.3")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 13:10
S105	450872	aluminum adj oxide	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 13:11
S106	57928	hafnium adj oxide	US-PGPUB; USPAT; USOCR;	OR	ON	2018/02/15 13:11

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S107	2014	(isolation or isolating or insulation or insulating) near6 S105 near6 S106	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 13:11

9/25/2018 2:07:39 PM
C:\Users\lpham\Documents\EAST\Workspaces\15-216,244.wsp

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

PTO/SB/08a (01-10)
Approved for use through 07/31/2012. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	15216244
Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	PHAM, LONG
Attorney Docket Number	143705.05221

U.S.PATENTS

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	4546945		1985-10-15	Nessfield	
	2	5583704		1996-12-10	Fujii	
	3	5802091		1998-08-01	Chakrabarti et al	
	4	6131511		2000-10-17	Wachi et al	
	5	6131512		2000-10-17	Verlinden et al	
	6	6479093		2002-11-12	Lauffer et al	
	7	6690968		2004-02-10	Mejia	
	8	7315014		2008-01-01	Lee et al	

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IPR2025-00845
Apple-Sony EX1002 Page 43

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	9	7728274		2010-06-01	Pilla et al	
	10	8268403		2007-04-30	Akiyama et al	
	11	8445950		2013-05-21	Iida et al	
	12	8445985		2013-05-21	Hiyama et al	
	13	8530264		2013-09-10	De Munck et al	
	14	8604405		2013-12-10	Liu et al	
	15	8729678		2014-05-20	Shim et al	
	16	8928784		2015-01-06	Watanabe et al	
	17	9064762		2015-06-23	Yamaguchi	
	18	9478572		2016-10-25	Miyanami	
	19	9659984		2017-05-23	Ohkubo et al	

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IPR2025-00845
Apple-Sony EX1002 Page 44

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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	20050184291		2005-08-25	Cole et al	
	2	20050184353		2005-08-25	Mouli	
	3	20080303932		2008-12-11	Wang et al	
	4	20080191296		2008-08-14	Wang et al.	
	5	20090090988		2009-04-09	OHGISHI	
	6	20090096049		2009-04-16	Oshiyama et al	
	7	20090278967		2009-11-12	Toumiya	
	8	20090200625		2009-08-13	Venezia et al.	
	9	20100108864		2010-05-06	OHTA et al	

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IPR2025-00845
Apple-Sony EX1002 Page 45

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	10	20100128161		2010-05-27	Yamaguchi	
	11	20100201834		2010-08-12	Maruyama et al.	
	12	20110241148		2011-10-06	Hiyama et al	
	13	20110241152		2011-10-06	Hsiao et al	
	14	20120025199		2012-02-02	Chen et al	
	15	20120153127		2012-06-21	Hirigoyen et al	
	16	20120153128		2012-06-21	Roy et al	
	17	20120188431		2012-07-26	Takimoto	
	18	20120217602		2012-08-30	Enomoto	
	19	20120049306		2012-03-01	Ohba et al.	
	20	20120228473		2012-09-13	Yoshitsugu	

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IPR2025-00845
Apple-Sony EX1002 Page 46

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	21	20130020468		2013-01-24	Mitsuhashi et al	
	22	20130207212		2013-08-15	Mao et al	
	23	20140374868		2014-12-25	LEE et al	
	24	20140054662		2014-02-27	Yanagita et al	
	25	20170244920		2017-08-24	Ohkubo et al	
	26	20120147241	A1	2012-06-14	YAMAGUCHI TETSUJI	

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FOREIGN PATENT DOCUMENTS

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]
1	1	101241923	CN		2008-08-13	TAIWAN SEMICONDUCTOR MFG	See corresponding US2008191296	☐
2	2	101465361	CN		2009-06-24	TAIWAN SEMICONDUCTOR MFG		☒
3	3	101740597	CN		2010-06-16	SONY CORP	See corresponding US2010128161	☐

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IPR2025-00845
Apple-Sony EX1002 Page 47

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Examiner Name	PHAM, LONG
Attorney Docket Number	143705.05221

4	4	101978498	CN		2011-02-16	OMNIVISION TECH INC	See corresponding US2009200625	☐
5	5	102270646	CN		2011-12-07	NA		☒
6	6	201725796	CN		2011-01-26	GALAXYCORE INC		☒
7	7	2011003860	JP		2011-01-06	SONY CORP	See corresponding US2010201834	☐
8	8	2012054321	JP		2012-03-15	SONY CORP	See corresponding US2012049306	☐
9	9	2012169530	JP		2012-09-06	SONY CORP		☒
10	10	2012191005	JP		2012-10-04	SONY CORP	See corresponding US2012228473	☐
11	11	20060020400	KR		2006-03-06	MAGNACHIP SEMICONDUCTOR LTD		☒
12	12	20080014301	KR		2008-02-14	SAMSUNG ELECTRONICS CO LTD		☒
13	13	20080097709	KR		2008-11-06	DONGBU ELECTRONICS CO LTD		☒
14	14	20110079323	KR		2011-07-07	DONGBU HITEK CO LTD		☒

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15	15	20170070266	KR		2017-06-21	SONY CORP	See corresponding US2014054662	☐
16	16	2012117931	WO		2012-09-07	SONY CORPORATION	See corresponding US2014054662	☐
	17	2007258684	JP		2007-10-04	SONY CORP	See corresponding US20120147241	☐

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NON-PATENT LITERATURE DOCUMENTS

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.	T[5]
	1	Byung Jun Park et al, Jpn. J. Appl. Phys. 46 2454, 2007, 5 pages.	☐
	2	Choubey et al., On Evolution of CMOS Image Sensors, Proceedings of the 8th International Conference on Sensing Technology, Sep. 2-4, 2014, Liverpool, UK, pages.	☐
	3	Fontaine, Ray, A Survey of Enabling Technologies in Successful Consumer Digital Imaging Products (Part 3: Pixel Isolation Structures), http://www.techinsights.com,July 24, 2017, 13 pages.	☐
	4	IMEC, 3D INTEGRATED IMAGE SENSORS FOR SMART IMAGING SYSTEMS, PIET DE MOOR, 2010, 32 pages.	☐
	5	KOREAN INTELLECTUAL PROPERTY OFFICE (KIPO), CMOS Image Sensor, KIPO, 2004, 29 pages.	☐
	6	MUNCK, Generic building blocks for 3D integration and their application on hybrid CMOS image sensors, KATHOLIEKE UNIVERSITEIT LEUVEN, Kapeldreef 75 — B-3001 Heverlee, September 2008, 328 pages.	☐

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IPR2025-00845
Apple-Sony EX1002 Page 49

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Examiner Name	PHAM, LONG
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	7	Rao, et al., Monolithic and Fully-Hybrid Backside Illuminated CMOS Imagers for Smart Sensing, IMEC, Kapeldreef 75, B-3001 Leuven, Belgium, 4 pages.	☐
	8	STMicroelctronics, BSI – technical challenges, IISW-2009, Bergen. 25th June 2009, 37 pages.	☐
	9	https://blogs.yahoo.co.jp/miyabiman_now/25628945.html	☐
	10	Agranov, et al., Pixel continues to shrink….Small Pixels for Novel CMOS Image Sensors, 4 pages.	☐
	11	Fontaine, A Review of the 1.4 µm Pixel Generation, Technology Analysis Group Chipworks Inc., 2011, 4 pages.	☐
	12	Lee et al., SNR Performance Comparison of 1.4um Pixel : FSI, Light-guide, and BSI, 2011, 3 pages.	☐
	13	Tournier, et al., Pixel-to-Pixel isolation by Deep Trench technology, STMicroelectronics, 850, rue Jean Monnet – F-38926 Crolles Cedex – France, 2011, 4 pages.	☐
	14	Tournier, et al., Pixel-to-Pixel isolation by Deep Trench technology: Application to CMOS Image Sensor, https://www.researchgate.net/publication/268300742, 2011, 5 pages.	☐
	15	B.J. Park et al., "Deep Trench Isolation for Crosstalk Suppression in Active Pixel Sensors with 1.7µm Pixel Pitch", in Japanese Journal of Applied Physics, Vol. 46, No. 4B, pp. 2454-5457, 2007	☐
	16	D. N. Yaung et al., "High performance 300mm backside illumination technology for continuous pixel shrinkage," 2011 International Electron Devices Meeting, Washington, DC, 2011, pp. 8.2.1-8.2.4.	☐
	17	http://electroiq.com/insights-from-leading-edge/2016/09/iftle-303-sony-introduces-ziptronix-dbi-technology-in-samsung-galaxy-s7, "Omnivision was the first to sample BSI in 2007 but costs were too high and adoption was thus very low", (2016)	☐

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IPR2025-00845
Apple-Sony EX1002 Page 50

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	18	http://joseph-tang.blogspot.com/2017/, Oshiyama et al. , Near-infrared Sensitivity Enhancement of a Back-illuminated Complementary Metal Oxide Semiconductor Image Sensor with a Pyramid Surface for Diffraction Structure,(2017)	☐
	19	K. Itonaga et al., "Extremely-low-noise CMOS Image Sensor with high saturation capacity," 2011 International Electron Devices Meeting, Washington, DC, 2011, pp. 8.1.1-8.1.4.	☐
	20	K. Minoglou et al., "Reduction of Electrical Crosstalk in Hybrid Backside Illuminated CMOS Imagers using Deep Trench Isolation," 2008 International Interconnect Technology Conference, Burlingame, CA, USA, 2008, pp. 129-131.	☐
	21	Y. Kitamura et al., "Suppression of crosstalk by using backside deep trench isolation for 1.12μm backside illuminated CMOS image sensor," 2012 International Electron Devices Meeting, San Francisco, CA, 2012, pp. 24.2.1-24.2.4.	☐

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EXAMINER SIGNATURE

Examiner Signature	/LONG PHAM/	Date Considered	09/25/2018

*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.

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Examiner Name	PHAM, LONG
Attorney Docket Number	143705.05221

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	/Reza Mollaaghababa, Reg. No. 43810/	Date (YYYY-MM-DD)	2018-07-31
Name/Print	Reza Mollaaghababa	Registration Number	43810

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.**

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IPR2025-00845
Apple-Sony EX1002 Page 52

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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.

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /J.S./

IPR2025-00845
Apple-Sony EX1002 Page 53

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BIB DATA SHEET

CONFIRMATION NO. 5052

SERIAL NUMBER	FILING or 371(c) DATE / RULE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
15/216,244	07/21/2016	257	2814	143705.05221

APPLICANTS

SiOnyx, LLC., Beverly, MA;

INVENTORS

Martin U. Pralle, Wayland, MA;
Jeffrey McKee, Tualatin, OR;
Jason Sickler, Arlington, MA;

**** CONTINUING DATA ***************************

This application is a CON of 14/747,875 06/23/2015 PAT 9905599
which is a CON of 13/841,120 03/15/2013 PAT 9064764
which claims benefit of 61/614,275 03/22/2012

**** FOREIGN APPLICATIONS ***************************

**** IF REQUIRED, FOREIGN FILING LICENSE GRANTED ****

08/03/2016

Foreign Priority claimed	35 USC 119(a-d) conditions met	Verified and Acknowledged	Met after Allowance	STATE OR COUNTRY	SHEETS DRAWINGS	TOTAL CLAIMS	INDEPENDENT CLAIMS
☐ Yes ☑ No	☐ Yes ☑ No	/LONG PHAM/ Examiner's Signature	☐ Initials	MA	4	26	2

ADDRESS

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Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736
UNITED STATES

TITLE

Pixel Isolation Elements, Devices and Associated Methods

FILING FEE RECEIVED	FEES: Authority has been given in Paper	
2560	No._____ to charge/credit DEPOSIT ACCOUNT No._____ for following:	☐ All Fees ☐ 1.16 Fees (Filing) ☐ 1.17 Fees (Processing Ext. of time) ☐ 1.18 Fees (Issue) ☐ Other _____ ☐ Credit

Doc code: RCEX
Doc description: Request for Continued Examination (RCE)

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	15/216,244	Filing Date	2016-07-21	Docket Number (if applicable)	143705.05221	Art Unit	2814
First Named Inventor	Martin U. Pralle			Examiner Name	Pham, Long		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☒ Amendment/Reply
- ☒ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____ (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 500436

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

X Patent Practitioner Signature

Applicant Signature

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
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Signature of Registered U.S. Patent Practitioner			
Signature	/Reza Mollaaghababa/	Date (YYYY-MM-DD)	2018-08-01
Name	Reza Mollaaghababa	Registration Number	43810

This collection of information is required by 37 CFR 1.114. 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.

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

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 records.

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.

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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.

REMARKS

Applicants amend claims 34, 36, 38, 42-45, 52, 57, 58 and add new claims 68-121 as indicated above. Support for the amendments and the new claims can be found, e.g., at paragraphs [0013], [0014], [0036], [0037], [0039], [0041], [0046], [0053], [0054], [0058], [0060], [0064] of the U.S. published application.

Allowable Subject Matter

Claims 35, 38, and 53 are deemed allowable if rewritten in independent form including all limitations of the base claim and any intervening claims.

The original claim 35 depends on independent claim 34. As indicated above, claim 34 is amended to incorporate the features of claim 35, and claim 35 is canceled. Claim 34 is further amended to recite that the at least two adjacent light sensitive pixels are *image sensor* pixels in order to further clarify that claim 34 is directed to an *imager* device.

Accordingly, claim 34 is believed to be in condition for allowance. Further, claim 38 depends on claim 34 and hence is also in condition for allowance at least because of its dependence on claim 34.

The original claim 53 depends on independent claim 52. Claim 52 is amended to incorporate the features of claim 53. In addition, similar to claim 34, claim 52 is amended to emphasize that the two adjacent light sensitive pixels are *image sensor* pixels.

Thus, claim 52 is believed to be in condition for allowance.

Rejections Pursuant to 35 U.S.C. §103

I. Claims 34, 36, and 39-51 are rejected as being unpatentable over Haddad et al. (WO 2011035188) in combination with Ooka (JP407074240) and Bour et al. (U.S. Patent No. 8,470,619).

As discussed above, claim 34 is amended to incorporate the features of allowable claim 35. Thus, claim 34 is believed to be in condition for allowance. Claims 36 and 39-51 depend, either directly or indirectly, on claim 34 and hence are also in condition for allowance and their rejection over the combination of Haddad, Ooka and Bour is moot.

IPR2025-00845
Apple-Sony EX1002 Page 58

II. Claims 52, 54-61 are rejected as being unpatentable over Haddad in combination with Ooka and Bour.

As discussed above, claim 52 is amended to incorporate the features of allowable claim 53. Thus, claim 52 and claims 54-61, which depend directly or indirectly, on claim 52 are in condition for allowance and their rejections over the combination of Haddad, Ooka and Bour is moot.

New Claims

New claims 68, 69, 70, 71, 76-82, 90-95, 102-107, 114-115, and 118-119 depend, either directly or indirectly, on claim 34 and hence are in condition for allowance at least for the reasons provided above in connection with claim 34. And new claims 72-75, 83-88, 96-101, 108-113, 116-117, and 120-121 depend, either directly or indirectly, on independent claim 52 and hence are in condition for allowance at least for the reasons provided above in connection with claim 52.

CONCLUSION

In view of the above amendments and remarks, Applicants respectfully request allowance of the application. The Examiner is invited to call the undersigned if there are any questions.

The Director is authorized to charge any deficiency in the fees filed, asserted to be filed or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit Account No. 50-0436, under Docket No. 143705.05221.

Dated: August 1, 2018

Electronic Signature: /Reza Mollaaghababa/
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IPR2025-00845
Apple-Sony EX1002 Page 59

AMENDMENTS TO THE CLAIMS

1-33. (Canceled)

34. (Currently Amended) An imager device, comprising:

at least two adjacent light sensitive image sensor pixels each having a light incident surface, and a backside surface opposite the light incident surface;

a peripheral isolation element at least partially separating said two adjacent light sensitive pixels;

each of said pixels having at least one doped region disposed on at least one of the light incident surface and the backside surface,

wherein the peripheral isolation element comprises at least two materials having different indices of refraction,

wherein said peripheral isolation element comprises a first, a second and a third layer, wherein said third layer is disposed between said first and second layers, and wherein each of said first and second layer exhibits an index of refraction less than an index of refraction of said third layer.

35. (Canceled)

36. (Currently Amended) The device of claim 34, wherein the index of refraction of at least one of said first and second layer is at least 0.2 lower relative to the refractive index of the third layer.

37. (Previously Presented) The device of claim 34, wherein at least of one of said at least two materials comprises silicon dioxide.

38. (Currently Amended) The device of claim 34 ~~35~~, wherein at least one of said first and second layers comprises silicon dioxide.

39. (Previously Presented) The device of claim 34, wherein the isolation element extends substantially from the light incident surface to the backside surface of at least one of said two adjacent light sensitive pixels.

IPR2025-00845
Apple-Sony EX1002 Page 60

40. (Previously Presented) The device of claim 34, wherein at least one of the first and second layer comprises Al_2O_3.

41. (Previously Presented) The device of claim 34, wherein said peripheral isolation element comprises an oxide.

42. (Currently Amended) The device of claim 34, wherein said peripheral isolation element provides a passivating negative charge.

43. (Currently Amended) The device of claim 34, wherein said peripheral isolation element exhibits a surface recombination velocity as low as 10 cm/s.

44. (Currently Amended) The device of claim 34, wherein the peripheral isolation element comprises at least one material having an index of refraction of less than about 2.1.

45. (Currently Amended) The device of claim 34, wherein the peripheral isolation element comprises any of aluminum oxide and hafnium oxide.

46. (Previously Presented) The device of claim 34, wherein at least one of said two adjacent light sensitive pixels comprises a textured region.

47. (Previously Presented) The device of claim 46, wherein said textured region is coupled to the light incident surface.

48. (Previously Presented) The device of claim 47, wherein said light incident surface comprises said textured region.

49. (Previously Presented) The device of claim 47, wherein said textured region comprises a textured film layer.

50. (Previously Presented) The device of claim 49, wherein said textured film layer comprises any of silicon dioxide, silicon nitride, amorphous silicon, polysilicon, a metal and combinations thereof.

IPR2025-00845
Apple-Sony EX1002 Page 61

51. (Previously Presented) The device of claim 46, wherein said backside surface comprises said textured region.

52. (Currently Amended) An imager device, comprising:

at least two adjacent light sensitive image sensor pixels each having a light incident surface, and a backside surface opposite the light incident surface;

a peripheral isolation element separating said at least two adjacent light sensitive pixels so as to reduce optical crosstalk therebetween, said isolation element comprising at least two materials having different indices of refraction,

at least one doped region disposed on at least one of the light incident surface and the backside surface,

wherein said peripheral isolation element comprises a first, a second and a third layer, wherein said third layer is disposed between said first and second layers, and wherein each of said first and second layers exhibits an index of refraction less than an index of refraction of said third layer.

53. (Canceled)

54. (Previously Presented) The device of claim 52, wherein at least one of said light incident surface and said backside surface of at least one of said two adjacent light sensitive pixels comprises a textured region.

55. (Previously Presented) The device of claim 54, wherein said textured region is a textured film layer.

56. (Previously Presented) The device of claim 55, wherein said textured film layer comprises any of silicon dioxide, silicon nitride, amorphous silicon, polysilicon, a metal and combinations thereof.

57. (Currently Amended) The device of claim 54, wherein said textured region reflects at least a portion of light internally incident thereon into the at least one pixel.

IPR2025-00845
Apple-Sony EX1002 Page 62

58. (Currently Amended) The device of claim 52, wherein the peripheral isolation element extends from the light incident surface to the backside surface of at least one of said two adjacent light sensitive pixels.

59. (Previously Presented) The device of claim 52, wherein said at least two materials comprises silicon dioxide and aluminum oxide.

60. (Previously Presented) The device of claim 54, wherein said at least two pixels are formed monolithically in a common semiconductor substrate.

61. (Previously Presented) The device of claim 54, wherein the textured region is formed by laser radiation.

62. (Canceled)

63. (Previously Presented) The device of claim 46, wherein the textured region is formed by one of plasma etching, reactive ion etching, porous silicon etching, lasing, chemical etching, nanoimprinting, material deposition, selective epitaxial growth, and combinations thereof.

64. (Previously Presented) The device of claim 46, wherein the textured region is formed by laser radiation.

65. (Canceled)

66. (Canceled)

67. (Previously Presented) The device of claim 46, wherein said textured region is coupled to the backside surface.

68. (New) The device of claim 34, wherein said peripheral isolation element comprises tantalum oxide.

IPR2025-00845
Apple-Sony EX1002 Page 63

69. (New) The device of claim 68, wherein said tantalum oxide comprises tantalum aluminum oxynitride.

70. (New) The device of claim 34, wherein said peripheral isolation element comprises lanthanum oxide.

71. (New) The device of claim 70, wherein said lanthanum oxide comprises lanthanum aluminum oxide.

72. (New) The device of claim 52, wherein said peripheral isolation element comprises tantalum oxide.

73. (New) The device of claim 72, wherein said tantalum oxide comprises tantalum aluminum oxynitride.

74. (New) The device of claim 52, wherein said peripheral isolation element comprises lanthanum oxide.

75. (New) The device of claim 74, wherein said lanthanum oxide comprises lanthanum aluminum oxide.

76. (New) The device of claim 34, wherein each of said at least two adjacent light sensitive image sensor pixels comprises a semiconductor portion providing said light incident surface and said backside surface, wherein said peripheral isolation element isolates the semiconductor portions of said at least two adjacent light sensitive image sensor pixels.

77. (New) The device of claim 76, wherein said peripheral isolation element optically isolates said semiconductor portions of said at least two adjacent light sensitive image sensor pixels.

78. (New) The device of claim 76, wherein said peripheral isolation element electrically isolates said semiconductor portions of said at least two adjacent light sensitive image sensor pixels.

IPR2025-00845
Apple-Sony EX1002 Page 64

79. (New) The device of claim 76, wherein an index of refraction of the semiconductor portion of each of said at least two adjacent image sensor pixels is different from indices of refraction of said layers of the peripheral isolation element such that light incident from each of said semiconductor portions on said peripheral isolation element is reflected, thereby providing optical isolation between the pixels.

80. (New) The device of claim 34, wherein said at least two adjacent light sensitive image sensor pixels are formed monolithically on a common semiconductor substrate and are isolated from one another by said peripheral isolation element.

81. (New) The device of claim 34, wherein said peripheral isolation element is a trench isolation element.

82. (New) The device of claim 34, wherein said peripheral isolation element has a width in a range from about 100 nm to about 50 microns.

83. (New) The device of claim 52, wherein each of said at least two adjacent light sensitive image sensor pixels comprises a semiconductor portion providing said light incident surface and said backside surface, wherein said peripheral isolation element isolates the semiconductor portions of said at least two adjacent light sensitive image sensor pixels.

84. (New) The device of claim 83, wherein said peripheral isolation element optically isolates said semiconductor portions of said at least two adjacent light sensitive image sensor pixels.

85. (New) The device of claim 84, wherein said peripheral isolation element electrically isolates said semiconductor portions of said at least two adjacent light sensitive image sensor pixels.

86. (New) The device of claim 85, wherein an index of refraction of the semiconductor portion of each of said at least two adjacent image sensor pixels is different from indices of refraction of said layers of the peripheral isolation element such that light incident from each of

IPR2025-00845
Apple-Sony EX1002 Page 65

said semiconductor portions on said peripheral isolation element is reflected, thereby providing optical isolation between the pixels.

87. (New) The device of claim 52, wherein said at least two adjacent light sensitive image sensor pixels are formed monolithically on a common semiconductor substrate and are isolated from one another by said peripheral isolation element.

88. (New) The device of claim 52, wherein said peripheral isolation element is a trench isolation element.

89. (New) The device of claim 52, wherein said peripheral isolation element has a width in a range from about 100 nm to about 50 microns.

90. (New) The imager device of claim 76 , wherein at least one of the first layer and the second layer of said peripheral isolation element and said semiconductor portion of each of said at least two adjacent pixels comprise different materials.

91. (New) The imager device of claim 34, wherein the first layer and the second layer of said peripheral isolation element comprise different materials .

92. (New) The imager device of claim 34, wherein the peripheral isolation element comprises at least three materials.

93. (New) The imager device of claim 34, wherein the peripheral isolation element comprises more than three layers.

94. (New) The imager device of claim 34, wherein the peripheral isolation element comprises a light trapping material filling a trench.

95. (New) The imager device of claim 94, wherein the trench is one of a shallow trench and a deep trench.

IPR2025-00845
Apple-Sony EX1002 Page 66

96. (New) The imager device of claim 83, wherein at least one of the first layer and the second layer of the peripheral isolation element and said semiconductor portion of each of said at least two adjacent pixels comprise different materials.

97. (New) The imager device of claim 52, wherein the first layer and the second layer of said peripheral isolation element comprise different materials.

98. (New) The imager device of claim 52, wherein the peripheral isolation element comprises at least three materials.

99. (New) The imager device of claim 52, wherein the peripheral isolation element comprises more than three layers.

100. (New) The imager device of claim 52, wherein the peripheral isolation element comprises a light trapping material filling a trench.

101. (New) The imager device of claim 100, wherein the trench is one of a shallow trench and a deep trench.

102. (New) The imager device of claim 34, wherein said peripheral isolation element comprises a trench isolation element formed by filling a trench with said first, said second, and said third layers.

103. (New) The imager device of claim 102, wherein said trench isolation element has a depth in a range of about 100 nm to about 50 microns.

104. (New) The imager device of claim 103, wherein said trench isolation element has a width in a range of about 100 nm to about 10 microns.

105. (New) The imager device of claim 34, wherein said peripheral isolation element is configured to reflect at least a portion of light incident thereon from any of said two adjacent light sensitive pixels back to that pixel.

IPR2025-00845
Apple-Sony EX1002 Page 67

106. (New) The imager device of claim 105, wherein the peripheral isolation element is further configured to optically isolate said two adjacent light sensitive pixels.

107. (New) The imager device of claim 106, wherein the peripheral isolation element is further configured to electrically isolate said two adjacent light sensitive pixels.

108. (New) The imager device of claim 52, wherein said peripheral isolation element comprises a trench isolation element formed by filling a trench with said first, said second, and said third layers.

109. (New) The imager device of claim 108, wherein said trench isolation element has a depth in a range of about 100 nm to about 50 microns.

110. (New) The imager device of claim 109, wherein said trench isolation element has a width in a range of about 100 nm to about 10 microns.

111. (New) The imager device of claim 52, wherein said peripheral isolation element is configured to reflect at least a portion of light incident thereon from any of said two adjacent light sensitive pixels back to that pixel.

112. (New) The imager device of claim 111, wherein the peripheral isolation element is further configured to optically isolate said two adjacent light sensitive pixels.

113. (New) The imager device of claim 112, wherein the peripheral isolation element is further configured to electrically isolate said two adjacent light sensitive pixels.

114. (New) The imager device of claim 34, wherein the peripheral isolation element comprises a textured region.

115. (New) The imager device of claim 34, wherein the peripheral isolation element further comprises a first textured region between the first layer and one of said adjacent pixels and a second textured region between the second layer and the other one of said adjacent pixels.

IPR2025-00845
Apple-Sony EX1002 Page 68

116. (New) The imager device of claim 52, wherein the peripheral isolation element comprises a textured region.

117. (New) The imager device of claim 52, wherein the peripheral isolation element further comprises a first textured region between the first layer and one of said adjacent pixels and a second textured region between the second layer and the other one of said adjacent pixels.

118. (New) The imager device of claim 34, wherein the peripheral isolation element comprises five layers.

119. (New) The imager device of claim 118, wherein the five layers include the first layer, the second layer, the third layer, a fourth layer disposed between the first layer and one of said adjacent pixels and a fifth layer disposed between the second layer and the other one of said adjacent pixels.

120. (New) The imager device of claim 52, wherein the peripheral isolation element comprises five layers.

121. (New) The imager device of claim 120, wherein the five layers include the first layer, the second layer, the third layer, a fourth layer disposed between the first layer and one of said adjacent pixels and a fifth layer disposed between the second layer and the other one of said adjacent pixels.

IPR2025-00845
Apple-Sony EX1002 Page 69

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Martin U. Pralle Application No.: 15/216,244 Filed: July 21, 2016 For: PIXEL ISOLATION ELEMENTS, DEVICES, AND ASSOCIATED METHODS	Confirmation No.: 5052 Art Unit: 2814 Examiner: Pham, Long

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

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August 1, 2018 (Dated) Electronic Signature: /Reza Mollaaghababa/ Reza Mollaaghababa, Reg. No. 43,810

RESPONSE TO FINAL OFFICE ACTION

Dear Sir:

This paper is filed in response to the final Office Action dated February 22, 2018.

Amendments to the Claims begin on page 2.

Remarks begin on page 12.

Electronic Patent Application Fee Transmittal

Application Number:	15216244
Filing Date:	21-Jul-2016
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Filer:	Reza Mollaaghababa/Irene Gommerstadt
Attorney Docket Number:	143705.05221

Filed as Large 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:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 3 months with $0 paid	1253	1	1400	1400
Miscellaneous:				
RCE- 1ST REQUEST	1801	1	1300	1300
		Total in USD ($)		**2700**

Electronic Acknowledgement Receipt

EFS ID:	33335460
Application Number:	15216244
International Application Number:	
Confirmation Number:	5052
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Customer Number:	136549
Filer:	Reza Mollaaghababa/Irene Gommerstadt
Filer Authorized By:	Reza Mollaaghababa
Attorney Docket Number:	143705.05221
Receipt Date:	01-AUG-2018
Filing Date:	21-JUL-2016
Time Stamp:	11:11:49
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$2700
RAM confirmation Number	080118INTEFSW11135200
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Transmittal Letter	1_143705_05221_IDS_Transmittal.pdf	104174 3c997ef4588e6843b8c261406b95dcde44a772fa	no	2
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2	Information Disclosure Statement (IDS) Form (SB08)	2_143705_05221_IDS_sb08_wRCE.pdf	2134296 505a02d3ea29400670b02320f3cc7f34f74be915	no	11
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3	Foreign Reference	1_CN101241923A_US20081912 96A1.pdf	767032 6ea5522a3466bcbb3e8f28c4911ff5e10a3eba20	no	11
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4	Foreign Reference	2_CN101465361A_w_Trans.pdf	8822663 1d8c53765d3a72bacdd6cd137d3c2cc10176b31a	no	26
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5	Foreign Reference	3_CN101740597A_US2010128161.pdf	772339 0b5431189b97a50f178ace3c4dad26bc57894ce2	no	10
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6	Foreign Reference	4_CN101978498A_US2009200625.pdf	602808 7b6358fa9358d718ecd55ad0fcfe7c187a170ae5	no	10
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7	Foreign Reference	5_CN102270646_w_Trans.pdf	9287155 dfb8aa37a1752ff9aa3fcfdcf81f6fa5bdb1ae16	no	29
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8	Foreign Reference	6_CN201725796U_w_Trans.pdf	6090769 d9d71d37839d3b78bbaa6b8eaf8a80b67ee154cf	no	21
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9	Foreign Reference	7_JP2011003860A_US2010201834A1.pdf	488526 dc852adb9361629f1d3a5f83cb0123f523696fe3	no	10
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10	Foreign Reference	8_JP2012054321A_US2012049306.pdf	490286 29a122c14c0806d973b124c0b607fdbe00575d66	no	10
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11	Foreign Reference	9_JP2012169530A_w_Trans.pdf	24050452 8f6c80f913843acca27f9c236ae0b2a8982eeef5	no	94
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12	Foreign Reference	10_JP2012191005A_US2012228473.pdf	473261 6fa90bd1fa2c31252461677281c3e3e0d24e37f8f	no	10
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13	Foreign Reference	11_KR20060020400A_w_Trans.pdf	4118885 0a5085d231a16921cc0b6cdf6840cd4742a0036d	no	18
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15	Foreign Reference	13_KR20080097709A_w_Trans.pdf	5530638 b7c1a34490431693724c8e29bd20155dbc349d8d	no	20
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16	Foreign Reference	14_KR20110079323A_w_Trans.pdf	5471824 a26ce5dd0b17470b216c5f4af4adf1557884d4f9	no	20
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17	Foreign Reference	15_KR20170070266A_US20140054662.pdf	496397 bafff2840a467f539211d3aa07e5ef870b47b045	no	10
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20	Non Patent Literature	1_Byung_et_al.pdf	515268 8ca788ca683394c2b2c7b94f9ec65dc299b7add3	no	5
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21	Non Patent Literature	2_Choubey_et_al.pdf	3037275 3261bfcf84afd37a6554d9f9a11cd5877452b00a	no	7
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22	Non Patent Literature	3_Fontaine_2017.pdf	5524486 a3dee3fd5cce8b4c2fc5e1a9d7bd9d9eb20b53ab	no	13
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31	Non Patent Literature	12_Lee_et_al.pdf	971657 fdc105ce214f3b42042f20c3d2c4048a88678f3f	no	3
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32	Non Patent Literature	13_Tournier_et_al.pdf	1651380 bb80a5f2cd1fe2ed9ad321bdaa3db64f1c84edcb	no	4
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33	Non Patent Literature	14_Tournier_et_al_Application_to_CMOS.pdf	1793844 b1873bb49bf7a9cadf4fbc0cc05ec48bb7f04063	no	5
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34	Non Patent Literature	15_Park_2454.pdf	1354989 303da6b3848a23e4419a59d429dcb682cc7d0b77	no	6
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35	Non Patent Literature	16_Yaung_8.pdf	340363 268c30957d82d66a02348acd4c79c864ac269d50	no	4
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36	Non Patent Literature	17_electroiq_com_insights_from_leading_edge_2016.pdf	1013528 796d1c9fcc425e935a0efe08fd875d3fbb6e7cdd	no	6
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37	Non Patent Literature	18_joseph_tang_blogspot_com_2017.pdf	2104246 f34b920354210b35e6344887014418cd3fb4e172	no	18
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38	Non Patent Literature	19_Itonaga_8.pdf	443939 d90dc7ba1e4d8bda0f33ce7a9c6a0bc9165522c1	no	4
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39	Non Patent Literature	20_Minoglou_129.pdf	232674 e78b82857ae0a13d4a35ddf3e7e24da9f7e07e5d	no	3
Warnings:					
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Warnings:					
Information:					
41	Request for Continued Examination (RCE)	RCE.pdf	1349985 bc270df465bb993c712724f1f177fdc56a81926b	no	3
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42		Response.pdf	182780 40e42d804e62454b3ae5133da5e0b0a833a3ebb4	yes	13

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Applicant Arguments/Remarks Made in an Amendment	12	13
Claims	2	11
Amendment Submitted/Entered with Filing of CPA/RCE	1	1

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43	Fee Worksheet (SB06)	fee-info.pdf	32418 cba98f60d38b5bf6564436ed1c22bbe73836bb54	no	2

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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.

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: SiOnyx, LLC. Application No.: 15/216,244 Filed: July 21, 2016 For: Pixel Isolation Elements, Devices and Associated Methods	Confirmation No.: 5052 Art Unit: 2814 Examiner: PHAM, LONG

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July 31, 2018 (Dated) — Electronic Signature: /Reza Mollaaghababa/
Reza Mollaaghababa, Reg. No. 43,810

INFORMATION DISCLOSURE STATEMENT (IDS) TRANSMITTAL LETTER

Dear Sir:

Pursuant to 37 CFR 1.56, 1.97 and 1.98, the attention of the Patent and Trademark Office is hereby directed to the references listed on the attached substitute for PTO/SB/08. It is respectfully requested that the information be expressly considered during the prosecution of this application, and that the references be made of record therein and appear among the "References Cited" on any patent to issue therefrom.

This Information Disclosure Statement is filed concurrent with the filing of a request for continued examination (37 CFR 1.97(b)(4)). A certification statement pursuant to 37 C.F.R. 1.97(e) is not submitted herewith.

In accordance with 37 CFR 1.98(a)(2)(ii), Applicant has not submitted copies of U.S. patents and U.S. patent applications. Applicant submits herewith copies of foreign patents and non-patent literature in accordance with 37 CFR 1.98(a)(2) and (d) that were not previously

provided in U.S. App. No. 14/747,875 (filed June 23, 2015) and 13/841,120 (filed March 15, 2013), to which the instant application claims priority as a continuation.

In accordance with 37 CFR 1.97(g), the filing of this Information Disclosure Statement shall not be construed to mean that a search has been made or that no other material information as defined in 37 CFR 1.56(a) exists. In accordance with 37 CFR 1.97(h), the filing of this Information Disclosure Statement shall not be construed to be an admission that the information cited in the statement is, or is considered to be, material to patentability as defined in § 1.56 (b).

It is submitted that the Information Disclosure Statement is in compliance with 37 CFR 1.98 and the Examiner is respectfully requested to consider the listed references.

The Director is hereby authorized to charge any deficiency in the fees filed, asserted to be filed or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit Account No. 50-0436, under Order No. 143705.05221.

Respectfully submitted,

Dated: July 31, 2018

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IPR2025-00845
Apple-Sony EX1002 Page 82

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	15216244
Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	PHAM, LONG
Attorney Docket Number	143705.05221

U.S.PATENTS

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
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	3	5802091		1998-08-01	Chakrabarti et al	
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	Attorney Docket Number	143705.05221

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Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2]	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]
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2	2	101465361	CN		2009-06-24	TAIWAN SEMICONDUCTOR MFG		☒
3	3	101740597	CN		2010-06-16	SONY CORP	See corresponding US2010128161	☐

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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	15216244
	Filing Date	2016-07-21
	First Named Inventor	Martin U. Pralle
	Art Unit	2814
	Examiner Name	PHAM, LONG
	Attorney Docket Number	143705.05221

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	/Reza Mollaaghababa, Reg. No. 43810/	Date (YYYY-MM-DD)	2018-07-31
Name/Print	Reza Mollaaghababa	Registration Number	43810

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.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/216,244	07/21/2016	Martin U. Pralle	143705.05221	5052

136549 7590 02/22/2018

Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736

EXAMINER
PHAM, LONG

ART UNIT	PAPER NUMBER
2814	

NOTIFICATION DATE	DELIVERY MODE
02/22/2018	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):

docketingbn@pepperlaw.com
davisdr@pepperlaw.com

Office Action Summary	Application No. 15/216,244	Applicant(s) PRALLE ET AL.	
	Examiner LONG PHAM	Art Unit 2814	AIA (First Inventor to File) Status No

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11/13/2017*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ 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.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *34-61,63,64 and 67* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *34, 36-37, 39-61, 63, 64, and 67* is/are rejected.

8)☒ Claim(s) *35,38 and 53* is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, 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.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ 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)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date *11/13/2017*.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

IPR2025-00845
Apple-Sony EX1002 Page 95

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

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 34, 36, 39-51 is/are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Haddad et al. WO 2011035188 (a reference cited by the applicant) in combination with Ooka (JP407074240) and Bour et al. (US pat 8470619) (reference previously cited).

With respect to claim 34, Haddad et al. teach an imager, comprising (see figs. 1-17, particularly fig. 3 and associated text):

at least two adjacent light sensitive pixels having a light incident surface (top), and a backside surface (bottom) opposite the light incident surface;

a peripheral isolation element 30 at least partially separating said two adjacent light sensitive pixels;

each of said pixels having at least one doped region 14,16 disposed on at least one of the light incident surface and the backside surface.

Haddad et al. fail to teach the peripheral isolation element comprises at least two materials having different indices of refraction.

Ooka teaches an imager in which an isolation element comprises at least two materials having different indices of refraction. See English abstract.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the teaching of Ooka into the device of Haddad et al. to achieve improved reflection efficiency and reabsorbing optical energy. See English abstract.

With respect to claim 36, Haddad et al. fail to teach the range for the relative values of the refractive index.

However, it would have been obvious to one of ordinary skill in the art of making semiconductor devices to determine the workable or optimal value or range for the range for the relative values of the refractive index through routine experimentation and optimization to obtain optimal or desired device performance because there is no evidence indicating that the range for the relative values of the refractive index is critical or produces any unexpected results and it has been held that it is not inventive to discover the optimum or workable ranges of a result-effective variable within given prior art conditions by routine experimentation. See MPEP 2144.05.

With respect to claim 37, Haddad et al. fail to teach the isolation element comprises of silicon dioxide.

However, the use of silicon dioxide as isolation element is well-known in semiconductor art.

With respect to claim 39, Haddad et al. teach the isolation element extends substantially from the light incident surface to the backside surface of at least one of said two djacent light sensitive pixels.

With respect to claim 40, Haddad et al. fail to teach the isolation element comprises of Al_2O_3.

However, the use of Al_2O_3as isolation element is well-known in semiconductor art.

With respect to claim 41, Haddad et al. fail to teach the isolation element comprises of oxide.

However, the use of oxide as isolation element is well-known in semiconductor art.

With respect to claim 42, if Haddad et al. uses Al_2O_3 as isolation element the isolation element would inherently have a passivating negative charge.

With respect to claim 43, if Haddad et al. uses oxide as isolation element the isolation element would inherently have a surface recombination velocity as low as 10 cm/s

With respect to claim 44, if Haddad et al. uses oxide as isolation element the isolation element would inherently have an index of refraction of less than 2.1.

With respect to claim 45, Haddad et al. fail to teach the isolation element comprises of al oxide and hf oxide.

However, the use of al oxide and hf oxide as isolation element is well-known in semiconductor art.

With respect to claim 46, Haddad et al. teach at least one of said adjacent light sensitive pixels comprises a textured region 60, 18, 40.

With respect to claim 47, Haddad et al. teach said textured region is coupled to the light incident surface.

With respect to claim 48, Haddad et al. teach said light incident surface comprises said textured region.

With respect to claim 49, Haddad et al. teach said textured region comprises a textured film layer.

With respect to claim 51, Haddad et al. teach said backside surface comprises of said textured region.

With respect to claims 50, Haddad et al. fail to teach the trapping or reflecting layer and textured or reflecting layer comprise of a metal layer.

Bour et al. teach using a textured or reflecting layer of metal or Al to enhance or control reflection of incident light. See col. 3, lines 40-50.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the teaching of Bour et al. into the device of Haddad et al. to achieve light efficiency. See col. 3, lines 40-50.

With respect to claims 63 and 64, how the textured region is formed has not given patentable weight since claimed invention is directed to a device.

With respect to claim 66, Haddad et al. teach said textured region is coupled to said backside surface.

Claims 52, 54-61 is/are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Haddad et al. WO 2011035188 (a reference cited by the applicant) in combination with Ooka (JP407074240) and Bour et al. (US pat 8470619) (reference previously cited).

With respect to claim 52, Haddad et al. teach an imager, comprising (see figs. 1-17, particularly fig. 3 and associated text):

at least two adjacent light sensitive pixels each having a light incident surface, and a backside surface opposite the light incident surface;

a peripheral isolation element separating said at least two adjacent light sensitive pixels so as to reduce optical crosstalk therebetween,;

at least one doped region disposed on at least one of the light incident surface and the backside surface .

Haddad et al. fail to teach the peripheral isolation element comprises at least two materials having different indices of refraction.

Ooka teaches an imager in which an isolation element comprises at least two materials having different indices of refraction. See English abstract.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the teaching of Ooka into the device of Haddad et al. to achieve improved reflection efficiency and reabsorbing optical energy. See English abstract.

With respect to claim 54, Haddad et al. teach at least one of said light incident surface and said backside surface of at least one of said two adjacent light sensitive pixels comprises a textured region.

With respect to claim 55, Haddad et al. teach said textured region is a textured film layer.

With respect to claim 56, Haddad et al. fail to teach the trapping or reflecting layer and textured or reflecting layer comprise of a metal layer.

Bour et al. teach using a textured or reflecting layer of metal or Al to enhance or control reflection of incident light. See col. 3, lines 40-50.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the teaching of Bour et al. into the device of Haddad et al. to achieve light efficiency. See col. 3, lines 40-50.

With respect to claim 57, Haddad et al. teach said textured region reflects at least a portion of light internally incident thereon into the pixel.

With respect to claim 58, Haddad et al. teach the isolation element extends from the light incident surface to the backside surface of at least onf of said two adjacent light sensitive pixels.

With respect to claim 59, Haddad et al. fail to teach the isolation element comprises of al oxide and hf oxide.

However, the use of al oxide and hf oxide as isolation element is well-known in semiconductor art.

With respect to claim 60, Haddad et al. teach said at least two pixels are formed monolithically in a common semiconductor substrate.

With respect to claim 61, how the textured region is formed has not given patentable weight since claimed invention is directed to a device.

Allowable Subject Matter

Claims 35, 38, and 53 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Response to Arguments

Applicant's arguments filed 11/13/2017 have been fully considered but they are not persuasive. See above rejection.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to LONG PHAM whose telephone

number is (571)272-1714. The examiner can normally be reached on Mon-Frid, 10am to 5pm.

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, Wael Fahmy can be reached on 571-272-1705. 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 http://pair-direct.uspto.gov. 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.

Long Pham
Primary Examiner
Art Unit 2814

/LONG PHAM/
Primary Examiner, Art Unit 2814

Notice of References Cited	Application/Control No. 15/216,244	Applicant(s)/Patent Under Reexamination PRALLE ET AL.	
	Examiner LONG PHAM	Art Unit 2814	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-				
	B	US-				
	C	US-				
	D	US-				
	E	US-				
	F	US-				
	G	US-				
	H	US-				
	I	US-				
	J	US-				
	K	US-				
	L	US-				
	M	US-				

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N	JP407074240	03-1995	JAPAN	OOKA	
	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.

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

PTO/SB/08a (03-15)
Approved for use through 07/31/2016. 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.

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Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

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	5236863		1993-08-17	Iranmesh	
	2	5410168		1995-04-25	Hisa	
	3	8076746		2011-12-13	McCarten et al.	
	4	9419159		2016-08-16	Sakamoto et al.	
	5	9673250		2017-06-06		

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

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	20040256561		2004-12-23	Beuhler et al.	

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /L.P./

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Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

	2	20070063219		2007-03-22	Sa'ar et al.	
	3	20070103580		2007-05-10	Noto	
	4	20070125951		2007-06-07	Snider et al.	
	5	20080142686		2008-06-19	Konno et al.	
	6	20090009596		2009-01-08	Kerr et al.	
	7	20090174026		2009-07-09	Carey et al.	
	8	20090242019		2009-10-01	Ramamoorthy et al.	
	9	20100102366		2010-04-29	Lee et al.	
	10	20110003424		2011-01-06	De Ceuster et al.	
	11	20110019050		2011-01-27	Yamashita	
	12	20120080733		2012-04-05	Doan et al.	

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	13	20120274744		2012-11-01	Wan	
	14	20140352779		2014-14-04	Smirnov et al.	
	15	20150076468		2015-03-19	Yamaguchi et al.	

If you wish to add additional U.S. Published Application citation information please click the Add button. Add

FOREIGN PATENT DOCUMENTS Remove

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]
	1	200627675	TW		2006-08-01	Lumileds Lighting US LLC		
	2	200818529	TW		2008-04-16	Newsouth Innovations		

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NON-PATENT LITERATURE DOCUMENTS Remove

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.	T[5]
	1	Campbell, Stephen A., "The Science and Engineering of Microeletronic Fabrication, 2nd Ed.", Oxford University Press, 2001, pp. 406-411.	
	2	Ohring, Milton." The Materials of Science of Thin Films"; pp.176-179; Academic Press, 1992.	

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

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Examiner Name	Long Pham
Attorney Docket Number	143705.05221

EXAMINER SIGNATURE

Examiner Signature	/LONG PHAM/	Date Considered	02/15/2018

*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.

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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	/Reza Mollaaghababa/	Date (YYYY-MM-DD)	2017-11-13
Name/Print	Reza Mollaaghababa	Registration Number	43810

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.**

ALL REFERENCES CONSIDERED EXCEPT WHERE LINED THROUGH. /L.P./

IPR2025-00845
Apple-Sony EX1002 Page 110

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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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.

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IPR2025-00845
Apple-Sony EX1002 Page 111

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15216244	PRALLE ET AL.
	Examiner	**Art Unit**
	LONG PHAM	2814

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

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

CLAIM		DATE								
Final	Original	09/07/2016	02/06/2017	06/10/2017	02/15/2018					
	34	÷	✓	✓	✓					
	35	÷	✓	✓	O					
	36	÷	✓	✓	✓					
	37	÷	✓	✓	✓					
	38	÷	✓	✓	O					
	39	÷	✓	✓	✓					
	40	÷	✓	✓	✓					
	41	÷	✓	✓	✓					
	42	÷	✓	✓	✓					
	43	÷	✓	✓	✓					
	44	÷	✓	✓	✓					
	45	÷	✓	✓	✓					
	46	÷	✓	✓	✓					
	47	÷	✓	✓	✓					
	48	÷	✓	✓	✓					
	49	÷	✓	✓	✓					
	50	÷	✓	✓	✓					
	51	÷	✓	✓	✓					
	52	÷	✓	✓	✓					
	53	÷	✓	✓	✓					
	54	÷	✓	✓	✓					
	55	÷	✓	✓	✓					
	56	÷	✓	✓	✓					
	57	÷	✓	✓	✓					
	58	÷	✓	✓	✓					
	59	÷	✓	✓	✓					
	60		✓	✓	✓					
	61		✓	✓	✓					
	62		O	-						
	63		✓	✓	✓					
	64		✓	✓	✓					
	65		O	-						
	66			✓	-					
	67				✓					

IPR2025-00845
Apple-Sony EX1002 Page 112

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	20	("20040256561" | "20070063219" | "20070103580" | "20070125951" | "20080142686" | "20090009596" | "20090174026" | "20090242019" | "20100102366" | "20110003424" | "20110019050" | "20120080733" | "20120274744" | "20140352779" | "20150076468" | "5236863" | "5410168" | "8076746" | "9419159" | "9673250").PN.	US-PGPUB; USPAT	OR	ON	2018/02/15 10:41
L2	24107	(layer or film) near3 (different near2 (refractive or refraction or refracting))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:45
L3	18	2 near4 isolation	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:45
L4	5	3 same4 (pixel or pixels)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:45
L5	13	3 not 4	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:47
L6	22683	bragg adj2 (reflective or reflector)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:51
L7	58	6 near4 isolation	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	2018/02/15 10:52

			IBM_TDB			
L8	6	7 same4 (pixel or pixels)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:52
L9	52	7 not 8	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:55
L10	29452	(isolation or isolating or insulation or insulating) near2 (multi-layer or multiple)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:57
L11	19	10 near10 (different near2 (refractive or refraction or refracting))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 10:58
L12	48	10 near3 (silicon adj2 dioxide)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 13:05
L13	1	12 same4 (pixel or pixels)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 13:05
L14	19531	(isolation or isolating or insulation or insulating) near2 (silicon adj2 dioxide)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 13:08
L15	53	14 near4 (benefit or advantage or beneficial or advantageous)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 13:08
L16	4006	(isolation or isolating or insulation or insulating) near2 ("Al.sub.2O.sub.3")	US-PGPUB; USPAT; USOCR; FPRS;	OR	ON	2018/02/15 13:10

			EPO; JPO; DERWENT; IBM_TDB			
L17	450872	aluminum adj oxide	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 13:11
L18	57928	hafnium adj oxide	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 13:11
L19	2014	(isolation or isolating or insulation or insulating) near6 17 near6 18	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/02/15 13:11
S2	84	US-3035052-$.DID. OR US-20030029495-$.DID. OR US-20040222187-$.DID. OR US-20050127401-$.DID. OR US-20050227390-$.DID. OR US-20060011955-$.DID. OR US-20060079062-$.DID. OR US-20060118781-$.DID. OR US-20060180885-$.DID. OR US-20060231914-$.DID. OR US-20070145505-$.DID. OR US-20080026550-$.DID. OR US-20080036022-$.DID. OR US-20080044943-$.DID. OR US-20080076240-$.DID. OR US-20080099804-$.DID. OR US-20080178932-$.DID. OR US-20080258604-$.DID. OR US-20090065051-$.DID. OR US-20090142879-$.DID. OR US-20090160983-$.DID. OR US-20090194671-$.DID. OR US-20090200586-$.DID. OR US-20090213883-$.DID. OR US-3487223-$.DID. OR US-4277793-$.DID. OR US-4419533-$.DID. OR US-4493942-$.DID. OR US-4514582-$.DID. OR US-4536608-$.DID. OR US-4663188-$.DID. OR US-4829013-$.DID. OR US-5080725-$.DID. OR US-5081049-$.DID. OR US-5100478-$.DID. OR US-5114876-$.DID. OR US-5164324-$.DID. OR US-5322988-$.DID. OR US-5346850-$.DID. OR US-5597621-$.DID. OR US-5714404-$.DID. OR US-5731213-$.DID. OR US-5792280-$.DID. OR US-6147297-$.DID. OR US-6498336-$.DID. OR US-6580053-$.DID. OR US-6583936-$.DID. OR US-6667528-$.DID. OR US-6759262-$.DID. OR US-6800541-	US-PGPUB; USPAT; USOCR; JPO; IBM_TDB	OR	ON	2014/06/25 14:14

		$.DID. OR US-7057256-$.DID. OR US-7091411-$.DID. OR US-7109517-$.DID. OR US-7247527-$.DID. OR US-7314832-$.DID. OR US-7354792-$.DID. OR US-7390689-$.DID. OR US-7442629-$.DID. OR US-7456452-$.DID. OR US-7482532-$.DID. OR US-7498650-$.DID. OR US-7504325-$.DID. OR US-7504702-$.DID. OR US-7511750-$.DID. OR US-7745901-$.DID. OR US-7781856-$.DID. OR US-7816220-$.DID. OR US-7847253-$.DID. OR US-7884439-$.DID. OR US-7884446-$.DID. OR US-8030726-$.DID. OR US-8058615-$.DID. OR US-8207051-$.DID. OR US-8476681-$.DID. OR US-3666484-$.DID. OR US-2030766-$.DID. OR JP-07173484-$.DID. OR JP-071734840721-$.DID. OR JP-2008187003-$.DID. OR JP-2011091128-$.DID. OR JP-2152226-$.DID. OR JP-63116421-$.DID. OR JP-9298308-$.DID. OR KR-20010061058-$.DID. OR KR-20100118864-$.DID. OR WO-2006086014-$.DID. OR WO-2009100023-$.DID. OR WO-2011035188-$.DID. OR WO-2011119618-$.DID.				
S3	7768	(light adj2 (trapping or trapped))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 14:16
S4	11	S2 and S3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 14:16
S5	2251	(reflector or Bragg) and S3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:40
S6	14	(reflector or Bragg) and S2	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:41
S7	888	(reflector or Bragg) near3 backside	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:55
S8	51623	(reflector or Bragg) near3 (side or	US-PGPUB;	OR	ON	2014/06/25

		sidewall or edge or wall)	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			15:55
S9	112640	pixel near5 (side or sidewall or edge or wall)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:56
S10	143	S7 same S8	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:56
S11	2	S9 same4 S10	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:56
S12	3	S9 and S10	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:57
S13	1	S12 not S11	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:57
S14	179	S7 same4 S8	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:58
S15	145	S14 and (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:59
S16	129	S14 same10 (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	2014/06/25 15:59

			IBM_TDB			
S17	128	S14 same8 (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:59
S18	1204	(reflector or Bragg) near5 backside	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:09
S19	71202	(reflector or Bragg) near5 (side or sidewall or edge or wall)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:09
S20	280	S18 same4 S19	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:09
S21	195	S20 same4 (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:09
S22	7	S18 same2 S9	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:10
S23	7	S22 same4 (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:10
S24	217	S18 same S19	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:13
S25	0	(light adj2 sensitive adj2 pixel) same4 S24	US-PGPUB; USPAT; USOCR; FPRS;	OR	ON	2014/06/25 16:14

			EPO; JPO; DERWENT; IBM_TDB			
S26	0	(light adj2 sensitive adj2 pixel) and S24	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:14
S27	14	pixel same4 S24	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:14
S28	7	S27 and index	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:18
S29	26925	(high adj2 index) near3 (layer or film)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:48
S30	27823	(low adj2 index) near3 (layer or film)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:48
S31	12802	S29 near10 S30	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:48
S32	1170	(reflector or Bragg) same S31	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:49
S33	611	(reflector or Bragg) near10 S31	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:49
S34	4200	S30 near5 ("between")	US-PGPUB; USPAT;	OR	ON	2014/06/26 12:49

			USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			
S35	1972	S34 near10 S29	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:50
S36	81	(reflector or Bragg) near10 S35	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:50
S37	188	S29 near5 (polysilicon or polycrystalline or poly or (amorphous adj2 silicon) or germanium)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:53
S38	2500	S30 near5 (oxide or nitride or oxynitride or oxynitrides)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:53
S39	14	S37 near20 S38	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:53
S40	0	(reflector or Bragg) same S39	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:54
S41	0	S39 near20 ("between")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:54
S42	51	backside near6 (textured near2 (layer or film))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 13:12

S43	10	S42 AND ((H01L21/02686 OR H01L27/1214 OR H01L21/02532 OR H01L21/02595 OR H01L31/0236 OR H01L21/0237 OR H01L21/02403 OR H01L21/0243 OR H01L21/02472 OR H01L21/02483 OR H01L21/02494 OR H01L21/02554 OR H01L21/02565 OR H01L21/02573 OR H01L21/02587 OR H01L21/02609 OR H01L21/0262 OR H01L21/365 OR H01L2224/16 OR H01L27/14625 OR H01L27/14627 OR H01L27/14629 OR H01L27/1463 OR H01L27/14685 OR H01L31/02168 OR H01L31/022425 OR H01L31/02363 OR H01L31/042 OR H01L31/0527 OR H01L31/0682 OR H01L31/18 OR H01L31/1804 OR H01L33/0087 OR H01L33/22 OR H01L33/24 OR H01L33/28 OR H01L33/385 OR H01L33/405 OR H01L33/483 OR H01L33/60 OR H01L33/62).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 13:25
S44	5	S39 AND ((H01L21/02686 OR H01L27/1214 OR H01L21/02532 OR H01L21/02595 OR H01L31/0236 OR H01L21/0237 OR H01L21/02403 OR H01L21/0243 OR H01L21/02472 OR H01L21/02483 OR H01L21/02494 OR H01L21/02554 OR H01L21/02565 OR H01L21/02573 OR H01L21/02587 OR H01L21/02609 OR H01L21/0262 OR H01L21/365 OR H01L2224/16 OR H01L27/14625 OR H01L27/14627 OR H01L27/14629 OR H01L27/1463 OR H01L27/14685 OR H01L31/02168 OR H01L31/022425 OR H01L31/02363 OR H01L31/042 OR H01L31/0527 OR H01L31/0682 OR H01L31/18 OR H01L31/1804 OR H01L33/0087 OR H01L33/22 OR H01L33/24 OR H01L33/28 OR H01L33/385 OR H01L33/405 OR H01L33/483 OR H01L33/60 OR H01L33/62).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 13:25
S45	2	S36 AND ((H01L21/02686 OR H01L27/1214 OR H01L21/02532 OR H01L21/02595 OR H01L31/0236 OR H01L21/0237 OR H01L21/02403 OR H01L21/0243 OR H01L21/02472 OR H01L21/02483 OR H01L21/02494 OR H01L21/02554 OR H01L21/02565 OR H01L21/02573 OR H01L21/02587 OR H01L21/02609 OR H01L21/0262 OR H01L21/365 OR H01L2224/16 OR H01L27/14625 OR H01L27/14627 OR H01L27/14629 OR H01L27/1463 OR H01L27/14685 OR H01L31/02168 OR H01L31/022425 OR H01L31/02363 OR H01L31/042 OR H01L31/0527 OR H01L31/0682 OR H01L31/18 OR H01L31/1804 OR H01L33/0087 OR H01L33/22 OR H01L33/24 OR H01L33/28 OR H01L33/385 OR H01L33/405 OR H01L33/483 OR H01L33/60 OR H01L33/62).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 13:25

IPR2025-00845
Apple-Sony EX1002 Page 121

S46	1	("20140138785").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2015/01/05 11:26
S47	3930	(257/432).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2015/01/05 11:54
S48	218	(257/228).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2015/01/05 11:54
S50	1	("9373732").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2016/07/13 15:10
S51	1	("9373732").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2016/07/15 10:13
S52	395	reflective near3 (aluminum adj oxide)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/07/15 13:07
S53	35214	(rough or textured) near2 (layer or film)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:24
S54	44833	light adj2 incident adj2 surface	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:24
S55	38	S53 same S54	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:25
S56	10	S55 same efficiency	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:25
S57	0	S55 same ((silicon adj oxide) or "SiO" or (silicon adj nitride) or "SiN")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:29
S58	0	S55 same ((silicon adj oxide) or "SiO" or (silicon adj nitride) or "SiN")	US-PGPUB; USPAT; USOCR;	OR	ON	2017/02/06 01:30

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S59	3	S55 same (metal or polysilicon or amorphous)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:30
S60	1864	S53 same efficiency	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:32
S61	42	S60 same ((silicon adj oxide) or "SiO" or (silicon adj nitride) or "SiN")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:32
S62	351	S60 same ((silicon adj oxide) or "SiO" or (silicon adj nitride) or "SiN" or metal or polysilicon or amorphous)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:32
S63	85	S62 same4 incident	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:33
S64	228102	(reflective near2 (material or layer or film))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:11
S65	530599	("AlO" or (aluminum adj oxide)) or ("HfO" or (hafnium adj oxide))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:12
S66	403	S64 near3 S65	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:12
S67	2	S66 near4 (benefit or beneficial or	US-PGPUB;	OR	ON	2017/02/06

		advantages or advantageous or advantegeously)	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			11:13
S68	2	S66 near10 (benefit or beneficial or advantages or advantageous or advantegeously)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:13
S69	31128	(anti or non) near2 S64	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:20
S70	121	S65 near4 S69	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:20
S71	2	S70 same (benefit or beneficial or advantages or advantageous or advantegeously)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:20
S72	2	(dope or doping or implanting or implant or implants implantation or dopes) near2 (light adj incident adj surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:04
S73	6	(dope or doping or implanting or implant or implants implantation or dopes) near2 (light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:05
S74	13	(dope or doping or implanting or implant or implants implantation or dopes) near4 (light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:05
S75	167141	(doped or implanted) adj2 (region or section or portion or part)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	2017/02/06 12:13

			IBM_TDB			
S76	1	S75 near4 (light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:13
S77	26	S75 near10 (light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:15
S78	25	S77 not S76	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:15
S79	1	("9064764").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2017/02/06 12:20
S80	44833	(light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:49
S81	167141	(doped or implanted) adj2 (region or section or portion or part)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:49
S82	9	S80 near6 S81	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:49
S83	364064	(light adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:50
S84	54	S83 near4 S81	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:50

S85	53	S84 not S82	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:50
S86	21	("20030214595" | "20030228883" | "20050093100" | "20060086956" | "20060128087" | "20070189583" | "20070237504" | "20080158398" | "20080192133" | "20080284884" | "20100200658" | "20110194100" | "20110292380" | "20140198240" | "5101260" | "5600130" | "5626687" | "5635089" | "6082858" | "6204506" | "6907135").PN.	US-PGPUB; USPAT	OR	ON	2017/02/07 07:43
S87	21	("20030214595" | "20030228883" | "20050093100" | "20060086956" | "20060128087" | "20070189583" | "20070237504" | "20080158398" | "20080192133" | "20080284884" | "20100200658" | "20110194100" | "20110292380" | "20140198240" | "5101260" | "5600130" | "5626687" | "5635089" | "6082858" | "6204506" | "6907135").PN.	US-PGPUB; USPAT	OR	ON	2017/02/07 07:44
S88	20	("20010044266" | "20050088634" | "20080173620" | "20090027640" | "20090093100" | "20090114630" | "20090308457" | "20100140768" | "20130135439" | "4886958" | "5351446" | "5641969" | "5727096" | "6327022" | "6331885" | "6340281" | "7800684" | "7897942" | "9184204" | "9369641").PN.	US-PGPUB; USPAT	OR	ON	2017/06/01 13:32

2/ 15/ 2018 2:07:49 PM
C:\ Users\ lpham\ Documents\ EAST\ Workspaces\ 15-216,244.wsp

IPR2025-00845
Apple-Sony EX1002 Page 126

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Martin U. Pralle	Confirmation No.: 5●52
Application No.: 15/216,244	Art Unit: 2814
Filed: July 21, 2●16	Examiner: Pham, Long
For: PIXEL ISOLATION ELEMENTS, DEVICES, AND ASSOCIATED METHODS	

Commissioner for Patents
P. O. Box 145●
Alexandria, VA 22313-145●

Certificate of Mailing

I hereby certify that this correspondence is being electronically filed via EFS-Web to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

November 13, 2017 (Dated) — Electronic Signature: /Reza Mollaaghababa/ (Reza Mollaaghababa, Reg. No. 43,810)

RESPONSE TO NON-FINAL OFFICE ACTION

Dear Sir:

This paper is filed in response to the non-final Office Action dated June 19, 2●17.

Amendments to the Claims begin on page 2.

Remarks begin on page 7.

AMENDMENTS TO THE CLAIMS

1-33. (Canceled)

34. (Currently Amended) An imager ~~A light trapping~~ device, comprising:

at least ~~one~~ two adjacent light sensitive ~~pixel~~ pixels each having a light incident surface, and a backside surface opposite the light incident surface~~, and a peripheral sidewall extending at least partially around the pixel periphery~~;

~~a backside light trapping material substantially covering the backside surface;~~

~~a peripheral light trapping material~~ a peripheral isolation element at least partially separating said two adjacent light sensitive pixels ~~substantially covering the peripheral sidewall~~;

each of said pixels having at least one doped region disposed on at least one of the light incident surface and the backside surface,

wherein the peripheral isolation element comprises at least two materials having different indices of refraction ~~light trapping material creates a surface field at the peripheral sidewall~~.

35. (Currently Amended) The device of claim 34, wherein said peripheral isolation element comprises a first, a second and a third layer, wherein said third layer is disposed between said first and second layers, and wherein each of said first and second layer exhibits an index of refraction less than an index of refraction of said third layer ~~the backside light trapping material reflects the light incident thereon back into the pixel~~.

36. (Currently Amended) The device of claim 34, wherein the index of refraction of at least one of said first and second layer is at least 0.2 lower relative the refractive index of the third layer ~~peripheral light trapping material reflects light incident thereon into the pixel~~.

37. (Currently Amended) The device of claim 34, wherein at least of one of said at least two materials comprises silicon dioxide ~~the peripheral sidewall extends completely around the pixel periphery~~.

IPR2025-00845
Apple-Sony EX1002 Page 128

38. (Currently Amended) The device of claim 35 ~~34~~, wherein at least one of said first and second layers comprises silicon dioxide ~~the peripheral sidewall extends from the light incident surface to the backside surface~~.

39. (Currently Amended) The device of claim 34, wherein the ~~peripheral sidewall~~ isolation element extends ~~through the pixel~~ substantially from the light incident surface to the backside surface of at least one of said two adjacent light sensitive pixels.

40. (Currently Amended) The device of claim 35 ~~34~~, wherein at least one of the first and second layer comprises Al_2O_3 ~~backside light trapping material and the peripheral light trapping material comprises a metal layer~~.

41. (Currently Amended) The device of claim 34, wherein said ~~peripheral light trapping material~~ peripheral isolation element comprises an oxide.

42. (Currently Amended) The device of claim 34, wherein said ~~peripheral light trapping material~~ isolation element provides a passivating negative charge.

43. (Currently Amended) The device of claim 34, wherein said ~~peripheral light trapping material~~ isolation element exhibits a surface recombination velocity as low as 10 cm/s.

44. (Currently Amended) The device of claim 34, wherein the ~~peripheral sidewall material~~ isolation element comprises at least one material having ~~has~~ an index of refraction of less than about 2.1.

45. (Currently Amended) The device of claim 34, wherein the ~~peripheral light trapping material~~ isolation element comprises any of aluminum oxide and hafnium oxide.

46. (Currently Amended) The device of claim 34, wherein at least one of said two adjacent light sensitive ~~pixel~~ pixels comprises a textured region.

IPR2025-00845
Apple-Sony EX1002 Page 129

47. (Previously Presented) The device of claim 46, wherein said textured region is coupled to the light incident surface.

48. (Currently Amended) The device of claim 47, wherein said light incident surface comprises said textured region ~~is located on said light incident surface~~.

49. (Previously Presented) The device of claim 47, wherein said textured region comprises a textured film layer.

50. (Previously Presented) The device of claim 49, wherein said textured film layer comprises any of silicon dioxide, silicon nitride, amorphous silicon, polysilicon, a metal and combinations thereof.

51. (Currently Amended) The device of claim 46, wherein said backside surface comprises said textured region ~~An array of light trapping pixel devices of claim 34~~.

52. (Currently Amended) An imager ~~A light trapping~~ device, comprising:

at least two adjacent ~~one~~ light sensitive ~~pixel~~ pixels each having a light incident surface, and a backside surface opposite the light incident surface~~, and a peripheral sidewall extending at least partially around the pixel periphery~~;

~~a backside light trapping material at least partially covering the backside surface;~~

a peripheral isolation element separating said at least two adjacent light sensitive pixels so as to reduce optical crosstalk therebetween, said isolation element comprising at least two materials having different indices of refraction ~~a peripheral light trapping material substantially covering the peripheral sidewall~~; ~~and~~

at least one doped region disposed on at least one of the light incident surface and the backside surface~~; and~~

~~a textured region positioned to interact with light incident thereon so as to increase quantum efficiency of the device~~.

53. (Currently Amended) The device of claim 52, wherein said peripheral isolation element comprises a first, a second and a third layer, wherein said third layer is disposed between said

IPR2025-00845
Apple-Sony EX1002 Page 130

first and second layers, and wherein each of said first and second layers exhibits an index of refraction less than an index of refraction of said third layer ~~said backside light trapping material substantially covers the backside surface~~.

54. (Currently Amended) The device of claim 52, wherein at least one of said light incident surface and said backside surface of at least one of said two adjacent light sensitive pixels comprises a textured region ~~is located on the light incident surface~~.

55. (Currently Amended) The device of claim 54 ~~52~~, wherein said textured region is a textured film layer ~~coupled to the light incident surface~~.

56. (Previously Presented) The device of claim 55, wherein said textured film layer comprises any of silicon dioxide, silicon nitride, amorphous silicon, polysilicon, a metal and combinations thereof.

57. (Currently Amended) The device of claim 54 ~~52~~, wherein said textured region reflects at least a portion of light internally incident thereon into the pixel.

58. (Currently Amended) The device of claim 52, wherein the isolation element ~~peripheral sidewall~~ extends from the light incident surface to the backside surface of at least one of said two adjacent light sensitive pixels.

59. (Currently Amended) The device of claim 52 ~~34~~, wherein said at least two materials comprises silicon dioxide and aluminum oxide ~~the peripheral sidewall extends through the pixel substantially from the light incident surface to the backside surface~~.

60. (Currently Amended) The device of claim 54 ~~52~~, wherein said at least two pixels are formed monolithically in a common semiconductor substrate ~~the textured region is formed by one of plasma etching, reactive ion etching, porous silicon etching, lasing, chemical etching, nanoimprinting, material deposition, selective epitaxial growth, and combinations thereof~~.

IPR2025-00845
Apple-Sony EX1002 Page 131

61. (Currently Amended) The device of claim 54 ~~52~~, wherein the textured region is formed by laser radiation.

62. (Canceled)

63. (Previously Presented) The device of claim 46, wherein the textured region is formed by one of plasma etching, reactive ion etching, porous silicon etching, lasing, chemical etching, nanoimprinting, material deposition, selective epitaxial growth, and combinations thereof.

64. (Previously Presented) The device of claim 46, wherein the textured region is formed by laser radiation.

65. (Canceled)

66. (Canceled)

67. (New) The device of claim 46, wherein said textured region is coupled to the backside surface.

IPR2025-00845
Apple-Sony EX1002 Page 132

REMARKS

Applicant amends claims 34-46, 48, 51-55, and 57-61, cancel claim 66 without prejudice, and add new claim 67 as indicated above. Support for the amendments can be found, e.g., at paragraphs [●●39], [●●43], [●●44], [●●45], [●●47], and [●●52], as well as FIG. 2 of Applicant's published U.S. application. No new matter is added.

Rejections Pursuant to 35 U.S.C. §102

1. *Claims 34-39, 46-49, 51, 63, and 64 are rejected as being anticipated by PCT Pub. No. WO 2011035188 ("Haddad")*

Claim 34, as amended, recites an imager device, which comprises at least two adjacent light sensitive pixels each having a light incident surface, a backside surface opposite the light incident surface, and a peripheral isolation element at least partially separating said two adjacent light sensitive pixels. Each of the pixels has at least one doped region disposed on at least one of the light incident surface and the backside surface, wherein the peripheral isolation element comprises at least two materials having different indices of refraction.

Haddad is generally directed to a photosensitive imager device that can include a semiconductor substrate having multiple doped regions forming at least one junction, a textured region coupled to the semiconductor substrate and positioned to interact with electromagnetic radiation, and an electrical transfer element coupled to the semiconductor substrate and operable to transfer an electrical signal from the junction. Abstract.

Haddad does not, however, disclose an isolation element disposed between two adjacent light sensitive pixels, where the isolation element comprises at least two materials having different indices of refraction, as recited in amended claim 1. In particular, Haddad does not disclose that its peripheral light trapping material (e.g., element 3● depicted in FIG. 30) includes at least two materials having different indices of refraction.

Thus, Haddad does not anticipate independent claim 34. Further, claims 35-39, 46, 51, 63, and 64 depend on claim 34 and hence are patentable over Haddad at least for the reasons provided in connection with claim 34.

IPR2025-00845
Apple-Sony EX1002 Page 133

II. Claims 52-55 and 57-61 are rejected as being anticipated by Haddad

Independent claim 52 recites an imager device, which comprises at least two adjacent light sensitive pixels each having a light incident surface, and a backside surface opposite the light incident surface. The imager device further includes a peripheral isolation element separating said at least two adjacent light sensitive pixels so as to reduce optical crosstalk therebetween, said isolation element comprising at least two materials having different indices of refraction. The imager device further includes at least one doped region disposed on at least one of the light incident surface and the backside surface.

The reasoning provided above in connection with claim 34 applies equally to establish that independent claim 52 is also patentable over the cited art. In particular, Haddad does not disclose an isolation element comprising at least two materials having different indices of refraction.

Further, claims 53-55 and 57-61 depend directly or indirectly on claim 52 and hence are also patentable over the cited art at least for the reasons provided above in connection with claim 52.

Rejections Pursuant to 35 U.S.C. §103

I. Claims 41, 43, and 44 are rejected as being unpatentable over Haddad and further in view of JP H03183037 (Yanagisawa)[1]

Yanagisawa is directed to an optical storage medium. Page 1. Yanagisawa discloses that conventionally aluminum or gold is used as the material of the reflective film. *Id.* Yanagisawa explains that such conventional reflective films can experience corrosion when exposed to high temperature and high humidity. *Id.* Yanagisawa indicates that it is an object of its purported invention to provide an optical storage medium that is weather resistant, and particularly to an optical storage medium that has excellent corrosion resistance and adhesiveness. *Id.*

[1] Applicant notes that the Office Action identifies this reference as JP 403183037. Applicant notes that the publication number is JP H03183037, as indicated on the IDS filed on February 13, 2017 (reference B14). Additionally, Applicant notes that it has relied on a machine translation of this reference provided by EPO's Espace (and which is appended hereto as Exhibit 1) for understanding Yanagisawa's disclosure and refers to this machine translation in the following discussion.

IPR2025-00845
Apple-Sony EX1002 Page 134

Specifically, Yanagisawa discloses forming combined layers of high-refractive index layers of adequate film thicknesses on a transparent substrate, thereby obtaining high reflectivity. Abstract. For example, Yanagisawa discloses a combination of high-refractive index layers consisting of silicon, germanium and low-refractive index layers consisting of silicon oxide, magnesium fluoride on a transparent substrate. *Id.*

As an initial matter, Yanagisawa is non-analogous art relative to the claimed invention. In particular, Yanagisawa is not in the field of the claimed invention. Nor is Yanagisawa reasonably pertinent to the problems faced by the present inventor. As such, it is non-analogous art relative to the claimed invention. *See In re Bigio*, 381 F.3d 1320, 1325 (Fed. Cir. 2004) (holding that two separate tests define the scope of analogous art: (1) whether the art is from the same field of endeavor, regardless of the problem addressed, and (2) if the reference is not within the field of inventor's endeavor, whether the reference still is reasonably pertinent to the particular problem with which the inventor is involved).

While the claimed invention is directed to an imager device, Yanagisawa is directed to an optical storage medium. Further, the teachings of Yanagisawa regarding an optical storage medium are not pertinent to the problem faced by the present inventors. In particular, the present inventors explain that imagers can be incorporated into a variety of devices, including digital cameras, camcorders, cornputer, cell phones, etc. *See*, published application at para. [0002]. The present inventors further explain that "[d]ue to the ever decreasing size (foot print) of these devices, image sensors have correspondingly seen a decrease in size." *Id.* However, "pixel size reduction can lead to a significant sacrifice in image quality." *Id.* In particular, "[a]s pixel sizes continue to decrease, image signal to noise tends to decrease while electrical and optical cross-talk between adjacent sensor pixels tends to increase." *Id.* The teachings of Yanagisawa regarding an optical storage medium is not pertinent to solving the problem of cross-talk between pixels in an imager device.

Moreover, even if one were to cornbine Haddad with Yanagisawa one still would not arrive at the subject matter of claims 41, 43, and 44. Each of these claims depends on claim 34 and hence incorporates the limitations of claim 34. As discussed above, Haddad does not disclose a peripheral isolation element that comprises at least two materials with different indices

IPR2025-00845
Apple-Sony EX1002 Page 135

of refraction. And Yanagisawa does not cure this gap in the teachings of Haddad. In particular, Yanagisawa does not disclose, or even suggest, using its reflective layers as an isolation element in an imager device.

Thus, claims 41, 43 and 44 are patentable over the cited art.

II. Claims 42 and 45 are rejected as being unpatentable over Haddad further in view of U.S. Patent No. 8,906,670 ("Gray")

Claims 42 and 45 depend on claim 34 and hence incorporate the features of claim 34. As discussed above, Haddad does not disclose the subject matter of claim 34. Gray does not cure the gap in the teachings of Haddad with regard to the subject matter of claim 34. Rather, Gray is simply directed to optical confinement structures such as zero-mode waveguides. (7:11-13).

New Claims

New claim 67 depends, via intervening claim 46, on claim 34 and further recites that the textured region recited in claim 46 is coupled to the backside surface. This claim is patentable over the cited art at least for the reasons provided above in connection with claim 34.

Conclusion

In view of the above amendments and remarks, Applicant respectfully requests reconsideration and allowance of the application. Applicant invites the Examiner to call the undersigned if there are any outstanding issues.

The Director is authorized to charge any deficiency in the fees filed, asserted to be filed or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit Account No. 50-0436, under Docket No. 143705.05601.

Dated: November 13, 2017

Electronic Signature: /Reza Mollaaghababa/
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IPR2025-00845
Apple-Sony EX1002 Page 136

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IPR2025-00845
Apple-Sony EX1002 Page 137

Exhibit 1

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DESCRIPTION JPH03183037

[0001]

BACKGROUND OF THE INVENTION 1. Field of the Invention The present invention relates to an optical storage used for audio equipment or information equipment. Conventionally, a compact disc (hereinafter abbreviated as CD), which is one of optical storage bodies,), Aluminum or gold is used as the material of the reflective film. However, in recent years, CD-ROMs on which computer data are recorded on CDs have become widespread, and more highly-preserved at high temperature and high humidity is desired more than ever before. Problems to be Solved by the Invention In the conventional optical memory using a gold or aluminum reflective film, under such harsh environments, corrosion occurs when the deposited reflective film is aluminum, and in the case of gold, There is a problem that it is peeled from the body and the error rate used as an indicator of signal reading increases and it can not be adapted to the above-mentioned needs. Also, the reflective film materials other than the aluminum yarn were in a state of being unusable due to insufficient reflectance. SUMMARY OF THE INVENTION The present invention has been made to solve the conventional problems as described above, and it is an object of the present invention to provide an optical storage medium having a weather resistance, particularly excellent corrosion resistance and adhesiveness, . Means for Solving the Problems The present invention is a method for manufacturing a magnetic recording medium including a transparent substrate and a combination layer or a low refractive index layer which is formed in order of a high refractive index layer and a low refractive index layer, And a high refractive index layer in that order on a recording bit forming surface of the transparent substrate; and a high refractive index layer coated on the recording bit forming surface of the transparent substrate, Layer and a

IPR2025-00845
Apple-Sony EX1002 Page 139

low refractive index layer in this order, and a reflective layer which is coated on the combination layer. The high refractive index layer used in this presentation is mainly silicon, germanium, boron, zinc sulfide,! ! Titanium dioxide, magnesium oxide, indium oxide, antimony oxide, antimony sulfide, tellurium, cadmium telluride, lead telluride and the like can be used. Further, the low refractive index layer used in the present invention is silicon oxide. Magnesium fluoride, aluminum oxide, cerium bromide, magnesium oxide, calcium bromide. Sodium bromide, lithium bromide, carbon (amorphous or diamond), and the like can be used. The reflective layer used in the present invention may be a reflective layer made of chromium, molybdenum, tungsten, vanadium, niobium, tantalum, titanium, zirconium, hafnium, manganese, rhenium, ruthenium, iron, osmium, cobalt, rhodium, iridium, nickel, palladium, platinum, Metals such as cadmium, tin, lead, thallium, antimony, bismuth, indium, gallium and the like or alloys thereof or metal nitrides such as titanium nitride, zirconium nitride, hafnium nitride and the like can be used.

Also anti - gold or silver alone!) Since it is not desirable in terms of adhesion and copper and aluminum in view of corrosiveness in terms of adhesion, it is preferable to use it as an alloy with a metal used as the reflective layer It is desirable to use it. The transparent substrate used in the present invention is an acrylic resin. Polycarbonate resin, polyolefin resin, epoxy resin, fluororesin, glass, sol-gel glass and the like can be used. In the optical memory of the present invention, a high refractive index layer and a low refractive index layer are alternately formed on a transparent substrate on which recording bits are formed by injection molding or tight adhesion transfer from a stamper by sputtering, ion blending, cluster An ion beam method, a plasma CVD method, an evaporation method, or the like, and then, if necessary, a reflective film is formed on the combination layer in the same manner as described above. For the transparent substrate, for example, a silicic acid polymer is spin-coated on a glass substrate, a stamper is brought into close contact with the spin coating, and bits are transferred to form a transparent substrate with bits. Also, resin may be injected into the mold of the stamper and removed from the mold to form a transparent substrate with bits. The optical memory of the present invention produced in this way has both high reflectance and high weather resistance (high adhesion and high corrosion resistance), and is far superior to the conventional gold or aluminum reflection film coated directly on a transparent substrate It has reliability concerning long-term data preservation. In the optical memory of the present invention, a combination layer comprising a high refractive index layer and a low refractive index layer is formed on a transparent substrate. By this combination layer, reflected light from each layer causes multiple interference. At this time, when the film thickness of each layer is selected to an appropriate value, the phases coincide and the reflectance can be increased to nearly 100%. Therefore, it is unnecessary to directly form a reflection film made of A ° C, ALJ, or the like directly on the transparent substrate as in the related art, and an optical memory with high reliability is provided. Even with only the combined layer of the high refractive index layer and the low refractive index layer, the reflectance can be made close to 100%, but a combination of multiple layers is required. Therefore, if a reflective layer is provided on the combination layer of the low refractive index

IPR2025-00845
Apple-Sony EX1002 Page 140

layer and the high refractive index layer, high reflectance can be obtained with a small number of combination layers. In addition, as the difference in refractive index between the high refractive index layer and the low refractive index layer is large, the film thickness of the two layers can be reduced, and the shape (depth, width, length) of the bit is unlikely to be impaired. DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS Embodiments of the present invention will be described in detail below with reference to the drawings. 1 (a) is a partial cross-sectional view thereof, and FIG. 1 (b) is an enlarged cross-sectional view of a portion A in (a) of FIG. 1, showing an embodiment of the optical memory of the present invention. is there.

Here, two samples coated with the material, the structure, or the film thickness of the transparent substrate 1, the high refractive index layer 2, and the low refractive index layer 3 are not shown in Table 1 and 2, respectively, were prepared. 2 (a) is a partial cross-sectional view thereof, FIG. 2 (b) is an enlarged view of a part B in (a) of FIG. 2, FIG. 2 shows another embodiment of the optical storage 1 of the present invention, FIG. Here, the transparent substrate 1, the low refractive index layer 3, and the high refractive index layer 2 are the materials shown in (1) and (IV) of Table 1, respectively. Two samples coated with 4 M and film thickness were made. FIG. 3 is a partial cross-sectional view showing another embodiment of the optical memory 1 of the present invention. The three samples coated with the material, the structure and the film thickness shown in V, Vl, VN of Table 1 by the transparent substrate 1, the high refractive index layer 2, the low refractive index layer 3 and the reflection layer 4 Was prepared. Table 1 also shows the foul rate of each sample obtained. (Hereinafter referred to as "margins") Next, a weather resistance test at a temperature of 70 ° C. and a relative humidity of 95% was conducted for 6 months on a comparative sample in which aluminum and gold were formed as reflective films on a transparent substrate made of these samples and a polycarbonate resin , And the number of errors as an indicator of the quality of the signal was measured. After six months of weathering test, the number of errors of the sample of the present invention was not deteriorated at all, but the comparative sample using the aluminum reflective film was corroded and the comparative sample using the gold reflective film was erroneous Deteriorated as the measurement became impossible. As described in detail above, the optical memory of the present invention has excellent adhesion to a transparent substrate, has corrosion resistance and high reflectance, uses a reflective film of aluminum yarn The reliability can be improved much more than the optical memory body which has been subjected to the light irradiation.

[0002]

Brief Description of the Drawings

IPR2025-00845
Apple-Sony EX1002 Page 141

[0003]

FIGS. 1 to 3 are partial cross-sectional views of one embodiment of the optical storage of the present invention, respectively. 1 transparent substrate 2 high refractive index layer 3 low refractive index layer 4 reflective layer

IPR2025-00845
Apple-Sony EX1002 Page 142

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Martin U. Pralle	Confirmation No.: 5052
Application No.: 15/216,244	Art Unit: 2814
Filed: July 21, 2016	Examiner: Pham, Long
For: PIXEL ISOLATION ELEMENTS, DEVICES, AND ASSOCIATED METHODS	

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November 13, 2017 (Dated) — Electronic Signature: /Reza Mollaaghababa/ (Reza Mollaaghababa, Reg. No. 43,810)

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Pursuant to 37 CFR 1.56, 1.97 and 1.98, the attention of the Patent and Trademark Office is hereby directed to the references listed on the attached PTO/SB/08. It is respectfully requested that the information be expressly considered during the prosecution of this application, and that the references be made of record therein and appear among the "References Cited" on any patent to issue therefrom.

This Information Disclosure Statement is filed more than three months after the U.S. filing date, OR more than three months after the date of entry of the national stage of a PCT application, AND after the mailing date of the first Office Action on the merits, but before the mailing date of a Final Office Action or Notice of Allowance (37 CFR 1.97(c)). This IDS is accompanied with the fee set forth in 37 C.F.R. 1.17(p).

In accordance with 37 CFR 1.98(a)(2)(ii), Applicant has not submitted copies of U.S. patents and U.S. patent applications.

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It is submitted that the Information Disclosure Statement is in compliance with 37 CFR 1.98 and the Examiner is respectfully requested to consider the listed references.

The Director is hereby authorized to charge any deficiency in the fees filed, asserted to be filed or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit Account No. 50-0436, under Order No. 143705.05221.

Respectfully submitted,

Dated: November 13, 2017

Electronic Signature: /Reza Mollaaghababa/
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IPR2025-00845
Apple-Sony EX1002 Page 144

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	15216244
Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

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	2	5410168		1995-04-25	Hisa	
	3	8076746		2011-12-13	McCarten et al.	
	4	9419159		2016-08-16	Sakamoto et al.	
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	Application Number	15216244
	Filing Date	2016-07-21
	First Named Inventor	Martin U. Pralle
	Art Unit	2814
	Examiner Name	Long Pham
	Attorney Docket Number	143705.05221

	2	20070063219		2007-03-22	Sa'ar et al.	
	3	20070103580		2007-05-10	Noto	
	4	20070125951		2007-06-07	Snider et al.	
	5	20080142686		2008-06-19	Konno et al.	
	6	20090009596		2009-01-08	Kerr et al.	
	7	20090174026		2009-07-09	Carey et al.	
	8	20090242019		2009-10-01	Ramamoorthy et al.	
	9	20100102366		2010-04-29	Lee et al.	
	10	20110003424		2011-01-06	De Ceuster et al.	
	11	20110019050		2011-01-27	Yamashita	
	12	20120080733		2012-04-05	Doan et al.	

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	Application Number	15216244
	Filing Date	2016-07-21
	First Named Inventor	Martin U. Pralle
	Art Unit	2814
	Examiner Name	Long Pham
	Attorney Docket Number	143705.05221

	13	20120274744		2012-11-01	Wan		
	14	20140352779		2014-14-04	Smirnov et al.		
	15	20150076468		2015-03-19	Yamaguchi et al.		

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	2	200818529	TW		2008-04-16	Newsouth Innovations		

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	1	Campbell, Stephen A., "The Science and Engineering of Microeletronic Fabrication, 2nd Ed.", Oxford University Press, 2001, pp. 406-411.	
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	Art Unit	2814
	Examiner Name	Long Pham
	Attorney Docket Number	143705.05221

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	Application Number	15216244
	Filing Date	2016-07-21
	First Named Inventor	Martin U. Pralle
	Art Unit	2814
	Examiner Name	Long Pham
	Attorney Docket Number	143705.05221

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).

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

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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	/Reza Mollaaghababa/	Date (YYYY-MM-DD)	2017-11-13
Name/Print	Reza Mollaaghababa	Registration Number	43810

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.**

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Electronic Patent Application Fee Transmittal

Application Number:	15216244
Filing Date:	21-Jul-2016
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Filer:	Reza Mollaaghababa
Attorney Docket Number:	143705.05221

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Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
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Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 2 months with $0 paid	1252	1	600	600
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Submission- Information Disclosure Stmt	1806	1	180	180
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Electronic Acknowledgement Receipt

EFS ID:	30934601
Application Number:	15216244
International Application Number:	
Confirmation Number:	5052
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
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Attorney Docket Number:	143705.05221
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/216,244	Filing Date 07/21/2016	☐ 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 $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	x $ =	
☐ 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

AMENDMENT **11/13/2017**

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	* 31	Minus	** 32	= 0	x $0 =	0
Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	x $0 =	0
☐ Application Size Fee (37 CFR 1.16(s))						
☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
					TOTAL ADD'L FEE	**0**

AMENDMENT

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
Total (37 CFR 1.16(i))	*	Minus	**	=	x $ =	
Independent (37 CFR 1.16(h))	*	Minus	***	=	x $ =	
☐ 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.
** 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 number found in the appropriate box in column 1.

LIE
BURNELL L. ROSS

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.

UNITED STATES PATENT AND TRADEMARK OFFICE

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/216,244	07/21/2016	Martin U. Pralle	143705.05221

CONFIRMATION NO. 5052

POA ACCEPTANCE LETTER

136549
Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736

OC000000092381365

Date Mailed: 06/28/2017

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 06/23/2017.

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**.

/sphouminh/

IPR2025-00845
Apple-Sony EX1002 Page 157

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Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736

Courtesy Reminder for
Application Serial No: 15/216,244

Attorney Docket No: 143705.05221
Customer Number: 136549
Date of Electronic Notification: 06/19/2017

This is a courtesy reminder that new correspondence is available for this application. If you have not done so already, please review the correspondence. The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

An email notification regarding the correspondence was sent to the following email address(es) associated with your customer number:
docketingbn@pepperlaw.com
davisdr@pepperlaw.com

To view your correspondence online or update your email addresses, please visit us anytime at **https://sportal.uspto.gov/secure/myportal/privatepair.** If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov or call 1-866-217-9197.

PTO/AIA/80 (07-12)
Approved for use through 11/30/2014. OMB 0651-0035
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.

POWER OF ATTORNEY TO PROSECUTE APPLICATIONS BEFORE THE USPTO

I hereby revoke all previous powers of attorney given in the application identified in the attached statement under 37 CFR 3.73(c).

I hereby appoint:

☒ Practitioners associated with Customer Number: 136549

OR

☐ Practitioner(s) named below (if more than ten patent practitioners are to be named, then a customer number must be used):

Name	Registration Number	Name	Registration Number

As attorney(s) or agent(s) to represent the undersigned before the United States Patent and Trademark Office (USPTO) in connection with any and all patent applications assigned only to the undersigned according to the USPTO assignment records or assignments documents attached to this form in accordance with 37 CFR 3.73(c).

Please change the correspondence address for the application identified in the attached statement under 37 CFR 3.73(c) to:

☑ The address associated with Customer Number: 136549

OR

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

Assignee Name and Address: SiOnyx, LLC
100 Cummings Center, Suit 243F
Beverly, MA 01915

A copy of this form, together with a statement under 37 CFR 3.73(c) (Form PTO/AIA/96 or equivalent) is required to be Filed in each application in which this form is used. The statement under 37 CFR 3.73(c) may be completed by one of The practitioners appointed in this form, and must identify the application in which this Power of Attorney is to be filed.

SIGNATURE of Assignee of Record

The individual whose signature and title is supplied below is authorized to act on behalf of the assignee

Signature		Date	12/18/15
Name	Stephen Saylor	Telephone	508.524.4305
Title	CEO, SiOnyx LLC		

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 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.

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:	29590814
Application Number:	15216244
International Application Number:	
Confirmation Number:	5052
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Customer Number:	136549
Filer:	Reza Mollaaghababa/Jillian Stockel
Filer Authorized By:	Reza Mollaaghababa
Attorney Docket Number:	143705.05221
Receipt Date:	23-JUN-2017
Filing Date:	21-JUL-2016
Time Stamp:	13:26:08
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	SIOnyx_POA.pdf	135241 3e9144ffe18fe0c3a5f4a21cbd2f422b21d9b7ac	no	2

Warnings:

IPR2025-00845
Apple-Sony EX1002 Page 161

Information:	
Total Files Size (in bytes):	135241

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.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/216,244	07/21/2016	Martin U. Pralle	143705.05221	5052

136549 7590 06/19/2017

Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736

EXAMINER
PHAM, LONG

ART UNIT	PAPER NUMBER
2814	

NOTIFICATION DATE	DELIVERY MODE
06/19/2017	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):

docketingbn@pepperlaw.com
davisdr@pepperlaw.com

Office Action Summary	Application No. 15/216,244	Applicant(s) PRALLE ET AL.	
	Examiner LONG PHAM	Art Unit 2814	AIA (First Inventor to File) Status No

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *5/12/17*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ 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.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *34-61,63,64 and 66* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *34-61,63,64 and 66* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, 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.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ 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)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date *5/12/17*.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

IPR2025-00845
Apple-Sony EX1002 Page 164

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

In light of the new ground of rejections, the indication of allowability of claims 62 and 65 has been withdrawn.

DETAILED ACTION

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claim(s) 34-39, 46-49 and 51 and 63-64 and 66 is/are rejected under pre-AIA 35 U.S.C. 102(a) as being anticipated by Haddad et al. WO 2011035188 (a reference cited by the applicant).

With respect to claim 34, Haddad et al. teach a light trapping device, comprising (see figs. 1-17, particularly fig. 3 and associated text):

at least one light sensitive pixel having a light incident surface (top), a backside surface (bottom) opposite the light incident surface, and a peripheral sidewall extending at least partially around the pixel periphery;

a **backside light trapping material** 20 substantially covering the backside surface;

a **peripheral light trapping material** 30 substantially covering the peripheral sidewall; and

at least **one doped region** 14,16 disposed on at least one of the light incident surface and the backside surface,

wherein the peripheral light trapping material inherently creates a surface field at the peripheral sidewall.

With respect to claim 35, Haddad et al. teach the backside light trapping material reflects the light incident thereon back into the pixel.

With respect to claim 36, Haddad et al. teach the peripheral light trapping material reflects light incident thereon into the pixel.

With respect to claim 37, Haddad et al. teach the peripheral sidewall extends completely around the pixel periphery.

With respect to claim 38, Haddad et al. teach the peripheral sidewall extends from the light incident surface to the backside surface.

With respect to claim 39, Haddad et al. teach wherein the peripheral sidewall extends through the pixel substantially from the light incident surface to the backside surface.

With respect to claim 46, Haddad et al. teach said pixel comprises **a textured region** 60, 18, 40.

With respect to claim 47, Haddad et al. teach said textured region is coupled to the light incident surface.

With respect to claim 48, Haddad et al. teach said textured region is located on said light incident surface.

With respect to claim 49, Haddad et al. teach said textured region comprises a textured film layer.

With respect to claim 51, Haddad et al. teach an array of light trapping pixel device.

With respect to claims 63 and 64, how the textured region is formed has not given patentable weight since claimed invention is directed to a device.

With respect to claim 66, Haddad et al. teach said textured region is coupled to said backside surface.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 41, 43, 44, are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Haddad et al. WO 2011035188 as applied to claims

34-39, 46-49 and 51 and 63-64 and 66 above, and further in view of Yanagisawa (JP 403183037) (a reference cited by the applicant).

With respect to claims 41, 43, and 44, Haddad et al. teach the peripheral light trapping material but fails to teach the peripheral light trapping material is made of silicon oxide or having a refractive index of less than about 2.1 or having a surface recombination velocity as low as 10 cm/s.

Yanagisawa teaches using a material of silicon oxide or having a refractive index of less than about 2.1 or having a surface recombination velocity as low as 10 cm/s to control reflectivity. See English abstract.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the teaching of Yanagisawa into the device of Haddad et al. to achieve the above benefit.

Claims 42 and 45 rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Haddad et al. WO 2011035188 as applied to claims 34-34-39, 46-49 and 51 and 63-64 and 66 above, and further in view of Gray et al. (US pat 8906670) (reference previously cited).

With respect to claims 42 and 45, Haddad et al. teach the peripheral light trapping material but fails to teach the peripheral light trapping material is made of aluminum oxide or having passivating negative charge.

Gray et al. teach using a material of aluminum oxide or having passivating negative charge to control reflectivity. See col. 2, lines 1-15.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the teaching of Gray et al. into the device of Haddad et al. to achieve the above benefit. See col. 2, lines 1-15.

Claims 40 and 50 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Haddad et al. WO 2011035188 as applied to claims 34-39, 46-49 and 51 and 63-64 and 66 above, and further in view of Bour et al. (US pat 8470619) (reference previously cited).

With respect to claims 40 and 50, Haddad et al. fail to teach the trapping or reflecting layer and textured or reflecting layer comprise of a metal layer.

Bour et al. teach using a textured or reflecting layer of metal or Al to enhance or control reflection of incident light. See col. 3, lines 40-50.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the teaching of Bour et al. into the device of Haddad et al. to achieve light efficiency. See col. 3, lines 40-50.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

Claim(s) 52-55, 57-61 is/are rejected under pre-AIA 35 U.S.C. 102(a) as being anticipated by Haddad et al. WO 2011035188 (a reference cited by the applicant).

With respect to claim 52, Haddad et al. teach a light trapping device, comprising (see figs. 1-17, particularly fig.1-6 and associated text):

at least one light sensitive pixel having a light incident surface (top), a backside surface (bottom) opposite the light incident surface, and a peripheral sidewall extending at least partially around the pixel periphery;

a **backside light trapping material** 20 at least partially covering the backside surface;

a **peripheral light trapping material** 30 substantially covering the peripheral sidewall; and

at least one doped region 14,16 disposed on at least one of the light incident surface and the backside surface; and

a **textured region** 60 positioned to interact with light incident thereon so as to increase quantum efficiency of the device.

With respect to claim 53, Haddad et al. teach said backside light trapping material substantially covers the backside surface.

With respect to claim 54, Haddad et al. teach said textured region is located on the light incident surface.

With respect to claim 55, Haddad et al. teach said textured region is a textured film layer coupled to the light incident surface.

With respect to claim 57, Haddad et al. teach said textured region reflects at least a portion of light internally incident thereon into the pixel.

With respect to claim 58, Haddad et al. teach the peripheral sidewall extends from the light incident surface to the backside surface.

With respect to claim 59, Haddad et al. teach the peripheral sidewall extends through the pixel substantially from the light incident surface to the backside surface.

With respect to claims 60 and 61, how the textured region is formed has not given patentable weight since claimed invention is directed to a device.

Claim 56 is rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Haddad et al. WO 2011035188 as applied to claims 52-55 and 57-61 above, and further in view of Bour et al. (US pat 8470619) (reference previously cited).

With respect to claim 56, Haddad et al. fail to teach the trapping or reflecting layer and textured or reflecting layer comprise of a metal layer.

Bour et al. teach using a textured or reflecting layer of metal or Al to enhance or control reflection of incident light. See col. 3, lines 40-50.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the teaching of Bour et al. into the device of Haddad et al. to achieve light efficiency. See col. 3, lines 40-50.

Response to Arguments

Applicant's arguments with respect to claims 34-61, 63-64, and 66 have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to LONG PHAM whose telephone number is (571)272-1714. The examiner can normally be reached on Mon-Frid, 10am to 5pm.

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, Wael Fahmy can be reached on 571-272-1705. 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 http://pair-direct.uspto.gov. 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.

Long Pham
Primary Examiner
Art Unit 2814

/LONG PHAM/
Primary Examiner, Art Unit 2814

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

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(Not for submission under 37 CFR 1.99)

Application Number	15216244
Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

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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	4886958		1989-12-12	Merryman	
	2	5351446		1994-10-04	Langsdorf	
	3	5641969		1997-06-24	Cooke et al.	
	4	5727096		1998-03-10	Ghirardi et al.	
	5	6327022		2001-12-04	Nishi	
	6	6331885		2001-12-18	Nishi	
	7	6340281		2002-01-22	Haraguchi	
	8	7800684		2010-09-21	Tatani	

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IPR2025-00845
Apple-Sony EX1002 Page 174

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

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First Named Inventor	Martin U. Pralle
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Examiner Name	Long Pham
Attorney Docket Number	143705.05221

	9	7897942		2011-03-01	Bereket	
	10	9184204		2015-11-10	Hu	
	11	9369641		2016-06-14	Hu	

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	2	20050088634		2005-04-28	Kosugi	
	3	20090093100		2005-05-06	Chen	
	4	20080173620		2008-07-24	Grek	
	5	20090027640		2009-01-29	Shibazaki	
	6	20090114630		2009-05-07	Hawryluk	

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IPR2025-00845
Apple-Sony EX1002 Page 175

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Examiner Name	Long Pham
Attorney Docket Number	143705.05221

	7	20090308457		2009-12-17	Smith et al.	
	8	20100140768		2010-06-10	Zafiropoulo	
	9	20130135439		2013-05-30	Kakuko et al.	

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	1	19838439	DE		2000-04-27	Fraunhofer-Ges Forschung		
	2	2509107	EP		2012-10-10	Boly Media Comm.		
	3	2010278472	JP		2010-12-09	Sony, Corp.		
	4	100825808	KR		2008-04-29	Samsung Electronics Co. Ltd.		
	5	20090077274	KR		2009-07-15	LG Electronics Inc.		
	6	2009147085	WO		2009-12-10	Thiel et al.		

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IPR2025-00845
Apple-Sony EX1002 Page 176

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15216244
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	First Named Inventor	Martin U. Pralle
	Art Unit	2814
	Examiner Name	Long Pham
	Attorney Docket Number	143705.05221

	7	2011003871	WO	2011-01-13	International Business Machines Corporation		
	8	2011035188	WO	2011-03-24	Sionyx, Inc.		
	9	2011119618	WO	2011-03-22	Sionyx, Inc.		
	10	2012174752	WO	2012-12-27	Boly Media Comm.		
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	1	Carey, P.G. et al., "In-situ Doping of Silicon Using Gas Immersion Laser Doping (GILD) Process," Appl. Surf. Sci. 43, 325-332 (1989).	
	2	Gibbons, J., "Ion Implantation in Semiconductors-Part II; Damage Production and Annealing", proceedings of the IEEE Vol. 60, No. 9 pp. 1062-1096. Jun. 1972.	
	3	Ziou et al., "Depth from defocus using the hermite transform", IMAGE PROCESSING, 1998. ICIP 98. Intl. Conference on Chicago, IL. October 1998 pp. 958 - 962.	

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IPR2025-00845
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Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

EXAMINER SIGNATURE

Examiner Signature	/LONG PHAM/	Date Considered	06/10/2017

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IPR2025-00845
Apple-Sony EX1002 Page 178

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Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

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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	/Reza Mollaaghababa/	Date (YYYY-MM-DD)	2017-05-12
Name/Print	Reza Mollaaghababa	Registration Number	43810

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IPR2025-00845
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IPR2025-00845
Apple-Sony EX1002 Page 180

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S2	84	US-3035052-$.DID. OR US-20030029495-$.DID. OR US-20040222187-$.DID. OR US-20050127401-$.DID. OR US-20050227390-$.DID. OR US-20060011955-$.DID. OR US-20060079062-$.DID. OR US-20060118781-$.DID. OR US-20060180885-$.DID. OR US-20060231914-$.DID. OR US-20070145505-$.DID. OR US-20080026550-$.DID. OR US-20080036022-$.DID. OR US-20080044943-$.DID. OR US-20080076240-$.DID. OR US-20080099804-$.DID. OR US-20080178932-$.DID. OR US-20080258604-$.DID. OR US-20090065051-$.DID. OR US-20090142879-$.DID. OR US-20090160983-$.DID. OR US-20090194671-$.DID. OR US-20090200586-$.DID. OR US-20090213883-$.DID. OR US-3487223-$.DID. OR US-4277793-$.DID. OR US-4419533-$.DID. OR US-4493942-$.DID. OR US-4514582-$.DID. OR US-4536608-$.DID. OR US-4663188-$.DID. OR US-4829013-$.DID. OR US-5080725-$.DID. OR US-5081049-$.DID. OR US-5100478-$.DID. OR US-5114876-$.DID. OR US-5164324-$.DID. OR US-5322988-$.DID. OR US-5346850-$.DID. OR US-5597621-$.DID. OR US-5714404-$.DID. OR US-5731213-$.DID. OR US-5792280-$.DID. OR US-6147297-$.DID. OR US-6498336-$.DID. OR US-6580053-$.DID. OR US-6583936-$.DID. OR US-6667528-$.DID. OR US-6759262-$.DID. OR US-6800541-$.DID. OR US-7057256-$.DID. OR US-7091411-$.DID. OR US-7109517-$.DID. OR US-7247527-$.DID. OR US-7314832-$.DID. OR US-7354792-$.DID. OR US-7390689-$.DID. OR US-7442629-$.DID. OR US-7456452-$.DID. OR US-7482532-$.DID. OR US-7498650-$.DID. OR US-7504325-$.DID. OR US-7504702-$.DID. OR US-7511750-$.DID. OR US-7745901-$.DID. OR US-7781856-$.DID. OR US-7816220-$.DID. OR US-7847253-$.DID. OR US-7884439-$.DID. OR US-7884446-$.DID. OR US-8030726-$.DID. OR US-8058615-$.DID. OR US-8207051-$.DID.	US-PGPUB; USPAT; USOCR; JPO; IBM_TDB	OR	ON	2014/06/25 14:14

		OR US-8476681-$.DID. OR US-3666484-$.DID. OR US-2030766-$.DID. OR JP-07173484-$.DID. OR JP-071734840721-$.DID. OR JP-2008187003-$.DID. OR JP-2011091128-$.DID. OR JP-2152226-$.DID. OR JP-63116421-$.DID. OR JP-9298308-$.DID. OR KR-20010061058-$.DID. OR KR-20100118864-$.DID. OR WO-2006086014-$.DID. OR WO-2009100023-$.DID. OR WO-2011035188-$.DID. OR WO-2011119618-$.DID.				
S3	7768	(light adj2 (trapping or trapped))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 14:16
S4	11	S2 and S3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 14:16
S5	2251	(reflector or Bragg) and S3	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:40
S6	14	(reflector or Bragg) and S2	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:41
S7	888	(reflector or Bragg) near3 backside	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:55
S8	51623	(reflector or Bragg) near3 (side or sidewall or edge or wall)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:55
S9	112640	pixel near5 (side or sidewall or edge or wall)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:56

S10	143	S7 same S8	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:56
S11	2	S9 same4 S10	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:56
S12	3	S9 and S10	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:57
S13	1	S12 not S11	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:57
S14	179	S7 same4 S8	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:58
S15	145	S14 and (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:59
S16	129	S14 same10 (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:59
S17	128	S14 same8 (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 15:59
S18	1204	(reflector or Bragg) near5 backside	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2014/06/25 16:09

			DERWENT; IBM_TDB			
S19	71202	(reflector or Bragg) near5 (side or sidewall or edge or wall)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:09
S20	280	S18 same4 S19	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:09
S21	195	S20 same4 (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:09
S22	7	S18 same2 S9	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:10
S23	7	S22 same4 (photodiode or pixel or light)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:10
S24	217	S18 same S19	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:13
S25	0	(light adj2 sensitive adj2 pixel) same4 S24	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:14
S26	0	(light adj2 sensitive adj2 pixel) and S24	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:14
S27	14	pixel same4 S24	US-PGPUB; USPAT; USOCR;	OR	ON	2014/06/25 16:14

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S28	7	S27 and index	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/25 16:18
S29	26925	(high adj2 index) near3 (layer or film)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:48
S30	27823	(low adj2 index) near3 (layer or film)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:48
S31	12802	S29 near10 S30	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:48
S32	1170	(reflector or Bragg) same S31	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:49
S33	611	(reflector or Bragg) near10 S31	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:49
S34	4200	S30 near5 ("between")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:49
S35	1972	S34 near10 S29	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:50
S36	81	(reflector or Bragg) near10 S35	US-PGPUB;	OR	ON	2014/06/26

			USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			12:50
S37	188	S29 near5 (polysilicon or polycrystalline or poly or (amorphous adj2 silicon) or germanium)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:53
S38	2500	S30 near5 (oxide or nitride or oxynitride or oxynitrides)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:53
S39	14	S37 near20 S38	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:53
S40	0	(reflector or Bragg) same S39	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:54
S41	0	S39 near20 ("between")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 12:54
S42	51	backsi denear6 (texturednear2 (layer or fi lm))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 13:12
S43	10	S42 AND ((H01L21/02686 OR H01L27/1214 OR H01L21/02532 OR H01L21/02595 OR H01L31/0236 OR H01L21/0237 OR H01L21/02403 OR H01L21/0243 OR H01L21/02472 OR H01L21/02483 OR H01L21/02494 OR H01L21/02554 OR H01L21/02565 OR H01L21/02573 OR H01L21/02587 OR H01L21/02609 OR H01L21/0262 OR H01L21/365 OR H01L2224/16 OR H01L27/14625 OR H01L27/14627 OR H01L27/14629 OR H01L27/1463 OR H01L27/14685 OR H01L31/02168 OR H01L31/022425 OR H01L31/02363 OR	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 13:25

		H01L31/042 OR H01L31/0527 OR H01L31/0682 OR H01L31/18 OR H01L31/1804 OR H01L33/0087 OR H01L33/22 OR H01L33/24 OR H01L33/28 OR H01L33/385 OR H01L33/405 OR H01L33/483 OR H01L33/60 OR H01L33/62).CPC.)				
S44	5	S39 AND ((H01L21/02686 OR H01L27/1214 OR H01L21/02532 OR H01L21/02595 OR H01L31/0236 OR H01L21/0237 OR H01L21/02403 OR H01L21/0243 OR H01L21/02472 OR H01L21/02483 OR H01L21/02494 OR H01L21/02554 OR H01L21/02565 OR H01L21/02573 OR H01L21/02587 OR H01L21/02609 OR H01L21/0262 OR H01L21/365 OR H01L2224/16 OR H01L27/14625 OR H01L27/14627 OR H01L27/14629 OR H01L27/1463 OR H01L27/14685 OR H01L31/02168 OR H01L31/022425 OR H01L31/02363 OR H01L31/042 OR H01L31/0527 OR H01L31/0682 OR H01L31/18 OR H01L31/1804 OR H01L33/0087 OR H01L33/22 OR H01L33/24 OR H01L33/28 OR H01L33/385 OR H01L33/405 OR H01L33/483 OR H01L33/60 OR H01L33/62).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 13:25
S45	2	S36 AND ((H01L21/02686 OR H01L27/1214 OR H01L21/02532 OR H01L21/02595 OR H01L31/0236 OR H01L21/0237 OR H01L21/02403 OR H01L21/0243 OR H01L21/02472 OR H01L21/02483 OR H01L21/02494 OR H01L21/02554 OR H01L21/02565 OR H01L21/02573 OR H01L21/02587 OR H01L21/02609 OR H01L21/0262 OR H01L21/365 OR H01L2224/16 OR H01L27/14625 OR H01L27/14627 OR H01L27/14629 OR H01L27/1463 OR H01L27/14685 OR H01L31/02168 OR H01L31/022425 OR H01L31/02363 OR H01L31/042 OR H01L31/0527 OR H01L31/0682 OR H01L31/18 OR H01L31/1804 OR H01L33/0087 OR H01L33/22 OR H01L33/24 OR H01L33/28 OR H01L33/385 OR H01L33/405 OR H01L33/483 OR H01L33/60 OR H01L33/62).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2014/06/26 13:25
S46	1	("20140138785").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2015/01/05 11:26
S47	3930	(257/432).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2015/01/05 11:54
S48	218	(257/228).CCLS.	US-PGPUB; USPAT; USOCR	OR	OFF	2015/01/05 11:54
S50	1	("9373732").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2016/07/13 15:10
S51	1	("9373732").PN.	US-PGPUB;	OR	OFF	2016/07/15

			USPAT; USOCR			10:13
S52	395	reflective near3 (aluminum adj oxide)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2016/07/15 13:07
S53	35214	(rough or textured) near2 (layer or film)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:24
S54	44833	light adj2 incident adj2 surface	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:24
S55	38	S53 same S54	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:25
S56	10	S55 same efficiency	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:25
S57	0	S55 same ((silicon adj oxide) or "SiO" or (silicon adj nitride) or "SiN")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:29
S58	0	S55 same ((silicon adj oxide) or "SiO" or (silicon adj nitride) or "SiN")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:30
S59	3	S55 same (metal or polysilicon or amorphous)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:30
S60	1864	S53 same efficiency	US-PGPUB; USPAT; USOCR;	OR	ON	2017/02/06 01:32

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S61	42	S60 same ((silicon adj oxide) or "SiO" or (silicon adj nitride) or "SiN")	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:32
S62	351	S60 same ((silicon adj oxide) or "SiO" or (silicon adj nitride) or "SiN" or metal or polysilicon or amorphous)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:32
S63	85	S62 same4 incident	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 01:33
S64	228102	(reflective near2 (material or layer or film))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:11
S65	530599	("AlO" or (aluminum adj oxide)) or ("HfO" or (hafnium adj oxide))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:12
S66	403	S64 near3 S65	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:12
S67	2	S66 near4 (benefit or beneficial or advantages or advantageous or advantegeously)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:13
S68	2	S66 near10 (benefit or beneficial or advantages or advantageous or advantegeously)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:13
S69	31128	(anti or non) near2 S64	US-PGPUB;	OR	ON	2017/02/06

			USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			11:20
S70	121	S65 near4 S69	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:20
S71	2	S70 same (benefit or beneficial or advantages or advantageous or advantegeously)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 11:20
S72	2	(dope or doping or implanting or implant or implants implantation or dopes) near2 (light adj incident adj surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:04
S73	6	(dope or doping or implanting or implant or implants implantation or dopes) near2 (light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:05
S74	13	(dope or doping or implanting or implant or implants implantation or dopes) near4 (light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:05
S75	167141	(doped or implanted) adj2 (region or section or portion or part)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:13
S76	1	S75 near4 (light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:13
S77	26	S75 near10 (light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT;	OR	ON	2017/02/06 12:15

			IBM_TDB			
S78	25	S77 not S76	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 12:15
S79	1	("9064764").PN.	US-PGPUB; USPAT; USOCR	OR	OFF	2017/02/06 12:20
S80	44833	(light adj2 incident adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:49
S81	167141	(doped or implanted) adj2 (region or section or portion or part)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:49
S82	9	S80 near6 S81	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:49
S83	364064	(light adj2 surface)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:50
S84	54	S83 near4 S81	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:50
S85	53	S84 not S82	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2017/02/06 17:50
S86	21	("20030214595" | "20030228883" | "20050093100" | "20060086956" | "20060128087" | "20070189583" | "20070237504" | "20080158398" | "20080192133" | "20080284884" | "20100200658" | "20110194100" | "20110292380" | "20140198240" | "5101260" | "5600130" | "5626687" |	US-PGPUB; USPAT	OR	ON	2017/02/07 07:43

		"5635089" | "6082858" | "6204506" | "6907135").PN.				
S87	21	("20030214595" | "20030228883" | "20050093100" | "20060086956" | "20060128087" | "20070189583" | "20070237504" | "20080158398" | "20080192133" | "20080284884" | "20100200658" | "20110194100" | "20110292380" | "20140198240" | "5101260" | "5600130" | "5626687" | "5635089" | "6082858" | "6204506" | "6907135").PN.	US-PGPUB; USPAT	OR	ON	2017/02/07 07:44
S88	20	("20010044266" | "20050088634" | "20080173620" | "20090027640" | "20090093100" | "20090114630" | "20090308457" | "20100140768" | "20130135439" | "4886958" | "5351446" | "5641969" | "5727096" | "6327022" | "6331885" | "6340281" | "7800684" | "7897942" | "9184204" | "9369641").PN.	US-PGPUB; USPAT	OR	ON	2017/06/01 13:32

6/10/2017 5:12:02 PM
C:\Users\lpham\Documents\EAST\Workspaces\15-216,244.wsp

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15216244	PRALLE ET AL.
	Examiner	Art Unit
	LONG PHAM	2814

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

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

CLAIM		DATE								
Final	Original	09/07/2016	02/06/2017	06/10/2017						
	34	÷	✓	✓						
	35	÷	✓	✓						
	36	÷	✓	✓						
	37	÷	✓	✓						
	38	÷	✓	✓						
	39	÷	✓	✓						
	40	÷	✓	✓						
	41	÷	✓	✓						
	42	÷	✓	✓						
	43	÷	✓	✓						
	44	÷	✓	✓						
	45	÷	✓	✓						
	46	÷	✓	✓						
	47	÷	✓	✓						
	48	÷	✓	✓						
	49	÷	✓	✓						
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	58	÷	✓	✓						
	59	÷	✓	✓						
	60		✓	✓						
	61		✓	✓						
	62		O	-						
	63		✓	✓						
	64		✓	✓						
	65		O	-						
	66			✓						

IPR2025-00845
Apple-Sony EX1002 Page 193

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Martin U. Pralle Application No.: 15/216,244 Filed: July 21, 2016 For: PIXEL ISOLATION ELEMENTS, DEVICES, AND ASSOCIATED METHODS	Confirmation No.: 5052 Art Unit: 2814 Examiner: Pham, Long

Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

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I hereby certify that this correspondence is being electronically filed via EFS-Web to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

May 12, 2017 (Dated) Electronic Signature: /Reza Mollaaghababa/ (Reza Mollaaghababa, Reg. No. 43,810)

RESPONSE TO NON-FINAL OFFICE ACTION

Dear Sir:

This paper is filed in response to the non-final Office Action dated February 13, 2017.

Amendments to the Claims begin on page 2.

Remarks begin on page 6.

AMENDMENTS TO THE CLAIMS

1-33. (Canceled)

34. (Currently Amended) A light trapping device, comprising:

at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall extending at least partially around the pixel periphery;

a backside light trapping material substantially covering the backside surface; ~~and~~

a peripheral light trapping material substantially covering the peripheral sidewall[[,]]; and

at least one doped region disposed on at least one of the light incident surface and the backside surface,

wherein the peripheral light trapping material creates a surface field at the peripheral sidewall.

35. (Previously Presented) The device of claim 34, wherein the backside light trapping material reflects the light incident thereon back into the pixel.

36. (Previously Presented) The device of claim 34, wherein the peripheral light trapping material reflects light incident thereon into the pixel.

37. (Previously Presented) The device of claim 34, wherein the peripheral sidewall extends completely around the pixel periphery.

38. (Previously Presented) The device of claim 34, wherein the peripheral sidewall extends from the light incident surface to the backside surface.

39. (Previously Presented) The device of claim 34, wherein the peripheral sidewall extends through the pixel substantially from the light incident surface to the backside surface.

40. (Previously Presented) The device of claim 34, wherein at least one of the backside light trapping material and the peripheral light trapping material comprises a metal layer.

IPR2025-00845
Apple-Sony EX1002 Page 195

41. (Previously Presented) The device of claim 34, wherein said peripheral light trapping material comprises an oxide.

42. (Previously Presented) The device of claim 34, wherein said peripheral light trapping material provides a passivating negative charge.

43. (Previously Presented) The device of claim 34, wherein said peripheral light trapping material exhibits a surface recombination velocity as low as 10 cm/s.

44. (Previously Presented) The device of claim 34, wherein the peripheral sidewall material has an index of refraction of less than about 2.1.

45. (Previously Presented) The device of claim 34, wherein the peripheral light trapping material comprises any of aluminum oxide and hafnium oxide.

46. (Previously Presented) The device of claim 34, wherein said pixel comprises a textured region.

47. (Previously Presented) The device of claim 46, wherein said textured region is coupled to the light incident surface.

48. (Previously Presented) The device of claim 47, wherein said textured region is located on said light incident surface.

49. (Previously Presented) The device of claim 47, wherein said textured region comprises a textured film layer.

50. (Previously Presented) The device of claim 49, wherein said textured film layer comprises any of silicon dioxide, silicon nitride, amorphous silicon, polysilicon, a metal and combinations thereof.

51. (Previously Presented) An array of light trapping pixel devices of claim 34.

IPR2025-00845
Apple-Sony EX1002 Page 196

52. (Currently Amended) A light trapping device, comprising:

at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall extending at least partially around the pixel periphery;

a backside light trapping material at least partially covering the backside surface;

a peripheral light trapping material substantially covering the peripheral sidewall; ~~and~~

at least one doped region disposed on at least one of the light incident surface and the backside surface; and

a textured region positioned to interact with light incident thereon so as to increase quantum efficiency of the device.

53. (Previously Presented) The device of claim 52, wherein said backside light trapping material substantially covers the backside surface.

54. (Previously Presented) The device of claim 52, wherein said textured region is located on the light incident surface.

55. (Previously Presented) The device of claim 52, wherein said textured region is a textured film layer coupled to the light incident surface.

56. (Previously Presented) The device of claim 55, wherein said textured film layer comprises any of silicon dioxide, silicon nitride, amorphous silicon, polysilicon, a metal and combinations thereof.

57. (Previously Presented) The device of claim 52, wherein said textured region reflects at least a portion of light internally incident thereon into the pixel.

58. (Previously Presented) The device of claim 52, wherein the peripheral sidewall extends from the light incident surface to the backside surface.

59. (Previously Presented) The device of claim 34, wherein the peripheral sidewall extends through the pixel substantially from the light incident surface to the backside surface.

IPR2025-00845
Apple-Sony EX1002 Page 197

60. (Previously Presented) The device of claim 52, wherein the textured region is formed by one of plasma etching, reactive ion etching, porous silicon etching, lasing, chemical etching, nanoimprinting, material deposition, selective epitaxial growth, and combinations thereof.

61. (Currently Amended) The device of claim 52, wherein the textured region is formed by ~~lasing~~ laser radiation.

62. (Canceled)

63. (Previously Presented) The device of claim 46, wherein the textured region is formed by one of plasma etching, reactive ion etching, porous silicon etching, lasing, chemical etching, nanoimprinting, material deposition, selective epitaxial growth, and combinations thereof.

64. (Currently Amended) The device of claim 46, wherein the textured region is formed by ~~lasing~~ laser radiation.

65. (Canceled)

66. (New) The device of claim 46, wherein said textured region is coupled to said backside surface.

IPR2025-00845
Apple-Sony EX1002 Page 198

REMARKS

Allowable Claims

The Office Action indicates that claims 62 and 65 are allowable if rewritten in independent form to include all of the limitations of the base claims on which they depend.

Claim 62 depends on independent claim 52 and claim 65 depends on independent claim 34. Applicants amend independent claims 34 and 52 to incorporate the limitations of allowable claims 65 and 62, respectively. Thus, amended claims 34 and 52 as well as the remainder of the pending claims, which depend on these claims, are believed to be in condition for allowance.

Rejections Pursuant to 35 U.S.C. §102

Claims 34-40 and 51 are rejected as being anticipated by Velichko.

In view of the above amendments, the rejection of these claims is moot and will not be discussed.

Rejections Pursuant to 35 U.S.C. §103

Claims 41, 43, and 44 are rejected as being unpatentable over Velichko in view of Yanagisawa.

In view of the above amendments, the rejection of these claims is moot and will not be discussed.

New Claim

New Independent claim 66 depends on claim 46, which in turn depends on claim 34, and further recites that said textured region is coupled to said backside surface. Support for the new claim 66 can be found in paragraph [0039] of the published U.S. patent application.

New claim 66 is patentable at least because of its dependence on allowable claim 34.

CONCLUSION

In view of the above amendments and remarks, Applicants respectfully request reconsideration and allowance of the application. Applicants invite the Examiner to call the undersigned if there are any outstanding issues.

IPR2025-00845
Apple-Sony EX1002 Page 199

Dated: May 12, 2017

Electronic Signature: /Reza Mollaaghababa/
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IPR2025-00845
Apple-Sony EX1002 Page 200

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Martin U. Pralle	Confirmation No.: 5052
Application No.: 15/216,244	Art Unit: 2814
Filed: July 21, 2016	Examiner: Pham, Long
For: PIXEL ISOLATION ELEMENTS, DEVICES, AND ASSOCIATED METHODS	

VIA EFS-WEB
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

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May 12, 2017 (Dated) — Electronic Signature: /Reza Mollaaghababa/ Reza Mollaaghababa, Reg. No. 43,810

INFORMATION DISCLOSURE STATEMENT (IDS) TRANSMITTAL LETTER

Pursuant to 37 CFR 1.56, 1.97 and 1.98, the attention of the Patent and Trademark Office is hereby directed to the references listed on the attached PTO/SB/08. It is respectfully requested that the information be expressly considered during the prosecution of this application, and that the references be made of record therein and appear among the "References Cited" on any patent to issue therefrom.

This Information Disclosure Statement is filed more than three months after the U.S. filing date, OR more than three months after the date of entry of the national stage of a PCT application, AND after the mailing date of the first Office Action on the merits, but before the mailing date of a Final Office Action or Notice of Allowance (37 CFR 1.97(c)). This IDS is accompanied with the fee set forth in 37 C.F.R. 1.17(p).

In accordance with 37 CFR 1.98(a)(2)(ii), Applicant has not submitted copies of U.S. patents and U.S. patent applications.

In accordance with 37 CFR 1.97(g), the filing of this Information Disclosure Statement shall not be construed to mean that a search has been made or that no other material information

as defined in 37 CFR 1.56(a) exists. In accordance with 37 CFR 1.97(h), the filing of this Information Disclosure Statement shall not be construed to be an admission that the information cited in the statement is, or is considered to be, material to patentability as defined in § 1.56 (b).

It is submitted that the Information Disclosure Statement is in compliance with 37 CFR 1.98 and the Examiner is respectfully requested to consider the listed references.

The Director is hereby authorized to charge any deficiency in the fees filed, asserted to be filed or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit Account No. 50-0436, under Order No. 143705.05221.

Respectfully submitted,

Dated: May 12, 2017

Electronic Signature: /Reza Mollaaghababa/

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IPR2025-00845
Apple-Sony EX1002 Page 202

PTO/SB/08a (03-15)
Approved for use through 07/31/2016. 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	15216244
Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

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	4886958		1989-12-12	Merryman	
	2	5351446		1994-10-04	Langsdorf	
	3	5641969		1997-06-24	Cooke et al.	
	4	5727096		1998-03-10	Ghirardi et al.	
	5	6327022		2001-12-04	Nishi	
	6	6331885		2001-12-18	Nishi	
	7	6340281		2002-01-22	Haraguchi	
	8	7800684		2010-09-21	Tatani	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15216244
	Filing Date	2016-07-21
	First Named Inventor	Martin U. Pralle
	Art Unit	2814
	Examiner Name	Long Pham
	Attorney Docket Number	143705.05221

	9	7897942		2011-03-01	Bereket	
	10	9184204		2015-11-10	Hu	
	11	9369641		2016-06-14	Hu	

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U.S.PATENT APPLICATION PUBLICATIONS Remove

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	20010044266		2001-11-22	Katsuoka	
	2	20050088634		2005-04-28	Kosugi	
	3	20090093100		2005-05-06	Chen	
	4	20080173620		2008-07-24	Grek	
	5	20090027640		2009-01-29	Shibazaki	
	6	20090114630		2009-05-07	Hawryluk	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15216244
	Filing Date	2016-07-21
	First Named Inventor	Martin U. Pralle
	Art Unit	2814
	Examiner Name	Long Pham
	Attorney Docket Number	143705.05221

	7	20090308457		2009-12-17	Smith et al.	
	8	20100140768		2010-06-10	Zafiropoulo	
	9	20130135439		2013-05-30	Kakuko et al.	

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FOREIGN PATENT DOCUMENTS Remove

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]
	1	19838439	DE		2000-04-27	Fraunhofer-Ges Forschung		
	2	2509107	EP		2012-10-10	Boly Media Comm.		
	3	2010278472	JP		2010-12-09	Sony, Corp.		
	4	100825808	KR		2008-04-29	Samsung Electronics Co. Ltd.		
	5	20090077274	KR		2009-07-15	LG Electronics Inc.		
	6	2009147085	WO		2009-12-10	Thiel et al.		

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15216244
	Filing Date	2016-07-21
	First Named Inventor	Martin U. Pralle
	Art Unit	2814
	Examiner Name	Long Pham
	Attorney Docket Number	143705.05221

	7	2011003871	WO		2011-01-13	International Business Machines Corporation		
	8	2011035188	WO		2011-03-24	Sionyx, Inc.		
	9	2011119618	WO		2011-03-22	Sionyx, Inc.		
	10	2012174752	WO		2012-12-27	Boly Media Comm.		
	11	2014110484	WO		2014-07-17	Digimarc Corp.		

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NON-PATENT LITERATURE DOCUMENTS Remove

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	Carey, P.G. et al., "In-situ Doping of Silicon Using Gas Immersion Laser Doping (GILD) Process," Appl. Surf. Sci. 43, 325-332 (1989).	
	2	Gibbons, J., "Ion Implantation in Semiconductors-Part II; Damage Production and Annealing", proceedings of the IEEE Vol. 60, No. 9 pp. 1062-1096. Jun. 1972.	
	3	Ziou et al., "Depth from defocus using the hermite transform", IMAGE PROCESSING, 1998. ICIP 98. Intl. Conference on Chicago, IL. October 1998 pp. 958 - 962.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15216244
	Filing Date	2016-07-21
	First Named Inventor	Martin U. Pralle
	Art Unit	2814
	Examiner Name	Long Pham
	Attorney Docket Number	143705.05221

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	15216244
	Filing Date	2016-07-21
	First Named Inventor	Martin U. Pralle
	Art Unit	2814
	Examiner Name	Long Pham
	Attorney Docket Number	143705.05221

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	/Reza Mollaaghababa/	Date (YYYY-MM-DD)	2017-05-12
Name/Print	Reza Mollaaghababa	Registration Number	43810

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.

Electronic Patent Application Fee Transmittal

Application Number:	15216244
Filing Date:	21-Jul-2016
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Filer:	Reza Mollaaghababa/Jillian Stockel
Attorney Docket Number:	143705.05221

Filed as Large 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:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Miscellaneous:				
Submission- Information Disclosure Stmt	1806	1	180	180
		Total in USD ($)		**180**

Electronic Acknowledgement Receipt

EFS ID:	29194732
Application Number:	15216244
International Application Number:	
Confirmation Number:	5052
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Customer Number:	136549
Filer:	Reza Mollaaghababa/Jillian Stockel
Filer Authorized By:	Reza Mollaaghababa
Attorney Docket Number:	143705.05221
Receipt Date:	12-MAY-2017
Filing Date:	21-JUL-2016
Time Stamp:	14:03:25
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$180
RAM confirmation Number	051517INTEFSW14081200
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		5221_Response.pdf	130283 97a53444dda7018754753e6fcbdbfb42b514eb88	yes	7
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Amendment/Req. Reconsideration-After Non-Final Reject		1	1	
	Claims		2	5	
	Applicant Arguments/Remarks Made in an Amendment		6	7	
Warnings:					
Information:					
2	Transmittal Letter	5221_IDSTransmittal.pdf	93416 0d341bca69335fd4745269465a913a1194b1f69d	no	2
Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Form (SB08)	5221_SB08.pdf	1036648 15f28d1caf3f4de9ed59b96456bbcd05fed81a06	no	7
Warnings:					
Information:					
4	Foreign Reference	DE19838439.pdf	1680083 1bbd6553cd61e869de070de2645cd4308d79229f	no	9
Warnings:					
Information:					
5	Foreign Reference	EP2509107A1.pdf	1361527 7ce82ba536ff3d53d0413875489e5475a614a1d7	no	39

Warnings:					
Information:					
6	Foreign Reference	JP2010278472.pdf	412252 b8d1fc94e5f63cc03f3e7a3c274d82c0b5cb6e4c	no	14
Warnings:					
Information:					
7	Foreign Reference	KR100825808B1.pdf	646102 06d2e3325f454fa224d492eebbe50e6c5da62c9e	no	13
Warnings:					
Information:					
8	Foreign Reference	KR2009077274.pdf	1463669 60ca30c6321a2ce0f15a3d172394ee35f9732bd5	no	20
Warnings:					
Information:					
9	Foreign Reference	WO2009147085.pdf	914681 92df957ec313f823b1604eac4f222d69568e3a0d	no	19
Warnings:					
Information:					
10	Foreign Reference	WO2011003871.pdf	1095011 e6a1904f2a4623e78352c87e598aed2d50cb1df7	no	76
Warnings:					
Information:					
11	Foreign Reference	WO2011035188.pdf	822105 5a30ad842648e5bc3c9e9c6261ff272dce79856a	no	45
Warnings:					
Information:					
12	Foreign Reference	WO2011119618.pdf	2079786 263ea5074666524e598adfd3d2dbac345798edf4	no	43
Warnings:					
Information:					

13	Foreign Reference	WO2012174752A1.pdf	2917593 b5a400d6ee9594d956b1729384d5bc03eddf04cb	no	65
Warnings:					
Information:					
14	Foreign Reference	WO2014110484A2.pdf	1923614 12d98c93286052c4468e9da9b313f3132e547967	no	43
Warnings:					
Information:					
15	Non Patent Literature	CareyPG_1989.pdf	1535156 47a5cb16160430c66c5062052f010c4741441583	no	8
Warnings:					
Information:					
16	Non Patent Literature	Gibbons_1972.pdf	14804775 5e1c22a1c76a9da7b1e0ba78313bc891d2854de6	no	45
Warnings:					
Information:					
17	Non Patent Literature	Ziou_1998.pdf	489927 acd9f526b1469df3b2003edab8cd4aa450a9de36	no	5
Warnings:					
Information:					
18	Fee Worksheet (SB06)	fee-info.pdf	30348 ff32a841cccc2805afab34a3a5ddfbf333dfe892	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	33436976		

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
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/216,244	Filing Date 07/21/2016	☐ 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 $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	x $ =	
☐ 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

AMENDMENT	05/12/2017	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 31	Minus	** 32	= 0	x $80 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	x $420 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	0

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x $ =	
	☐ 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.

** 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 number found in the appropriate box in column 1.

LIE
GAIL WOOTEN

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.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/216,244	07/21/2016	Martin U. Pralle	143705.05221	5052

136549 7590 02/13/2017

Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736

EXAMINER
PHAM, LONG

ART UNIT	PAPER NUMBER
2814	

NOTIFICATION DATE	DELIVERY MODE
02/13/2017	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):

docketingbn@pepperlaw.com
davisdr@pepperlaw.com

Office Action Summary	Application No. 15/216,244	Applicant(s) PRALLE ET AL.	
	Examiner LONG PHAM	Art Unit 2814	AIA (First Inventor to File) Status No

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11/11/16*.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ 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.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *34-65* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *34-61,63 and 64* is/are rejected.

8)☒ Claim(s) *62 and 65* is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

* If any claims have been determined allowable, 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.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ 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)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☒ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date *1/11/16, 7/22/16.*

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

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

DETAILED ACTION

Election/Restrictions

Applicant's election without traverse of claims 34-59 and 60-65 in the reply filed on 11/11/16 is acknowledged.

Claim Rejections - 35 USC § 102

The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claim(s) 34-40 and 51 is/are rejected under pre-AIA 35 U.S.C. 102(e) as being anticipated by Velichko (US pub 20130200251).

With respect to claim 34, Velichko teaches a light trapping device, comprising (see figs. 1-23 and associated text):

at least one light sensitive pixel 34 having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall extending at least partially around the pixel periphery;

a backside light trapping material 42 substantially covering the backside surface; and

a peripheral light trapping material 36 substantially covering the peripheral sidewall,

wherein the peripheral light trapping material inherently creates a surface field at the peripheral sidewall.

With respect to claim 35, Velichko teaches the backside light trapping material reflects the light incident thereon back into the pixel.

With respect to claim 36, Velichko teaches the peripheral light trapping material reflects light incident thereon into the pixel.

With respect to claim 37, Velichko teaches the peripheral sidewall extends completely around the pixel periphery.

With respect to claim 38, Velichko teaches the peripheral sidewall extends from the light incident surface to the backside surface.

With respect to claim 39, Velichko teaches the peripheral sidewall extends through the pixel substantially from the light incident surface to the backside surface.

With respect to claim 40, Velichko teaches at least one of the backside light trapping material and the peripheral light trapping material comprises a metal layer.

With respect to claim 51, Velichko teaches an array of light trapping pixel devices.

Claim Rejections - 35 USC § 103

The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 41, 43, and 44 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Velichko (US pub 20130200251) as applied to claims 34-40 and 51 above, and further in view of Yanagisawa (JP 403183037) (a reference cited by the applicant).

With respect to claims 41, 43, and 44, Velichko teaches the peripheral light trapping material but fails to teach the peripheral light trapping material is made of silicon oxide or having a refractive index of less than about 2.1 or having a surface recombination velocity as low as 10 cm/s.

Yanagisawa teaches using a material of silicon oxide or having a refractive index of less than about 2.1 or having a surface recombination velocity as low as 10 cm/s to control reflectivity. See English abstract.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the teaching of Yanagisawa into the device of Velichko to achieve the above benefit.

Claims 46-50 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Velichko (US pub 20130200251) as applied to claims 34-40 and 51 above, and further in view of Bour et al. (US pat 8470619).

With respect to claims 46-50, Velichko fails to a textured film layer is located on the incident light surface.

Bour et al. teach using a textured layer of metal or Al to enhance or control reflection of incident light. See col. 3, lines 40-50.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the teaching of Bour et al. into the device of Velichko to achieve light efficiency. See col. 3, lines 40-50.

Claims 42 and 45 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Velichko (US pub 20130200251) as applied to claims 34-40 and 51 above, and further in view of Gray et al. (US pat 8906670).

With respect to claims 42 and 45, Velichko teaches the peripheral light trapping material but fails to teach the peripheral light trapping material is made of aluminum oxide or having passivating negative charge.

Gray et al. teach using a material of aluminum oxide or having passivating negative charge to control reflectivity. See col. 2, lines 1-15.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the teaching of Gray et al. into the device of Velichko to achieve the above benefit. See col. 2, lines 1-15.

Claims 52, 54, 55, 56, and 57, 53, 58, 59, 60-61, and 63-64 is/are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Velichko (US pub 20130200251) in combination with Bour et al. (US pat 8470619).

With respect to claims 52, 54, 55, 56, and 57, Velichko teaches a light trapping device, comprising (see figs. 1-23 and associated text):

at least one light sensitive pixel 34 having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall extending at least partially around the pixel periphery;

a backside light trapping material 42 at least partially covering the backside surface; and

a peripheral light trapping material 36 substantially covering the peripheral sidewall.

With respect to claims 52, 54, 55, 56, and 57, Velichko fails to teach a textured film layer is located on the incident light surface to increase quantum efficiency of the device.

Bour et al. teach using a textured layer of metal or Al to enhance or control reflection of incident light. See col. 3, lines 40-50.

It would have been obvious to one of ordinary skill in the art of making semiconductor devices to incorporate the teaching of Bour et al. into the device of Velichko to achieve light efficiency. See col. 3, lines 40-50.

With respect to claim 53, Velichko teaches said backside light trapping material substantially covers the backside surface.

With respect to claim 58, Velichko teaches the peripheral sidewall extends from the light incident surface to the backside surface.

With respect to claim 59, Velichko teaches the peripheral sidewall extends through the pixel substantially from the light incident surface to the backside surface.

With respect to claims 60, 61, 63, and 64, how the textured region is formed has not been given patentable weight because the claimed invention is directed to a device.

Allowable Subject Matter

Claims 62 and 65 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to LONG PHAM whose telephone number is (571)272-1714. The examiner can normally be reached on Mon-Frid, 10am to 5pm.

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, Wael Fahmy can be reached on 571-272-1705. 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 http://pair-direct.uspto.gov. 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.

Long Pham
Primary Examiner
Art Unit 2814

/LONG PHAM/
Primary Examiner, Art Unit 2814

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	Examiner LONG PHAM	Art Unit 2814	Page 1 of 1

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Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application No.:	15/216,244
	Filing Date:	July 21, 2016
	First Named Inventor:	Martin U. Pralle
	Group Art Unit:	TBA
(use as many sheets as necessary)	Examiner Name:	TBA
Sheet | 1 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 229

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IPR2025-00845
Apple-Sony EX1002 Page 230

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IPR2025-00845
Apple-Sony EX1002 Page 231

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IPR2025-00845
Apple-Sony EX1002 Page 232

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(use as many sheets as necessary)	Examiner Name:	TBA
Sheet | 5 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 233

Substitute for Form 1449/PTO	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application No.:	15/216,244
	Filing Date:	July 21, 2016
	First Named Inventor:	Martin U. Pralle
	Group Art Unit:	TBA
(use as many sheets as necessary)	Examiner Name:	TBA
Sheet | 6 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 234

Substitute for Form 1449/PTO	Complete if Known	
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	Filing Date:	July 21, 2016
	First Named Inventor:	Martin U. Pralle
	Group Art Unit:	TBA
(use as many sheets as necessary)	Examiner Name:	TBA
Sheet | 7 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 235

Substitute for Form 1449/PTO	Complete if Known	
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	Filing Date:	July 21, 2016
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	Group Art Unit:	TBA
(use as many sheets as necessary)	Examiner Name:	TBA
Sheet | 8 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 236

Substitute for Form 1449/PTO	Complete if Known	
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	Filing Date:	July 21, 2016
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	Group Art Unit:	TBA
(use as many sheets as necessary)	Examiner Name:	TBA
Sheet | 9 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 237

Substitute for Form 1449/PTO	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application No.:	15/216,244
	Filing Date:	July 21, 2016
	First Named Inventor:	Martin U. Pralle
	Group Art Unit:	TBA
(use as many sheets as necessary)	Examiner Name:	TBA
Sheet | 10 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 238

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Sheet | 11 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 239

Substitute for Form 1449/PTO	Complete if Known	
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	Filing Date:	July 21, 2016
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Sheet | 12 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 240

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Sheet | 13 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 241

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Sheet | 14 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 242

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IPR2025-00845
Apple-Sony EX1002 Page 243

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IPR2025-00845
Apple-Sony EX1002 Page 244

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IPR2025-00845
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Examiner Signature	/LONG PHAM/	Date Considered	02/07/2017

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IPR2025-00845
Apple-Sony EX1002 Page 246

Substitute for Form 1449/PTO	Complete if Known	
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Application No.:	15/216,244
	Filing Date:	July 21, 2016
	First Named Inventor:	Martin U. Pralle
	Group Art Unit:	TBA
(use as many sheets as necessary)	Examiner Name:	TBA
Sheet | 19 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 247

Substitute for Form 1449/PTO				Complete if Known	
				Application No.:	15/216,244
INFORMATION DISCLOSURE STATEMENT BY APPLICANT				Filing Date:	July 21, 2016
				First Named Inventor:	Martin U. Pralle
				Group Art Unit:	TBA
(use as many sheets as necessary)				Examiner Name:	TBA
Sheet	20	of	20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 248

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15216244	PRALLE ET AL.
	Examiner	Art Unit
	LONG PHAM	2814

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

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

CLAIM		DATE								
Final	Original	09/07/2016	02/06/2017							
	34	÷	✓							
	35	÷	✓							
	36	÷	✓							
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Doc code: IDS
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PTO/SB/08a (03-15)
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Application Number	15216244
Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

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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	5101260		1992-03-31	Nath	
	2	5600130		1997-02-04	VanZeghbroeck	
	3	5626687		1997-05-06	Campbell	
	4	5635089		1997-06-03	Singh et al.	
	5	6082858		2000-07-04	Grace et al.	
	6	6204506		2001-03-20	Akahori et al.	
	7	6907135		2005-06-14	Gifford	

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Application Number	15216244
Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

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	20030214595		2003-11-20	Mabuchi	
	2	20030228883		2003-12-11	Kusakari et al.	
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Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

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	1	JPH06244444	JP		1994-09-02	Hatachi Ltd.		
	2	WO200031679	WO		2000-06-02	Iriscan Inc.		
	3	JP2003242125	JP		2003-08-29	Cannon KK		
	4	JP2006255430	JP		2006-09-28	Fujitsu Ltd.		
	5	EP1818855	EP		2007-08-15	Smart Wireless Corp.		

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IPR2025-00845
Apple-Sony EX1002 Page 252

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	15216244
Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

NON-PATENT LITERATURE DOCUMENTS Remove

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.	T[5]
	1	Bernhard, C.G., "Structural and Functional Adaptation in a Visual System" Endevor Vol. 26, May 1967. pp. 79-84.	
	2	Clapham, P.B. et al, "Reduction of Lens Reflexion by the Moth Eye Principle" Nature, Vol 244. Aug. 1973, pp. 281-282.	
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EXAMINER SIGNATURE

Examiner Signature	/LONG PHAM/	Date Considered	02/07/2017

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[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.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	15216244
Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

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	/Andrew W. Schultz/	Date (YYYY-MM-DD)	2016-11-11
Name/Print	Andrew W. Schultz	Registration Number	66869

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IPR2025-00845
Apple-Sony EX1002 Page 254

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IPR2025-00845
Apple-Sony EX1002 Page 255

Docket No.: 143705.05221

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: Martin U. Pralle Application No.: 15/216,244 Filed: July 21, 2016 For: PIXEL ISOLATION ELEMENTS, DEVICES, AND ASSOCIATED METHODS	Confirmation No.: 5052 Art Unit: 2814 Examiner: Pham, Long

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November 11, 2016 — Dated

Electronic Signature: /Andrew W. Schultz/
Andrew Schultz, Reg. No. 66,869

RESPONSE TO RESTRICTION REQUIREMENT

Dear Sir:

This paper is filed in response to the Restriction Requirement dated September 13, 2016.

Amendments to the Claims begin on page 2.

Remarks begin on page 6.

AMENDMENTS TO THE CLAIMS

1-33. (Canceled)

34. (Previously Presented) A light trapping device, comprising:

at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall extending at least partially around the pixel periphery;

a backside light trapping material substantially covering the backside surface; and

a peripheral light trapping material substantially covering the peripheral sidewall,

wherein the peripheral light trapping material creates a surface field at the peripheral sidewall.

35. (Previously Presented) The device of claim 34, wherein the backside light trapping material reflects the light incident thereon back into the pixel.

36. (Previously Presented) The device of claim 34, wherein the peripheral light trapping material reflects light incident thereon into the pixel.

37. (Previously Presented) The device of claim 34, wherein the peripheral sidewall extends completely around the pixel periphery.

38. (Previously Presented) The device of claim 34, wherein the peripheral sidewall extends from the light incident surface to the backside surface.

39. (Previously Presented) The device of claim 34, wherein the peripheral sidewall extends through the pixel substantially from the light incident surface to the backside surface.

40. (Previously Presented) The device of claim 34, wherein at least one of the backside light trapping material and the peripheral light trapping material comprises a metal layer.

IPR2025-00845
Apple-Sony EX1002 Page 257

41. (Previously Presented) The device of claim 34, wherein said peripheral light trapping material comprises an oxide.

42. (Previously Presented) The device of claim 34, wherein said peripheral light trapping material provides a passivating negative charge.

43. (Previously Presented) The device of claim 34, wherein said peripheral light trapping material exhibits a surface recombination velocity as low as 10 cm/s.

44. (Previously Presented) The device of claim 34, wherein the peripheral sidewall material has an index of refraction of less than about 2.1.

45. (Previously Presented) The device of claim 34, wherein the peripheral light trapping material comprises any of aluminum oxide and hafnium oxide.

46. (Previously Presented) The device of claim 34, wherein said pixel comprises a textured region.

47. (Previously Presented) The device of claim 46, wherein said textured region is coupled to the light incident surface.

48. (Previously Presented) The device of claim 47, wherein said textured region is located on said light incident surface.

49. (Previously Presented) The device of claim 47, wherein said textured region comprises a textured film layer.

50. (Previously Presented) The device of claim 49, wherein said textured film layer comprises any of silicon dioxide, silicon nitride, amorphous silicon, polysilicon, a metal and combinations thereof.

51. (Previously Presented) An array of light trapping pixel devices of claim 34.

IPR2025-00845
Apple-Sony EX1002 Page 258

52. (Previously Presented) A light trapping device, comprising:

at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall extending at least partially around the pixel periphery;

a backside light trapping material at least partially covering the backside surface;

a peripheral light trapping material substantially covering the peripheral sidewall; and

a textured region positioned to interact with light incident thereon so as to increase quantum efficiency of the device.

53. (Previously Presented) The device of claim 52, wherein said backside light trapping material substantially covers the backside surface.

54. (Previously Presented) The device of claim 52, wherein said textured region is located on the light incident surface.

55. (Previously Presented) The device of claim 52, wherein said textured region is a textured film layer coupled to the light incident surface.

56. (Previously Presented) The device of claim 55, wherein said textured film layer comprises any of silicon dioxide, silicon nitride, amorphous silicon, polysilicon, a metal and combinations thereof.

57. (Previously Presented) The device of claim 52, wherein said textured region reflects at least a portion of light internally incident thereon into the pixel.

58. (Previously Presented) The device of claim 52, wherein the peripheral sidewall extends from the light incident surface to the backside surface.

59. (Previously Presented) The device of claim 34, wherein the peripheral sidewall extends through the pixel substantially from the light incident surface to the backside surface.

IPR2025-00845
Apple-Sony EX1002 Page 259

60. (New) The device of claim 52, wherein the textured region is formed by one of plasma etching, reactive ion etching, porous silicon etching, lasing, chemical etching, nanoimprinting, material deposition, selective epitaxial growth, and combinations thereof.

61. (New) The device of claim 52, wherein the textured region is formed by lasing.

62. (New) The device of claim 52, further comprising at least one doped region disposed on at least one of the light incident surface and the backside surface.

63. (New) The device of claim 46, wherein the textured region is formed by one of plasma etching, reactive ion etching, porous silicon etching, lasing, chemical etching, nanoimprinting, material deposition, selective epitaxial growth, and combinations thereof.

64. (New) The device of claim 46, wherein the textured region is formed by lasing.

65. (New) The device of claim 34, further comprising at least one doped region disposed on at least one of the light incident surface and the backside surface.

IPR2025-00845
Apple-Sony EX1002 Page 260

REMARKS

The outstanding Action subjects pending claims 34-59 to a Restriction Requirement. Specifically, the outstanding Action requires election of one of the following species: Species 1 (Figure 1); Species 2 (Figure 2); Species 3 (Figure 3); Species 4 (Figure 4); Species 5 (Figure 5); Species 6 (Figure 6); and Species 7 (Figure 7).

Applicant elects, with traverse, Species 4 for continued prosecution. Claims 34-59 are believed to read on the elected species and are thus subject to examination. Applicant's election should not be construed as Applicant's acceptance of the species grouping as alleged in the Restriction Requirement. To the extent that Species 1-7 include characteristics that are not mutually exclusive, Applicant believes that the requirement for the election of species is improper. Further, reconsideration and withdrawal of the requirement for a species election is requested insofar as the limited number of indicated species demonstrate that it would not be unduly burdensome for the Office to conduct a search covering the claims directed to all of the identified species.

New Claims

As shown above, Applicant submits herewith new claims 60-65. Support for these claims can be found throughout the published application, for example, at paragraphs [0011], [0039], and [0068]. Applicant believes that new claims 60-65 read on the elected species and are thus subject to examination.

IPR2025-00845
Apple-Sony EX1002 Page 261

Conclusion

The Director is authorized to charge any deficiency in the fees filed, asserted to be filed or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit Account No. 500436, under Docket No. 143705.05221.

Respectfully submitted,

Dated: November 11, 2016

Electronic Signature: /Andrew W. Schultz/

Andrew W. Schultz, Reg. No. 66,869
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125 High Street
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IPR2025-00845
Apple-Sony EX1002 Page 262

Electronic Patent Application Fee Transmittal

Application Number:	15216244
Filing Date:	21-Jul-2016
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Filer:	Andrew W. Schultz
Attorney Docket Number:	143705.05221

Filed as Large 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	1202	6	80	480
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**480**

Electronic Acknowledgement Receipt

EFS ID:	27473729
Application Number:	15216244
International Application Number:	
Confirmation Number:	5052
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Customer Number:	136549
Filer:	Andrew W. Schultz
Filer Authorized By:	
Attorney Docket Number:	143705.05221
Receipt Date:	11-NOV-2016
Filing Date:	21-JUL-2016
Time Stamp:	11:45:52
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$480
RAM confirmation Number	111416INTEFSW11465900
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	Foreign Reference	WO0031679A1.pdf	1809838 91b7b7738e44c2d154638f529ed64adef47c8dea	no	43
Warnings:					
Information:					
2	Foreign Reference	JP2003242125.pdf	12132549 484fee5dcca5e19f65e696ccdbf2dbd26f0b3dd3	no	25
Warnings:					
Information:					
3	Non Patent Literature	Bernhard_1967.pdf	1944267 624a981547fed2da979d572a4a6af24a8f610a74	no	7
Warnings:					
Information:					
4	Non Patent Literature	Clapham_1973.pdf	781985 7c0d66281e366313bd3b18368a6c9720e929a5e4	no	2
Warnings:					
Information:					
5	Non Patent Literature	Huang_2013.pdf	1050684 0036c290c8cf0e7ed24b136d7dd7c871f59d0a33	no	5
Warnings:					
Information:					
6	Non Patent Literature	Koh_2000.pdf	554663 a71c512b3b509d821356eb91d7cebdb2e7c1eec1	no	5
Warnings:					
Information:					

7	Non Patent Literature	Jansen_1995.pdf	769230 8bb71dd982d4be9f37371d8cc8e499de9091b007	no	6
Warnings:					
Information:					
8	Non Patent Literature	Zhong_2016.pdf	836181 7d538cd6d16fbdaac27992141c46adfe61f85f69	no	11
Warnings:					
Information:					
9	Foreign Reference	JPH062444444.pdf	942522 ffbfc75eb3fcfa536afcd9024b4fcf2b3d744385	no	16
Warnings:					
Information:					
10	Transmittal Letter	IDSTransmittal.pdf	93177 5374b293545cbf790c5732ec9b8d8ac261d1950b	no	2
Warnings:					
Information:					
11	Information Disclosure Statement (IDS) Form (SB08)	SB08.pdf	1036865 7bb6a35b0ee8e5cdcef1236d23bb40ec3cdfcf71	no	6
Warnings:					
Information:					
12		15216244_ResponseRR.pdf	150591 e6ca04e1748fdd97ae4112e8ad008ec239ae538b	yes	7

Multipart Description/PDF files in .zip description

Document Description	Start	End
Response to Election / Restriction Filed	1	1
Claims	2	5
Applicant Arguments/Remarks Made in an Amendment	6	7

Warnings:

Information:					
13	Fee Worksheet (SB06)	fee-info.pdf	30584 423e8558a92d08788a7a8b965cafa25c442295f5	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	22133136	

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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.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of: Martin U. Pralle	Confirmation No.: 5052
Application No.: 15/216,244	Art Unit: 2814
Filed: July 21, 2016	Examiner: Pham, Long
For: PIXEL ISOLATION ELEMENTS, DEVICES, AND ASSOCIATED METHODS	

VIA EFS-WEB
Commissioner for Patents
P. O. Box 1450
Alexandria, VA 22313-1450

Certificate of Mailing
I hereby certify that this correspondence is being electronically filed via EFS-Web to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

November 11, 2016 (Dated)
Electronic Signature: /Andrew W. Schultz/
Andrew W. Schultz, Reg. No. 66,869

INFORMATION DISCLOSURE STATEMENT (IDS) TRANSMITTAL LETTER

Pursuant to 37 CFR 1.56, 1.97 and 1.98, the attention of the Patent and Trademark Office is hereby directed to the references listed on the attached substitute for PTO/SB/1449. It is respectfully requested that the information be expressly considered during the prosecution of this application, and that the references be made of record therein and appear among the "References Cited" on any patent to issue therefrom.

This Information Disclosure Statement is filed before the mailing date of a first Office Action on the merits as far as is known to the undersigned (37 CFR 1.97(b)(3)).

In accordance with 37 CFR 1.98(a)(2)(ii), Applicant has not submitted copies of U.S. patents and U.S. patent applications.

In accordance with 37 CFR 1.97(g), the filing of this Information Disclosure Statement shall not be construed to mean that a search has been made or that no other material information as defined in 37 CFR 1.56(a) exists. In accordance with 37 CFR 1.97(h), the filing of this Information Disclosure Statement shall not be construed to be an admission that the information cited in the statement is, or is considered to be, material to patentability as defined in § 1.56 (b).

It is submitted that the Information Disclosure Statement is in compliance with 37 CFR 1.98 and the Examiner is respectfully requested to consider the listed references.

The Director is hereby authorized to charge any deficiency in the fees filed, asserted to be filed or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit Account No. 50-0436, under Order No. 143705.05221.

Respectfully submitted,

Dated: November 11, 2016

Electronic Signature: /Andrew W. Schultz/

Andrew W. Schultz, Reg. No. 66,869
Attorney for Applicant
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125 High Street
19th Floor, High Street Tower
Boston, MA 02210
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IPR2025-00845
Apple-Sony EX1002 Page 270

PTO/SB/08a (03-15)
Approved for use through 07/31/2016. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	15216244
Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

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	5101260		1992-03-31	Nath	
	2	5600130		1997-02-04	VanZeghbroeck	
	3	5626687		1997-05-06	Campbell	
	4	5635089		1997-06-03	Singh et al.	
	5	6082858		2000-07-04	Grace et al.	
	6	6204506		2001-03-20	Akahori et al.	
	7	6907135		2005-06-14	Gifford	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15216244
	Filing Date	2016-07-21
	First Named Inventor	Martin U. Pralle
	Art Unit	2814
	Examiner Name	Long Pham
	Attorney Docket Number	143705.05221

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	20030214595		2003-11-20	Mabuchi	
	2	20030228883		2003-12-11	Kusakari et al.	
	3	20050093100		2005-05-05	Tze-Chiang et al.	
	4	20060086956		2006-04-27	Furukawa et al.	
	5	20060128087		2006-06-15	Bamji et al.	
	6	20070237504		2007-10-11	Nakashiba	
	7	20080158398		2008-07-03	Yoel et a.	
	8	20080192133		2008-08-14	Takahiro et al.	
	9	20080284884		2008-11-20	Eiji et al.	
	10	20100200658		2010-08-12	Olmstead et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	15216244
	Filing Date	2016-07-21
	First Named Inventor	Martin U. Pralle
	Art Unit	2814
	Examiner Name	Long Pham
	Attorney Docket Number	143705.05221

	11	20110194100		2011-08-11	Thiel et al.	
	12	20110292380		2011-12-01	Bamji	
	13	20140198240		2014-07-17	Rhoads	
	14	20070189583		2007-08-16	Shimada et al.	

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FOREIGN PATENT DOCUMENTS Remove

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]
	1	JPH06244444	JP		1994-09-02	Hatachi Ltd.		
	2	WO200031679	WO		2000-06-02	Iriscan Inc.		
	3	JP2003242125	JP		2003-08-29	Cannon KK		
	4	JP2006255430	JP		2006-09-28	Fujitsu Ltd.		
	5	EP1818855	EP		2007-08-15	Smart Wireless Corp.		

If you wish to add additional Foreign Patent Document citation information please click the Add button Add

INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	15216244
Filing Date	2016-07-21
First Named Inventor	Martin U. Pralle
Art Unit	2814
Examiner Name	Long Pham
Attorney Docket Number	143705.05221

NON-PATENT LITERATURE DOCUMENTS Remove

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.	T[5]
	1	Bernhard, C.G., "Structural and Functional Adaptation in a Visual System" Endevor Vol. 26, May 1967. pp. 79-84.	
	2	Clapham, P.B. et al, "Reduction of Lens Reflexion by the Moth Eye Principle" Nature, Vol 244. Aug. 1973, pp. 281-282.	
	3	Huang, et al.; "Key Technique for texturing a uniform pyramid structure with a layer of silicon nitride on monocrystalline silicon wafer" Applied Surface Science; 2013 pp. 245-249.	
	4	Jansen, H. et al., "The Black Silicon Method: a universal method for determining the parameter setting of a flourine-based reactive ion etcher in deep silicon trench etching with profile control",J. Micromech. Microeng. Vol. 5, 1995 pp.115-120.	
	5	Koh et al., "Simple nanostructuring on silicon surface by means of focused beam patterning and wet etching", Applied Surface Science, 2000 pp. 599-603.	
	6	Zhong, S. et al. "Excellent Light Trapping in Ultra-thin Solar Cells," AFM-Journal, May 2016 pp. 1-11.	

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

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	15216244
	Filing Date	2016-07-21
	First Named Inventor	Martin U. Pralle
	Art Unit	2814
	Examiner Name	Long Pham
	Attorney Docket Number	143705.05221

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	/Andrew W. Schultz/	Date (YYYY-MM-DD)	2016-11-11
Name/Print	Andrew W. Schultz	Registration Number	66869

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.**

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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.

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
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 15/216,244	Filing Date 07/21/2016	☐ 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 $ =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*	x $ =	
☐ 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

AMENDMENT	11/11/2016	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 32	Minus	** 26	= 6	x $80 =	480
	Independent (37 CFR 1.16(h))	* 2	Minus	***3	= 0	x $420 =	0
	☐ Application Size Fee (37 CFR 1.16(s))						
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))						
						TOTAL ADD'L FEE	**480**

AMENDMENT		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=	x $ =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x $ =	
	☐ 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.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".
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The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

LIE
BRENDA HARRISON

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
15/216,244	07/21/2016	Martin U. Pralle	143705.05221

CONFIRMATION NO. 5052

136549
Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736

PUBLICATION NOTICE



Title: Pixel Isolation Elements, Devices and Associated Methods

Publication No.US-2016-0329366-A1
Publication Date:11/10/2016

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.

The publication may be accessed through the USPTO's publically available Searchable Databases via the Internet at www.uspto.gov. The direct link to access the publication is currently http://www.uspto.gov/patft/.

The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Office of Public Records. The Office of Public Records can be reached by telephone at (703) 308-9726 or (800) 972-6382, by facsimile at (703) 305-8759, by mail addressed to the United States Patent and Trademark Office, Office of Public Records, Alexandria, VA 22313-1450 or via the Internet.

In addition, information on the status of the application, including the mailing date of Office actions and the dates of receipt of correspondence filed in the Office, may also be accessed via the Internet through the Patent Electronic Business Center at www.uspto.gov using the public side of the Patent Application Information and Retrieval (PAIR) system. The direct link to access this status information is currently http://pair.uspto.gov/. Prior to publication, such status information is confidential and may only be obtained by applicant using the private side of PAIR.

Further assistance in electronically accessing the publication, or about PAIR, is available by calling the Patent Electronic Business Center at 1-866-217-9197.

Office of Data Managment, Application Assistance Unit (571) 272-4000, or (571) 272-4200, or 1-888-786-0101

IPR2025-00845
Apple-Sony EX1002 Page 278

UNITED STATES PATENT AND TRADEMARK OFFICE

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
15/216,244	07/21/2016	Martin U. Pralle	143705.05221	5052

136549 7590 09/13/2016

Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736

EXAMINER
PHAM, LONG

ART UNIT	PAPER NUMBER
2814	

NOTIFICATION DATE	DELIVERY MODE
09/13/2016	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):

docketingbn@pepperlaw.com
davisdr@pepperlaw.com

Office Action Summary	Application No. 15/216,244	Applicant(s) PRALLE ET AL.	
	Examiner LONG PHAM	Art Unit 2814	AIA (First Inventor to File) Status No

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

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 2 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ 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.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5)☒ Claim(s) *34-59* is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☐ Claim(s) _____ is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☒ Claim(s) *34-59* are subject to restriction and/or election requirement.

* If any claims have been determined allowable, 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.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ 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)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

4) ☐ Other: _____.

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

DETAILED ACTION

Election/Restrictions

This application contains claims directed to the following patentably distinct species: embodiment or species 1 of fig. 1, embodiment or species 2 of fig. 2, embodiment or species 3 of fig. 3, embodiment or species 4 of fig. 4, embodiment or species 5 of fig. 5, embodiment or species 6 of fig. 6, embodiment or species 7 of fig. 7. The species are independent or distinct because **the patentability or unpatentability of one species does not necessarily imply the patentability or unpatentability of another species**. In addition, these species are not obvious variants of each other based on the current record.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species, or a single grouping of patentably indistinct species, for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable. Currently, no independent claim appears to be generic to other independent claims.

There is a search and/or examination burden for the patentably distinct species as set forth above because at least the following

reason(s) apply: **The searches of the patentably distinct species are not co-extensive**.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected species or grouping of patentably indistinct species**, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

The election may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the election of species requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected species or grouping of patentably indistinct species.

Should applicant traverse on the ground that the species, or groupings of patentably indistinct species from which election is

required, are not patentably distinct, applicant should submit evidence or identify such evidence now of record showing them to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the species unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103 or pre-AIA 35 U.S.C. 103(a) of the other species.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141.A telephone call was made to -- on -- to request an oral election to the above restriction requirement, but did not result in an election being made.

The examiner has required restriction between product or apparatus claims and process claims. Where applicant elects claims directed to the product/apparatus, and all product/apparatus claims are subsequently found allowable, withdrawn process claims that include all the limitations of the allowable product/apparatus claims should be considered for rejoinder. All claims directed to a nonelected process invention must include all the limitations of an allowable product/apparatus claim for that process invention to be rejoined.

In the event of rejoinder, the requirement for restriction between the product/apparatus claims and the rejoined process claims

will be withdrawn, and the rejoined process claims will be fully examined for patentability in accordance with 37 CFR 1.104. Thus, to be allowable, the rejoined claims must meet all criteria for patentability including the requirements of 35 U.S.C. 101, 102, 103 and 112. Until all claims to the elected product/apparatus are found allowable, an otherwise proper restriction requirement between product/apparatus claims and process claims may be maintained. Withdrawn process claims that are not commensurate in scope with an allowable product/apparatus claim will not be rejoined. See MPEP § 821.04. Additionally, in order for rejoinder to occur, applicant is advised that the process claims should be amended during prosecution to require the limitations of the product/apparatus claims. **Failure to do so may result in no rejoinder.** Further, note that the prohibition against double patenting rejections of 35 U.S.C. 121 does not apply where the restriction requirement is withdrawn by the examiner before the patent issues. See MPEP § 804.01.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to LONG PHAM whose telephone number is (571)272-1714. The examiner can normally be reached on Mon-Frid, 10am to 5pm.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Wael Fahmy can be reached

on 571-272-1705. 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 http://pair-direct.uspto.gov. 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.

Long Pham
Primary Examiner
Art Unit 2814

/LONG PHAM/
Primary Examiner, Art Unit 2814

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	15216244	PRALLE ET AL.
	Examiner	Art Unit
	LONG PHAM	2814

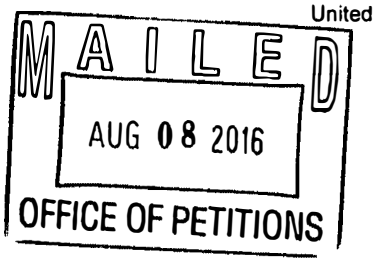
✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

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

CLAIM		DATE								
Final	Original	09/07/2016								
	34	÷								
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Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston MA 02110-2736

Doc Code: TRACK1.GRANT

Decision Granting Request for Prioritized Examination (Track I or After RCE)	Application No.: 15/216,244

1. THE REQUEST FILED July 21, 2016 IS **GRANTED.**

The above-identified application has met the requirements for prioritized examination

A. ☒ for an original nonprovisional application (Track I).
B. ☐ for an application undergoing continued examination (RCE).

2. **The above-identified application will undergo prioritized examination.** The application will be accorded special status throughout its entire course of prosecution until one of the following occurs:

A. filing a **petition for extension of time** to extend the time period for filing a reply;
B. filing an **amendment to amend the application to contain more than four independent claims, more than thirty total claims,** or a multiple dependent claim;
C. filing a **request for continued examination**;
D. filing a notice of appeal;
E. filing a request for suspension of action;
F. mailing of a notice of allowance;
G. mailing of a final Office action;
H. completion of examination as defined in 37 CFR 41.102; or
I. abandonment of the application.

Telephone inquiries with regard to this decision should be directed to Brian W. Brown at 571-272-5338.

/Brian W. Brown/
[*Signature*]

Petitions Examiner, Office of Petitions
(Title)

PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 15/216,244

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			N/A	280
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	600
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	720
TOTAL CLAIMS (37 CFR 1.16(i))	26 minus 20 =	* 6			OR	x 80 =	480
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2 minus 3 =	*				x 420 =	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			TOTAL	2080

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.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
15/216,244	07/21/2016	2852	2080	143705.05221	26	2

CONFIRMATION NO. 5052

FILING RECEIPT

136549
Pepper Hamilton LLP/SiOnyx LLC
Attn: Boston IP Docketing Department
125 High Street
19th Floor
Boston, MA 02110-2736

OC000000084850118

Date Mailed: 08/05/2016

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Martin U. Pralle, Wayland, MA;
Jeffrey McKee, Tualatin, OR;
Jason Sickler, Arlington, MA;

Applicant(s)

SiOnyx, LLC., Beverly, MA;

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 14/747,875 06/23/2015
which is a CON of 13/841,120 03/15/2013 PAT 9064764
which claims benefit of 61/614,275 03/22/2012

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

Permission to Access Search Results: Yes

Applicant may provide or rescind an authorization for access using Form PTO/SB/39 or Form PTO/SB/69 as appropriate.

IPR2025-00845
Apple-Sony EX1002 Page 289

If Required, Foreign Filing License Granted: 08/03/2016

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 15/216,244**

Projected Publication Date: 11/10/2016

Non-Publication Request: No

Early Publication Request: No

Title

Pixel Isolation Elements, Devices and Associated Methods

Preliminary Class

396

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.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at http://www.uspto.gov/web/offices/pac/doc/general/index.html.

For information on preventing theft of your intellectual property (patents, trademarks and copyrights), you may wish to consult the U.S. Government website, http://www.stopfakes.gov. Part of a Department of Commerce initiative, this website includes self-help "toolkits" giving innovators guidance on how to protect intellectual property in specific countries such as China, Korea and Mexico. For questions regarding patent enforcement issues, applicants may call the U.S. Government hotline at 1-866-999-HALT (1-866-999-4258).

IPR2025-00845
Apple-Sony EX1002 Page 290

LICENSE FOR FOREIGN FILING UNDER

Title 35, United States Code, Section 184

Title 37, Code of Federal Regulations, 5.11 & 5.15

GRANTED

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This license is to be retained by the licensee and may be used at any time on or after the effective date thereof unless it is revoked. This license is automatically transferred to any related applications(s) filed under 37 CFR 1.53(d). This license is not retroactive.

The grant of a license does not in any way lessen the responsibility of a licensee for the security of the subject matter as imposed by any Government contract or the provisions of existing laws relating to espionage and the national security or the export of technical data. Licensees should apprise themselves of current regulations especially with respect to certain countries, of other agencies, particularly the Office of Defense Trade Controls, Department of State (with respect to Arms, Munitions and Implements of War (22 CFR 121-128)); the Bureau of Industry and Security, Department of Commerce (15 CFR parts 730-774); the Office of Foreign AssetsControl, Department of Treasury (31 CFR Parts 500+) and the Department of Energy.

NOT GRANTED

No license under 35 U.S.C. 184 has been granted at this time, if the phrase "IF REQUIRED, FOREIGN FILING LICENSE GRANTED" DOES NOT appear on this form. Applicant may still petition for a license under 37 CFR 5.12, if a license is desired before the expiration of 6 months from the filing date of the application. If 6 months has lapsed from the filing date of this application and the licensee has not received any indication of a secrecy order under 35 U.S.C. 181, the licensee may foreign file the application pursuant to 37 CFR 5.15(b).

SelectUSA

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 U.S. offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to promote and facilitate business investment. SelectUSA provides information assistance to the international investor community; serves as an ombudsman for existing and potential investors; advocates on behalf of U.S. cities, states, and regions competing for global investment; and counsels U.S. economic development organizations on investment attraction best practices. To learn more about why the United States is the best country in the world to develop technology, manufacture products, deliver services, and grow your business, visit http://www.SelectUSA.gov or call +1-202-482-6800.

Substitute for Form 1449/PTO	Complete if Known	
	Application No.:	15/216,244
INFORMATION DISCLOSURE STATEMENT BY APPLICANT	Filing Date:	July 21, 2016
	First Named Inventor:	Martin U. Pralle
	Group Art Unit:	TBA
(use as many sheets as necessary)	Examiner Name:	TBA
Sheet | 1 | of | 20	Attorney Docket No.:	143705.05221

U. S. PATENT DOCUMENTS

Examiner's Initials	Cite No.	U.S. Patent Document Number Kind Code (if known)	Name of Patentee or Applicant of Cited Document	Date of Publication of Cited Document MM-DD-YYYY	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	
	A1	3487223	St. John	12/30/1969		
	A2	3922571	Smith	11/25/1975		
	A3	3973994	Redfield	8/10/1976		
	A4	3994012	Warner, Jr.	11/23/1976		
	A5	4017887	Davies et al.	4/12/1977		
	A6	4149174	Shannon	4/10/1979		
	A7	4176365	Kroger	11/27/1979		
	A8	4201450	Trapani	5/6/1980		
	A9	4242149	King et al.	12/30/1980		
	A10	4253882	Dalal	3/3/1981		
	A11	4277793	Webb	7/7/1981		
	A12	4322571	Stanbery	3/30/1982		
	A13	4419533	Czubatyj et al.	12/6/1983		
	A14	4452826	Shields et al.	6/5/1984		
	A15	4493942	Sheng et al.	1/15/1985		
	A16	4514582	Tiedje et al.	4/30/1985		
	A17	4536608	Sheng et al.	8/20/1985		
	A18	4568960	Petroff et al.	2/4/1986		
	A19	4593303	Dyck et al.	6/3/1986		
	A20	4593313	Nagasaki	6/3/1986		
	A21	4617593	Dudley	10/14/1986		
	A22	4630082	Sakai	12/16/1986		
	A23	4648936	Ashby et al.	3/10/1987		
	A24	4663188	Kane	5/5/1987		
	A25	4672206	Suzuki	6/9/1987		
	A26	4673770	Mandelkorn	6/16/1987		
	A27	4679068	Lillquist et al.	7/7/1987		
	A28	4751571	Lillquist	6/14/1988		
	A29	4775425	Guha et al.	10/4/1988		
	A30	4777490	Sharma et al.	10/11/1988		
	A31	4829013	Yamazaki	5/9/1989		
	A32	4883962	Elliot	11/28/1989		
	A33	4887255	Handa et al.	12/12/1989		
	A34	4894526	Bethea et al.	1/16/1990		
	A35	4910568	Taki, et al.	3/20/1990		
	A36	4910588	Kinoshita, et al.	3/20/1990		
	A37	4964134	Westbrook et al.	10/16/1990		
Examiner Signature				Date Considered		

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IPR2025-00845
Apple-Sony EX1002 Page 292

Substitute for Form 1449/PTO		Complete if Known	
		Application No.:	15/216,244
INFORMATION DISCLOSURE STATEMENT BY APPLICANT		Filing Date:	July 21, 2016
		First Named Inventor:	Martin U. Pralle
		Group Art Unit:	TBA
(use as many sheets as necessary)		Examiner Name:	TBA
Sheet | 2 | of | 20		Attorney Docket No.:	143705.05221

	A38	4965784	Land et al.	10/23/1990		
	A39	4968372	Maass	11/6/1990		
	A40	4999308	Nishiura et al.	3/12/1991		
	A41	5021100	Ishihara et al.	6/4/1991		
	A42	5021854	Huth	6/4/1991		
	A43	5080725	Green et al.	1/14/1992		
	A44	5081049	Green et al.	1/14/1992		
	A45	5100478	Kawabata	3/31/1992		
	A46	5114876	Weiner	5/19/1992		
	A47	5127964	Hamakawa et la.	7/7/1992		
	A48	5164324	Russell et al.	11/17/1992		
	A49	5208822	Haus et al	5/4/1993		
	A50	5223043	Olson et al.	6/29/1993		
	A51	5234790	Lang, et al.	8/10/1993		
	A52	5244817	Hawkins et al.	9/14/1993		
	A53	5296045	Banerjee et al.	3/22/1994		
	A54	5309275	Nishimura et al.	5/3/1994		
	A55	5322988	Russell et al.	6/21/1994		
	A56	5346850	Kaschmitter et al.	9/13/1994		
	A57	5370747	Noguchi et al.	12/6/1994		
	A58	5373182	Norton	12/13/1994		
	A59	5381431	Zayhowski	1/10/1995		
	A60	5383217	Uemura	1/17/1995		
	A61	5390201	Tomono et al.	2/14/1995		
	A62	5413100	Barthelemy et al.	5/9/1995		
	A63	5449626	Hezel	9/12/1995		
	A64	5454347	Shibata et al.	10/3/1995		
	A65	5502329	Pezzani	3/26/1996		
	A66	5523570	Hairston	6/4/1996		
	A67	5559361	Pezzani	9/24/1996		
	A68	5569615	Yamazaki et al.	10/29/1996		
	A69	5578858	Mueller et al.	11/26/1996		
	A70	5580615	Itoh et al.	12/3/1996		
	A71	5589008	Kepper	12/31/1996		
	A72	5589704	Levine	12/31/1996		
	A73	5597621	Hummel et al.	1/18/1997		
	A74	5627081	Tsuo et al.	5/6/1997		
	A75	5640013	Ishikawa, et al.	6/17/1997		
	A76	5641362	Meier	6/24/1997		
	A77	5705413	Harkin et al.	1/6/1998		
	A78	5705828	Noguchi et al.	1/6/1998		
	A79	5708486	Miyawaki et al.	1/13/1998		
	A80	5710442	Watanabe et al.	1/20/1998		
	A81	5714404	Mititsky et al.	2/3/1998		
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IPR2025-00845
Apple-Sony EX1002 Page 293

Substitute for Form 1449/PTO		Complete if Known	
		Application No.:	15/216,244
INFORMATION DISCLOSURE STATEMENT BY APPLICANT		Filing Date:	July 21, 2016
		First Named Inventor:	Martin U. Pralle
		Group Art Unit:	TBA
(use as many sheets as necessary)		Examiner Name:	TBA
Sheet | 3 | of | 20		Attorney Docket No.:	143705.05221

	A82	5731213	Ono	3/24/1998		
	A83	5751005	Wyles et al.	5/12/1998		
	A84	5758644	Diab et el.	6/2/1998		
	A85	5766127	Pologe et al.	6/16/1998		
	A86	5766964	Rohatgi et al.	6/16/1998		
	A87	5773820	Osajda, et al.	6/30/1998		
	A88	5779631	Chance	7/14/1998		
	A89	5781392	Clark	7/14/1998		
	A90	5792280	Ruby et al	8/11/1998		
	A91	5808350	Jack et al	9/15/1998		
	A92	5859446	Nagasu et al.	1/12/1999		
	A93	5861639	Bernier	1/19/1999		
	A94	5923071	Saito	7/13/1999		
	A95	5935320	Graf et al.	8/10/1999		
	A96	5942789	Morikawa	8/24/1999		
	A97	5943584	Shim et al	8/24/1999		
	A98	5963790	Matsuno et al	10/5/1999		
	A99	5977603	Ishikawa	11/2/1999		
	A100	6071796	Voutsas	6/6/2000		
	A101	6072117	Matsuyama et al.	6/6/2000		
	A102	6080988	Ishizuya et al.	6/27/2000		
	A103	6097031	Cole	8/1/2000		
	A104	6106689	Matsuyama	8/22/2000		
	A105	6107618	Fossum et al.	8/22/2000		
	A106	6111300	Cao et al.	8/29/2000		
	A107	6147297	Wettling et al.	11/14/2000		
	A108	6160833	Floyd et al.	12/12/2000		
	A109	6168965	Malinovich, et al.	1/2/2001		
	A110	6194722	Fiorini et al.	2/27/2001		
	A111	6229192	Gu	5/8/2001		
	A112	6252256	Ugge et al.	6/26/2001		
	A113	6290713	Russell	9/18/2001		
	A114	6291302	Yu	9/18/2001		
	A115	6313901	Cacharelis	11/6/2001		
	A116	6320296	Fujii et al.	11/20/2001		
	A117	6331445	Janz et al	12/18/2001		
	A118	6372591	Mineji et al.	4/16/2002		
	A119	6372611	Horikawa	4/16/2002		
	A120	6379979	Connolly	4/30/2002		
	A121	6420706	Lurie, et al.	7/16/2002		
	A122	6429036	Nixon, et al.	8/6/2002		
	A123	6429037	Wenham et al.	8/6/2002		
	A124	6465860	Shigenaka, et al.	10/15/2002		
	A125	6475839	Zhang, et al.	11/5/2002		
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IPR2025-00845
Apple-Sony EX1002 Page 294

Substitute for Form 1449/PTO		Complete if Known	
		Application No.:	15/216,244
INFORMATION DISCLOSURE STATEMENT BY APPLICANT		Filing Date:	July 21, 2016
		First Named Inventor:	Martin U. Pralle
		Group Art Unit:	TBA
(use as many sheets as necessary)		Examiner Name:	TBA
Sheet | 4 | of | 20		Attorney Docket No.:	143705.05221

	A126	6483116	Kozlowski et al.	11/19/2002		
	A127	6483929	Marakami et al.	11/19/2002		
	A128	6486522	Bishay et al.	11/26/2002		
	A129	6493567	Krivitski et al.	12/10/2002		
	A130	6498336	Tian et al.	12/24/2002		
	A131	6500690	Yamagishi et al.	12/31/2002		
	A132	6504178	Carlson et al.	1/7/2003		
	A133	6580053	Voutsas	6/17/2003		
	A134	6583936	Kaminsky et al.	6/24/2003		
	A135	6597025	Lauter et al	7/22/2003		
	A136	6607927	Ramappa et al.	8/19/2003		
	A137	6624049	Yamazaki	9/23/2003		
	A138	6639253	Duane et al.	10/28/2003		
	A139	6667528	Cohen et al.	12/23/2003		
	A140	6677655	Fitzgerald	1/13/2004		
	A141	6677656	Francois	1/13/2004		
	A142	6683326	Iguchi, et al.	1/27/2004		
	A143	6689209	Falster et el.	2/10/2004		
	A144	6753585	Kindt	6/22/2004		
	A145	6759262	Theil et al.	7/6/2004		
	A146	6790701	Shigenaka, et al.	9/14/2004		
	A147	6800541	Okumura	10/5/2004		
	A148	6801799	Mendelson	10/5/2004		
	A149	6803555	Parrish et al.	10/12/2004		
	A150	6815685	Wany	11/9/2004		
	A151	6818535	Lu et al.	11/16/2004		
	A152	6822313	Matsushita	11/23/2004		
	A153	6825057	Heyers, et al.	11/30/2004		
	A154	6864156	Conn	3/8/2005		
	A155	6864190	Han et al.	3/8/2005		
	A156	6867806	Lee et al.	3/15/2005		
	A157	6900839	Kozlowski et al.	5/31/2005		
	A158	6911375	Guarini et al.	6/28/2005		
	A159	6919587	Ballon et al.	7/19/2005		
	A160	6923625	Sparks	8/2/2005		
	A161	6927432	Holm, et al.	8/9/2005		
	A162	6984816	Holm, et al.	1/10/2006		
	A163	7008854	Forbes	3/7/2006		
	A164	7041525	Clevenger et al.	5/9/2006		
	A165	7057256	Carey, III et al.	6/6/2006		
	A166	7075079	Wood	7/11/2006		
	A167	7091411	Falk et al.	8/15/2006		
	A168	7109517	Zaidi	9/19/2006		
	A169	7126212	Enquist et al.	10/24/2006		
Examiner Signature				Date Considered		

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IPR2025-00845
Apple-Sony EX1002 Page 295

Substitute for Form 1449/PTO		Complete if Known	
		Application No.:	15/216,244
INFORMATION DISCLOSURE STATEMENT BY APPLICANT		Filing Date:	July 21, 2016
		First Named Inventor:	Martin U. Pralle
		Group Art Unit:	TBA
(use as many sheets as necessary)		Examiner Name:	TBA
Sheet | 5 | of | 20		Attorney Docket No.:	143705.05221

	A170	7132724	Merrill	11/7/2006		
	A171	7202102	Yao	4/10/2007		
	A172	7211501	Liu et al	5/1/2007		
	A173	7235812	Chu, et al.	6/26/2007		
	A174	7247527	Shimomura et al.	7/24/2007		
	A175	7247812	Tsao	7/24/2007		
	A176	7256102	Nakata, et al.	8/14/2007		
	A177	7271445	Forbes	9/18/2007		
	A178	7271835	Iizuka et al.	9/18/2007		
	A179	7285482	Ochi	10/23/2007		
	A180	7314832	Kountz et al.	1/1/2008		
	A181	7354792	Carey, III et al.	4/8/2008		
	A182	7358498	Geng et al.	4/15/2008		
	A183	7375378	Manivannan et al.	5/20/2008		
	A184	7390689	Mazur et al.	6/24/2008		
	A185	7432148	Li et al.	10/7/2008		
	A186	7442629	Mazur et al.	10/28/2008		
	A187	7446359	Lee, et al.	11/4/2008		
	A188	7446807	Hong	11/7/2008		
	A189	7456452	Wells et al.	11/25/2008		
	A190	7482532	Yi et al.	1/27/2009		
	A191	7498650	Lauxtermann	3/3/2009		
	A192	7504325	Koezuka et al.	3/17/2009		
	A193	7504702	Mazur et al.	3/17/2009		
	A194	7511750	Murakami	3/31/2009		
	A195	7521737	Augusto	4/21/2009		
	A196	7528463	Forbes	5/5/2009		
	A197	7542085	Altice, Jr. et al.	6/2/2009		
	A198	7547616	Fogel et al.	6/16/2009		
	A199	7551059	Farrier	6/23/2009		
	A200	7560750	Niira et al.	7/14/2009		
	A201	7564631	Li, et al.	7/21/2009		
	A202	7582515	Choi et al.	9/1/2009		
	A203	7592593	Kauffman, et al.	9/22/2009		
	A204	7595213	Kwon et al.	9/29/2009		
	A205	7605397	Kindem et al.	10/20/2009		
	A206	7615808	Pain, et al.	11/10/2009		
	A207	7618839	Rhodes	11/17/2009		
	A208	7619269	Ohkawa	11/17/2009		
	A209	7629582	Hoffman, et al.	12/8/2009		
	A210	7648851	Fu, et al.	1/19/2010		
	A211	7649156	Lee	1/19/2010		
	A212	7705879	Kerr et al.	4/27/2010		
	A213	7731665	Lee et al	6/8/2010		
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IPR2025-00845
Apple-Sony EX1002 Page 296

Substitute for Form 1449/PTO		Complete if Known	
		Application No.:	15/216,244
INFORMATION DISCLOSURE STATEMENT BY APPLICANT		Filing Date:	July 21, 2016
		First Named Inventor:	Martin U. Pralle
		Group Art Unit:	TBA
(use as many sheets as necessary)		Examiner Name:	TBA
Sheet | 6 | of | 20		Attorney Docket No.:	143705.05221

	A214	7741666	Nozaki, et al.	6/22/2010		
	A215	7745901	McCaffrey et al	6/29/2010		
	A216	7763913	Fan et al	7/27/2010		
	A217	7772028	Adkisson et al	8/10/2010		
	A218	7781856	Mazur et al.	8/24/2010		
	A219	7800192	Venezia, et al.	9/21/2010		
	A220	7816220	Mazur et al.	10/19/2010		
	A221	7828983	Weber et al	11/9/2010		
	A222	7847253	Carey et al.	12/7/2010		
	A223	7847326	Park, et al.	12/7/2010		
	A224	7855406	Yamaguchi et al	12/21/2010		
	A225	7875498	Elbanhawy, et al.	1/25/2011		
	A226	7880168	Lenchenkov	2/1/2011		
	A227	7884439	Mazur et al.	2/8/2011		
	A228	7884446	Mazur et al.	2/8/2011		
	A229	7910964	Kawahito et al.	3/22/2011		
	A230	7923801	Tian et al.	4/12/2011		
	A231	7968834	Veeder	6/28/2011		
	A232	8008205	Fukushima et al.	8/30/2011		
	A233	8013411	Cole	9/6/2011		
	A234	8030726	Sumi	10/4/2011		
	A235	8035343	Seman Jr.	10/11/2011		
	A236	8058615	McCaffrey	11/15/2011		
	A237	8080467	Carey et al.	12/20/2011		
	A238	8088219	Knerer et al.	1/3/2012		
	A239	8093559	Rajavel	1/10/2012		
	A240	8164126	Moon, et al.	4/24/2012		
	A241	8207051	Sickler et al.	6/26/2012		
	A242	8247259	Grolier et al.	8/21/2012		
	A243	8259293	Andreou et al.	9/4/2012		
	A244	8288702	Veeder	10/16/2012		
	A245	8476681	Haddad et al.	7/2/2013		
	A246	8564087	Yamamura et al.	10/22/2013		
	A247	8603902	Mazer et al.	12/10/2013		
	A248	8629485	Yamamura et al.	1/14/2014		
	A249	8680591	Haddad et al.	3/25/2014		
	A250	8742528	Yamamura et al.	6/3/2014		
	A251	8884226	Miyazaki, et al.	11/11/2014		
	A252	8916945	Sakamoto et al	12/23/2014		
	A253	8994135	Yamamura et al.	6/31/2015		
	A254	9190551	Yamamura et al.	11/17/2015		
	A255	RE43169	Parker	2/7/2012		
	A256	20010017344	Aebi	8/30/2001		
	A257	20010022768	Takahashi	9/20/2001		
Examiner Signature				Date Considered		

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IPR2025-00845
Apple-Sony EX1002 Page 297

Substitute for Form 1449/PTO		Complete if Known	
		Application No.:	15/216,244
INFORMATION DISCLOSURE STATEMENT BY APPLICANT		Filing Date:	July 21, 2016
		First Named Inventor:	Martin U. Pralle
		Group Art Unit:	TBA
(use as many sheets as necessary)		Examiner Name:	TBA
Sheet | 7 | of | 20		Attorney Docket No.:	143705.05221

	A258	20010044175	Barret et al.	11/22/2001		
	A259	20020020893	Lhorte	2/21/2002		
	A260	20020024618	Imai	2/28/2002		
	A261	20020056845	Iguchi et al.	5/16/2002		
	A262	20020060322	Tanabe et al.	5/23/2002		
	A263	20020079290	Holdermann	6/27/2002		
	A264	20020117699	Roy	8/29/2002		
	A265	20020148964	Dausch et al.	10/17/2002		
	A266	20020182769	Campbell	12/5/2002		
	A267	20030029495	Mazur et al.	2/13/2003		
	A268	20030030083	Lee et al.	2/13/2003		
	A269	20030045092	Shin	3/6/2003		
	A270	20030057357	Uppal et al.	3/27/2003		
	A271	20030111106	Nagano et al.	6/19/2003		
	A272	20030210332	Frame	11/13/2003		
	A273	20030213515	Sano et al.	11/20/2003		
	A274	20040014307	Shin et al.	1/22/2004		
	A275	20040016886	Ringermacher et al.	1/29/2004		
	A276	20040041168	Hembree et al.	3/4/2004		
	A277	20040046224	Rossel et al.	3/11/2004		
	A278	20040077117	Ding et al.	4/22/2004		
	A279	20040080638	Lee	4/29/2004		
	A280	20040130020	Kuwabara et al.	7/22/2004		
	A281	20040161868	Hong	8/19/2004		
	A282	20040222187	Lin	11/11/2004		
	A283	20040252931	Belleville et al.	12/16/2004		
	A284	20050051822	Manning	3/10/2005		
	A285	20050062041	Terakawa et al.	3/24/2005		
	A286	20050101100	Kretchmer et al.	5/12/2005		
	A287	20050101160	Garg et al.	5/12/2005		
	A288	20050127401	Mazur et al.	6/16/2005		
	A289	20050134698	Schroeder et al.	6/23/2005		
	A290	20050150542	Madan	7/14/2005		
	A291	20050158969	Binnis et al.	7/21/2005		
	A292	20050211996	Krishna, et al.	9/29/2005		
	A293	20050227390	Shtein et al.	10/13/2005		
	A294	20060006482	Rieve, et al.	1/12/2006		
	A295	20060011954	Ueda et al.	1/19/2006		
	A296	20060011955	Baggenstoss	1/19/2006		
	A297	20060060848	Chang et al.	3/23/2006		
	A298	20060071254	Rhodes	4/6/2006		
	A299	20060079062	Mazur et al.	4/13/2006		
	A300	20060097172	Park	5/11/2006		
	A301	20060231914	Carey et al.	10/19/2006		
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IPR2025-00845
Apple-Sony EX1002 Page 298

Substitute for Form 1449/PTO		Complete if Known	
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT		Filing Date:	July 21, 2016
		First Named Inventor:	Martin U. Pralle
		Group Art Unit:	TBA
(use as many sheets as necessary)		Examiner Name:	TBA
Sheet | 8 | of | 20		Attorney Docket No.:	143705.05221

	A302	20090097290	Chandrasekaran	4/16/2009		
	A303	20060118781	Rhodes	6/8/2006		
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	A305	20060132633	Nam, et al.	6/22/2006		
	A306	20060138396	Lin, et al.	6/29/2006		
	A307	20060145148	Hirai, et al.	7/6/2006		
	A308	20060145176	Lee	7/6/2006		
	A309	20060160343	Chong et al.	7/20/2006		
	A310	20060166475	Mantl	7/27/2006		
	A311	20060175529	Harmon et al.	8/10/2006		
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	A313	20060181627	Farrier	8/17/2006		
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	A315	20060214121	Schrey et al.	9/28/2006		
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	A317	20060231914	Carey, III et al.	10/19/2006		
	A318	20060238632	Shah	10/26/2006		
	A319	20060244090	Roy, et al.	11/2/2006		
	A320	20060255340	Manivannan et al.	11/16/2006		
	A321	20060257140	Seger	11/16/2006		
	A322	20070035849	Li et al.	2/15/2007		
	A323	20070035879	Hall,et al.	2/15/2007		
	A324	20070051876	Sumi et al.	3/8/2007		
	A325	20070052050	Dierickx	3/8/2007		
	A326	20070076481	Tennant	4/5/2007		
	A327	20070115554	Breitung et al	5/24/2007		
	A328	20070123005	Hiura et al.	5/31/2007		
	A329	20070138590	Wells, et al.	6/21/2007		
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IPR2025-00845
Apple-Sony EX1002 Page 299

Substitute for Form 1449/PTO		Complete if Known	
		Application No.:	15/216,244
INFORMATION DISCLOSURE STATEMENT BY APPLICANT		Filing Date:	July 21, 2016
		First Named Inventor:	Martin U. Pralle
		Group Art Unit:	TBA
(use as many sheets as necessary)		Examiner Name:	TBA
Sheet | 9 | of | 20		Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 300

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Sheet | 10 | of | 20		Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 301

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Sheet | 11 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 302

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(use as many sheets as necessary)	Examiner Name:	TBA
Sheet | 12 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 303

Substitute for Form 1449/PTO		Complete if Known	
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(use as many sheets as necessary)		Examiner Name:	TBA
Sheet | 13 | of | 20		Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 304

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Sheet | 14 | of | 20	Attorney Docket No.:	143705.05221

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IPR2025-00845
Apple-Sony EX1002 Page 305

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IPR2025-00845
Apple-Sony EX1002 Page 306

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IPR2025-00845
Apple-Sony EX1002 Page 307

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IPR2025-00845
Apple-Sony EX1002 Page 308

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IPR2025-00845
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IPR2025-00845
Apple-Sony EX1002 Page 311

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IPR2025-00845
Apple-Sony EX1002 Page 312

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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

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Electronic Acknowledgement Receipt

EFS ID:	26426350
Application Number:	15216244
International Application Number:	
Confirmation Number:	5052
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Customer Number:	136549
Filer:	Reza Mollaaghababa/Jillian Stockel
Filer Authorized By:	Reza Mollaaghababa
Attorney Docket Number:	143705.05221
Receipt Date:	22-JUL-2016
Filing Date:	
Time Stamp:	11:19:52
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	Foreign Reference	JPH06275641.pdf	296929 d60269e8faca202867f9294c16eb025e3795e501	no	6

Warnings:

IPR2025-00845
Apple-Sony EX1002 Page 320

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New Applications Under 35 U.S.C. 111

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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.

Electronic Acknowledgement Receipt

EFS ID:	26426659
Application Number:	15216244
International Application Number:	
Confirmation Number:	5052
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Customer Number:	136549
Filer:	Reza Mollaaghababa/Jillian stockel
Filer Authorized By:	Reza Mollaaghababa
Attorney Docket Number:	143705.05221
Receipt Date:	22-JUL-2016
Filing Date:	
Time Stamp:	11:34:25
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.)
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IPR2025-00845
Apple-Sony EX1002 Page 325

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38	Foreign Reference	Forbes_2010_BacksideNanoscale.pdf	5539706 5a8e9e26f6d2b38c34c06e59158295cc57a37983	no	4
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39	Foreign Reference	Forbes_2012_TexturingReflectivity.pdf	696945 2d051a6b663f518d45f890b52fb322c1059522d6	no	14
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51	Foreign Reference	HighPerformanceTech2004.pdf	7188181 db7e23468df8f71bc0e63250adfd2aa993c2947e	no	48
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Electronic Acknowledgement Receipt

EFS ID:	26426957
Application Number:	15216244
International Application Number:	
Confirmation Number:	5052
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Customer Number:	136549
Filer:	Reza Mollaaghababa/Jillian Stockel
Filer Authorized By:	Reza Mollaaghababa
Attorney Docket Number:	143705.05221
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Application Type:	Utility under 35 USC 111(a)

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Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Non Patent Literature	Joy_2007.pdf	6317763 1e7fa577eb7813813dd20ac793a934719d123ac8	no	4

Warnings:

IPR2025-00845
Apple-Sony EX1002 Page 335

Information:					
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60	Non Patent Literature	Wu_1999_APSCentennialMeeting.pdf	5020631 58fc0cf21a7da2ea09d0d8f84f73889a92d4710b	no	36
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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.

Electronic Acknowledgement Receipt

EFS ID:	26427090
Application Number:	15216244
International Application Number:	
Confirmation Number:	5052
Title of Invention:	Pixel Isolation Elements, Devices and Associated Methods
First Named Inventor/Applicant Name:	Martin U. Pralle
Customer Number:	136549
Filer:	Reza Mollaaghababa/Jillian Stockel
Filer Authorized By:	Reza Mollaaghababa
Attorney Docket Number:	143705.05221
Receipt Date:	22-JUL-2016
Filing Date:	
Time Stamp:	11:55:44
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	Non Patent Literature	Wu_2000_Thesis.pdf	5410273 6fd36a6c384a92d1ae9e5cfe85571a725a43d659	no	138

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IPR2025-00845
Apple-Sony EX1002 Page 345

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8	Non Patent Literature	Younkin_2001_Thesis.pdf	5144732 1f0e3703a2b18be1ab76bd3dd7c21651f222721c	no	136
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		Total Files Size (in bytes):	24136043		

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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.

Docket No. 143705.05221

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: Martin U. Pralle *et al.*	Confirmation No. TBA
Application No. TBA	Art Unit: Not yet assigned
Filed: July , 2016	Examiner: Not yet assigned
For: PIXEL ISOLATION ELEMENTS, DEVICES AND ASSOCIATED METHODS	

VIA EFS-WEB
Commissioner for Patents
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Alexandria, VA 22313-1450

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I hereby certify that this correspondence is being electronically filed via EFS-Web to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

July 21, 2016 — Dated

Electronic Signature: /Reza Mollaaghababa/
Andrew Schultz, Reg. No. 43,810

PRELIMINARY AMENDMENT

Dear Sir:

Prior to substantive examination of the above-referenced application, please amend the above-identified application as follows:

Amendments to the Specification begin on page 2.

Amendments to the Claims begin on page 3.

Remarks begin on page 6.

AMENDMENTS TO SPECIFICATION

Please amend the first paragraph following the heading "Priority Data" as follows:

The present application claims priority as a continuation application to U.S. Patent Application No.14/747,875 filed on June 26, 2015, which ~~this application~~ is a continuation of U.S. Patent Application Serial No. 13/841,120, filed on March 15, 2013, which claims the benefit of U.S. Provisional Patent Application Serial No. 61/614,275, filed on March 22, 2012, all ~~each~~ of which are incorporated herein by reference.

IPR2025-00845
Apple-Sony EX1002 Page 350

AMENDMENTS TO THE CLAIMS

Claims:

1-33 (Cancelled)

34. (New) A light trapping device, comprising:

at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall extending at least partially around the pixel periphery;

a backside light trapping material substantially covering the backside surface; and

a peripheral light trapping material substantially covering the peripheral sidewall,

wherein the peripheral light trapping material creates a surface field at the peripheral sidewall.

35. (New) The device of claim 34, wherein the backside light trapping material reflects the light incident thereon back into the pixel.

36. (New) The device of claim 34, wherein the peripheral light trapping material reflects light incident thereon into the pixel.

37. (New) The device of claim 34, wherein the peripheral sidewall extends completely around the pixel periphery.

38. (New) The device of claim 34, wherein the peripheral sidewall extends from the light incident surface to the backside surface.

39. (New) The device of claim 34, wherein the peripheral sidewall extends through the pixel substantially from the light incident surface to the backside surface.

40. (New) The device of claim 34, wherein at least one of the backside light trapping material and the peripheral light trapping material comprises a metal layer.

41. (New) The device of claim 34, wherein said peripheral light trapping material comprises an oxide.

42. (New) The device of claim 34, wherein said peripheral light trapping material provides a passivating negative charge.

IPR2025-00845
Apple-Sony EX1002 Page 351

43. (New) The device of claim 34, wherein said peripheral light trapping material exhibits a surface recombination velocity as low as 10 cm/s.

44. (New) The device of claim 34, wherein the peripheral sidewall material has an index of refraction of less than about 2.1.

45. (New) The device of claim 34, wherein the peripheral light trapping material comprises any of aluminum oxide and hafnium oxide.

46. (New) The device of claim 34, wherein said pixel comprises a textured region.

47. (New) The device of claim 46, wherein said textured region is coupled to the light incident surface.

48. (New) The device of claim 47, wherein said textured region is located on said light incident surface.

49. (New) The device of claim 47, wherein said textured region comprises a textured film layer.

50. (New) The device of claim 49, wherein said textured film layer comprises any of silicon dioxide, silicon nitride, amorphous silicon, polysilicon, a metal and combinations thereof.

51. (New) An array of light trapping pixel devices of claim 34.

52. (New) A light trapping device, comprising:

at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall extending at least partially around the pixel periphery;

a backside light trapping material at least partially covering the backside surface;

a peripheral light trapping material substantially covering the peripheral sidewall; and

a textured region positioned to interact with light incident thereon so as to increase quantum efficiency of the device.

53. (New) The device of claim 52, wherein said backside light trapping material substantially covers the backside surface.

54. (New) The device of claim 52, wherein said textured region is located on the light incident surface.

55. (New) The device of claim 52, wherein said textured region is a textured film layer coupled to the light incident surface.

IPR2025-00845
Apple-Sony EX1002 Page 352

56. (New) The device of claim 55, wherein said textured film layer comprises any of silicon dioxide, silicon nitride, amorphous silicon, polysilicon, a metal and combinations thereof.

57. (New) The device of claim 52, wherein said textured region reflects at least a portion of light internally incident thereon into the pixel.

58. (New) The device of claim 52, wherein the peripheral sidewall extends from the light incident surface to the backside surface.

59. (New) The device of claim 34, wherein the peripheral sidewall extends through the pixel substantially from the light incident surface to the backside surface.

IPR2025-00845
Apple-Sony EX1002 Page 353

REMARKS

Applicant respectfully requests that prior to the examination of the above-referenced patent application claims 1-33 be cancelled and claims 34-59 be added. Support for the new claims can be found throughout the application as filed, e.g. at pages 13 and 14 of the specification.

The Director is authorized to charge any deficiency in the fees filed, asserted to be filed, or which should have been filed herewith (or with any paper hereafter filed in this application by this firm) to our Deposit Account No. 50-0436, under Order No. 143705.05221.

Respectfully submitted,

Dated: July 21, 2016

Electronic Signature: /Reza Mollaaghababa/

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IPR2025-00845
Apple-Sony EX1002 Page 354

PIXEL ISOLATION ELEMENTS, DEVICES, AND ASSOCIATED METHODS

PRIORITY DATA

This application is a continuation of U.S. Patent Application Serial No. 13/841,120, filed March 15, 2013, which claims the benefit of U.S. Provisional Patent Application Serial No. 61/614,275, filed on March 22, 2012, each of which are incorporated herein by reference.

BACKGROUND

Image sensors are typically formed on various forms of semiconductor materials such as, for example, silicon. Imagers can be incorporated into a variety of devices, including digital cameras, camcorders, computers, cell phones, etc. Due to the ever decreasing size (foot print) of these devices, image sensors have correspondingly seen a decrease in size. Backside illuminated (BSI) image sensors have increased in importance due to the small size of these imagers as compared to front side illuminated (FSI) image sensors. However, pixel size reduction can lead to a significant sacrifice in image quality. As pixel sizes continue to decrease, image signal to noise tends to decrease while electrical and optical cross-talk between adjacent sensor pixels tends to increase. Traditional attempts to reduce the impact of these effects have included adding microlenses above each image sensor in front side pixel sensors to focus the light on the active detector regions, thereby increasing efficiency and reducing cross-talk. Backside illuminated pixel sensors can present different design considerations. For example, significant cross-talk can be generated due to reflection off the often planar back surface of the device.

SUMMARY

The present disclosure provides for light trapping pixels, devices incorporating such pixels, photovoltaic solar cells, and other optoelectronic devices, including various associated methods. In one aspect, for example, a light trapping device can include at least one light sensitive pixel having a light incident surface, a backside surface opposite

IPR2025-00845
Apple-Sony EX1002 Page 355

the light incident surface, and a peripheral sidewall disposed into at least a portion of the pixel and extending at least substantially around the pixel periphery. The pixel can also include a backside light trapping material substantially covering the backside surface and a peripheral light trapping material substantially covering the peripheral sidewall. The light contacting the backside light trapping material or the peripheral light trapping material is thus reflected back toward the pixel. In another aspect, the present disclosure additionally provides an array of light trapping pixels.

A variety of light trapping materials can be utilized and are contemplated, and any such material capable of being used to trap light in a pixel is considered to be within the present scope. In one aspect, at least one of the backside light trapping material and the peripheral light trapping material can include a high refractive index material sandwiched between two low refractive index materials. In another aspect, the backside light trapping material and the peripheral light trapping material includes a high refractive index material sandwiched between two low refractive index materials. It is contemplated that the two low refractive index materials have a refractive index of less than about 2.1. Non-limiting examples of low refractive index material can include nitrides, oxynitrides, gasses, at least a partial vacuum, and the like, including appropriate combinations thereof. Other non-limiting examples of low refractive index materials can include silicon oxide, silicon nitride, silicon dioxide, and the like. Furthermore, in another aspect a light trapping material can include a higher refractive index material sandwiched between two materials having a refractive index that is at least 0.2 lower as compared to the higher refractive index material. In this case, the materials are not limited by the definition of low vs. high refractive index outlined above, but are rather defined by the relative difference in refractive index.

Furthermore, it is contemplated that high refractive index materials have a refractive index of greater than or equal to about 2.1. Non-limiting examples of high refractive index material can include polycrystalline silicon, amorphous silicon, single crystal silicon, multicrystalline silicon, nanocrystalline silicon, germanium, and the like, including appropriate combinations thereof.

IPR2025-00845
Apple-Sony EX1002 Page 356

In one aspect, the peripheral sidewall can extend completely around the pixel periphery. In another aspect, the peripheral sidewall can extend from the light incident surface towards the backside surface.

In some aspects it is also contemplated that the light incident surface can include a frontside light trapping material at least partially covering the surface thereof. In one aspect, the frontside light trapping material can be an antireflective layer coating. In another aspect, the frontside light trapping material can be a reflective layer having an aperture to allow entry of light into the pixel, wherein the reflective layer is operable to reflect light impinging thereupon from inside the pixel back into the pixel. In some aspects it can be beneficial to include a lens functionally coupled to the aperture and operable to focus incident light through the aperture and into the pixel.

In another aspect the present disclosure additionally provides a substantially light trapping pixel device including a light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall extending from the light incident surface to the backside surface and extending around the pixel periphery. The pixel additionally includes a backside light trapping material substantially covering the backside surface, and a peripheral light trapping material substantially covering the peripheral sidewall. Furthermore, an internally reflective frontside light trapping material can cover at least a portion of the light incident surface that is operable to allow entrance of light into the pixel and is operable to reflect light impinging thereupon from inside the pixel back into the pixel, and the light contacting the backside light trapping material or the peripheral light trapping material is reflected back toward the pixel.

In yet another aspect, the present disclosure provides a method of making a light trapping device, including forming at least one pixel by forming a backside light trapping material on a semiconductor layer, the backside light trapping material including a high refractive index material sandwiched between two low refractive index materials, and forming a pixel device layer on the semiconductor layer opposite the light trapping material. The method can additionally include etching a trench circumscribing the pixel device layer and filling the trench with a light trapping material. In some aspects, the trench can be etched to a depth that contacts at least the first low refractive index

IPR2025-00845
Apple-Sony EX1002 Page 357

material. In some aspects, an incident light trapping material can be applied to the pixel device layer. It is also noted that the light trapping material can be located anywhere in the backside region of the device, and that the current scope is not limited to the location of materials or the manufacturing method described above.

In another aspect, filling the trench with the light trapping material can further include depositing a low refractive index material into the trench to fill a portion of the trench from the trench walls inward, ceasing deposition of the low refractive index material to leave an internal space within the trench, and depositing a high refractive index material into the trench to fill the internal space.

In another aspect, the method can include forming a textured region on at least a portion of the semiconductor layer between the semiconductor layer and the first low refractive index prior to depositing the first low refractive index material onto the semiconductor layer. Non-limiting examples of techniques for forming the textured region include plasma etching, reactive ion etching, porous silicon etching, lasing, chemical etching, nanoimprinting, material deposition, selective epitaxial growth, the like, including appropriate combinations thereof. In one specific aspect, forming the textured region includes laser texturing.

BRIEF DESCRIPTION OF THE DRAWINGS

For a further understanding of the nature and advantage of the present disclosure, reference is being made to the following detailed description of embodiments and in connection with the accompanying drawings, in which:

FIG. 1 is a cross-sectional view of multiple image sensor pixels in accordance with an embodiment of the present disclosure;

FIG. 2 is a cross-sectional view of multiple image sensor pixels in accordance with another embodiment of the present disclosure;

FIG. 3 is a cross-sectional view of multiple image sensor pixels in accordance with another embodiment of the present disclosure;

FIG. 4 is a cross-sectional view of a light trapping pixel in accordance with another embodiment of the present disclosure;

IPR2025-00845
Apple-Sony EX1002 Page 358

FIG. 5 is a cross-sectional view of a light trapping pixel in accordance with another embodiment of the present disclosure;

FIG. 6 is a cross-sectional view of a light trapping pixel in accordance with another embodiment of the present disclosure; and

FIG. 7 is a depiction of a method of making a light trapping pixel in accordance with yet another aspect of the present disclosure.

DETAILED DESCRIPTION

Before the present disclosure is described herein, it is to be understood that this disclosure is not limited to the particular structures, process steps, or materials disclosed herein, but is extended to equivalents thereof as would be recognized by those ordinarily skilled in the relevant arts. It should also be understood that terminology employed herein is used for the purpose of describing particular embodiments only and is not intended to be limiting.

Definitions

The following terminology will be used in accordance with the definitions set forth below.

It should be noted that, as used in this specification and the appended claims, the singular forms "a," and, "the" include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to "a dopant" includes one or more of such dopants and reference to "the layer" includes reference to one or more of such layers.

As used herein, the terms "light" and "electromagnetic radiation" can be used interchangeably and can refer to electromagnetic radiation in the ultraviolet, visible, near infrared and infrared spectra. The terms can further more broadly include electromagnetic radiation such as radio waves, microwaves, x-rays, and gamma rays. Thus, the term "light" is not limited to electromagnetic radiation in the visible spectrum. Many examples of light described herein refer specifically to electromagnetic radiation in the visible and infrared (and/or near infrared) spectra. For purposes of this disclosure, visible range wavelengths are considered to be from approximately 350 nm to 800 nm and non-visible wavelengths are considered to be longer than about 800 nm or shorter than about 350 nm. Furthermore, the infrared spectrum is considered to include a near

IPR2025-00845
Apple-Sony EX1002 Page 359

infrared portion of the spectrum including wavelengths of approximately 800 to 1100 nm, a short wave infrared portion of the spectrum including wavelengths of approximately 1100 nm to 3 micrometers, and a mid-to-long wavelength infrared (or thermal infrared) portion of the spectrum including wavelengths greater than about 3 micrometers up to about 30 micrometers. These are generally and collectively referred to herein as "infrared" portions of the electromagnetic spectrum unless otherwise noted.

As used herein, "quantum efficiency" (QE) is typically referring to "external quantum efficiency" (EQE) which is defined as the ratio of electrons collected per photons incident on an optoelectronic device. "Internal quantum efficiency" is defined as the ratio of electrons collected per photons absorbed by an optoelectronic device..

As used herein, the terms "3D" and "three dimensional" can be used interchangeably, and refer to obtaining distance information using electromagnetic radiation.

As used herein, the terms "disordered surface" and "textured surface" can be used interchangeably, and refer to a surface having a topology with nano- to micron-sized surface variations. Such a surface topology can be formed by the irradiation of a laser pulse or laser pulses, chemical etching, wet or dry etching including masked or maskless etching, lithographic patterning, interference of multiple simultaneous laser pulses, reactive ion etching, plasma etching or any other technique that can be used to form such a topology. While the characteristics of such a surface can be variable depending on the materials and techniques employed, in one aspect such a surface can be several hundred nanometers thick and made up of nanocrystallites (e.g. from about 10 to about 50 nanometers), nanopores, and the like. In another aspect, such a surface can include micron-sized structures (e.g. about 1 μm to about 60 μm). In yet another aspect, the surface can include nano-sized and/or micron-sized structures from about 5 nm and about 500 μm. A variety of criteria can be utilized to measure the size of such structures. For example, for cone-like structures the above ranges are intended to be measured from the peak of a structure to the valley formed between that structure and an adjacent neighboring structure. For structures such as nanopores, the above ranges are intended to be approximate diameters. Additionally, the surface structures can be spaced at various average distances from one another. In one aspect, neighboring structures can be spaced

IPR2025-00845
Apple-Sony EX1002 Page 360

at a distance of from about 50nm to about 50 μm. In another aspect, neighboring structures can be spaced at a distance of from about 50nm to about 2 μm. Such spacing is intended to be from a center point of one structure to the center point of a neighboring structure.

As used herein, the term "fluence" refers to the amount of energy from a single pulse of laser radiation that passes through a unit area. In other words, "fluence" can be described as the energy density of one laser pulse.

As used herein, the term "target region" refers to an area of a semiconductor material that is intended to be doped or surface modified. The target region of a semiconductor material can vary as the surface modifying process progresses. For example, after a first target region is doped or surface modified, a second target region may be selected on the same semiconductor material.

As used herein, the term "absorptance" refers to the fraction of incident electromagnetic radiation absorbed by a material or device.

As used herein, the term "monolithic" refers to an electronic device in which electronic components are formed on the same substrate. For example, two monolithic pixel elements are pixel elements that are formed on the same semiconductor substrate.

As used herein, the term "substantially" refers to the complete or nearly complete extent or degree of an action, characteristic, property, state, structure, item, or result. For example, an object that is "substantially" enclosed would mean that the object is either completely enclosed or nearly completely enclosed. The exact allowable degree of deviation from absolute completeness may in some cases depend on the specific context. However, generally speaking the nearness of completion will be so as to have the same overall result as if absolute and total completion were obtained. The use of "substantially" is equally applicable when used in a negative connotation to refer to the complete or near complete lack of an action, characteristic, property, state, structure, item, or result. For example, a composition that is "substantially free of" particles would either completely lack particles, or so nearly completely lack particles that the effect would be the same as if it completely lacked particles. In other words, a composition that is "substantially free of" an ingredient or element may still actually contain such item as long as there is no measurable effect thereof.

IPR2025-00845
Apple-Sony EX1002 Page 361

As used herein, the term "about" is used to provide flexibility to a numerical range endpoint by providing that a given value may be "a little above" or "a little below" the endpoint.

As used herein, a plurality of items, structural elements, compositional elements, and/or materials may be presented in a common list for convenience. However, these lists should be construed as though each member of the list is individually identified as a separate and unique member. Thus, no individual member of such list should be construed as a de facto equivalent of any other member of the same list solely based on their presentation in a common group without indications to the contrary.

Concentrations, amounts, and other numerical data may be expressed or presented herein in a range format. It is to be understood that such a range format is used merely for convenience and brevity and thus should be interpreted flexibly to include not only the numerical values explicitly recited as the limits of the range, but also to include all the individual numerical values or sub-ranges encompassed within that range as if each numerical value and sub-range is explicitly recited. As an illustration, a numerical range of "about 1 to about 5" should be interpreted to include not only the explicitly recited values of about 1 to about 5, but also include individual values and sub-ranges within the indicated range. Thus, included in this numerical range are individual values such as 2, 3, and 4 and sub-ranges such as from 1-3, from 2-4, and from 3-5, etc., as well as 1, 2, 3, 4, and 5, individually.

This same principle applies to ranges reciting only one numerical value as a minimum or a maximum. Furthermore, such an interpretation should apply regardless of the breadth of the range or the characteristics being described.

The Disclosure

The present disclosure provides semiconductor devices and associated methods that can exhibit various enhanced properties, such as, for example, enhanced light detection properties. More specifically, in one aspect the disclosure relates to image sensor pixels and elements for trapping light within such pixels. In other aspects, various light trapping elements can additionally isolate neighboring pixels in an image sensor. Isolation elements can be configured to optically and/or electrically isolate neighboring

IPR2025-00845
Apple-Sony EX1002 Page 362

pixels from one another in addition to trapping light with in the pixel. It is additionally contemplated that the present disclosure is applicable to other optoelectronic devices such as solar cells, and that all such should be included in the present scope.

In various aspects, image sensors can be front side or backside illuminated, 3D sensors, or any other device or system that incorporate a unique isolation element configured to reduce cross-talk between pixel elements. For example, in one aspect an image sensor can be capable of detecting visible and infrared light, whereas an isolation element associated with such an imager can be designed and configured to reduce and in some cases eliminate electrical and/or optical cross-talk between neighboring pixels from straying visible and infrared light. In some cases, isolation elements can be doped with a dopant that enables the repelling of electrical carriers from the isolation elements or in other words from the side walls of the device. In other cases, isolation elements can include light trapping or reflective materials to optically isolate neighboring pixels. It is additionally contemplated that isolation elements can include both a dopant and a light trapping or reflective material to both electrically and optically isolate the pixels. Moreover, isolation elements can also include surface features formed thereon or associated therewith. Additionally, in some cases a pixel can include a textured region to enhance the detection of infrared light among other things.

In one aspect, a variety of optoelectronic devices are provided such as, without limitation, photosensitive diodes, pixels, and imagers capable of detecting visible and infrared light while exhibiting reduced optical and electrical cross-talk between neighboring pixels or diodes. It is also contemplated that the present scope include methods associated with such devices, including methods of making and using. The present devices can additionally exhibit enhanced absorption and quantum efficiencies. Such devices can also include a plurality of photodiodes or pixels. In some cases, the present devices can achieve a quantum efficiency of 10% for wavelengths at 1064nm and having a thickness of less than 10 microns. In another embodiment, the present device can achieve a quantum efficiency of about 20% for wavelengths at 940nm and a thickness of less than 10 microns.

In one aspect, a device can include at least a semiconductor substrate having a first side for receiving incident light and a second side opposite the first side. Either or

IPR2025-00845
Apple-Sony EX1002 Page 363

both the first or second sides can include at least one doped region. Furthermore, the image sensor can include at least one isolation element or feature for at least partially separating and isolating neighboring pixels. FIG. 1 illustrates a simplified drawing of an imager having a first pixel 102 and a second pixel 104, that are formed monolithically on a common semiconductor substrate 106 and are isolated from one another by an isolation element 114. Doped regions 108 and 110 can be disposed on either the first side 120 or second side 122 of the semiconductor substrate, or in some cases on opposite sides of the device. In the present figure, the device is configured such that the first side is capable of receiving incident light. A textured region 112 having surface features is shown on the second side 122 of the semiconductor substrate 106. This architecture having the texture region 112 on the back side 122 can enable enhanced detection and absorption of electromagnetic radiation having wavelengths in the range of about 600 nm to about 1200 nm. It should be noted that this architecture can be used in either a FSI or BSI image sensor architecture. Furthermore, the textured region can be located on the first side 120, the second side 122, or both the first and second sides.

In a typical FSI imager, incident light enters the semiconductor device by first passing by transistors and metal circuitry. The light, however, scatters off of the transistors and circuitry prior to entering the light sensing portion of the imager, thus causing optical loss and noise. A lens can be disposed on the topside of a FSI pixel to direct and focus the incident light to the light sensing active region of the device, thus partially avoiding the circuitry. BSI imagers, one the other hand, are configured to have the light sensing portion of the device opposite the circuitry. Incident light enters the device via the light sensing portion and is at least partially absorbed by the device prior to reaching the circuitry. BSI designs allow for smaller pixel architecture and a high fill factor for the imager. As mentioned, the devices according to aspects of the present disclosure can be adapted for either configuration. It should also be understood that devices according to aspects of the present disclosure can be incorporated into complimentary metal-oxide-semiconductor (CMOS) imager architectures or charge-coupled device (CCD) imager architectures, as well as other optoelectronic devices.

Regarding isolation elements, also referred to herein as trench isolation features or sidewalls, various processes can be employed to form the isolation elements. It is

IPR2025-00845
Apple-Sony EX1002 Page 364

contemplated that the isolation features can extend from either the first surface or the second surface into the semiconductor material and depending on the depth of the trench can be considered either deep trench isolation or shallow trench isolation. The dimensions of the trench can vary, depending on the application. For example, trenches can have parallel walls, or they can have sloping walls, bottle neck architecture, or any other useful configuration. The depth of the trench isolation feature can be in the range of from about 100 nm to about 50 μm depending on the design of the device. The width can be in the range of from about 100 nm to about 10 μm. For simplicity, the figures in this disclosure show deep trench isolation but it should be understood that shallow trench isolation architectures can be utilized, and that deep trench isolation need not completely extend from one side to the other. The processes contemplated for forming trenches or other isolation features can include, reactive ion etch, isotropic plasma etch, wet chemical etch, laser irradiation, or any other known etch technique.

A variety of reflective materials can be utilized in constructing the isolation features in order to provide optical isolation, light trapping, and/or electrical isolation, and any such material capable of incorporation into a photosensitive device is considered to be within the present scope. Non-limiting examples of such materials include a Bragg reflector, a metal reflector, a metal reflector over a dielectric material, a transparent conductive oxide such as zinc oxide, indium oxide, or tin oxide, and the like, including combinations thereof. Non-limiting examples of metal reflector materials can include silver, aluminum, gold, platinum, reflective metal nitrides, reflective metal oxides, and the like, including combinations thereof. In one specific aspect, the dielectric layer can include an oxide layer and the reflecting region can include a metal layer. The surface of the metal layer on an oxide acts as a mirror-like reflector for the incident electromagnetic radiation. In addition, in some aspects trench isolation features can be doped to further affect the properties of the material with respect to electrical isolation.

In one specific aspect, a reflective region can include a transparent conductive oxide, an oxide, and a metal layer. The transparent oxide can be textured and a metal reflector deposited thereupon. The textured surface of the metal on a roughened transparent conductive oxide can act as a diffusive scattering site for the incident electromagnetic radiation.

IPR2025-00845
Apple-Sony EX1002 Page 365

In some cases, materials having disparate properties can be utilized in the trench isolation features in order to derive a useful combined interaction. As is shown in FIG. 2, for example, an imager having at least two pixels or photodiodes (202 and 204) and at least one isolation element 214. The pixels are shown formed monolithically on a common semiconductor substrate 206. Doped regions 208 and 210 can be disposed on either the first side 220 or second side 222 of the semiconductor substrate. A textured region 212 having surface features is created on the second side 222 of the semiconductor substrate 206.

In some aspects, the isolation element 214 can be designed to function as a Bragg reflector. In such cases, the isolation element 214 includes at least two layers 216 comprised of material having a lower refractive index (n) as compared to the material of the third layer 218 disposed or sandwiched therebetween. In other words, the isolation element includes a high refractive index material sandwiched between two low refractive index materials, and such a configuration forms a Bragg reflector. Additionally, in some aspects the low reflective index materials can be chosen to have a lower refractive index as compared to the semiconductor substrate 206.

Furthermore, in another aspect an isolation element or light trapping material can include a higher refractive index material sandwiched between two materials having a refractive index that is at least 0.2 lower as compared to the higher refractive index material. In this case, the materials are not limited by the definition of low vs. high refractive index outlined below, but are rather defined by the relative difference in refractive index. For example, in one aspect a light trapping material can include silicon dioxide/silicon nitride/silicon dioxide, each material of which would be considered to be a low refractive index material. There is, however, a greater than 0.2 difference in the refractive indexes between silicon dioxide and silicon nitride, and thus such an isolation element would be included within the present scope. It is also noted that the light trapping material can have greater than three layers. As one non-limiting example, a material can have silicon dioxide/silicon nitride/polysilicon/silicon nitride/silicon dioxide.

As has been described, in some aspects a Bragg reflector can be utilized as an isolation element to trap electromagnetic radiation within the pixel. A Bragg reflector is a structure formed from multiple layers of alternating materials with varying refractive

IPR2025-00845
Apple-Sony EX1002 Page 366

indexes, or by a periodic variation of some characteristic (e.g. height) of a dielectric waveguide, resulting in periodic variation in the effective refractive index in the guide. Each layer boundary causes a partial reflection of an optical wave. For waves whose wavelength is close to four times the optical thickness of the layers, the many reflections combine with constructive interference, and the layers act as a high-quality reflector. Thus the coherent super-positioning of reflected and transmitted light from multiple interfaces in the structure interfere so as to provide the desired reflective, transmissive, and absorptive behavior. In one aspect, a Bragg reflector can be made as in FIG. 2, whereby a high refractive index material sandwiched between two low refractive index materials. In one specific aspect, for example, the Bragg reflector can be constructed of a layer of polysilicon sandwiched between two layers of silicon dioxide. Because of the high refractive index difference between silicon and silicon dioxide, and the thickness of these layers, this structure can be fairly low loss even in regions where bulk silicon absorbs appreciably. Additionally, because of the large refractive index difference, the optical thickness of the entire layer set can be thinner, resulting in a broader-band behavior and fewer fabrications steps.

In terms of optical isolation from pixel to pixel, the large index of refraction mismatch can result in total reflection at the trench side walls. To prevent excessive dark current in the pixels, a passivation layer may be disposed on the side walls of the trench to prevent the generation of carriers and leakage current. Silicon nitride deposited over a thin grown oxide layer is also commonly used, in this case the oxide may be a low temperature grown plasma oxide.

It can be shown through calculations that a low recombination velocity of silicon oxide and silicon nitride is the result of moderately high positive oxide charge ($5x10^{11}$ to $1x10^{12}$ cm^{-2}) and relatively low midgap interface state density ($1x10^{10}$ to $4x10^{10}$ cm^{-2} eV^{-1}). The addition of silicon oxide or nitride can reduce surface recombination and surface generation. Reducing the surface recombination can increase quantum efficiency of photon collection and surface generation can cause excessive dark current in the imagers thereby reducing the quality of the image.

Since the positive oxide charge of silicon nitride or silicon oxynitride is relatively low on silicon on insulator imagers a p-type layer can be adjacent the silicon oxide,

IPR2025-00845
Apple-Sony EX1002 Page 367

silicon oxynitride and/or silicon nitride layers as an alternative embodiment. In this case the p-type layer will accumulate the surface or the backside of the p-type silicon layer and p-type sidewalls.

Other possible passivation techniques include a hot steam anneal of hydrogenated silicon nitride or the use of amorphous silicon.

Aluminum oxide can also be deposited in the trench to form an isolating barrier. Aluminum oxide can have low stress, a negative fixed charge and higher index of refraction than silicon oxide or low stress silicon oxynitride nitride. Low surface recombination velocities, as low as 10 cm/s can be obtained through various deposition processes of Al_2O_3 layers on the silicon substrate. Low surface recombination can be achieved by field induced surface passivation due to a high density of negative charges stored at the interface. PECVD aluminum oxide is described here for the backside passivation of the backside and backside trenches in backside illuminated image sensors.

The index of refraction of the aluminum oxide can be increased slightly as required by the addition of other metallic elements to make ternary insulators like Aluminum Oxynitride (AlON), Hafnium Aluminum Oxide (HfAlO), Zirconium Aluminum Oxide (ZrAlO), Lanthanum Aluminum Oxide (LaAlO), Titanium Aluminum Oxide (TiAlO) or quaternary dielectrics like Hafnium Aluminum Oxynitride (HfAlON), Tantalum Aluminum Oxynitride (TaAlON), Lanthanum Aluminum Oxynitride (LaAlON).

Low temperature PECVD deposition processes are contemplated for the backside passivation of the backside and backside trenches in backside illuminated image sensors. As previously mentioned the large index of refraction mismatch between silicon and the insulators in the trenches results in reflection of the incident light and provides optical isolation. The trenches also provide electrical isolation. Additionally, it can also be beneficial to dope the sidewalls to create a surface field that will improve electrical isolation between the pixels. In one aspect, it can also be beneficial to dope the low refractive index material of the Bragg-type reflectors to increase such electrical isolation.

Returning to FIG. 2, layers the silicon oxide and polysilicon can optically and electrically isolate the adjacent pixels, as well as function to trap light within the pixel. While any thicknesses capable of forming such a reflector are considered to be within the

IPR2025-00845
Apple-Sony EX1002 Page 368

present scope, layer 216 can have a thickness in the range of from about 50 nm to about 500 nm. Layer 118 can have a thickness in the range of from about 5 nm to about 100 nm. Thus, the difference in refractive indexes and thickness can determine the intensity of the internal reflection of electromagnetic radiation. Notably, other materials such as metals, as well as other material not listed herein can be used to increase internal reflection of the light.

It is noted that, for the purposes of the present disclosure, in one aspect a low refractive index material can have a refractive index of less than about 2.1. In the case of the sandwiched materials, the two low refractive index materials can be the same or different materials having a refractive index of less than about 2.1. Non-limiting examples of low refractive index materials can include oxides, nitrides, oxynitrides, gasses, at least a partial vacuums, and the like, including appropriate combinations thereof. Non-limiting specific examples of such materials can include silicon oxide, silicon nitride, silicon oxynitride, and the like, including combinations thereof. Additionally, a high K dielectric material can also make a suitable low reflective index material due to their low refractive index properties and good dielectric properties, and as such, are considered to be within the present scope. One example is Hafnium oxide, which has a refractive index of about 1.9. Other examples of high K dielectrics include hafnium silicate, zirconium silicate, zirconium dioxide, and the like.

Additionally, in another aspect a high refractive index material can include a material having a refractive index of greater than or equal to about 2.1. Thus, in the case of the sandwiched materials, the high refractive index material disposed between the low refractive index materials has a refractive index of about 2.1 or greater. Non-limiting examples of high refractive index materials can include polycrystalline silicon, amorphous silicon, single crystal silicon, multicrystalline silicon, nanocrystalline silicon, germanium, and the like, including appropriate combinations thereof.

In still another aspect of the present disclosure, a photosensitive imager having at least two pixels (302 and 304) and at least one trench isolation region 314 is shown in FIG. 3. The pixels can include a semiconductor substrate 306, having a first and second surface, 320 and 322 respectively; at least two doped regions 308 and 310, and a textured region 312 formed at least on the opposite side of the light incident surface (i.e. the

IPR2025-00845
Apple-Sony EX1002 Page 369

second side 322). The textured region 312 can have surface features configured to reflect and disperse light. Further, the sidewalls can include a texture region 312 to increase the internal reflections of light. Regarding the isolation element 314 in FIG. 3, the isolation element can include several layers of materials that can passivate the sidewalls and each have a different index of refraction, as was described in FIG. 2. Further, a textured region 312 can be formed on the side walls of the isolation element(s) 314.

The present disclosure additionally provides pixels and imager devices, including imager arrays, which trap light therewithin. In one aspect as is shown in FIG. 4, for example, a light trapping pixel device can include a light sensitive pixel or device 402 having a light incident surface 420, a backside surface 422 opposite the light incident surface 420, and a peripheral sidewall 424 disposed into at least a portion of the pixel 402 and extending at least substantially around the pixel periphery. It is noted that the pixel sidewall is also known as a trench. The pixel can also include a backside light trapping material 426 substantially covering, partially covering, or completely covering the backside surface 422. A peripheral light trapping material 428 can be substantially covering, partially covering, or completely covering the peripheral sidewall 424. As such, light contacting the backside light trapping material 426 or the peripheral light trapping material 428 is reflected back toward the pixel 402. Also shown in FIG. 4 are at least two doped regions 408 and 410 and an optional textured region 412. It is noted that, in addition to a single pixel as shown, pixel arrays are also contemplated and are to be included in the present scope.

The light trapping materials of FIG. 4 can be as described above, either single or multiple layer structures. In one aspect, for example, at least one of the backside light trapping material 426 and the peripheral light trapping material 428 includes a high refractive index material sandwiched between two low refractive index materials. In another aspect, the backside light trapping material 426 and the peripheral light trapping material 428 includes a high refractive index material sandwiched between two low refractive index materials. It is noted that these light trapping materials are shown in FIG. 4 as a single layer for clarity, and that multiple layers are contemplated. Furthermore, the peripheral sidewall can extend for a portion, a substantial portion, or completely around the pixel periphery. Additionally, as has been described herein, the

IPR2025-00845
Apple-Sony EX1002 Page 370

peripheral sidewall can extend partially into the pixel, substantially through the pixel, or completely through the pixel to the backside surface. Thus, both deep and shallow trenches are contemplated.

In another aspect, as is shown in FIG. 5, a pixel 502 can include a frontside light trapping material 530 that at least partially covers, substantially covers, or completely covers the light incident surface 520. The frontside light trapping material 530 can be multiple layer of materials have a variety of properties and uses, including passivation, antireflection, light trapping, and the like, including combinations thereof. Note that numerical indicators in FIG. 5 from previous figures are intended to reflect the previous descriptions for those elements, and as such, reference is made to FIG. 4.

In another aspect, as is shown in FIG. 6, a pixel 602 can include a frontside light trapping material 632 associated with the light incident surface 620 that is an internal reflective layer having an aperture 634 to allow entry of light 690 into the pixel 602. The frontside light trapping material 632 is thus operable to reflect light impinging thereupon from inside the pixel 602 back into the pixel. Additionally, in some aspects a lens 636 can be functionally coupled to the aperture 634 to focus incident light 690 through the aperture 634 and into the pixel 602. The effective surface area of the aperture compared to the frontside surface area of the pixel can vary depending on the design of the device and the presence, absence, or particular properties of a lens. In one aspect, however, the aperture can be large enough to accept and trap incoming light to a degree that increases the efficiency of the pixel. In one specific aspect, the aperture has an effective surface area of less than about 90% of the incident light surface total surface area. It is noted that various elements such as the doped regions and the optional textured layer are not shown in FIG. 6 for clarity. Furthermore, numerical indicators in FIG. 6 from previous figures are intended to reflect the previous descriptions for those elements, and as such, reference is made to FIG. 4.

The frontside light trapping material can be made of a variety of materials including metals as have been described herein with respect to other light trapping materials. As such, any material that can be applied to the light incident surface and that is internally reflective toward the inside of the pixel is considered to be within the present scope. Thus, the aforementioned pixel is reflective on 6 internal sides, and as such, light

IPR2025-00845
Apple-Sony EX1002 Page 371

entering the pixel that is not absorbed will interact with and be reflected internally be either the backside, peripheral sidewall, or frontside light trapping materials. Light is thus effectively maintained inside the pixel until it is absorbed.

In another aspect of the present disclosure, a method of making a light trapping pixel device is provided. Such a method can include, as is shown in FIG. 7, 702 forming a pixel by: 704 forming a backside light trapping material on a semiconductor layer, the backside light trapping material including a high refractive index material sandwiched between two low refractive index materials, and 706 forming a pixel device layer on the semiconductor layer opposite the light trapping material. The method can additionally include 708 etching a trench circumscribing the pixel device layer and 710 filling the trench with a light trapping material. Further details regarding the wafer bonding and wafer-bonded structures described can be found in copending US Application Serial No. 13/069,135, filed on March 22, 2011, which is incorporated herein by reference.

The formation of the backside light trapping material can be accomplished by a variety of techniques, all of which are considered to be within the present scope. In one aspect, for example, depositing a first low refractive index material onto the semiconductor layer, bonding the first low refractive index material to a high refractive index material having a second low refractive index material coupled thereto such that the high refractive index material is sandwiched in between the first and second low refractive index materials. In some cases the second low refractive index material can be coupled to a carrier wafer. In another aspect, the first low refractive index can be deposited onto the semiconductor layer followed by deposition of the high refractive index material and then the second low refractive index material. In another aspect, the layered structure can be formed on a carrier wafer, and the outermost low refractive index material can then be bonded to the semiconductor layer. The carrier wafer can then be optionally removed. In yet another aspect, the first refractive index material can be deposited onto the semiconductor layer, the second refractive index material can be deposited onto a carrier wafer, and the high refractive index material can be deposited onto either the first or second refractive index material, followed by bonding of the structure together.

IPR2025-00845
Apple-Sony EX1002 Page 372

As has been described, the trench can be a shallow trench or a deep trench. In one aspect, however, etching the trench circumscribing the pixel device layer can further include etching the trench to a depth that contacts at least the first low refractive index material. Furthermore, the method can also include applying an incident light trapping material to the pixel device layer.

In some aspects the various trenches can be filled with a material, or they can be gas filled or have a partial vacuum applied thereto. For those aspects whereby the trenches will be filled in with a non-gas material, a variety of deposition techniques are contemplated and all are considered to be within the present scope. In one aspect, however, the trench can be filled with a high refractive index material and a low refractive index material in a sandwich structure as has been described. In one exemplary technique, the filling of the trench with such light trapping material can include depositing a low refractive index material into the trench to fill a portion of the trench from the trench walls inward, ceasing deposition of the low refractive index material to leave an internal space within the trench, and depositing a high refractive index material into the trench to fill the internal space. As such, the sandwiched layer of low-high-low refractive index materials is thus created in the trench.

In another aspect, the method can also include forming a textured region on at least a portion of the semiconductor layer between the semiconductor layer and the first low refractive index prior to depositing the first low refractive index material onto the semiconductor layer. Non-limiting examples of texture formation techniques can include plasma etching, reactive ion etching, porous silicon etching, lasing, chemical etching, nanoimprinting, material deposition, selective epitaxial growth, and combinations thereof. In one specific aspect, the textured region includes laser texturing.

A device design having a textured region located on, for example, the back surface of a photodetector, provides significant performance benefits. The textured region can have surface features that can lead to higher recombination of photocarriers for short wavelengths (e.g. in the blue green part of the spectrum) due to the very shallow penetration of those wavelengths into the detecting volume of the device. By physically locating the textured on the back surface of the device, a pristine surface is provided for the collection of short wavelengths on the top surface (i.e. the light incident surface), and

IPR2025-00845
Apple-Sony EX1002 Page 373

the longer wavelengths that penetrate deep into or through the detecting region of the semiconductor material are collected by or with the help of the textured region opposite the light incident surface.

The textured region can be of various thicknesses, depending on the desired use of the material. In one aspect, for example, the textured region has a thickness of from about 500 nm to about 100 μm. In another aspect, the textured region has a thickness of from about 500 nm to about 15 μm. In yet another aspect, the textured region has a thickness of from about 500 nm to about 2 μm. In a further aspect, the textured region has a thickness of from about 500 nm to about 1 μm. In another aspect, the textured region has a thickness of from about 200 nm to about 2 μm.

The textured region can function to diffuse electromagnetic radiation, to redirect electromagnetic radiation, and/or to absorb electromagnetic radiation, thus increasing the quantum efficiency of the device. The textured region can include surface features to further increase the effective absorption length of the device. Non-limiting examples of shapes and configurations of surface features include cones, pillars, pyramids, micolenses, quantum dots, inverted features, gratings, protrusions, sphere-like structures, and the like, including combinations thereof. Additionally, surface features can be micron-sized, nano-sized, or a combination thereof. For example, cones, pyramids, protrusions, and the like can have an average height within this range. In one aspect, the average height would be from the base of the feature to the distal tip of the feature. In another aspect, the average height would be from the surface plane upon which the feature was created to the distal tips of the feature. In one specific aspect, a feature (e.g. a cone) can have a height of from about 50 nm to about 2 μm. As another example, quantum dots, microlenses, and the like can have an average diameter within the micron-sized and/or nano-sized range.

In addition to or instead of surface features, the textured region can include a textured film layer. In one aspect, for example, the textured region can include a substantially conformal textured film layer. Such a textured film layer can have an average thickness of from about 1 nm to about 20 μm. In those aspects where the textured region includes surface features, the conformal textured film layer can have a varying thickness relative to the location on the surface features upon which is deposited.

IPR2025-00845
Apple-Sony EX1002 Page 374

In the case of cones, for example, the conformal textured film layer can become thinner toward the tips of the cones. Such a conformal film layer can include various materials, including, without limitation, SiO_2, Si_3N_4, amorphous silicon, polysilicon, a metal or metals, and the like, including combinations thereof. The conformal textured film layer can also be one or more layers of the same or different materials, and can be formed during the creation of surface features or in a separate process.

Textured regions according to aspects of the present disclosure can allow a photosensitive device to experience multiple passes of incident electromagnetic radiation within the device, particularly at longer wavelengths (i.e. infrared). Such internal reflection increases the effective absorption length to be greater than the thickness of the semiconductor layer. This increase in absorption length increases the quantum efficiency of the device, leading to an improved signal to noise ratio.

The texturing process can texture the entire substrate to be processed or only a portion of the substrate. In one aspect, for example, a substrate such as the semiconductor layer can be textured and patterned by an appropriate technique over an entire surface to form the texture region. In another aspect, a substrate such as the semiconductor layer can be textured and patterned across only a portion of a surface by using a selective etching technique, such as a mask, photolithography, and an etch or a laser process to define a specific structure or pattern.

In addition to surface features, the textured region can have a surface morphology that is designed to focus or otherwise direct electromagnetic radiation. For example, in one aspect the textured region has a surface morphology operable to direct electromagnetic radiation into the semiconductor layer. Non-limiting examples of various surface morphologies include sloping, pyramidal, inverted pyramidal, spherical, square, rectangular, parabolic, asymmetric, symmetric, and the like, including combinations thereof.

The textured region, including surface features as well as surface morphologies, can be formed by various techniques, including plasma etching, reactive ion etching, porous silicon etching, lasing, chemical etching (e.g. anisotropic etching, isotropic etching), nanoimprinting, material deposition, selective epitaxial growth, and the like.

IPR2025-00845
Apple-Sony EX1002 Page 375

One effective method of producing a textured region is through laser processing. Such laser processing allows discrete target areas of a substrate to be textured, as well as entire surfaces. A variety of techniques of laser processing to form a textured region are contemplated, and any technique capable of forming such a region should be considered to be within the present scope. Laser treatment or processing can allow, among other things, enhanced absorption properties and thus increased electromagnetic radiation focusing and detection.

In one aspect, for example, a target region of the substrate to be textured can be irradiated with laser radiation to form a textured region. Examples of such processing have been described in further detail in U.S. Patents 7,057,256, 7,354,792 and 7,442,629, which are incorporated herein by reference in their entireties. Briefly, a surface of a substrate material is irradiated with laser radiation to form a textured or surface modified region. Such laser processing can occur with or without a dopant material. In those aspects whereby a dopant is used, the laser can passed through a dopant carrier and onto the substrate surface. In this way, dopant from the dopant carrier is introduced into the target region of the substrate material. Such a region incorporated into a substrate material can have various benefits in accordance with aspects of the present disclosure. For example, the textured region typically has a textured surface that increases the surface area and increases the probability of radiation absorption. In one aspect, such a textured region is a substantially textured surface including micron-sized and/or nano-sized surface features that have been generated by the laser texturing. In another aspect, irradiating the surface of a substrate material includes exposing the laser radiation to a dopant such that irradiation incorporates the dopant into the substrate. Various dopant materials are known in the art, and are discussed in more detail herein.

Thus the surface of the substrate at the target region is thus chemically and/or structurally altered by the laser treatment, which may, in some aspects, result in the formation of surface features appearing as structures or patterned areas on the surface and, if a dopant is used, the incorporation of such dopants into the substrate material. In some aspects, the features or structures can be on the order of 50 nm to 20 μm in size and can assist in the absorption of electromagnetic radiation. In other words, the textured surface can increase the probability of incident radiation being absorbed.

IPR2025-00845
Apple-Sony EX1002 Page 376

A variety of semiconductor materials are contemplated for use with the pixel devices and methods according to aspects of the present disclosure. Such materials can be utilized as the semiconductor layer and/or the semiconductor substrate, as well as for the secondary semiconductor layer and the epitaxially grown semiconductor layer. Non-limiting examples of such semiconductor materials can include group IV materials, compounds and alloys comprised of materials from groups II and VI, compounds and alloys comprised of materials from groups III and V, and combinations thereof. More specifically, exemplary group IV materials can include silicon, carbon (e.g. diamond), germanium, and combinations thereof. Various exemplary combinations of group IV materials can include silicon carbide (SiC) and silicon germanium (SiGe). In one specific aspect, the semiconductor material can be or include silicon. Exemplary silicon materials can include amorphous silicon (a-Si), microcrystalline silicon, multicrystalline silicon, and monocrystalline silicon, as well as other crystal types. In another aspect, the semiconductor material can include at least one of silicon, carbon, germanium, aluminum nitride, gallium nitride, indium gallium arsenide, aluminum gallium arsenide, and combinations thereof.

Exemplary combinations of group II-VI materials can include cadmium selenide (CdSe), cadmium sulfide (CdS), cadmium telluride (CdTe), zinc oxide (ZnO), zinc selenide (ZnSe), zinc sulfide (ZnS), zinc telluride (ZnTe), cadmium zinc telluride (CdZnTe, CZT), mercury cadmium telluride (HgCdTe), mercury zinc telluride (HgZnTe), mercury zinc selenide (HgZnSe), and combinations thereof.

Exemplary combinations of group III-V materials can include aluminum antimonide (AlSb), aluminum arsenide (AlAs), aluminum nitride (AlN), aluminum phosphide (AlP), boron nitride (BN), boron phosphide (BP), boron arsenide (BAs), gallium antimonide (GaSb), gallium arsenide (GaAs), gallium nitride (GaN), gallium phosphide (GaP), indium antimonide (InSb), indium arsenide (InAs), indium nitride (InN), indium phosphide (InP), aluminum gallium arsenide (AlGaAs, $Al_xGa_{1-x}As$), indium gallium arsenide (InGaAs, $In_xGa_{1-x}As$), indium gallium phosphide (InGaP), aluminum indium arsenide (AlInAs), aluminum indium antimonide (AlInSb), gallium arsenide nitride (GaAsN), gallium arsenide phosphide (GaAsP), aluminum gallium nitride (AlGaN), aluminum gallium phosphide (AlGaP), indium gallium nitride (InGaN),

IPR2025-00845
Apple-Sony EX1002 Page 377

indium arsenide antimonide (InAsSb), indium gallium antimonide (InGaSb), aluminum gallium indium phosphide (AlGaInP), aluminum gallium arsenide phosphide (AlGaAsP), indium gallium arsenide phosphide (InGaAsP), aluminum indium arsenide phosphide (AlInAsP), aluminum gallium arsenide nitride (AlGaAsN), indium gallium arsenide nitride (InGaAsN), indium aluminum arsenide nitride (InAlAsN), gallium arsenide antimonide nitride (GaAsSbN), gallium indium nitride arsenide antimonide (GaInNAsSb), gallium indium arsenide antimonide phosphide (GaInAsSbP), and combinations thereof.

The semiconductor material can be of any thickness that allows the desired property or functionality of the semiconductor device, and thus any such thickness of semiconductor material is considered to be within the present scope. The textured region can increase the efficiency of the device such that, in some aspects, the semiconductor material can be thinner than has previously been possible. Decreasing the thickness reduces the amount of semiconductor material used to make such a device. In one aspect, for example, a semiconductor material such as the semiconductor layer has a thickness of from about 500 nm to about 50 μm. In another aspect, the semiconductor material has a thickness of less than or equal to about 500 μm. In yet another aspect, the semiconductor material has a thickness of from about 1 μm to about 10 μm. In a further aspect, the semiconductor material can have a thickness of from about 5 μm to about 750 μm. In yet a further aspect, the semiconductor material can have a thickness of from about 5 μm to about 100 μm.

Additionally, various configurations of semiconductor materials are contemplated, and any such material configuration that can be incorporated into a semiconductor device is considered to be within the present scope. In one aspect, for example, the semiconductor material can include monocrystalline materials. In another aspect, the semiconductor material can include multicrystalline materials. In yet another aspect, the semiconductor material can include microcrystalline materials. It is also contemplated that the semiconductor material can include amorphous materials.

As has been described, the semiconductor substrate can be of any size, shape, and material capable of supporting the semiconductor layer and associated components during manufacture and/or use. The semiconductor substrate can be made from various

IPR2025-00845
Apple-Sony EX1002 Page 378

materials, including the semiconductor materials described above, as well as non-semiconductor materials. Non-limiting examples of such materials can include metals, polymeric materials, ceramics, glass, and the like. In some aspects, the semiconductor substrate and the semiconductor layer have the same or substantially the same thermal expansion properties.

Furthermore, the semiconductor material according to aspects of the present disclosure can comprise multiple layers. In some aspects, layers can vary in majority carrier polarity (i.e. donor or acceptor impurities). The donor or acceptor impurities are typically determined by the type of dopant/impurities introduced into the device either through a growth process, deposition process, epitaxial process, implant process, lasing process or other known process to those skilled in the art. In some aspects such semiconductor materials can include an n-type layer, an intrinsic (i-type) layer, and a p-type layer, thus forming a p-i-n semiconductor material stack that creates a junction and/or depletion region. A semiconductor material devoid of an i-type layer is also contemplated in accordance with the present disclosure. In other aspects the semiconductor material may include multiple junctions. Additionally, in some aspects, variations of n(--), n(-), n(+), n(++), p(--), p(-), p(+), or p(++) type semiconductor layers can be used. The minus and positive signs are indicators of the relative magnitude of the doping of the semiconductor material.

A variety of dopant materials are contemplated for both the formation of doped regions in the semiconductor layer and for doping of the textured region, and any dopant that can be used in such processes to modify a material is considered to be within the present scope. It should be noted that the particular dopant utilized can vary depending on the material being doped, as well as the intended use of the resulting material.

A dopant can be either a charge donating or a charge accepting dopant species. More specifically, an electron donating or a hole donating species can cause a region to become more positive or negative in polarity as compared to the substrate upon which the rests. In one aspect, for example, the doped region can be p-doped. In another aspect the doped region can be n-doped.

In one aspect, non-limiting examples of dopant materials can include S, F, B, P, N, As, Se, Te, Ge, Ar, Ga, In, Sb, and combinations thereof. It should be noted that the

IPR2025-00845
Apple-Sony EX1002 Page 379

scope of dopant materials should include, not only the dopant materials themselves, but also materials in forms that deliver such dopants (i.e. dopant carriers). For example, S dopant materials includes not only S, but also any material capable being used to dope S into the target region, such as, for example, H_2S, SF_6, SO_2, and the like, including combinations thereof. In one specific aspect, the dopant can be S. Sulfur can be present at an ion dosage level of from about 5×10^{14} to about 3×10^{20} ions/cm^2. Non-limiting examples of fluorine-containing compounds can include ClF_3, PF_5, F_2 SF_6, BF_3, GeF_4, WF_6, SiF_4, HF, CF_4, CHF_3, CH_2F_2, CH_3F, C_2F_6, C_2HF_5, C_3F_8, C_4F_8, NF_3, and the like, including combinations thereof. Non-limiting examples of boron-containing compounds can include $B(CH_3)_3$, BF_3, BCl_3, BN, $C_2B_{10}H_{12}$, borosilica, B_2H_6, and the like, including combinations thereof. Non-limiting examples of phosphorous-containing compounds can include PF_5, PH_3, $POCl_3$, P_2O_5, and the like, including combinations thereof. Non-limiting examples of chlorine-containing compounds can include Cl_2, SiH_2Cl_2, HCl, $SiCl_4$, and the like, including combinations thereof. Dopants can also include arsenic-containing compounds such as AsH_3 and the like, as well as antimony-containing compounds. Additionally, dopant materials can include mixtures or combinations across dopant groups, i.e. a sulfur-containing compound mixed with a chlorine-containing compound. In one aspect, the dopant material can have a density that is greater than air. In one specific aspect, the dopant material can include Se, H_2S, SF_6, or mixtures thereof. In yet another specific aspect, the dopant can be SF_6 and can have a predetermined concentration range of about 5.0×10^{-8} mol/cm^3 to about 5.0×10^{-4} mol/cm^3. As one non-limiting example, SF_6 gas is a good carrier for the incorporation of sulfur into a substrate via a laser process without significant adverse effects on the material. Additionally, it is noted that dopants can also be liquid solutions of n-type or p-type dopant materials dissolved in a solution such as water, alcohol, or an acid or basic solution. Dopants can also be solid materials applied as a powder or as a suspension dried onto the wafer.

In another aspect, the band structure optimization can be realized by forming a heterojunction along a modified semiconductor interface. For example, a layer of amorphous silicon can be deposited on the textured region interface, thus forming a heterojunction that bends the minority carrier band towards the desired energy direction.

IPR2025-00845
Apple-Sony EX1002 Page 380

CLAIMS

What is claimed is:

1. A light trapping device, comprising:

at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall disposed into at least a portion of the pixel and extending at least substantially around the pixel periphery;

a backside light trapping material substantially covering the backside surface; and

a peripheral light trapping material substantially covering the peripheral sidewall;

wherein light contacting the backside light trapping material or the peripheral light trapping material is reflected back toward the pixel.

2. The device of claim 1, wherein at least one of the backside light trapping material and the peripheral light trapping material includes a high refractive index material sandwiched between two low refractive index materials.

3. The device of claim 1, wherein the backside light trapping material and the peripheral light trapping material includes a high refractive index material sandwiched between two low refractive index materials.

4. The device of claim 3, wherein the two low refractive index materials have a refractive index of less than about 2.1.

5. The device of claim 4, wherein at least one of the two low refractive index material includes a member selected from the group consisting of an oxide, a nitride, oxynitrides, a gas, at least a partial vacuum, and combinations thereof.

6. The device of claim 4, wherein the at least one of the two low refractive index materials includes a member selected from the group consisting of silicon oxide, silicon nitride, silicon dioxide, and combinations thereof.

IPR2025-00845
Apple-Sony EX1002 Page 381

7. The device of claim 3, wherein the high refractive index material includes a material having a refractive index of greater than or equal to about 2.1.

8. The device of claim 7, wherein the high refractive index material includes a member selected from the group consisting of polycrystalline silicon, amorphous silicon, single crystal silicon, multicrystalline silicon, nanocrystalline silicon, germanium, and combinations thereof.

9. The device of claim 2, wherein at least one of the two low refractive index materials is doped with a dopant to create a surface field.

10. The device of claim 9, wherein the dopant is boron or antimony.

11. The device of claim 1, wherein at least one of the backside light trapping material and the peripheral light trapping material includes a first material sandwiched between two second materials, wherein the first material has a higher refractive index as compared to the two second materials, and wherein the difference in refractive index between the first material and the two second materials is at least 0.2.

12. The device of claim 1, wherein the peripheral sidewall extends completely around the pixel periphery.

13. The device of claim 1, wherein the peripheral sidewall extends from the light incident surface to the backside surface.

14. The device of claim 1, further comprising a frontside light trapping material at least partially covering the light incident surface.

15. The device of claim 14, wherein the frontside light trapping material is an antireflective layer coating.

IPR2025-00845
Apple-Sony EX1002 Page 382

16. The device of claim 14, wherein the frontside light trapping material is a reflective layer having an aperture to allow entry of light into the pixel, wherein the reflective layer is operable to reflect light impinging thereupon from inside the pixel back into the pixel.

17. The device of claim 16, further comprising a lens functionally coupled to the aperture and operable to focus incident light through the aperture and into the pixel.

18. The device of claim 16, wherein the aperture has an effective surface area of _____ % of the incident light surface total surface area.

19. The device of claim 1, wherein at least one of the backside light trapping material and the peripheral light trapping material is a metal layer.

20. The device of claim 1, wherein at least one of the backside light trapping material and the peripheral light trapping material has a sloped surface at the pixel device interface.

21. The device of claim 1, further comprising a textured layer positioned to interact with light proximal to the backside surface.

22. The device of claim 21, wherein the textured layer is located between the backside surface and the backside light trapping material.

23. An array of light trapping pixel devices of claim 1.

24. A substantially light trapping device, comprising:

at least one light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall extending from the light incident surface to the backside surface and extending around the pixel periphery;

a backside light trapping material substantially covering the backside surface;

IPR2025-00845
Apple-Sony EX1002 Page 383

a peripheral light trapping material substantially covering the peripheral sidewall; and

an internally reflective frontside light trapping material covering at least a portion of the light incident surface operable allow entrance of light into the pixel and operable to reflect light impinging thereupon from inside the pixel back into the pixel, and wherein light contacting the backside light trapping material or the peripheral light trapping material is reflected back toward the pixel.

25. The device of claim 24, wherein the internally reflective frontside light trapping material includes an aperture to allow entry of light into the pixel.

26. The device of claim 25, further comprising a lens functionally coupled to the aperture and operable to focus incident light through the aperture and into the pixel.

27. A method of making a light trapping device, comprising:

forming a pixel by:

forming a backside light trapping material on a semiconductor layer, the backside light trapping material including a high refractive index material sandwiched between two low refractive index materials; and

forming a pixel device layer on the semiconductor layer opposite the light trapping material;

etching a trench circumscribing the pixel device layer; and

filling the trench with a peripheral light trapping material.

28. The method of claim 27, wherein etching the trench circumscribing the pixel device layer can further include etching the trench to a depth that contacts at least the backside light trapping material.

29. The method of claim 27, further comprising applying an incident light trapping material to the pixel device layer.

IPR2025-00845
Apple-Sony EX1002 Page 384

30. The method of claim 27, wherein filling the trench with the peripheral light trapping material further includes:

depositing a low refractive index material into the trench to fill a portion of the trench from the trench walls inward;

ceasing deposition of the low refractive index material to leave an internal space within the trench; and

depositing a high refractive index material into the trench to fill the internal space.

31. The method of claim 27, further comprising forming a textured region on at least a portion of the semiconductor layer between the semiconductor layer and the backside light trapping material.

32. The method of claim 31, wherein forming the textured region includes a technique selected from the group consisting of plasma etching, reactive ion etching, porous silicon etching, lasing, chemical etching, nanoimprinting, material deposition, selective epitaxial growth, and combinations thereof.

33. The method of claim 32, wherein forming the textured region includes laser texturing.

IPR2025-00845
Apple-Sony EX1002 Page 385

ABSTRACT OF THE DISCLOSURE

Light trapping pixels, devices incorporating such pixels, and various associated methods are provided. In one aspect, for example, a light trapping pixel device can include a light sensitive pixel having a light incident surface, a backside surface opposite the light incident surface, and a peripheral sidewall disposed into at least a portion of the pixel and extending at least substantially around the pixel periphery. The pixel can also include a backside light trapping material substantially covering the backside surface and a peripheral light trapping material substantially covering the peripheral sidewall. The light contacting the backside light trapping material or the peripheral light trapping material is thus reflected back toward the pixel.

IPR2025-00845
Apple-Sony EX1002 Page 386

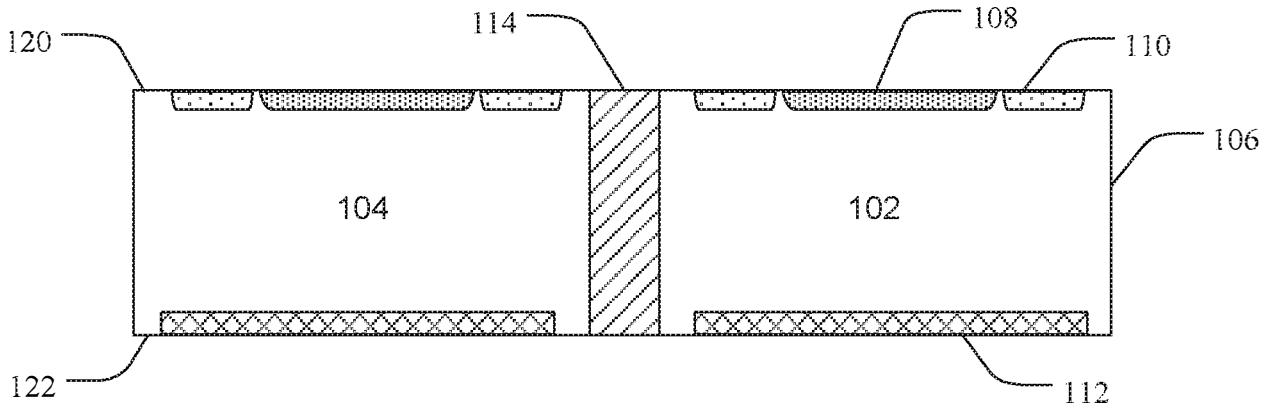

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FIG. 1

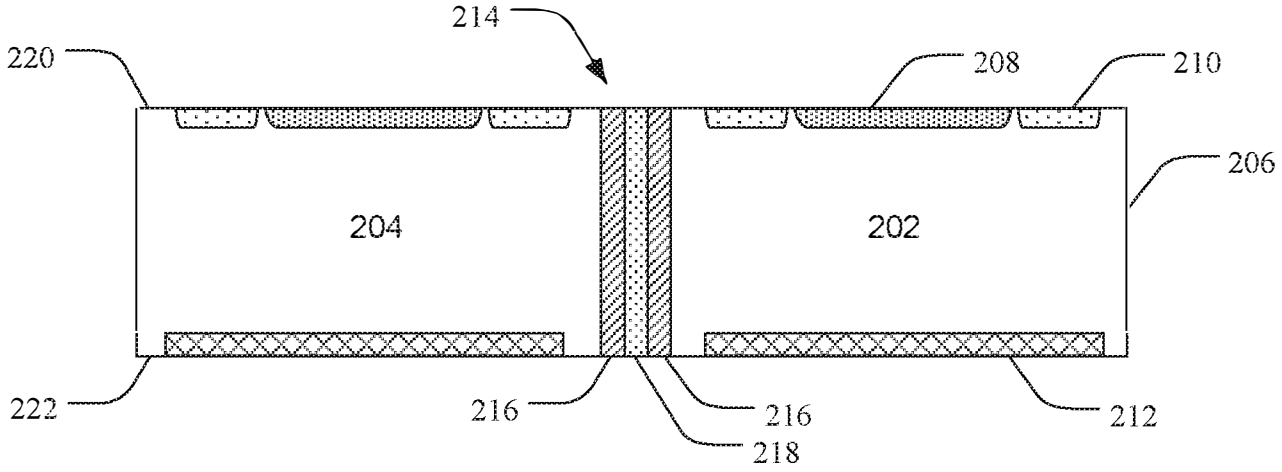

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FIG. 2

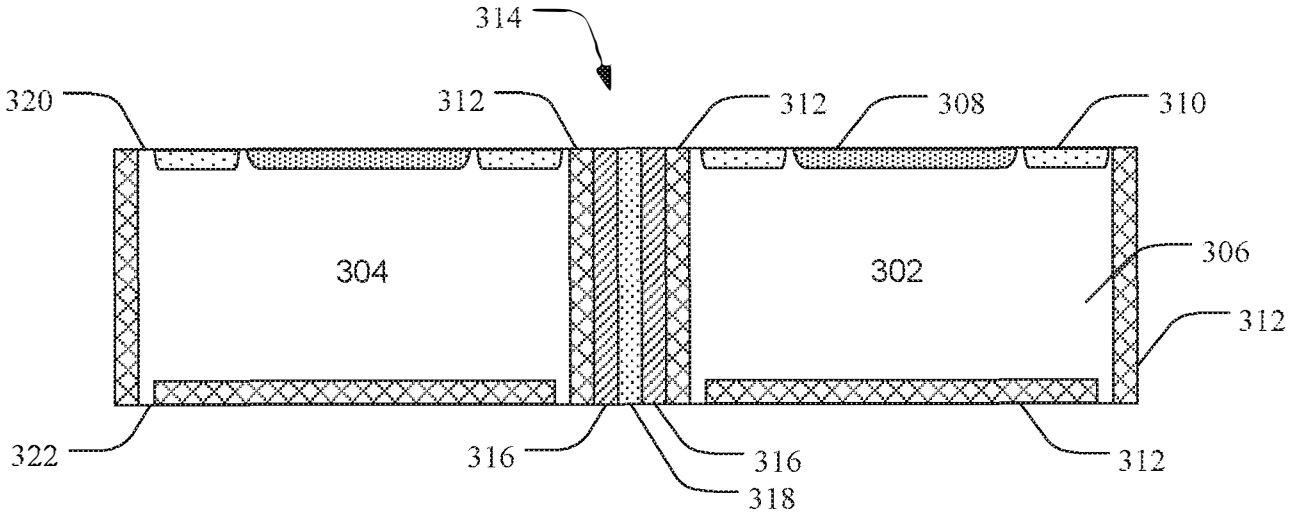


FIG. 3

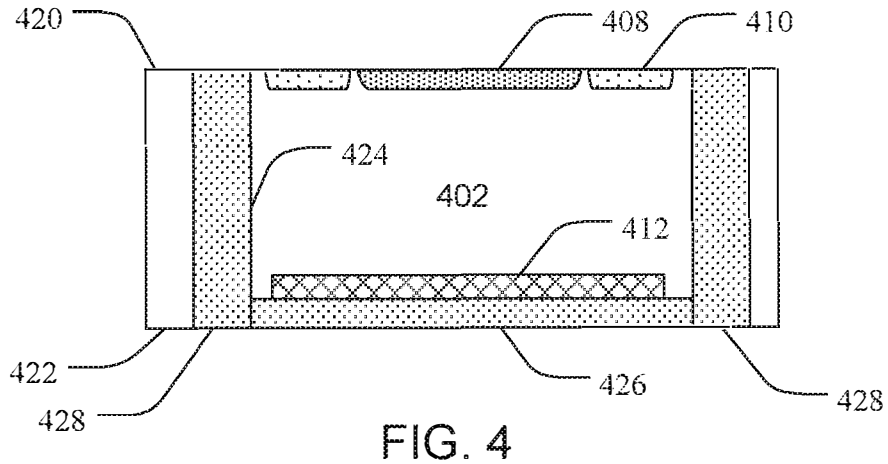


FIG. 4

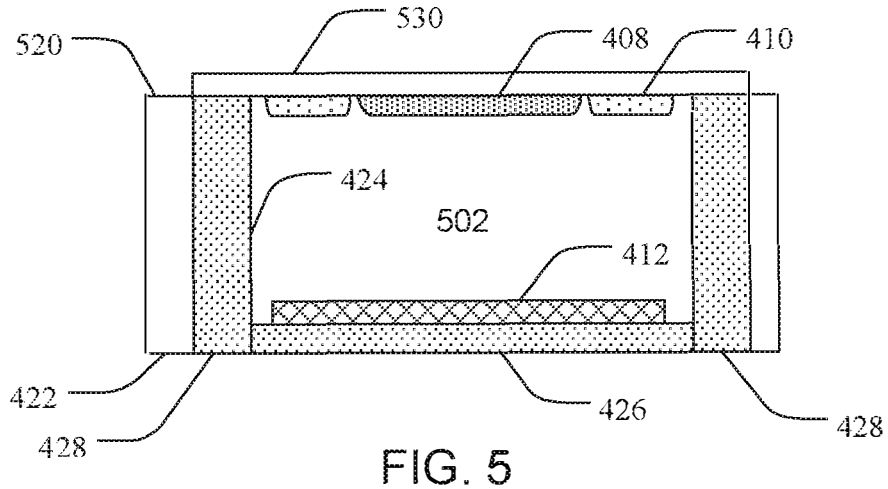


FIG. 5

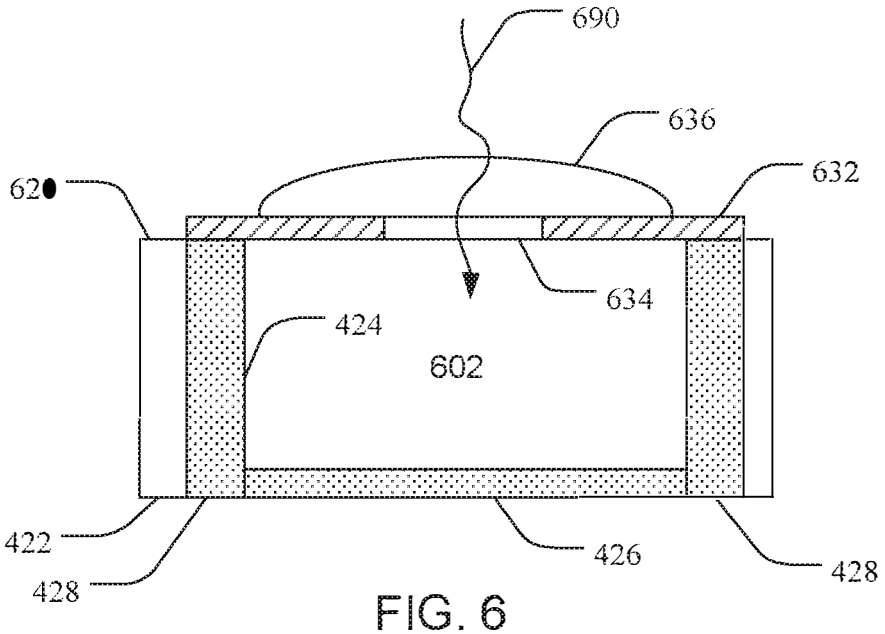


FIG. 6

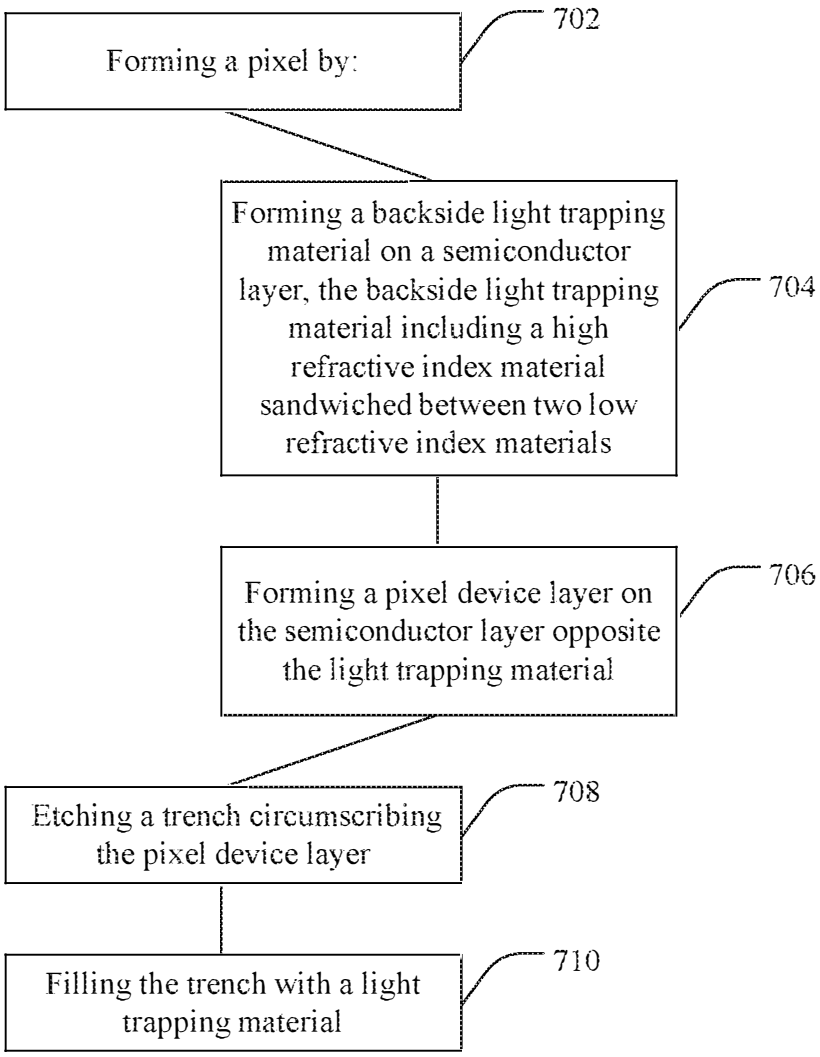

Forming a pixel by:
702
Forming a backside light trapping material on a semiconductor layer, the backside light trapping material including a high refractive index material sandwiched between two low refractive index materials
704
Forming a pixel device layer on the semiconductor layer opposite the light trapping material
706
Etching a trench circumscribing the pixel device layer
708
Filling the trench with a light trapping material
710

FIG. 7

Docket Number: 3035-052.NP

Substitute Form PTO/AIA/01

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	Pixel Isolation Elements, Devices and Associated Methods

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 13/841,120

filed on 3/15/2013.

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

I have reviewed and understand the contents of the above-identified application, including the claims. I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT International filing date of the continuation-in-part application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

LEGAL NAME OF INVENTOR

Inventor: Martin U. Pralle Date (Optional): 4/3/14

Signature:

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/AIA/01 form for each additional inventor.

Docket Number: **3035-052.NP** Substitute Form PTO/AIA/01

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	Pixel Isolation Elements, Devices and Associated Methods

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 13/841,120 filed on 3/15/2013.

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

I have reviewed and understand the contents of the above-identified application, including the claims. I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT International filing date of the continuation-in-part application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

LEGAL NAME OF INVENTOR

Inventor: Jeffrey McKee Date (Optional): 4-7-14

Signature: _____

Note: An application data sheet (PTO/SB/14 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/AIA/01 form for each additional inventor.

Docket Number: 3035-052.NP

Substitute Form PTO/AIA/01

DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING AN APPLICATION DATA SHEET (37 CFR 1.76)

Title of Invention	Pixel Isolation Elements, Devices and Associated Methods

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 13/841,120 filed on 3/15/2013.

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

I have reviewed and understand the contents of the above-identified application, including the claims. I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior application and the national or PCT international filing date of the continuation-in-part application.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

LEGAL NAME OF INVENTOR

Inventor: Jason Sickler Date (Optional): 4/3/2014

Signature:

Note: An application data sheet (PTO/SB/14 or equivalent), including the entire inventive entity, must accompany this form. Use an additional PTO/AIA/01 form for each additional inventor.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	PIXEL ISOLATION ELEMENTS, DEVICES, AND ASSOCIATED METHODS
First Named Inventor/Applicant Name:	Martin U. Pralle
Filer:	Reza Mollaaghababa/Jillian Stockel
Attorney Docket Number:	143705.05221

Filed as Large Entity

Filing Fees for Track I Prioritized Examination - Nonprovisional Application under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Utility application filing	1011	1	280	280
Utility Search Fee	1111	1	600	600
Utility Examination Fee	1311	1	720	720
Request for Prioritized Examination	1817	1	4000	4000
Pages:				
Claims:				
Miscellaneous-Filing:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Publ. Fee- Early, Voluntary, or Normal	1504	1	0	0
PROCESSING FEE, EXCEPT PROV. APPLS.	1830	1	140	140
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**5740**

Electronic Acknowledgement Receipt

EFS ID:	26419797
Application Number:	15216244
International Application Number:	
Confirmation Number:	5052
Title of Invention:	PIXEL ISOLATION ELEMENTS, DEVICES, AND ASSOCIATED METHODS
First Named Inventor/Applicant Name:	Martin U. Pralle
Customer Number:	136549
Filer:	Reza Mollaaghababa/Jillian Stockel
Filer Authorized By:	Reza Mollaaghababa
Attorney Docket Number:	143705.05221
Receipt Date:	21-JUL-2016
Filing Date:	
Time Stamp:	16:14:12
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$5740
RAM confirmation Number	072216INTEFSW16173400
Deposit Account	1014
Authorized User	Jillian Stockel

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	TrackOne Request	Track1Request.pdf	114195 a7ade690c6b3330fbc82f15edada66256664514b	no	2
Warnings:					
Information:					
2	Application Data Sheet	ADS.pdf	1823528 f0fd7298a4da0303a6fb370f62f2faff3fad8b7c	no	9
Warnings:					
Information:					
3		PrelimAmend.pdf	151850 f37acb24567cab72fca7aed8cf394f6d0eae3054	yes	6

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Preliminary Amendment	1	1
	Specification	2	2
	Claims	3	5
	Applicant Arguments/Remarks Made in an Amendment	6	6

Warnings:					
Information:					
4		Application.pdf	207483 81af94c1214367d3a0a910c2609429c2e2adf978	yes	32

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**

	Specification		1		26
	Claims		27		31
	Abstract		32		32
Warnings:					
Information:					
5	Drawings-only black and white line drawings	Figures.pdf	65750 073a8337332888f269a9da027e6f9eb03a9bff5d	no	4
Warnings:					
Information:					
6	Oath or Declaration filed	Declarations.pdf	140546 4454d41ac86edc7fd4afce025214660932df26d9	no	3
Warnings:					
Information:					
7	Fee Worksheet (SB06)	fee-info.pdf	40295 832d0db6a46167451600f1dc0753ae1ec56a3db1	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	2543647		

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.

Doc Code: TRACK1.REQ
Document Description: **TrackOne Request**

PTO/AIA/424 (04-14)

CERTIFICATION AND REQUEST FOR PRIORITIZED EXAMINATION UNDER 37 CFR 1.102(e) (Page 1 of 1)

First Named Inventor:	Martin U. Pralle	Nonprovisional Application Number (if known):	
Title of Invention:	Pixel Isolation Elements, Devices, and Associated Methods		

APPLICANT HEREBY CERTIFIES THE FOLLOWING AND REQUESTS PRIORITIZED EXAMINATION FOR THE ABOVE-IDENTIFIED APPLICATION.

1. The processing fee set forth in 37 CFR 1.17(i)(1) and the prioritized examination fee set forth in 37 CFR 1.17(c) have been filed with the request. The publication fee requirement is met because that fee, set forth in 37 CFR 1.18(d), is currently $0. The basic filing fee, search fee, and examination fee are filed with the request or have been already been paid. I understand that any required excess claims fees or application size fee must be paid for the application.

2. I understand that the application may not contain, or be amended to contain, more than four independent claims, more than thirty total claims, or any multiple dependent claims, and that any request for an extension of time will cause an outstanding Track I request to be dismissed.

3. The applicable box is checked below:

I. ☑ Original Application (Track One) - Prioritized Examination under § 1.102(e)(1)

i. (a) The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a). This certification and request is being filed with the utility application via EFS-Web.

---OR---

(b) The application is an original nonprovisional plant application filed under 35 U.S.C. 111(a). This certification and request is being filed with the plant application in paper.

ii. An executed inventor's oath or declaration under 37 CFR 1.63 or 37 CFR 1.64 for each inventor, **or** the application data sheet meeting the conditions specified in 37 CFR 1.53(f)(3)(i) is filed with the application.

II. ☐ Request for Continued Examination - Prioritized Examination under § 1.102(e)(2)

i. A request for continued examination has been filed with, or prior to, this form.
ii. If the application is a utility application, this certification and request is being filed via EFS-Web.
iii. The application is an original nonprovisional utility application filed under 35 U.S.C. 111(a), or is a national stage entry under 35 U.S.C. 371.
iv. This certification and request is being filed prior to the mailing of a first Office action responsive to the request for continued examination.
v. No prior request for continued examination has been granted prioritized examination status under 37 CFR 1.102(e)(2).

Signature /Reza Mollaaghababa/	Date July 21, 2016
Name (Print/Typed) Reza Mollaaghababa	Practitioner Registration Number 43810

Note: *This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. Submit multiple forms if more than one signature is required.**

☑ *Total of 1 forms are submitted.

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.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	143705.05221
	Application Number	
Title of Invention	Pixel Isolation Elements, Devices and Associated Methods	

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
	Martin	U.	Pralle	

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

City	State/Province	Country of Residence
Wayland	MA	US

Mailing Address of Inventor:

Address 1	15 Rice Spring Lane
Address 2	
City	Wayland
State/Province	MA
Postal Code	01778
Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jeffrey		McKee	

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

City	State/Province	Country of Residence
Tualatin	OR	US

Mailing Address of Inventor:

Address 1	22850 SW. Eno Place
Address 2	
City	Tualatin
State/Province	OR
Postal Code	97062
Country	US

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Jason		Sickler	

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

PTO/AIA/14 (11-15)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	143705.05221
	Application Number	
Title of Invention	Pixel Isolation Elements, Devices and Associated Methods	

City	Arlington	State/Province	MA	Country of Residence	US

Mailing Address of Inventor:

Address 1	53 Varnum Street		
Address 2			
City	Arlington	**State/Province**	MA
Postal Code	02474	**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	136549		
Email Address	DocketingBN@pepperlaw.com	Add Email	Remove Email

Application Information:

Title of the Invention	Pixel Isolation Elements, Devices and Associated Methods		
Attorney Docket Number	143705.05221	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	4	**Suggested Figure for Publication (if any)**	

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.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	143705.05221
	Application Number	
Title of Invention	Pixel Isolation Elements, Devices and Associated Methods	

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	136549		

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	14747875	2015-06-23
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
14747875	Continuation of	13841120	2013-03-15
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
13841120	Claims benefit of provisional	61614275	2012-03-22

Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the **Add** button. Add

Foreign Priority Information:

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	143705.05221
	Application Number	
Title of Invention	Pixel Isolation Elements, Devices and Associated Methods	

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

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.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	143705.05221
	Application Number	
Title of Invention	Pixel Isolation Elements, Devices and Associated Methods	

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.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	143705.05221
	Application Number	
Title of Invention	Pixel Isolation Elements, Devices and Associated Methods	

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	SiOnyx, LLC.		
Mailing Address Information For Applicant:			
Address 1	100 Cummings Ctr., Suite 243-F		
Address 2			
City	Beverly	**State/Province**	MA
Country	US	Postal Code	01915
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.

PTO/AIA/14 (11-15)
Approved for use through 04/30/2017. 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 contains a valid OMB control number.

Application Data Sheet 37 CFR 1.76	Attorney Docket Number	143705.05221
	Application Number	
Title of Invention	Pixel Isolation Elements, Devices and Associated Methods	

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:

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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).**

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

Signature	/Reza Mollaaghababa/			Date (YYYY-MM-DD)	2016-07-21
First Name	Reza	Last Name	Mollaaghababa	Registration Number	43810

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	143705.05221
	Application Number	
Title of Invention	Pixel Isolation Elements, Devices and Associated Methods	

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