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In re Patent Application of: Homayoon Haddad *et al.*

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For: SHALLOW TRENCH TEXTURED REGIONS AND
ASSOCIATED METHODS

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FIRST PRELIMINARY AMENDMENT

Dear Sir,

Prior to examination on the merits, please amend the above-identified U.S. patent application as follows:

Amendments to the Specification begin on page 2 of this paper.

Remarks begin on page 3.

ABSTRACT OF THE DISCLOSURE

Photosensitive devices and associated methods are provided. In one aspect, for example, a photosensitive imager device can include a semiconductor layer having multiple doped regions forming a least one junction, a textured region coupled to the
5 semiconductor layer and positioned to interact with electromagnetic radiation. The textured region can be formed from a series of shallow trench isolation features.

CLAIMS

What is claimed is:

- 5 1. An optoelectronic device having enhanced absorption of electromagnetic radiation,
comprising:
 a semiconductor layer coupled to a support substrate; and
 an array of shallow trench isolation surface features positioned between the
semiconductor layer and the support substrate, the surface features positioned to interact
10 with electromagnetic radiation that passes through the semiconductor layer.
2. The device of claim 1, wherein the semiconductor layer is single crystal silicon.
3. The device of claim 1, further comprising a first bonding layer coupled between the
15 semiconductor layer and the support substrate.
4. The device of claim 3, wherein the first bonding layer is coupled between the support
substrate and the surface features.
- 20 5. The device of claim 3, further comprising a second bonding layer positioned between
the first bonding layer and the support substrate.
6. The device of claim 5, further comprising a reflector layer disposed between the first
bonding layer and the second bonding layer.
25 7. The device of claim 1, wherein the surface features are formed in the support
substrate.
8. The device of claim 1, wherein the surface features are formed in the semiconductor
30 layer.

9. The device of claim 1, wherein the surface features are arranged according to a predetermined pattern.
10. The device of claim 9, wherein the predetermined pattern is an at least substantially
5 uniform grid.
11. The device of claim 9, wherein the predetermined pattern is a non-uniform arrangement.
- 10 12. The device of claim 1, wherein the surface features have an at least substantially uniform height.
13. The device of claim 1, wherein the surface features are not uniform in height.
- 15 14. The device of claim 1, further comprising a device layer coupled to the semiconductor layer on a side opposite the surface features.
15. The device of claim 1, wherein the device is architecturally configured as a front-side illuminated optoelectronic device.
- 20 16. The device of claim 1, wherein the device is architecturally configured as a back-side illuminated optoelectronic device.
17. A method of making an optoelectronic device, comprising:
- 25 creating an array of surface features on a semiconductor layer using shallow trench isolation etching; and
- bonding the array of surface features between a support substrate and a semiconductor layer.
- 30 18. The method of claim 17, wherein creating the array of surface features further comprises creating the array of surface features on at least a portion of a surface of the

semiconductor layer.

19. The method of claim 17, wherein creating the array of surface features further
comprises creating the array of surface features on at least a portion of a surface of the
5 support substrate.

20. The method of claim 17, wherein bonding the array of surface features between the
support substrate and the semiconductor layer further includes:
depositing a first bonding layer onto the semiconductor layer; and
10 bonding the first bonding layer to a second bonding layer disposed on the support
substrate.

15

SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS

PRIORITY DATA

This application is a continuation of U.S. patent application Ser. No. 14/884,181,
5 filed on October 15, 2015, which is a continuation of U.S. patent application Ser. No.
14/084,392, filed Nov. 19, 2013, which claims the benefit of U.S. Provisional Patent
Application Ser. No. 61/841,326, filed on Jun. 29, 2013, each of which are incorporated
herein by reference in their entirety.

BACKGROUND

The interaction of light with semiconductor materials has been a significant
innovation. Silicon imaging devices are used in various technologies, such as digital
cameras, optical mice, video cameras, cell phones, and the like. Charge-coupled devices
(CCDs) were widely used in digital imaging, and were later improved upon by
15 complementary metal-oxide-semiconductor (CMOS) imagers having improved
performance. Many traditional CMOS imagers utilize front side illumination (FSI). In
such cases, electromagnetic radiation is incident upon the semiconductor surface
containing the CMOS devices and circuits. Backside illumination (BSI) CMOS imagers
have also been used, and in many designs electromagnetic radiation is incident on the
20 semiconductor surface opposite the CMOS devices and circuits. CMOS sensors are
typically manufactured from silicon and can convert visible incident light into a
photocurrent and ultimately into a digital image. Silicon-based technologies for detecting
infrared incident electromagnetic radiation have been problematic, however, because
silicon is an indirect bandgap semiconductor having a bandgap of about 1.1eV. Thus the
25 absorption of electromagnetic radiation having wavelengths of greater than about 1100
nm is, therefore, very low in silicon.

SUMMARY

The present disclosure provides optoelectronic devices having enhanced light
30 absorption characteristics, including systems incorporating such devices and various
associated methods. In one aspect, for example, an optoelectronic device having

enhanced absorption of electromagnetic radiation is provided. Such a device can include a semiconductor layer coupled to a support substrate and an array of shallow trench isolation surface features positioned between the semiconductor layer and the support substrate, the surface features positioned to interact with electromagnetic radiation that passes through the semiconductor layer. In one aspect, the semiconductor layer is single crystal silicon. In another aspect, a device layer can be coupled to the semiconductor layer on a side opposite the surface features.

In one aspect, a first bonding layer can be coupled between the semiconductor layer and the support substrate. While various configurations are contemplated, in one specific aspect first bonding layer can be coupled between the support substrate and the surface features. In another aspect, a second bonding layer can be positioned between the first bonding layer and the support substrate. In yet another aspect, a reflector layer can be disposed between the first bonding layer and the second bonding layer.

The surface features can have a variety of configurations and can be formed in a variety of locations between the semiconductor layer and the semiconductor support. For example, in one aspect the surface features can be formed in the support substrate. In another aspect, the surface features can be formed in the semiconductor layer. Furthermore, in one aspect the surface features can be arranged according to a predetermined pattern. In one specific aspect, such a predetermined pattern can be an at least substantially uniform grid. In specific aspect, such a predetermined pattern can be a non-uniform arrangement. Additionally, in one aspect the surface features can have an at least substantially uniform height. In another aspect, the surface features are not uniform in height.

Additionally, a variety of architectural configurations are contemplated. For example, in one aspect the device can be architecturally configured as a front-side illuminated optoelectronic device. In another aspect, the device can be architecturally configured as a back-side illuminated optoelectronic device.

In another aspect, a method of making an optoelectronic device is provided. Such a method can include creating an array of surface features using shallow trench isolation etching and bonding the array of surface features between a support substrate and a semiconductor layer. In another aspect, creating the array of surface features can further

include creating the array of surface features on at least a portion of a surface of the semiconductor layer. In yet another aspect, creating the array of surface features further includes creating the array of surface features on at least a portion of a surface of the support substrate. Furthermore, in one aspect bonding the array of surface features
5 between the support substrate and the semiconductor layer can further include depositing a first bonding layer onto the semiconductor layer and bonding the first bonding layer to a second bonding layer disposed on the support substrate. In some aspects a reflector can be deposited on at least one of the first bonding layer or the second bonding layer prior to bonding the semiconductor layer to the support substrate. In a further aspect the method
10 can include thinning the semiconductor layer at a surface opposite the support substrate to a thickness of from about 1 microns to about 10 microns to create a pristine thinned surface and forming a device layer on the thinned surface. The semiconductor can then be further processed as desired to form the optoelectronic device.

15

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:

20 FIG. 1 provides data showing the optical absorption of textured silicon compared to standard silicon as a function of wavelength in accordance with an embodiment of the present disclosure;

FIG. 2 is a cross-sectional view of an image sensor in accordance with another embodiment of the present disclosure;

25 FIG. 3 is a cross-sectional view of an image sensor in accordance with another embodiment of the present disclosure;

FIG. 4 is a cross-sectional view of a textured layer associated with a substrate in accordance with another embodiment of the present disclosure;

30 FIG. 5 is a cross-sectional view of a textured layer associated with the substrate in accordance with another embodiment of the present disclosure; and

FIG. 6 is a cross-sectional view of a textured region associated with the substrate in accordance with another embodiment of the present layer.

DETAILED DESCRIPTION

5 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
10 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
15 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
20 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,
25 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 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
30 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, the term “detection” refers to the sensing, absorption, and/or collection of electromagnetic radiation.

5 As used herein, the term “backside illumination” refers to a device architecture design whereby electromagnetic radiation is incident on a surface of a semiconductor material that is opposite a surface containing the device circuitry. In other words, electromagnetic radiation is incident upon and passes through a semiconductor material prior to contacting the device circuitry.

10 As used herein, the term “frontside illumination” refers to a device architecture design whereby electromagnetic radiation is incident on a surface of a semiconductor material that contains the device circuitry. In other words, electromagnetic radiation is incident upon and passes through the device circuitry region prior to contacting the semiconductor material.

15 As used herein, the term “absorptance” refers to the fraction of incident electromagnetic radiation absorbed by a material or device.

As used herein, the terms “textured layer” 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 a variety of known STI
20 techniques. It is noted that laser ablation techniques, at least in one aspect, are specifically disclaimed. While the characteristics of such a surface can be variable depending on the materials and techniques employed, in one aspect such a surface can include micron-sized structures (e.g. about 1 μm to about 10 μm). In yet another aspect, the surface can include nano-sized and/or micron-sized structures from about 5 nm and
25 about 10 μm . In another aspect, surface structures can be from about 100 nm to about 1 micron. 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
30 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

at a distance of from about 50nm to about 2 μ m. 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 “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.

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

Traditional silicon photodetecting imagers have limited light absorption/detection properties. For example, such silicon based detectors can be mostly transparent to infrared light, particularly with thin silicon layers. In some cases, other materials such as InGaAs can be used to detect infrared light having wavelengths greater than about 1000 nm, silicon is still commonly used to detect wavelengths in the visible spectrum (i.e. visible light, 350 nm – 800 nm). Traditional silicon materials require substantial optical path lengths to detect photons from electromagnetic radiation having wavelengths longer than approximately 700 nm. As a result, visible light can be absorbed at relatively shallow depths in silicon, and absorption of longer wavelengths (e.g. 900 nm) in silicon of a standard wafer depth (e.g. approximately 750 μ m) is poor. Increasing the thicknesses of the silicon layer to allow longer wavelength absorption thus greatly increases the thicknesses of the photodetecting imager.

The optoelectronic devices according to aspects of the present disclosure exhibit increased light absorption due to an increase in the effective optical path length for longer wavelengths of light as compared to traditional devices. The absorption depth in conventional silicon detectors is the depth into silicon at which the radiation intensity is reduced to about 36% of the value at the surface of the semiconductor. The increased optical path length of photons with the present silicon materials results in an apparent reduction in the absorption depth, or a reduced apparent or effective absorption depth. For example, the effective absorption depth of silicon can be reduced such that these longer wavelengths can be absorbed in silicon layers that are less than 850 microns thick.

In other words, by increasing the optical path length, these devices are able to absorb longer wavelengths (e.g. > 1000 nm for silicon) within a thinner silicon material. In addition to absorbing light having longer wavelengths in thin silicon materials (e.g. less than 30 microns thick as compared to 700 microns thick), the response rate or response speed can also be increased by using such thin materials.

The optoelectronic devices of the present disclosure can be front side illumination (FSI) or back side illumination (BSI) devices. In a typical FSI imager, incident light enters the semiconductor device by first passing by transistors and metal circuitry. The light, however, can scatter 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 thus 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 at least partially avoiding the circuitry. A variety of lenses and lens configurations are contemplated, however in one aspect the lens can be a micro-lens.

BSI imagers, on the other hand, are configured such that incident light enters the device via the light sensitive region opposite the circuitry and is mostly absorbed prior to reaching the circuitry, thus greatly reducing scattering and/or noise. BSI designs also allow for greater sensitivity, smaller pixel architecture, and a high fill factor for the imager. Additionally, it should also be understood that devices according to aspects of the present disclosure, whether they be FSI or BSI, can be incorporated into complimentary metal-oxide-semiconductor (CMOS) imager architectures or charge-coupled device (CCD) imager architectures.

Generally, and without limitation, the present disclosure provides a variety of optoelectronic devices, such as, broadband photosensitive diodes, pixels, and imagers capable of detecting visible as well as infrared electromagnetic radiation, including associated methods of making such devices. In one specific aspect, for example, an optoelectronic device is provided having enhanced absorption of electromagnetic radiation. Such a device can include a semiconductor layer coupled to a support substrate and an array of shallow trench isolation surface features positioned between the semiconductor layer and the support substrate, the surface features positioned to interact with electromagnetic radiation that passes through the semiconductor layer.

It has thus been discovered that such an array of shallow trench isolation surface features positioned in an architecturally appropriate manner can greatly increase the optical absorption of silicon materials. As is shown in FIG. 1, for example, such a textured region can increase the optical absorption of silicon as compared to non-textured silicon over an electromagnetic spectrum range of at least about 700 nm to about 1100 nm.

As can be seen in FIG. 2, for example, a FSI device is shown 200 having a semiconductor layer 202 coupled to a support substrate 204, where the semiconductor layer can include one or more doped regions 206, 208, that form at least one junction. A textured layer 210 including an array or plurality of STI surface features is positioned between the semiconductor layer 202 and the support substrate 204. A circuitry layer 212 is coupled to the semiconductor layer 202 on a side opposite the support substrate 204. Light 214 is shown impinging on the device 200 and passing through the circuitry layer 212 prior to contacting the semiconductor layer 202. Light 214 that is not absorbed by and subsequently passes through the semiconductor layer 202 contacts the textured layer 210 and is redirected back into the semiconductor layer 202, thus allowing light to be absorbed in a subsequent pass. As such, the textured layer 210 increases the effective optical path length of the light 214 as it passes through the device. In one aspect, the semiconductor layer can be single crystal silicon.

Turning to FIG. 3, a BSI device is shown 300 having a semiconductor layer 302 coupled to a support substrate 304, where the semiconductor layer can include one or more doped regions 306, 308, that form at least one junction. In this case the support substrate 304 can be a circuitry layer or a bulk substrate including a circuitry layer. A textured layer 310 including an array or plurality of surface features is positioned between the semiconductor layer 302 and the support substrate 304. Light 312 is shown impinging on the device 300 and passing through the semiconductor layer 302 without contacting any circuit elements that may be positioned in or at the support substrate 304. Light 312 that is not absorbed by and subsequently passes through the semiconductor layer 302 contacts the textured layer 310 and is redirected back into the semiconductor layer 302. As with the FSI device shown in FIG. 2, the textured layer 310 increases the effective optical path length of the light 312 as it passed through the device. In one

aspect, the semiconductor layer can be single crystal silicon.

The multiple doped regions for both the FSI and the BSI case can have the same doping profile or different doping profiles, depending on the device. Furthermore, any number or configuration of doped regions is considered to be within the present scope. In
5 some aspects the semiconductor layer can be doped, and thus can be considered to be a doped region.

Additionally, the device can include deep trench isolation (DTI) to isolate the imager and to provide light trapping functionality. In some aspects such a device can include a silicon handle wafer in addition to the support substrate to facilitate
10 manipulation of the device. In some aspects, the support substrate can be a silicon handle wafer. One technique for coupling a silicon handle wafer to the semiconductor layer includes oxide bonding. Further details regarding substrates, bonding, and various imager details can be found in US Patent Application Serial Number 13/069,135, which is incorporated herein by reference.

15 Optoelectronic devices according to aspects of the present disclosure can include photodiodes or pixels that are capable of absorbing electromagnetic radiation within a given wavelength range. Such imagers can be passive pixel sensors (PPS), active pixel sensors (APS), digital pixel sensor imagers (DPS), or the like. Such devices can also be architecturally configured as a three or four transistor active pixel sensor (3T APS or 4T
20 APS). Additionally, devices having greater than 4 transistors are also within the present scope. Such devices can also include pinned photodiode architectures as used in CMOS imagers. Also, such optoelectronic devices can be used in time-of-flight (TOF) applications, as well as various structured light applications. It is also contemplated that such devices can also be configured as rolling shutter or global shutter readout devices.

25 In some aspects, a device can include a passivation layer positioned between the textured layer and the doped regions. In some aspects, the passivation layer can be doped to create a surface field, as is described more fully below. It is noted, that with or without the passivation region, the textured region can be located on the light incident side of the semiconductor material, on a side of the semiconductor material opposite the light
30 incident side, or both on the light incident side and opposite the light incident side. Additionally, the device can also include an electrical transfer element coupled to the

semiconductor layer and operable to transfer an electrical signal from the doped regions. Additionally, an electrical transfer element can include a variety of devices, including without limitation, transistors, sensing nodes, transfer gates, transfer electrodes, and the like.

5 As has been described, the textured layer is comprised of a plurality of surface features, where such surface features have been formed in an array or other grouping across an interface between the semiconductor layer and the support substrate. In some aspects, the textured region can cover the entire interface between the semiconductor layer and the support substrate, while in other aspects the textured region may cover only
10 a portion of the interface between the semiconductor layer and the support substrate. For example, in one aspect the textured layer can cover the interface between the materials at least in regions where light passing through the semiconductor layer would contact the interface. In another aspect, the textured layer can cover the interface between the materials only in regions where light passing through the semiconductor layer would
15 contact the interface. As such, it should be understood that the coverage area of the textured layer can be dependent on the design of the device, as well as the intended pattern of light trapping and/or light redirection that is desired. It is thus intended that the scope of the present disclosure not necessarily be limited by the degree to which the interface includes textured layer.

20 Furthermore, in some aspects one or more intervening layers can be present between the semiconductor layer and the support substrate. Such layers can be used to facilitate bonding, for reflecting light, for a variety of other purposes. In one aspect, for example, one or more bonding layers can be utilized to facilitate bonding the support substrate to the semiconductor layer. In such cases, it can be beneficial to apply a first
25 bonding layer to the semiconductor layer and a second bonding layer to the support substrate as a bonding mechanism. The bonding layer can include a material capable of facilitating bonding between the support substrate and the semiconductor layer. Non-limiting examples can include silicon oxides, silicon nitrides, amorphous silicons, and the like. The thickness of a given bonding layer can additionally vary depending on the
30 manufacturing techniques utilized and preferences of the designer. In one aspect, however, a bonding layer can be thick enough to facilitate bonding and thin enough to

minimize waveguide effects within the device. In another aspect, a bonding layer can have a thickness of from about 30 nm to about 3 microns. In yet another aspect, a bonding layer can have a thickness of from about 40 nm to about 2 microns.

The position of the textured layer can thus be affected by the nature of the coupling of the support substrate and the semiconductor layer as well as the location where the textured layer is formed. In one aspect, the textured layer can be formed in or on the semiconductor layer. In another aspect, the textured layer can be formed in or on the support substrate. For the situation where the textured layer is formed in or on the semiconductor layer, one or more bonding layers can be coupled between the support substrate and the textured layer. If two or more bonding layers are utilized, a first bonding layer can be formed on the textured layer, a second bonding layer can be formed on the support substrate, and the first and second bonding layers can then be bonded together.

For the situation where the textured layer is formed in or on the support substrate, one or more bonding layers can be coupled between semiconductor layer and the textured layer. For example, in one aspect one or more bonding layer can be coupled between the support substrate and the surface features. If two or more bonding layers are utilized, a first bonding layer can be formed on the textured layer, a second bonding layer can be formed on the semiconductor layer, and the first and second bonding layers can then be bonded together.

As has been described, a light reflector layer can additionally be disposed between any two of the above referenced layers or materials. For example, in one aspect a reflector layer can be applied to one side of the textured layer. In another aspect, a reflector layer can be applied to either side of a bonding layer. In one specific aspect, a reflector layer can be positioned between a first and second bonding layer. The reflector layer can include any material capable of reflecting light back into the semiconductor layer. Non-limiting examples can include metals, ceramics, oxides, glass, distributed Bragg reflector stacks, and the like, including alloys and combinations thereof.

The surface features of the textured layer can be made by any process capable of etching in a repeatable and predictable manner. In one aspect, however, the surface features can be formed by any number of shallow trench isolation (STI) techniques.

While such manufacturing techniques are known, they have previously been utilized for creating regions of electrical isolation between circuit elements. Thus, such implementations have been utilized around the peripheries of circuit elements. The present scope, however, is directed to creating arrays of surface features in locations to interact with light. Through this interaction, light can be redirected, diffused, focused, or otherwise manipulated by the surface feature array.

Additionally, STI techniques can be used to form such surface features having a variety of shapes, patterns, and the like. In one aspect, for example, the surface features can be arranged into an array according to a predetermined pattern. In one specific aspect, such a predetermined pattern can be a uniform or substantially uniform grid. Additionally, a predetermined pattern can be an organized, an ordered, or a periodic pattern. In another aspect, the predetermined pattern can be a non-uniform or a substantially non-uniform pattern. Surface feature array patterns can also be disordered, quasi-periodic, random, or the like.

As has been described, the textured layer can function to diffuse light, to redirect light, and to thus increase the quantum efficiency of the device. In some cases, a portion of the light passes through the semiconductor layer to contact the textured layer. The surface features of the textured layer thus facilitate an increase the effective optical path length of the semiconductor layer. Such surface features can be micron-sized and/or nano-sized, and can be any shape or configuration that can be formed via a STI technique. Non-limiting examples of such shapes and configurations include cones, pillars, pyramids, inverted features, trenches, gratings, protrusions, and the like, including combinations thereof. Additionally, factors such as manipulating the feature sizes, dimensions, material type, dopant profiles, texture location, etc. can allow tuning of the textured layer for a specific wavelength or range of wavelengths. In one aspect, tuning the device can allow specific wavelengths or ranges of wavelengths to be absorbed. In another aspect, tuning the device can allow specific wavelengths or ranges of wavelengths to be reduced or eliminated via filtering.

Textured layers according to aspects of the present disclosure can allow a semiconductor layer to experience multiple passes of light within the device, particularly at longer wavelengths (i.e. infrared). Such internal reflection can increase the effective

optical path length, thus allowing a material such as silicon to absorb light at thicknesses that are less than standard silicon. As has been described, this increase in the effective optical path length of electromagnetic radiation in silicon increases the quantum efficiency of the device, thus leading to an improved signal to noise ratio.

5 The materials used for making the textured layer can vary depending on the design and the desired characteristics of the device. As such, any material that can be utilized in the construction of a textured region is considered to be within the present scope. In one aspect, the textured region can be formed directly on the semiconductor layer (e.g. a silicon epi-layer). In another aspect, an additional material can be deposited
10 onto the semiconductor layer to support the formation of the textured layer. Non-limiting examples of such materials include semiconductor materials, dielectric materials, silicon, polysilicon, amorphous silicon, transparent conductive oxides, and the like, including composites and combinations thereof. In one specific aspect, the textured layer can be a textured polysilicon layer. Thus a polysilicon layer can be deposited onto the
15 semiconductor layer, either directly or onto an intermediate passivation layer, and then textured to form the textured region. In another aspect, the textured layer can be a textured dielectric layer. In this case the textured layer can be a portion of a dielectric layer making up a passivation region disposed on the semiconductor layer. In yet another aspect the textured layer can be a transparent conductive oxide or another semiconductor
20 material. In the case of dielectric layers, the textured layer can be a textured portion of a passivation layer or the textured layer can be formed from other dielectric material deposited over a passivation layer.

 Various methods can be utilized to form STI features, and any such shallow trench formation technique is considered to be within the present scope. It is noted that,
25 in one aspect, texturing techniques that involve laser ablation are specifically disclaimed from the present scope.

 In some cases, the textured layer can be formed by using a patterned mask and photolithography, followed by etching to define a specific structure or pattern. In one aspect, STI techniques can be used to form the textured region. Various STI techniques
30 are contemplated, and any such technique is considered to be within the present scope. In one non-limiting example, an oxide material is deposited on the material to be etched

with shallow trenches. A uniform coating of a nitride material is deposited on the oxide material followed by a patterned coating of a resist material to be used as a mask. Thus the pattern of the mask will define the future pattern of the textured region. Any of a number of etch processes can then be applied across the layered material. As a result, regions of the layered material beneath the resist are protected from the etch, while regions of the layered material that are not located beneath the resist are etched by the process. This process is continued to produce a shallow trench (or a hole) etched in the unprotected regions between the resist material through the nitride material, the oxide material, and into the substrate. Following etching of the shallow trench, the resist material can be removed by any appropriate process. It is noted that, while the term “shallow trench” is used to describe the etching process, the resulting etch pattern is not limited to trenches, but also includes holes, pits, cones, and the like.

In some aspects, the etched regions can be left as open spaces. In other aspects, further processing can be performed to fill in the etched regions. For example, an oxide material can be deposited along the sides and bottom of the trenches similar to an oxide liner. Such can be deposited by a thermal oxide process, a direct oxide deposition, or any other useful process. Once the etched regions are sufficiently filled, the resulting surface can be further processed by techniques such as CMP processing, and then, once exposed, the nitride layer can be removed.

In another aspect, the etched regions can be highly doped along sidewalls and/or bottoms with a dopant profile to create a surface field. A back surface field can function to impede the movement of photo-generated carriers from the junction toward the textured layer, and as such the dopant profile should be designed accordingly. The use of the back surface field in the etched regions can thus be used to electrically passivate the regions around the textured layer.

The surface features can have a variety of configurations, structures, and sizes, depending on the desired characteristics of the resulting device. In one aspect, as is shown in FIG. 4 for example, surface features 402 are shown formed in a material layer 404, such as, for example, the semiconductor layer. The surface features in this case are arranged uniformly as a uniform grid pattern comprised of a series of spaces or holes 406 and lines 408 or pillars. Various uniform grid patterns are contemplated, and in one

aspect the pattern can include a uniformly spaced series pillars surrounded by spaces, or vice versa depending on whether the pattern is viewed from the topside or the bottom side of the etched material. In another aspect, the uniform grid pattern can include a series of lines surrounding a uniformly spaced series of spaces or holes cut between the lines, or vice versa.

Additionally, as has been described, the etch pattern of surface features can be a predetermined nonuniform pattern. As is shown in FIG. 5, for example, the spaces etched into the material layer 504 are of approximately the same size and shape and the lines or pillars 508 vary in width. FIG. 6 shows an etch pattern where both the spaces and the lines or pillars 608 are varied. It should be noted that a variety of etch patterns are contemplated, and that the present scope should not be limited thereby. With respect to nonuniform patterns, in some aspects the patterns can be random, either for the line or pillar, the spaces, or both.

In addition to the pattern formed by the STI process, the depth of the etch can also have an impact on optical absorption. In one aspect, for example, the surface features can have a uniform or substantially uniform depth or height. While the depth or height can vary depending on the intended use and design of the device, in one aspect the height or depth can be from about 50 nm to about 2 microns. It is noted that, in standard STI processes, the processing depth is about 0.35 microns, which is also considered to be within the present scope. In another aspect, the surface features can have a non-uniform depth or height, and thus can vary across the surface of the textured layer. Such variation in depth can be random in some cases, and nonrandom in other cases depending on the desired design of the device. In one aspect, the depth or height can be from about 50 nm to about 2 microns. In some aspects discrete levels of depths can be utilized. For example, in one aspect one level may have a depth of 0.35 microns, while another level may have a depth of 0.7 microns. By using different masks, different depth levels can be achieved. Similarly, subsequent levels can be etched to create a third level, a fourth level, or more. It is noted that in some aspects each level can have a depth of from about 50 nm to about 2 microns.

As has been described, the various devices according to aspects of the present disclosure can exhibit increased absorption as compared to traditional photosensitive

devices. For example, for an active semiconductor layer according to aspects of the present disclosure that has a thickness of from about 1 micron to about 10 microns, the absorption characteristics can be as follows: in one aspect the semiconductor layer can absorb from about 60% to about 80% of incident 700 nm light; in another aspect, the semiconductor layer can absorb from about 40% to about 60% of incident 850 nm light; in yet another aspect, the semiconductor layer can absorb from about 25% to about 40% of incident 940 nm light; in a further aspect, the semiconductor layer can absorb from about 15% to about 30% of incident 1000 nm light; and in yet a further aspect, the semiconductor layer can absorb from about 5% to about 10% of incident 1064 nm light. Furthermore, depending on the architecture, devices according to aspects of the present disclosure can exhibit external quantum efficiencies (EQE) that are from about 1% to about 5% less than the above described absorption values for a given wavelength of light. Additionally, it is further noted that the devices of the present disclosure have at least substantially the same dark current as a standard EPI device with no textured region.

While the present disclosure has focused on silicon materials, it should be understood that a variety of semiconductor materials are also contemplated for use and should be considered to be within the present scope. 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. In yet another aspect, the semiconductor materials can include any material that is useful for making imagers, including, Si, SiGe, InGaAs, and the like, including combinations thereof.

A silicon semiconductor layer can be of any thickness that allows electromagnetic radiation detection and conversion functionality, and thus any such thickness of silicon material is considered to be within the present scope. In some aspects the textured layer increases the efficiency of the device such that the silicon material can be thinner than
 5 has previously been possible. Decreasing the thickness of the silicon material reduces the amount of silicon required to make such a device. In one aspect, for example, the silicon material has a thickness of from about 500 nm to about 50 μm . In another aspect, the silicon material has a thickness of less than or equal to about 100 μm . In yet another aspect, the silicon material has a thickness of from about 1 μm to about 10 μm . In a
 10 further aspect, the silicon material can have a thickness of from about 5 μm to about 50 μm . In yet a further aspect, the silicon material can have a thickness of from about 5 μm to about 10 μm .

A variety of dopant materials are contemplated for both the formation of the multiple doped regions and to create a surface field at the shallow trench regions, and any
 15 such dopant that can be used in such processes 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 charge donating or accepting dopant species. More specifically, an electron donating or a hole donating species can cause a region to become
 20 more positive or negative in polarity as compared to the semiconductor layer. In one aspect, for example, the doped region can be p-doped. In another aspect the doped region can be n-doped. A highly doped region can also be formed on or near the doped region to create a pinned diode. In one non-limiting example, the semiconductor layer can be negative in polarity, and a doped region and a highly doped region can be doped with p+
 25 and n dopants respectively. In some aspects, variations of n(--), n(-), n(+), n(++), p(--), p(-), p(+), or p(++), type doping of the regions can be used. 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.

30

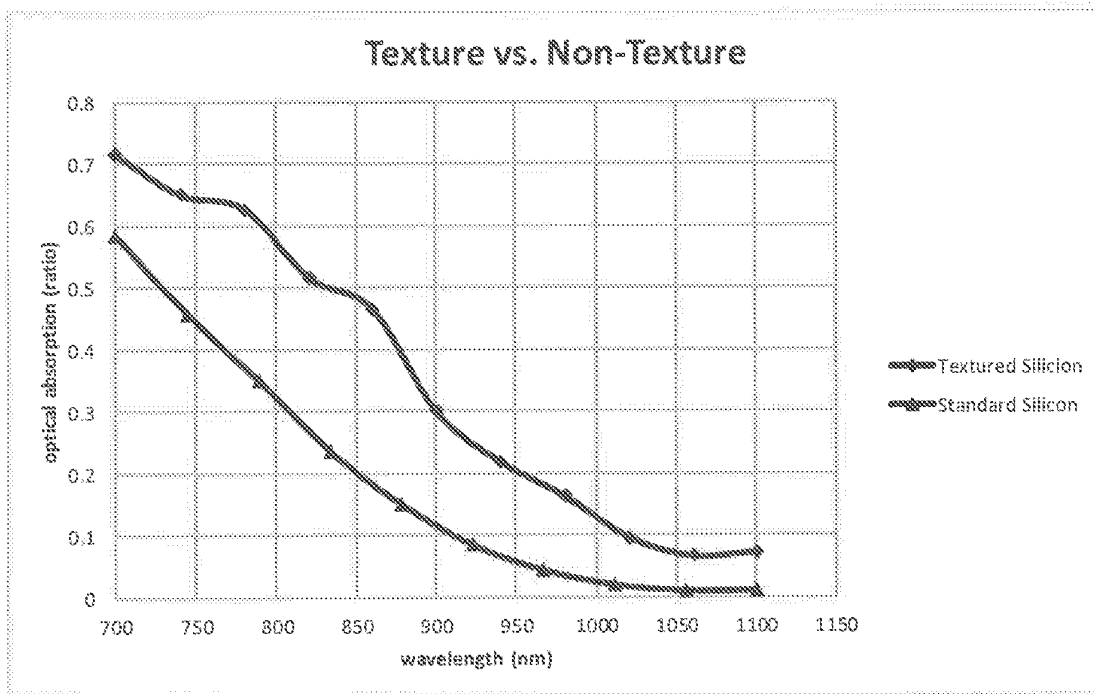


FIG. 1

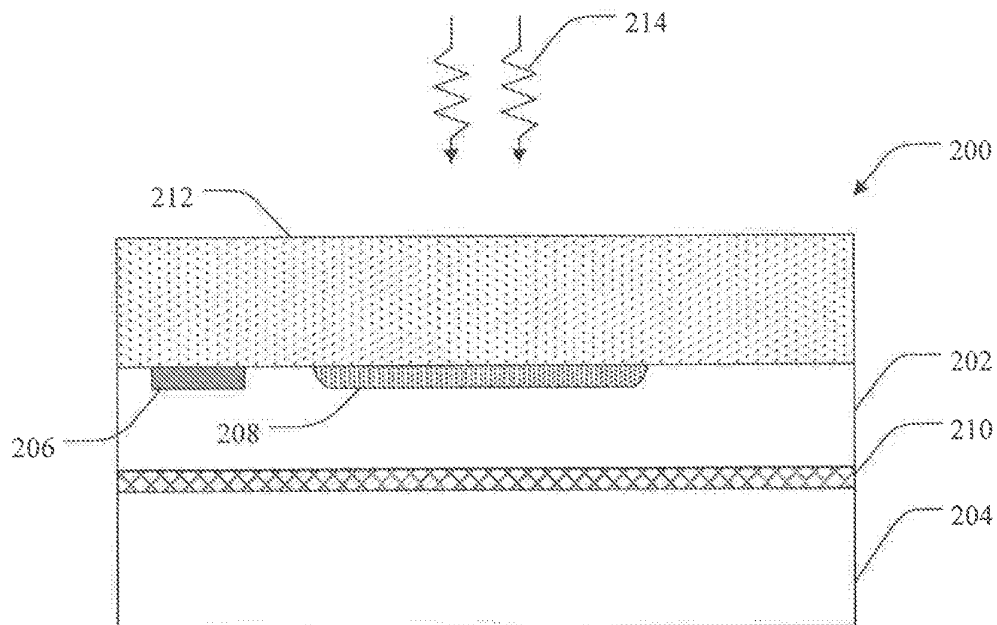


FIG. 2

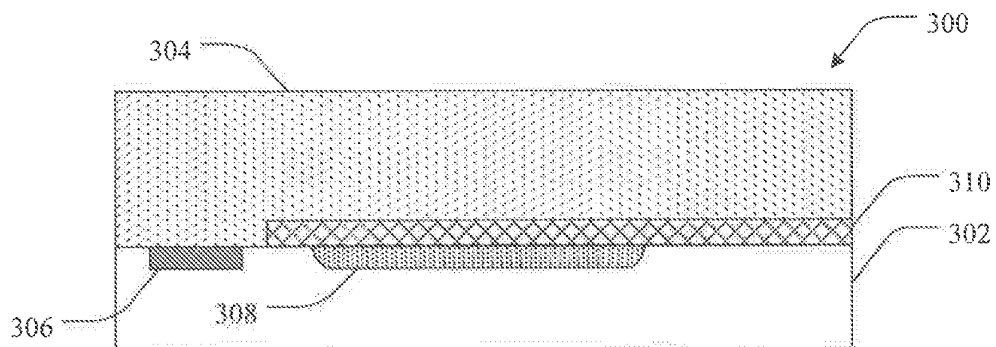


FIG. 3

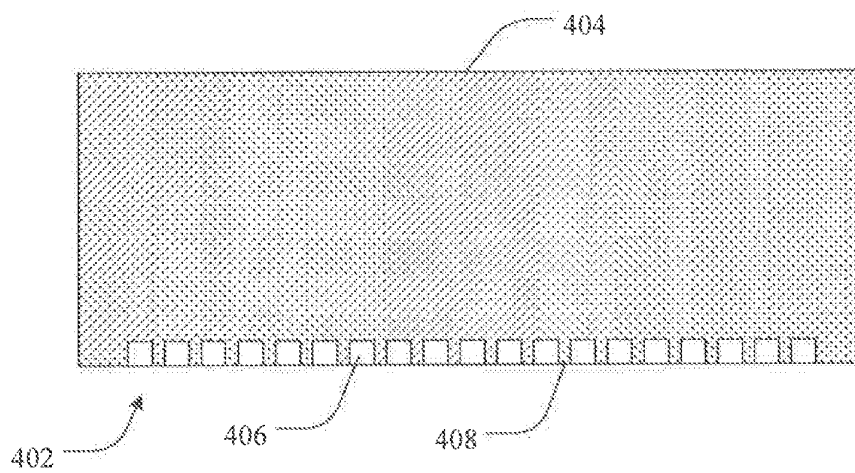


FIG. 4

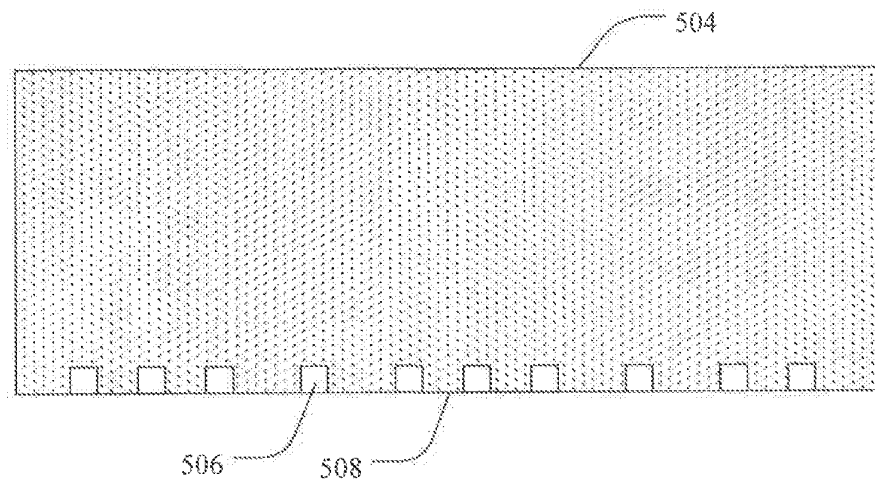


FIG. 5

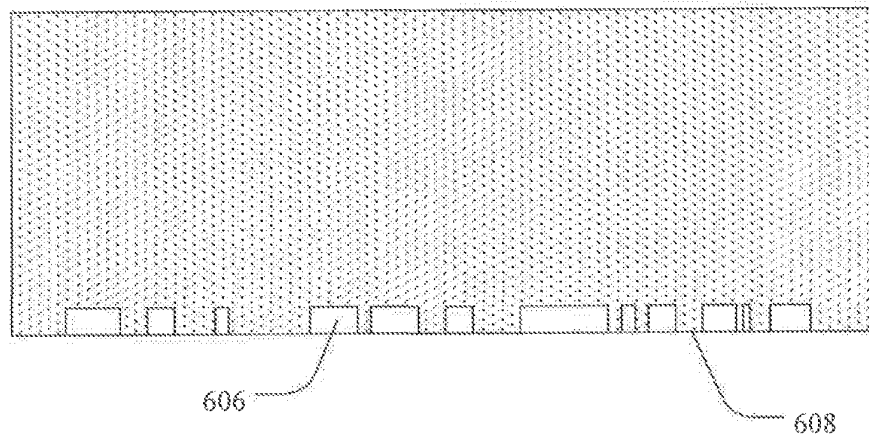


FIG. 6

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING
AN APPLICATION DATA SHEET (37 CFR 1.76)**

**Title of
Invention** Shallow Trench Textured Regions 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 14/084,392
filed on 11/19/2013

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: Homayoon Haddad

Date (Optional): _____

Signature: 

Note: An application data sheet (PTO/AIA/01 or equivalent), including naming the entire inventive entity, must accompany this form. Use an additional PTO/AIA/01 form for each additional inventor.

**DECLARATION (37 CFR 1.63) FOR UTILITY OR DESIGN APPLICATION USING
AN APPLICATION DATA SHEET (37 CFR 1.76)****Title of
Invention**

Shallow Trench Textured Regions 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 14/084,392filed on 11/19/2013

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.

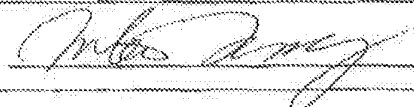
I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in 37 CFR 1.56, including for continuation-in-part applications, material information which became available between the filing date of the prior 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: Jutao Jiang

Date (Optional):

29/10/2015Signature: 

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.

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	143705.06031 (SXM-000)
		Application Number	
Title of Invention	SHALLOW TRENCH TEXTURED REGIONS 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		
	Homayoon		HADDAD			
Residence Information (Select One) • US Residency Non US Residency Active US Military Service						
City	Beaverton	State/Province	OR	Country of Residence	US	
Mailing Address of Inventor:						
Address 1	16640 SW Sanderling Ct.					
Address 2						
City	Beaverton	State/Province	OR			
Postal Code	97007	Country	US			
Inventor	2				Remove	
Legal Name						
Prefix	Given Name	Middle Name	Family Name	Suffix		
	Jutao		JIANG			
Residence Information (Select One) • US Residency Non US Residency Active US Military Service						
City	Tigard	State/Province	OR	Country of Residence	US	
Mailing Address of Inventor:						
Address 1	15121 SW Kenton Dr.					
Address 2						
City	Tigard	State/Province	OR			
Postal Code	97224	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).
--

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	143705.06031 (SXM-000)
		Application Number	
Title of Invention	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS		

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

Customer Number	00959		
Email Address	ipboston.docketing@nelsonmullins.com	Add Email	Remove Email

Application Information:

Title of the Invention	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS		
Attorney Docket Number	143705.06031 (SXM-000)	Small Entity Status Claimed	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	3	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.

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	00959		

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	143705.06031 (SXM-000)
		Application Number	
Title of Invention	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS		

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	15/614256	2017-06-05		
Prior Application Status	Patented	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
15/614256	Continuation of	14/884181	2015-10-15	9673250	2017-06-06
Prior Application Status	Patented	Remove			
Application Number	Continuity Type	Prior Application Number	Filing Date (YYYY-MM-DD)	Patent Number	Issue Date (YYYY-MM-DD)
14/884181	Continuation of	14/084392	2013-11-19	9209345	2015-12-08
Prior Application Status	Expired	Remove			
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)		
14/084392	Claims benefit of provisional	61/841326	2013-06-29		
Additional Domestic Benefit/National Stage Data may be generated within this form by selecting the Add button. Add					

Foreign Priority Information:

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

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

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	143705.06031 (SXM-000)
		Application Number	
Title of Invention	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS		

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

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

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	143705.06031 (SXM-000)
		Application Number	
Title of Invention	SHALLOW TRENCH TEXTURED REGIONS 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.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	143705.06031 (SXM-000)
		Application Number	
Title of Invention	SHALLOW TRENCH TEXTURED REGIONS 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.		
Address 2	Suite 135P		
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.

Application Data Sheet 37 CFR 1.76		Attorney Docket Number	143705.06031 (SXM-000)
		Application Number	
Title of Invention	SHALLOW TRENCH TEXTURED REGIONS 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:				Remove
NOTE: This Application Data Sheet must be signed in accordance with 37 CFR 1.33(b). However, if this Application Data Sheet is submitted with the INITIAL filing of the application and either box A or B is not checked in subsection 2 of the "Authorization or Opt-Out of Authorization to Permit Access" section, then this form must also be signed in accordance with 37 CFR 1.14(c).				
This Application Data Sheet must be signed by a patent practitioner if one or more of the applicants is a juristic entity (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, all joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of all joint inventor-applicants.				
See 37 CFR 1.4(d) for the manner of making signatures and certifications.				
Signature	/Andrew Schultz/		Date (YYYY-MM-DD)	2019-07-08
First Name	Andrew	Last Name	Schultz	Registration Number
				66869
Additional Signature may be generated within this form by selecting the Add button.				Add

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	143705.06031 (SXM-000)
		Application Number	
Title of Invention	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS		

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

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.
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:				
Filing Date:				
Title of Invention:		SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS		
First Named Inventor/Applicant Name:		Homayoon Haddad		
Filer:		Andrew W. Schultz		
Attorney Docket Number:		143705.06031 (SXM-000)		
Filed as Large Entity				
Filing Fees for Utility under 35 USC 111(a)				
Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1720

Electronic Acknowledgement Receipt

EFS ID:	36514592
Application Number:	16505283
International Application Number:	
Confirmation Number:	2766
Title of Invention:	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS
First Named Inventor/Applicant Name:	Homayoon Haddad
Customer Number:	959
Filer:	Andrew W. Schultz
Filer Authorized By:	
Attorney Docket Number:	143705.06031 (SXM-000)
Receipt Date:	08-JUL-2019
Filing Date:	
Time Stamp:	17:50:08
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$1720
RAM confirmation Number	070919INTEFSW00005853120080
Deposit Account	120080
Authorized User	Andrew Schultz
The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows: 37 CFR 1.16 (National application filing, search, and examination fees) 37 CFR 1.17 (Patent application and reexamination processing fees)	

37 CFR 1.19 (Document supply fees)
37 CFR 1.20 (Post Issuance fees)
37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		Prel_Amendment.pdf	169589	yes	3
			42a2db38c388040dcdc6a0fb8d9610875b19c48		
	Multipart Description/PDF files in .zip description				
	Document Description	Start	End		
	Applicant Arguments/Remarks Made in an Amendment	3	3		
	Specification	2	2		
	Preliminary Amendment	1	1		
Warnings:					
Information:					
2		Application.pdf	1749392	yes	22
			f28db3852f3a90540800136ffc50b333dcf07364		
	Multipart Description/PDF files in .zip description				
	Document Description	Start	End		
	Abstract	22	22		
	Claims	19	21		
	Specification	1	18		
Warnings:					
Information:					
3	Drawings-only black and white line drawings	Drawings.pdf	290339	no	3
			d2b1f56ad5d8a745a378e8816bfa63777b9cd860		
Warnings:					
Information:					

4	Oath or Declaration filed	Declaration.pdf	656399	no	2
			a6d8a05c1dc4449fb420433ed42b4ab8332025d8		
Warnings:					
Information:					
5	Application Data Sheet	ADS.pdf	1344348	no	9
			ea3c4ce1b6807984af6b3ae7df1c24f4463ab4c6		
Warnings:					
Information:					
6	Fee Worksheet (SB06)	fee-info.pdf	35040	no	2
			5a8265c55e4d2b8fb897d4703ff471f559dbf02		
Warnings:					
Information:					
Total Files Size (in bytes):			4245107		
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. <u>New Applications Under 35 U.S.C. 111</u> 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. <u>National Stage of an International Application under 35 U.S.C. 371</u> 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. <u>New International Application Filed with the USPTO as a Receiving Office</u> 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.					

App. No.: To be assigned
Art Unit: To be assigned

Docket No.: 143705.06031 (SXM-000)
Examiner: To be assigned

REMARKS

Prior to examination on the merits, Applicant respectfully requests that the specification be amended as shown on the attached sheets. No new matter is added.

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. 12-0080, under Docket No. 143705.06031 (SXM-000).

Dated: July 8, 2019

Respectfully submitted,
Electronic Signature: /Andrew W. Schultz/
Andrew W. Schultz, Reg. No. 66,869
Attorney for Applicant
Nelson Mullins Riley & Scarborough LLP
One Post Office Square, 30th Floor
Boston, MA 02109
Tel: (617) 217-4674
Fax: (617) 217-4699

App. No.: To be assigned
Art Unit: To be assigned

Docket No.: 143705.06031 (SXM-000)
Examiner: To be assigned

AMENDMENTS TO THE SPECIFICATION

Please amend the first paragraph of page 1 under the heading PRIORITY DATA as follows:

This application is a continuation of U.S. Patent application Ser. No. 15/614,256, filed June 5, 2017, which is a continuation of U.S. patent application Ser. No. 14/884,181, filed on October 15, 2015, which is a continuation of U.S. patent application Ser. No. 14/084,392, filed Nov. 19, 2013, which claims the benefit of U.S. Provisional Patent Application Ser. No. 61/841,326, filed on Jun. 29, 2013, each of which are incorporated herein by reference in their entirety.



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 NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/505,283	07/08/2019	2812	1720	143705.06031 (SXM-000)	20	2

CONFIRMATION NO. 2766

FILING RECEIPT



CC000000109815886

959

NELSON MULLINS RILEY & SCARBOROUGH LLP
FLOOR 30, SUITE 3000
ONE POST OFFICE SQUARE
BOSTON, MA 02109

Date Mailed: 07/24/2019

Receipt is acknowledged of this non-provisional utility 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 FIRST INVENTOR, 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 corrected Filing Receipt, including a properly marked-up ADS showing the changes with strike-through for deletions and underlining for additions. If you received a "Notice to File Missing Parts" or other Notice requiring a response for this application, please submit any request for correction 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 provided that the request is grantable.

Inventor(s)

Homayoon HADDAD, Beaverton, OR;
Jutao JIANG, Tigard, OR;

Applicant(s)

SiOnyx, LLC, Beverly, MA;

Power of Attorney: None

Domestic Priority data as claimed by applicant

This application is a CON of 15/614,256 06/05/2017 PAT 10347682
which is a CON of 14/884,181 10/15/2015 PAT 9673250
which is a CON of 14/084,392 11/19/2013 PAT 9209345
which claims benefit of 61/841,326 06/29/2013

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.

If Required, Foreign Filing License Granted: 07/22/2019

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/505,283**

Projected Publication Date: 10/31/2019

Non-Publication Request: No

Early Publication Request: No
Title

SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS

Preliminary Class

438

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

page 2 of 4

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).

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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 Assets Control, 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).

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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.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875						Application or Docket Number 16/505,283			
APPLICATION AS FILED - PART I									
(Column 1)		(Column 2)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY			
FOR	NUMBER FILED	NUMBER EXTRA	RATE(\$)	FEE(\$)		RATE(\$)	FEE(\$)		
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300		
SEARCH FEE (37 CFR 1.16(k), (l), or (m))	N/A	N/A	N/A			N/A	660		
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760		
TOTAL CLAIMS (37 CFR 1.16(i))	20	minus 20 = *				x 100 =	0.00		
INDEPENDENT CLAIMS (37 CFR 1.16(h))	2	minus 3 = *				x 460 =	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	1720		
APPLICATION AS AMENDED - PART II									
(Column 1)		(Column 2)		(Column 3)		SMALL ENTITY		OR OTHER THAN SMALL ENTITY	
AMENDMENT A	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)	RATE(\$)	ADDITIONAL FEE(\$)		
	Total (37 CFR 1.16(i))	*	Minus **	=	x =	x =	=		
	Independent (37 CFR 1.16(h))	*	Minus ***	=	x =	x =	=		
	Application Size Fee (37 CFR 1.16(s))								
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								
				TOTAL ADD'L FEE		TOTAL ADD'L FEE			
AMENDMENT B	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE(\$)	ADDITIONAL FEE(\$)	RATE(\$)	ADDITIONAL FEE(\$)		
	Total (37 CFR 1.16(i))	*	Minus **	=	x =	x =	=		
	Independent (37 CFR 1.16(h))	*	Minus ***	=	x =	x =	=		
	Application Size Fee (37 CFR 1.16(s))								
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))								
				TOTAL ADD'L FEE		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.									

To: ipboston.docketing@nelsonmullins.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 959

Jul 24, 2019 03:47:47 AM

Dear PAIR Customer:

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FLOOR 30, SUITE 3000
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BOSTON, MA 02109
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 959 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

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Application	Document	Mailroom Date	Attorney Docket No.
16505283	APP.FILE.REC	07/24/2019	143705.06031 (SXM-000)

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If you have any questions, please email the Electronic Business Center (EBC) at EBC@uspto.gov with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE
PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: Homayoon Haddad *et al.*

Application No.: 16/505,283

Filed: July 8, 2019

For: SHALLOW TRENCH TEXTURED REGIONS AND
ASSOCIATED METHODS

Confirmation No.: 2766

Art Unit: 2895

Examiner: Everhart, Caridad

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.

October 17, 2019

Dated

Electronic Signature: /Andrew W. Schultz/

Andrew Schultz, Reg. No. 66,869

SECOND PRELIMINARY AMENDMENT

Dear Sir,

Prior to examination on the merits, please amend the above-identified U.S. patent application as follows:

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 6.

Electronic Patent Application Fee Transmittal				
Application Number:		16505283		
Filing Date:		08-Jul-2019		
Title of Invention:		SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS		
First Named Inventor/Applicant Name:		Homayoon HADDAD		
Filer:		Andrew W. Schultz/Irene Gommerstadt		
Attorney Docket Number:		SXM-060CN3		
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	15	100	1500
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 (\$)				1500

Electronic Acknowledgement Receipt

EFS ID:	37487209
Application Number:	16505283
International Application Number:	
Confirmation Number:	2766
Title of Invention:	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS
First Named Inventor/Applicant Name:	Homayoon HADDAD
Customer Number:	959
Filer:	Andrew W. Schultz/Irene Gommerstadt
Filer Authorized By:	Andrew W. Schultz
Attorney Docket Number:	SXM-060CN3
Receipt Date:	17-OCT-2019
Filing Date:	08-JUL-2019
Time Stamp:	16:25:55
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$ 1500
RAM confirmation Number	E20190GG26333745
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		Prel_Amendment.pdf	175944	yes	6
			af6921b24920f38b55c55fbbb0d0b1e8ec03b6b4		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Applicant Arguments/Remarks Made in an Amendment		6	6	
	Claims		2	5	
	Preliminary Amendment		1	1	
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30448	no	2
			5a5c685d8abed764b1c63761916df8d23e44760a		
Warnings:					
Information:					
Total Files Size (in bytes):			206392		

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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.

REMARKS

Prior to examination on the merits, Applicant respectfully requests that the specification be amended, that claims 1-20 be canceled, and that claims 21-55 be added as shown on the attached sheets. No new matter is added.

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. 50-1196, under Docket No. SXM-060CN3.

Dated: October 17, 2019

Respectfully submitted,
Electronic Signature: /Andrew W. Schultz/
Andrew W. Schultz, Reg. No. 66,869
Attorney for Applicant
Nelson Mullins Riley & Scarborough LLP
One Post Office Square, 30th Floor
Boston, MA 02109
Tel: (617) 217-4674
Fax: (617) 217-4699

AMENDMENTS TO THE CLAIMS

- 1-20. (Canceled)
21. (New) A photosensitive imager device capable of detecting visible and infrared electromagnetic radiation, comprising:
- a semiconductor layer having a light incident side and an opposed side, said semiconductor layer having multiple doped regions forming at least one junction,
 - a textured region comprising a plurality of surface features configured to interact with incident electromagnetic radiation so as to increase the quantum efficiency of the device,
 - a support substrate coupled to said semiconductor layer, and
 - a first bonding layer disposed between the semiconductor layer and the support substrate.
22. (New) The device of claim 21, wherein the textured region is located on the light incident side of the semiconductor layer.
23. (New) The device of claim 22, further comprising a device layer coupled to the semiconductor layer on said side opposed to the light incident side.
24. (New) The device of claim 22, wherein the textured region is formed by etching.
25. (New) The device of claim 24, wherein said surface features comprise pyramids.
26. (New) The device of claim 22, further comprising a reflector layer disposed between the textured layer and the support substrate.
27. (New) The device of claim 21, further comprising deep trench isolation for isolating the device.
28. (New) The device of claim 27, wherein said deep trench isolation provides light trapping functionality.
29. (New) The device of claim 21, wherein the semiconductor layer is single crystal silicon.
30. (New) The device of claim 21, wherein the semiconductor layer comprises silicon and germanium.

31. (New) The device of claim 21, wherein the surface features are formed in the semiconductor layer.
32. (New) The device of claim 21, wherein the surface features have a substantially uniform height.
33. (New) The device of claim 21, wherein the surface features are not uniform in height.
34. (New) The device of claim 21, wherein said first bonding layer comprises any of silicon oxide, silicon nitride and amorphous silicon.
35. (New) The device of claim 21, wherein said semiconductor layer has a thickness in a range of about 1 micron to about 10 microns.
36. (New) The device of claim 35, wherein the device exhibits a quantum efficiency of at least about 35% for electromagnetic radiation at a wavelength of about 940 nm.
37. (New) The device of claim 21, wherein said bonding layer has a thickness in a range of about 30 nm to about 3 microns.
38. (New) The device of claim 21, wherein said plurality of surface features have a height in a range of about 50 nm to about 2 microns.
39. (New) The device of claim 21, wherein said plurality of surface features have a height in a range from about 0.35 microns to about 0.7 microns.
40. (New) The device of claim 21, wherein said plurality of surface features are formed by using a patterned mask and photolithography followed by etching.
41. (New) The device of claim 21, wherein said plurality of surface features comprise multiple etched levels.
42. (New) The device of claim 21, wherein said textured region increases optical absorption of the semiconductor layer over an electromagnetic spectrum range of at least about 700 nm to about 1100 nm.

43. (New) The device of claim 21, further comprising a second bonding layer positioned between the first bonding layer and the support substrate.
44. (New) The device of claim 21, wherein the surface features are arranged according to a pattern.
45. (New) The device of claim 44, wherein the pattern is an at least substantially uniform grid.
46. (New) The device of claim 44, wherein the pattern is a non-uniform arrangement.
47. (New) A method of making a photosensitive image device, comprising:
providing a semiconductor layer having a light incident side and an opposed side, said semiconductor layer having multiple doped regions forming at least one junction;
providing a support substrate;
creating a plurality of surface features on one of the semiconductor layer and the support substrate; and
bonding the semiconductor layer to the support substrate.
48. (New) The method of claim 47, wherein bonding the semiconductor layer to the support substrate comprises:
depositing a first bonding layer onto the semiconductor layer; and
bonding the first bonding layer to a second bonding layer disposed on the support substrate.
49. (New) The method of claim 47, wherein the plurality of surface features are formed on the light incident side of the semiconductor layer.
50. (New) The method of claim 47, wherein the surface features are formed via etching.
51. (New) The method of claim 50, further comprising depositing an oxide material within at least a portion of the semiconductor layer or support substrate removed via etching.

52. (New) The method of claim 51, wherein depositing the oxide material comprises at least partially filling one of trenches, holes, pits, and cones formed in the semiconductor layer during etching.

53. (New) The method of claim 51, further comprising processing the region of the semiconductor layer or support substrate comprising the surface features with CMP after depositing the oxide material.

54. (New) The method of claim 47, wherein the surface features are formed by shallow trench isolation etching.

55. (New) The method of claim 47, wherein the surface features are formed in the semiconductor layer.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 16/505,283		Filing Date 07/08/2019		☐ To be Mailed				
ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO												
APPLICATION AS FILED - PART I												
		(Column 1)	(Column 2)									
FOR		NUMBER FILED	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), (l), 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 \$ 100 =							
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 =	*		x \$ 460 =							
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).										
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))												
* If the difference in column 1 is less than zero, enter "0" in column 2.					TOTAL							
APPLICATION AS AMENDED - PART II												
		(Column 1)	(Column 2)		(Column 3)							
AMENDMENT	10/17/2019	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)		ADDITIONAL FEE (\$)				
	Total (37 CFR 1.16(i))	* 35	Minus	** 20	= 15	x \$ 100 =		1500				
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0	x \$ 460 =		0				
	☐ Application Size Fee (37 CFR 1.16(s))											
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))											
								TOTAL ADD'L FEE		1500		
		(Column 1)	(Column 2)		(Column 3)							
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA	RATE (\$)		ADDITIONAL FEE (\$)				
	Total (37 CFR 1.16(i))	*	Minus	**	=	x \$ 0 =						
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x \$ 0 =						
	☐ Application Size Fee (37 CFR 1.16(s))											
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))											
								TOTAL ADD'L FEE				
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.								SLIE				
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".								/SHARON M WEST/				
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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.												

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/505,283	07/08/2019	Homayoon HADDAD	SXM-060CN3

CONFIRMATION NO. 2766

959

NELSON MULLINS RILEY & SCARBOROUGH LLP
FLOOR 30, SUITE 3000
ONE POST OFFICE SQUARE
BOSTON, MA 02109

PUBLICATION NOTICE



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Title:SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS

Publication No.US-2019-0333959-A1

Publication Date:10/31/2019

NOTICE OF PUBLICATION OF APPLICATION

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

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/505,283	07/08/2019	Homayoon HADDAD	SXM-060CN3	2766
959 7590 02/13/2020 NELSON MULLINS RILEY & SCARBOROUGH LLP FLOOR 30, SUITE 3000 ONE POST OFFICE SQUARE BOSTON, MA 02109			EXAMINER EVERHART, CARIDAD	
			ART UNIT	PAPER NUMBER
			2895	
			NOTIFICATION DATE	DELIVERY MODE
			02/13/2020	ELECTRONIC

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

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

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

ipboston.docketing@nelsonmullins.com

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Claim Rejections - 35 USC § 103

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

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

A patent for a claimed invention may not be obtained, notwithstanding that the claimed invention is not identically disclosed as set forth in section 102, if the differences between the claimed invention and the prior art are such that the claimed invention as a whole would have been obvious before the effective filing date of the claimed invention to a person having ordinary skill in the art to which the claimed invention pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103 are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

This application currently names joint inventors. In considering patentability of the claims the examiner presumes that the subject matter of the various claims was commonly owned as of the

effective filing date of the claimed invention(s) absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and effective filing dates of each claim that was not commonly owned as of the effective filing date of the later invention in order for the examiner to consider the applicability of 35 U.S.C. 102(b)(2)(C) for any potential 35 U.S.C. 102(a)(2) prior art against the later invention.

Claims 21-26, 29-35, 38-42, 47, 49-52, and 55 is/are rejected under 35 U.S.C. 103 as being unpatentable over Gaebler et al (US 2009/0261353 A1)(“Gaebler”) in view of Fonash et al (US 2014/0242744 A1)(“Fonash”).

Gaebler discloses a photosensitive imager or sensor (para. 0010) in the visible and IR range (para. 0027), including a semiconductor layer 201 (Fig. 2a and para. 0165) having a light incident side and an opposed side and multiple doped regions, which are the Diff regions in Fig. 2a, and a junction, for example the n and p regions form a pn junction in Fig. 2a

A textured region, the nanostructured region 2 (para. 0153 and Fig. 2a) including a plurality of surface features which are the nanostructures which increase the quantum efficiency resulting from a reduction of reflections (para. 0168)

A support substrate coupled to the semiconductor layer, as a separate substrate is subsequently transferred to the device (para. 0031).

Gaebler is silent with respect to a bonding layer.

Fonash, in the same field of endeavor of nanostructured light detection devices (para. 0003 and 0007), discloses adhering the device to a support substrate using an adhesive material attached to the support substrate (para. 0048-0049).

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have formed a bonding layer between the semiconductor layer and the support

substrate as disclosed by Fonash in the device disclosed by Gaebler in order to obtain the benefit of providing support and protection for the device.

Re claim 22: Fig. 2b of Gaebler shows the textured region is on the light incident side of the semiconductor layer.

Re claim 23: The combination of Gaebler and Fonash discloses a device layer coupled to the opposite side of the semiconductor layer, as Fonash discloses the support substrate may include a conducting layer (para. 0063). It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have combined the support substrate with a conductive layer as disclosed by Fonash with the device disclosed by Gaebler in order to obtain the benefit of supporting the conduction of the nanostructures as disclosed by Fonash (para. 0063).

Re claim 24: Gaebler discloses etching to form the nanostructures (para. 0123).

Re claim 25: Gaebler discloses pyramids for the nanostructures (Fig. 1b).

Re claim 26: Gaebler discloses a metal layer on the nanostructures (para. 0038), which is between the nanostructures and the substrate, as Gaebler discloses a substrate on the nanostructures (para. 0031), and the metal layer is expected to be reflective.

Re claim 29: Gaebler discloses crystal silicon (para. 0002).

Re claim 30: Gaebler discloses the material may include germanium in addition to silicon (para. 0023).

Re claim 31: Gaebler discloses in Fig. 2b the features are formed in the semiconductor layer.

Re claim 32: Gaebler discloses in Fig. 1a the features are substantially of uniform height.

Re claim 33: Gaebler discloses in Fig. 1b the features are not all of uniform height.

Re claim 34: The combination of Gaebler and Fonash discloses silicon oxide as the bonding layer, as Fonash discloses anodic bonding (para. 0047), which is well known in the art to include a silicon oxide layer formed on the silicon layer to be bonded. It would have been obvious to one of ordinary skill

in the art before the effective filing date of the claimed invention to have combined the bonding step disclosed by Fonash with the method disclosed by Gaebler because Fonash discloses a method of art recognized suitability for an intended purpose (MPEP 2144.07).

Re claim 35: The combination of Gaebler and Fonash discloses as obvious the recited range of thickness of the semiconductor layer, as Fonash discloses the thickness of the semiconductor layer, which is the thickness of the layer 18 as being 10 to 5000 nm (para. 0039), which overlaps the recited range, and therefore the recited range is obvious (MPEP 2144.05). It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have combined the thickness disclosed by Fonash with the device disclosed by Gaebler because Fonash discloses a material of art recognized suitability for an intended purpose (MPEP 2144.07).

Re claims 38-39: Gaebler discloses a range of the height of the nanostructures of 400-1000 or 1500 nm, which overlaps the recited range, and therefore the recited range is obvious (MPEP 2144.05).

Re claim 40: Gaebler discloses a masking and photolithography step followed by etching (para. 0116, 0129, 0145).

Re claim 41: Gaebler discloses in Fig. 1b multiple etched levels.

Re claim 42: Gaebler discloses the device is a sensor in the infrared range (para. 0017), which is a disclosure of a range of about 700-1100 nm, as the range 700-1100 nm is well known in the art to be the infrared range.

Re claim 47: The combination of Gaebler and Fonash discloses a method including providing a semiconductor layer having a light incident side and an opposed side and having multiple doped regions forming a junction, providing a support substrate, creating a plurality of surface features on the semiconductor layer and bonding the semiconductor layer to the support substrate, as Gaebler discloses

Providing a semiconductor layer 201 (Fig. 2a and para. 0165) having a light incident side and an opposed side and multiple doped regions, which are the Diff regions in Fig. 2a, and a junction, for example the n and p regions form a pn junction in Fig. 2a

Forming a nanostructured region 2 (para. 0153 and Fig. 2a) including a plurality of surface features which are the nanostructures which increase the quantum efficiency resulting from a reduction of reflections (para. 0168)

Providing a support substrate coupled to the semiconductor layer, as a separate substrate is subsequently transferred to the device (para. 0031).

Gaebler is silent with respect to a bonding layer.

Fonash, in the same field of endeavor of nanostructured light detection devices (para. 0003 and 0007), discloses adhering the device to a support substrate using an adhesive material attached to the support substrate (para. 0048-0049).

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have formed a bonding layer between the semiconductor layer and the support substrate as disclosed by Fonash in the method disclosed by Gaebler in order to obtain the benefit of providing support and protection for the device.

Re claim 49: Gaebler discloses the surface features formed on the light incident side of the semiconductor layer (Fig. 2b).

Re claim 50: Gaebler discloses etching to form the nanostructures (para. 0123).

Re claim 51: Gaebler discloses depositing an oxide material (SOG or HSQ) on the nanostructures (para. 0187) to protect the structures.

Re claim 52: Gaebler discloses the deposition of the material as disclosed in the rejection of claim 51 above includes that the holes between the pyramid shapes would be filled with the SOG or HSQ material.

Re claim 55: Gaebler discloses that the surface features are formed in the semiconductor layer (Fig. 2b and para. 0153).

Claims 27-28 is/are rejected under 35 U.S.C. 103 as being unpatentable over Gaebler et al (US 2009/0261353 A1)("Gaebler") in view of Fonash et al (US 2014/0242744 A1)("Fonash") as applied to claim 21 above, and further in view of Doan et al (US 2008/0057612 A1)("Doan").

Gaebler in view of Fonash discloses the limitations of claim 21 as stated above. Fonash discloses isolation structure (para. 0057-0059). Gaebler in view of Fonash is silent with respect to trench isolation.

Doan, in the same field of endeavor of photodetectors (para. 0003-0004) discloses trench isolation to isolate pixels so that signals for a given pixel will not spill over into neighboring pixels (para. 0004), which is also a disclosure of light trapping functionality.

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have included isolation as disclosed by Fonash in the device disclosed by Gaebler in order to obtain the benefit of isolation of the pixels as disclosed by Doan.

Re claim 28: The combination of Gaebler in view of Fonash and of Doan discloses light trapping functionality, as stated in the rejection of claim 27 above.

Claims 37 and 43 and 48 is/are rejected under 35 U.S.C. 103 as being unpatentable over Gaebler et al (US 2009/0261353 A1)("Gaebler") in view of Fonash et al (US 2014/0242744 A1)("Fonash") as applied to claim 21 above, and further in view of Ben Mohamed et al (US 2012/0001293 A1)("Ben Mohammed").

Re claims 37 and 43:

Gaebler in view of Fonash discloses the limitations of claim 21 as stated above. Gaebler in view of Fonash is silent with respect to the recited thickness of the bonding layer and with respect to a second bonding layer.

Ben Mohammed, in the same field of endeavor of photoelectric and detector devices (para. 0050), discloses substrates to be bonded (para. 0002), and discloses a range of thickness of insulating material between the substrates, one of which is semiconductor and the other of which is glass, which overlaps the recited range (para. 0015-0016) and therefore the recited range is obvious (MPEP 2144.05).

It would have been obvious to one of ordinary skill in the art before the effective filing date of the claimed invention to have combined the disclosure made by Ben Mohamed and the device disclosed by Gaebler in view of Fonash because Ben Mohamed discloses a method which is of art recognized suitability for an intended purpose (MPEP 2144.07).

Re claim 48: The combination of Gaebler and Fonash and Ben Mohamed discloses the bonding of the first and second substrates after forming the bonding layer on the first and on the second substrate, as Ben Mohamed discloses bonding the first and second substrates after forming the bonding layer on the first and on the second substrate (para. 0021). The reasons for combining the references are the same as stated above in the rejection of claims 37 and 43.

Allowable Subject Matter

Claims 36, 44-46, and 53-54 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.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CARIDAD EVERHART whose telephone number is (571)272-1892. The examiner can normally be reached on M-F 6:00 AM-4:00 PM.

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

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eliseo Ramos-Feliciano can be reached on 571-272-7925. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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/CARIDAD EVERHART/
Primary Examiner, Art Unit 2895

<i>Notice of References Cited</i>	Application/Control No. 16/505,283		Applicant(s)/Patent Under Reexamination HADDAD et al.	
	Examiner CARIDAD EVERHART		Art Unit 2895	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-20120001293-A1	01-2012	Ben Mohamed; Nadia	H01L21/762	257/506
*	B	US-20140242744-A1	08-2014	Fonash; Stephen J.	H01L31/02366	438/71
*	C	US-20090261353-A1	10-2009	Gaebler; Daniel	H01L31/0236	257/82
*	D	US-20080057612-A1	03-2008	Doan; Hung Q.	H01L21/76237	438/57
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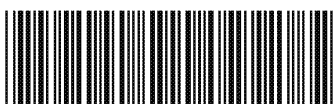
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Search Notes 	Application/Control No. 16/505,283	Applicant(s)/Patent Under Reexamination HADDAD et al.
	Examiner CARIDAD EVERHART	Art Unit 2895

CPC - Searched*		
Symbol	Date	Examiner
H01L27/1446, 14625	02/07/2020	ce
H01L31/0236, 18	02/07/2020	ce
H01L25/167	02/07/2020	ce

CPC Combination Sets - Searched*		
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Search Notes		
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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L7	1447	((infra adj red) or infrared) and visible and (nanostructur\$3) and (sensor or camera or photosensitive or imager or detector)) and ((ir or (infra adj red) or infrared) and visible and (textured or texture or microtextur\$3 or nanotextur\$3) and (sensor or camera or photosensitive or imager or detector))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/02/07 15:35
L8	95	7 AND ((H01L27/1446 OR H01L27/14625 OR H01L31/0236 OR H01L31/18 OR H01L25/167).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/02/07 15:42
L9	51	h01l27/146.ipc. and (((infra adj red) or infrared) and visible and (nanostructur\$3) and (sensor or camera or photosensitive or imager or detector)) and ((ir or (infra adj red) or infrared) and visible and (textured or texture or microtextur\$3 or nanotextur\$3) and (sensor or camera or photosensitive or imager or detector))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/02/07 16:02
L10	33	h01l31/0232.ipc. and (((infra adj red) or infrared) and visible and (nanostructur\$3) and (sensor or camera or photosensitive or imager or detector)) and ((ir or (infra adj red) or infrared) and visible and (textured or texture or microtextur\$3 or nanotextur\$3) and (sensor or camera or photosensitive or imager or detector))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/02/07 16:02
L11	21	h01l31/028.ipc. and (((infra adj red) or infrared) and visible and (nanostructur\$3) and (sensor or camera or photosensitive or imager or detector)) and ((ir or (infra adj red) or infrared) and visible and (textured or texture or microtextur\$3 or nanotextur\$3) and (sensor or camera or photosensitive or imager or detector))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/02/07 16:03
L12	49	h01l31/18.ipc. and (((infra adj red) or infrared) and visible and (nanostructur\$3) and (sensor or camera or photosensitive or imager or detector)) and ((ir or (infra adj red) or infrared) and visible and (textured or texture or microtextur\$3 or nanotextur\$3) and (sensor or camera or photosensitive or imager or detector))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/02/07 16:03
L13	107	9 or 10 or 11 or 12	US-PGPUB; USPAT; USOCR; FPRS; EPO;	OR	ON	2020/02/07 16:03

EAST Search History

			JPO; DERWENT; IBM_TDB			
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EAST Search History (Interference)

< This search history is empty >

2/ 7/ 2020 4:12:29 PM

C:\ Users\ ceverhart\ Documents\ EAST\ Workspaces\ 16505283b6.wsp

Bibliographic Data

Application No: 16/505,283

Foreign Priority claimed: ☐ Yes ☒ No

35 USC 119 (a-d) conditions met: ☐ Yes ☒ No

☐ Met After Allowance

Verified and Acknowledged:

/CARIDAD EVERHART/

Examiner's Signature

Initials

Title:

SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
07/08/2019	257	2895	SXM-060CN3
RULE			

APPLICANTS

SiOnyx, LLC, Beverly, MA,

INVENTORS

Homayoon HADDAD Beaverton, OR, UNITED STATES

Jutao JIANG Tigard, OR, UNITED STATES

CONTINUING DATA

This application is a CON of 15614256 06/05/2017 PAT 10347682

15614256 is a CON of 14884181 10/15/2015 PAT 9673250

14884181 is a CON of 14084392 11/19/2013 PAT 9209345

14084392 has PRO of 61841326 06/29/2013

FOREIGN APPLICATIONS

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07/22/2019

STATE OR COUNTRY

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\$1,720

EAST Search History**EAST Search History (Prior Art)**

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	9101	((infra adj red) or infrared) and visible and (nanostructur\$3) and (sensor or camera or photosensitive or imager or detector)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/02/07 14:40
L2	10784	((infra adj red) or infrared) and visible and (microstructur\$3) and (sensor or camera or photosensitive or imager or detector)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/02/07 14:40
L3	526	(L1 or L2) and (((si or silicon) same (wafer or substrate)) and (pn near4 junction))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/02/07 14:40
L4	526	3 and (camera or detector or sensor or sensing or photodetector or (pn adj junction))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/02/07 14:53
L5	526	4 and ((nanostructur\$3 or nanotextur\$3 or microtextur\$3 or microstructur\$3) or imager)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/02/07 15:14

EAST Search History (Interference)

< This search history is empty >

2/ 7/ 2020 3:23:13 PM**C:\Users\ceverhart\Documents\EAST\Workspaces\16505283b4.wsp**

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From: PAIR_eOfficeAction@uspto.gov
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Application	Document	Mailroom Date	Attorney Docket No.
16505283	CTNF	02/13/2020	SXM-060CN3
	892	02/13/2020	SXM-060CN3

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: Homayoon Haddad *et al.*

Application No.: 16/505,283

Filed: July 8, 2019

For: SHALLOW TRENCH TEXTURED REGIONS AND
ASSOCIATED METHODS

Confirmation No.: 2766

Art Unit: 2895

Examiner: Everhart, Caridad

VIA EFS-WEB

Commissioner for Patents

P. O. Box 1450

Alexandria, VA 22313-1450

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August 13, 2020

Dated

Electronic Signature: /Andrew W. Schultz/

Andrew Schultz, Reg. No. 66,869

AMENDMENT AND RESPONSE TO NON-FINAL OFFICE ACTION

Dear Sir,

This paper is filed in response to the non-final Office Action dated February 13, 2020.
The fee for a three-month extension of time is submitted herewith.

Amendments to the Claims begin on page 2 of this paper.

Arguments begin on page 9.

AMENDMENTS TO THE CLAIMS

1-20. (Canceled)

21. (Currently Amended) A photosensitive imager device capable of detecting visible and infrared electromagnetic radiation, comprising:

a semiconductor layer having a light incident side and an opposed side, said semiconductor layer having multiple doped regions forming at least one junction,
a textured region comprising a plurality of surface features configured to interact with incident electromagnetic radiation so as to increase the quantum efficiency of the device,
wherein the surface features are arranged according to a pattern,
a support substrate coupled to said semiconductor layer, and
a first bonding layer disposed between the semiconductor layer and the support substrate.

22. (Previously Presented) The device of claim 21, wherein the textured region is located on the light incident side of the semiconductor layer.

23. (Previously Presented) The device of claim 22, further comprising a device layer coupled to the semiconductor layer on said side opposed to the light incident side.

24. (Previously Presented) The device of claim 22, wherein the textured region is formed by etching.

25. (Previously Presented) The device of claim 24, wherein said surface features comprise pyramids.

26. (Previously Presented) The device of claim 22, further comprising a reflector layer disposed between the textured layer and the support substrate.

27. (Previously Presented) The device of claim 21, further comprising deep trench isolation for isolating the device.

28. (Previously Presented) The device of claim 27, wherein said deep trench isolation provides light trapping functionality.

29. (Previously Presented) The device of claim 21, wherein the semiconductor layer is single crystal silicon.
30. (Previously Presented) The device of claim 21, wherein the semiconductor layer comprises silicon and germanium.
31. (Previously Presented) The device of claim 21, wherein the surface features are formed in the semiconductor layer.
32. (Previously Presented) The device of claim 21, wherein the surface features have a substantially uniform height.
33. (Previously Presented) The device of claim 21, wherein the surface features are not uniform in height.
34. (Previously Presented) The device of claim 21, wherein said first bonding layer comprises any of silicon oxide, silicon nitride and amorphous silicon.
35. (Previously Presented) The device of claim 21, wherein said semiconductor layer has a thickness in a range of about 1 micron to about 10 microns.
36. (Previously Presented) The device of claim 35, wherein the device exhibits a quantum efficiency of at least about 35% for electromagnetic radiation at a wavelength of about 940 nm.
37. (Previously Presented) The device of claim 21, wherein said bonding layer has a thickness in a range of about 30 nm to about 3 microns.
38. (Previously Presented) The device of claim 21, wherein said plurality of surface features have a height in a range of about 50 nm to about 2 microns.
39. (Previously Presented) The device of claim 21, wherein said plurality of surface features have a height in a range from about 0.35 microns to about 0.7 microns.
40. (Previously Presented) The device of claim 21, wherein said plurality of surface features are formed by using a patterned mask and photolithography followed by etching.

41. (Previously Presented) The device of claim 21, wherein said plurality of surface features comprise multiple etched levels.
42. (Previously Presented) The device of claim 21, wherein said textured region increases optical absorption of the semiconductor layer over an electromagnetic spectrum range of at least about 700 nm to about 1100 nm.
43. (Previously Presented) The device of claim 21, further comprising a second bonding layer positioned between the first bonding layer and the support substrate.
44. (Canceled)
45. (Currently Amended) The device of claim ~~[[44]]~~ 21, wherein the pattern is an at least substantially uniform grid.
46. (Currently Amended) The device of claim ~~[[44]]~~ 21, wherein the pattern is a non-uniform arrangement.
47. (Currently Amended) A method of making a photosensitive image device, comprising:
providing a semiconductor layer having a light incident side and an opposed side, said semiconductor layer having multiple doped regions forming at least one junction;
providing a support substrate;
bonding the semiconductor layer to the support substrate;
creating a plurality of surface features on one of the semiconductor layer and the support substrate, wherein the surface features are formed via etching; ~~[[and]]~~
~~bonding the semiconductor layer to the support substrate.~~
depositing an oxide material within at least a portion of the semiconductor layer or support substrate removed during etching; and
processing the region of the semiconductor layer or support substrate comprising the surface features with CMP after depositing the oxide material.
48. (Previously Presented) The method of claim 47, wherein bonding the semiconductor layer to the support substrate comprises:
depositing a first bonding layer onto the semiconductor layer; and

bonding the first bonding layer to a second bonding layer disposed on the support substrate.

49. (Previously Presented) The method of claim 47, wherein the plurality of surface features are formed on the light incident side of the semiconductor layer.

50. (Canceled)

51. (Canceled)

52. (Currently Amended) The method of claim ~~[[51]]~~ 47, wherein depositing the oxide material comprises at least partially filling one of trenches, holes, pits, and cones formed in the semiconductor layer during etching.

53. (Canceled)

54. (Previously Presented) The method of claim 47, wherein the surface features are formed by shallow trench isolation etching.

55. (Previously Presented) The method of claim 47, wherein the surface features are formed in the semiconductor layer.

56. (New) A photosensitive imager device capable of detecting visible and infrared electromagnetic radiation, comprising:

- a semiconductor layer having a light incident side and an opposed side, said semiconductor layer having multiple doped regions forming at least one junction,
- a textured region comprising a plurality of surface features configured to interact with incident electromagnetic radiation so as to increase the quantum efficiency of the device,
- a support substrate coupled to said semiconductor layer, and
- a first bonding layer disposed between the semiconductor layer and the support substrate, wherein the device exhibits a quantum efficiency of at least about 35% for electromagnetic radiation at a wavelength of about 940.

57. (New) The device of claim 56, wherein the textured region is located on the light incident side of the semiconductor layer.

58. (New) The device of claim 57, further comprising a device layer coupled to the semiconductor layer on said side opposed to the light incident side.
59. (New) The device of claim 57, wherein the textured region is formed by etching.
60. (New) The device of claim 59, wherein said surface features comprise pyramids.
61. (New) The device of claim 57, further comprising a reflector layer disposed between the textured layer and the support substrate.
62. (New) The device of claim 56, further comprising deep trench isolation for isolating the device.
63. (New) The device of claim 62, wherein said deep trench isolation provides light trapping functionality.
64. (New) The device of claim 56, wherein the semiconductor layer is single crystal silicon.
65. (New) The device of claim 56, wherein the semiconductor layer comprises silicon and germanium.
66. (New) The device of claim 56, wherein the surface features are formed in the semiconductor layer.
67. (New) The device of claim 56, wherein the surface features have a substantially uniform height.
68. (New) The device of claim 56, wherein the surface features are not uniform in height.
69. (New) The device of claim 56, wherein said first bonding layer comprises any of silicon oxide, silicon nitride and amorphous silicon.
70. (New) The device of claim 56, wherein said semiconductor layer has a thickness in a range of about 1 micron to about 10 microns.
71. (New) The device of claim 56, wherein said bonding layer has a thickness in a range of about 30 nm to about 3 microns.

72. (New) The device of claim 56, wherein said plurality of surface features have a height in a range of about 50 nm to about 2 microns.

73. (New) The device of claim 56, wherein said plurality of surface features have a height in a range from about 0.35 microns to about 0.7 microns.

74. (New) The device of claim 56, wherein said plurality of surface features are formed by using a patterned mask and photolithography followed by etching.

75. (New) The device of claim 56, wherein said plurality of surface features comprise multiple etched levels.

76. (New) The device of claim 56, wherein said textured region increases optical absorption of the semiconductor layer over an electromagnetic spectrum range of at least about 700 nm to about 1100 nm.

77. (New) The device of claim 56, further comprising a second bonding layer positioned between the first bonding layer and the support substrate.

78. (New) The device of claim 56, wherein the surface features are arranged according to a pattern that is an at least substantially uniform grid.

79. (New) The device of claim 56, wherein the surface features are arranged according to a pattern that is a non-uniform arrangement.

80. (New) A method of making a photosensitive image device, comprising:
providing a semiconductor layer having a light incident side and an opposed side, said semiconductor layer having multiple doped regions forming at least one junction;
providing a support substrate;
bonding the semiconductor layer to the support substrate; and
creating a plurality of surface features on one of the semiconductor layer and the support substrate, wherein the surface features are formed by shallow trench isolation etching.

81. (New) The method of claim 80, wherein bonding the semiconductor layer to the support substrate comprises:

depositing a first bonding layer onto the semiconductor layer; and
bonding the first bonding layer to a second bonding layer disposed on the support
substrate.

82. (New) The method of claim 80, wherein the plurality of surface features are formed on
the light incident side of the semiconductor layer.

83. (New) The method of claim 80, wherein the surface features are formed in the
semiconductor layer.

REMARKS

The pending Office Action addresses claims 21-55, of which claims 21-35, 37-43, 47-52, and 55 stand rejected. Claims 36, 44-46, 53, and 54 are objected to as being dependent upon a rejected base claims, but are indicated as being allowable if rewritten in independent form including all of the limitations of any intervening claim.

Applicant thanks Examiner Everhart for the indication that claims 36, 44-46, 53, and 54 would be allowable. As discussed below, the claims are amended herein in accordance with the Examiner's indication of allowable subject matter.

Amendments to the Claims

Applicant presents the following claim amendments in an effort to expedite prosecution. These amendments should not be construed as Applicant's acceptance of the Examiner's rejections. Applicant reserves the right to prosecute any of the former claims in a continuing application.

Claims 21, 45-47, and 52 are amended as shown on the attached sheets. In particular, independent claim 21 is amended for form and to incorporate the recitations of allowable claim 44, which is hereby canceled. Dependent claims 45 and 46 are amended to depend from claim 21 due to the cancellation of claim 44, from which these claims previously depended. Independent claim 47 is amended to incorporate the recitations of allowable claim 53 and its intervening base claims 50 and 51, which are also canceled. Dependent claim 52 is amended to depend from claim 47 due to the cancellation of claim 51, from which it previously depended.

In addition to above amendments to the pending claims, Applicant presents new independent claims 56 and 80 (and various dependent claims). Applicant notes that new independent claim 56 represents the previous version of independent claim 21, with the addition of the subject matter of allowable claim 36. Dependent claims 57-79 depend from new independent claim 56 and represent the subject matter of claims 22-35, 37-43, 45, and 46, respectively. Additionally, new independent claim 80 represents the previous version of independent claim 47, with the addition of the subject matter of allowable claim 54. Dependent claims 81-83 depend from new independent claim 80 and represent the subject matter of claims 48, 49, and 55, respectively.

Rejections Pursuant to 35 U.S.C. § 103

The Office Action rejects claims 21-26, 29-35, 38-42, 47, 49-52, and 55 pursuant to 35 U.S.C. § 103 as being obvious over U.S. Patent Pub. No. 20090261353 of Gaebler *et al.* (“Gaebler”) in view of U.S. Patent Pub. No. 20140242744 of Fonash *et al.* (“Fonash”). Dependent claims 27 and 28 stand rejected as being obvious over Gaebler and Fonash and further in view of U.S. Patent Pub. No. 20080057612 of Doan *et al.*, while dependent claims 37, 43, and 48 stand rejected as being obvious over Gaebler and Fonash and further in view of U.S. Patent Pub. No. 20120001293 of Mohamed *et al.*

The above amendments obviate the basis of the rejection of these claims in light of the Examiner’s indication of allowable subject matter. Moreover, new independent claims 57 and 80 (and their dependent claims) are also believed to overcome the cited art in light of the Examiner’s indication.

Conclusion

Applicant believe that the claims are in proper condition for allowance and allowance thereof is respectfully requested. The Examiner is encouraged to telephone the undersigned attorney for Applicant if such communication is deemed to expedite prosecution of this application.

No fees are believed to be due with filing. However, 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. 50-1196, under Docket No. SXM-060CN3.

Dated: August 13, 2020

Respectfully submitted,
Electronic Signature: /Andrew W. Schultz/
Andrew W. Schultz, Reg. No. 66,869
Attorney for Applicant
Nelson Mullins Riley & Scarborough LLP
One Post Office Square, 30th Floor
Boston, MA 02109
Tel: (617) 217-4674
Fax: (617) 217-4699

Electronic Patent Application Fee Transmittal				
Application Number:		16505283		
Filing Date:		08-Jul-2019		
Title of Invention:		SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS		
First Named Inventor/Applicant Name:		Homayoon HADDAD		
Filer:		Andrew W. Schultz		
Attorney Docket Number:		SXM-060CN3		
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	24	100	2400
INDEPENDENT CLAIMS IN EXCESS OF 3	1201	1	460	460
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Extension - 3 months with \$0 paid	1253	1	1400	1400
Miscellaneous:				
Total in USD (\$)				4260

Electronic Acknowledgement Receipt

EFS ID:	40281750
Application Number:	16505283
International Application Number:	
Confirmation Number:	2766
Title of Invention:	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS
First Named Inventor/Applicant Name:	Homayoon HADDAD
Customer Number:	959
Filer:	Andrew W. Schultz
Filer Authorized By:	
Attorney Docket Number:	SXM-060CN3
Receipt Date:	13-AUG-2020
Filing Date:	08-JUL-2019
Time Stamp:	20:42:55
Application Type:	Utility under 35 USC 111(a)

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1		Response20200813.pdf	192304	yes	10
			ebf5019dc50c39ea30e7a0fe9c120c4485c1bfe4		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Amendment/Req. Reconsideration-After Non-Final Reject		1	1	
	Claims		2	8	
	Applicant Arguments/Remarks Made in an Amendment		9	10	
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	34185	no	2
			c516e67e33966c1176633bd65ac7b99ad3687257e		
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Application Number	16/505,283		
Filing Date	July 8, 2019		
First Named Inventor	Homayoon HADDAD		
Title	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS		
Art Unit	2895		
Examiner Name	EVERHART, CARIDAD		
Attorney Docket Number	SXM-060CN3		
SIGNATURE of Applicant or Patent Practitioner			
Signature	/Andrew W. Schultz/	Date (Optional)	August 18, 2020
Name	Andrew Schultz	Registration Number	66,869
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			
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☐	*Total of <u>1</u> forms are submitted.		

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Dated: August 18, 2020

Electronic Signature for Andrew Schultz: /Andrew W. Schultz/

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Document Description: Power of Attorney

PTO/AIA/82B (07-13)
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Application Number	Filing Date

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City	Boston	State	MA	Zip	02109-2127
Country	US				
Telephone	800-237-2000	Email	ipboston.docketing@nelsonmullins.com		

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)

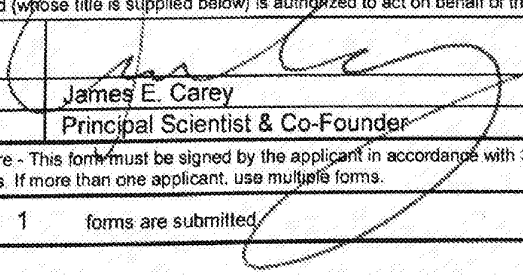
☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☒ 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	James E. Carey		
Title	Principal Scientist & Co-Founder		

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

Electronic Acknowledgement Receipt

EFS ID:	40312380
Application Number:	16505283
International Application Number:	
Confirmation Number:	2766
Title of Invention:	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS
First Named Inventor/Applicant Name:	Homayoon HADDAD
Customer Number:	959
Filer:	Andrew W. Schultz/Irene Gommerstadt
Filer Authorized By:	Andrew W. Schultz
Attorney Docket Number:	SXM-060CN3
Receipt Date:	18-AUG-2020
Filing Date:	08-JUL-2019
Time Stamp:	12:31:41
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Power of Attorney	POA.pdf	2869889 9595993eb38a7b1aa903e8367e0e81f966847b75	no	2

Warnings:

Information:	
Total Files Size (in bytes):	2869889
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. <u>New Applications Under 35 U.S.C. 111</u> 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. <u>National Stage of an International Application under 35 U.S.C. 371</u> 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. <u>New International Application Filed with the USPTO as a Receiving Office</u> 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.	

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 16/505,283		Filing Date 07/08/2019		☐ To be Mailed					
ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO													
APPLICATION AS FILED - PART I													
		(Column 1)	(Column 2)										
FOR		NUMBER FILED	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), (l), 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 \$ 100 =								
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 =	*		x \$ 460 =								
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).											
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))													
* If the difference in column 1 is less than zero, enter "0" in column 2.					TOTAL								
APPLICATION AS AMENDED - PART II													
		(Column 1)	(Column 2)		(Column 3)								
AMENDMENT	08/13/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE (\$)	ADDITIONAL FEE (\$)					
	Total (37 CFR 1.16(i))	* 59	Minus	** 35	= 24		x \$ 100 =	2400					
	Independent (37 CFR 1.16(h))	* 4	Minus	*** 3	= 1		x \$ 460 =	460					
	☐ Application Size Fee (37 CFR 1.16(s))												
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))												
							TOTAL ADD'L FEE		2860				
		(Column 1)	(Column 2)		(Column 3)								
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE (\$)	ADDITIONAL FEE (\$)					
	Total (37 CFR 1.16(i))	*	Minus	**	=		x \$ 0 =						
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x \$ 0 =						
	☐ Application Size Fee (37 CFR 1.16(s))												
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))												
							TOTAL ADD'L FEE						
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.							LIE						
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".							/ANTJUAN M RIVERA/						
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".													
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.													

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

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



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

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/505,283	07/08/2019	Homayoon HADDAD	SXM-060CN3

CONFIRMATION NO. 2766

POA ACCEPTANCE LETTER



959
NELSON MULLINS RILEY & SCARBOROUGH LLP
FLOOR 30, SUITE 3000
ONE POST OFFICE SQUARE
BOSTON, MA 02109

Date Mailed: 08/21/2020

NOTICE OF ACCEPTANCE OF POWER OF ATTORNEY

This is in response to the Power of Attorney filed 08/18/2020.

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

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

/yfeferra/

To: ipboston.docketing@nelsonmullins.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 959

Aug 21, 2020 03:56:25 AM

Dear PAIR Customer:

NELSON MULLINS RILEY & SCARBOROUGH LLP
FLOOR 30, SUITE 3000
ONE POST OFFICE SQUARE
BOSTON, MA 02109
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 959 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

Disclaimer:

The list of documents shown below is provided as a courtesy and is not part of the official file wrapper. The content of the images shown in PAIR is the official record.

Application	Document	Mailroom Date	Attorney Docket No.
16505283	N570	08/21/2020	SXM-060CN3

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 with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE
PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM



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.
16/505,283	07/08/2019	Homayoon HADDAD	SXM-060CN3	2766
959 7590 10/22/2020 NELSON MULLINS RILEY & SCARBOROUGH LLP FLOOR 30, SUITE 3000 ONE POST OFFICE SQUARE BOSTON, MA 02109			EXAMINER EVERHART, CARIDAD	
			ART UNIT 2895	PAPER NUMBER
			NOTIFICATION DATE 10/22/2020	DELIVERY MODE 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):

ipboston.docketing@nelsonmullins.com

Office Action Summary	Application No. 16/505,283	Applicant(s) HADDAD et al.	
	Examiner CARIDAD EVERHART	Art Unit 2895	AIA (FITF) Status Yes

-- 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 8/13/2020.
☐ 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) 21-43,45-49,52 and 54-83 is/are pending in the application.
5a) Of the above claim(s) ____ is/are withdrawn from consideration.
- 6) ☒ Claim(s) 21-43,45-49,52 and 54-79 is/are allowed.
- 7) ☒ Claim(s) 80-83 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 ____.
- 3) ☒ Interview Summary (PTO-413)
Paper No(s)/Mail Date ____.
- 4) ☐ Other: ____.

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Response to Arguments

Applicant's arguments filed 8/13/2020 have been fully considered. New grounds of rejection are made with respect to new claims 80-83.

Claim Rejections - 35 USC § 103

In the event the determination of the status of the application as subject to AIA 35 U.S.C. 102 and 103 (or as subject to pre-AIA 35 U.S.C. 102 and 103) is incorrect, any correction of the statutory basis for the rejection will not be considered a new ground of rejection if the prior art relied upon, and the rationale supporting the rejection, would be the same under either status.

The text of those sections of Title 35, U.S. Code not included in this action can be found in a prior Office action.

Claims 80 and 82-83 is/are rejected under 35 U.S.C. 103 as being unpatentable over Huang (US 4,772,335).

Huang discloses a method of making an ultraviolet light detector or sensor (col. 1, lines 51-60), which is a photosensitive image device,

Including providing a semiconductor layer having a light incident side and an opposed side, as Huang discloses the light is incident from the top, as Huang discloses the light enters through the layer 22 to the layer 23, in that order (col. 3, lines 39-54 and Fig. 2), and Huang also discloses multiple doped regions including a junction (col. 3, lines 39-54 and col. 1, lines 63-68)

Providing a support substrate 14, which is glass (col. 3, lines 20-39),

Bonding the semiconductor layer to the support substrate, as Huang discloses bonding the semiconductor layers to the substrate through an insulating layer (col. 5, lines 19-34) and

Creating a plurality of surface features on the semiconductor (col. 6, lines 47-54) , the surface features are formed by shallow trench isolation etching, as Huang discloses creating texturing features such as grooved or features by lithography in the semiconductor layer to capture incident light (col. 5, lines 44-68 and col. 6, lines 1-2), in which Huang discloses the grooves can be formed by lithography (col. 5, lines 65-68 and col. 6, lines 1-20), which is a disclosure of shallow trench etching ,and Huang also discloses the light which is captured is incident light (col. 6, lines 47-54), , which is a disclosure that light is captured from the semiconductor side of the device, and Huang also discloses the features are formed in the semiconductor layer, as stated above, and Huang also discloses the features are formed by etching (col. 5, lines 60-67), and these features may be formed in the semiconductor layer (col. 6, lines 47-53).

Huang discloses more than one doped region as stated above, which is a disclosure of multiple doped regions, or would suggest to one of ordinary skill in the art to form multiple doped regions, as duplication of parts is obvious (MPEP 2144.04(VI(B))).

Re claim 82: Huang discloses the plurality of surface features are formed on the light incident side of the semiconductor layer, as stated above in the rejection of claim 80.

Re claim 83: Huang discloses the surface features are formed in the semiconductor layer, as stated above in the rejection of claim 80.

Claim 81 is/are rejected under 35 U.S.C. 103 as being unpatentable over Huang (US 4.772,335). as applied to claim 80 above, and further in view of Rey et al (US 2010/0310839 A1)(“Rey”).

Huang discloses the limitations of claim 80 as stated above. Huang is silent with respect to the recited steps of bonding the semiconductor to the substrate.

Rey discloses a method of bonding a semiconductor to a substrate including depositing a first bonding layer onto the semiconductor layer and bonding the first bonding layer to a second bonding layer disposed on the support substrate (para. 0072), the substrate may be a semiconductor substrate (para. 0027) and Ray also discloses applying an adhesion layer to the substrate which is to receive the semiconductor layer (para. 0080).

It would have been obvious to one of ordinary skill in the art to have combined the steps disclosed by Ray with the method disclosed by Huang in order to obtain a bonded a semiconductor bonded to a substrate of a different material.

Allowable Subject Matter

Claims 21-43, 45-49, 52, and 54-79 are allowed.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CARIDAD EVERHART whose telephone number is (571)272-1892. The examiner can normally be reached on M-F 6:00 AM-4:00 PM.

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

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eliseo Ramos-Feliciano can be reached on 571-272-7925. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <https://ppair-my.uspto.gov/pair/PrivatePair>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/CARIDAD EVERHART/
Primary Examiner, Art Unit 2895

<i>Examiner-Initiated Interview Summary</i>	Application No. 16/505,283	Applicant(s) HADDAD et al.	
	Examiner CARIDAD EVERHART	Art Unit 2895	AIA (FITF) Status Yes

All participants (applicant, applicant's representative, PTO personnel):

(1) CARIDAD EVERHART. (3) ____.

(2) Attorney Andrew W. Schultz. (4) ____.

Date of Interview: 15 October 2020.

Type: ☒ Telephonic ☐ Video Conference
☐ Personal [copy given to: ☐ applicant ☐ applicant's representative]

Exhibit shown or demonstration conducted: ☐ Yes ☐ No.
If Yes, brief description: ____.

Issues Discussed ☐ 101 ☐ 112 ☐ 102 ☐ 103 ☐ Others
(For each of the checked box(es) above, please describe below the issue and detailed description of the discussion)

Claim(s) discussed: ____.

Identification of prior art discussed: ____.

Substance of Interview
(For each issue discussed, provide a detailed description and indicate if agreement was reached. Some topics may include: identification or clarification of a reference or a portion thereof, claim interpretation, proposed amendments, arguments of any applied references etc...)

The examiner left a message on a voice message machine stating that the examiner was calling to request permission for an examiner's amendment. The examiner also called on 10/19/2020..

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

☐ Attachment

	/CARIDAD EVERHART/ Primary Examiner, Art Unit 2895
--	---

<i>Notice of References Cited</i>	Application/Control No. 16/505,283		Applicant(s)/Patent Under Reexamination HADDAD et al.	
	Examiner CARIDAD EVERHART		Art Unit 2895	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-20100310839-A1	12-2010	Rey; Alain-Marcel	B44C1/04	428/203
*	B	US-4772335-A	09-1988	Huang; Wingo C.	H01L31/022475	136/258
*	C	US-20130014814-A1	01-2013	Han; Sang Eon	H01L31/035209	136/255
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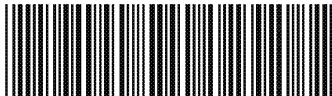
FOREIGN PATENT DOCUMENTS

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

NON-PATENT DOCUMENTS

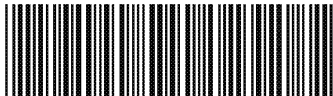
*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
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*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

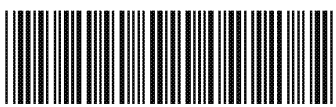
<i>Index of Claims</i> 	Application/Control No. 16/505,283	Applicant(s)/Patent Under Reexamination HADDAD et al.
	Examiner CARIDAD EVERHART	Art Unit 2895

✓	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	02/08/2020	10/19/2020							
	21	✓	=							
	22	✓	=							
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<i>Index of Claims</i> 	Application/Control No. 16/505,283	Applicant(s)/Patent Under Reexamination HADDAD et al.
	Examiner CARIDAD EVERHART	Art Unit 2895

CLAIM		DATE								
Final	Original	02/08/2020	10/19/2020							
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	81		✓							
	82		✓							
	83		✓							

Search Notes 	Application/Control No. 16/505,283	Applicant(s)/Patent Under Reexamination HADDAD et al.
	Examiner CARIDAD EVERHART	Art Unit 2895

CPC - Searched*		
Symbol	Date	Examiner
H01L27/1446, 14625	02/07/2020	ce
H01L31/0236, 18	02/07/2020	ce
H01L25/167	02/07/2020	ce
H01L27/1446, 14625	10/14/2020	ce
H01L25/167	10/14/2020	ce
H01L31/18, 0236	10/14/2020	ce
B23K26/355	10/14/2020	ce
B82Y40/00	10/14/2020	ce
H01L11/3247	10/14/2020	ce

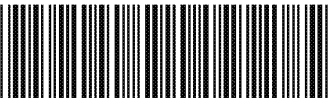
CPC Combination Sets - Searched*		
Symbol	Date	Examiner

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
EAST attached	02/07/2020	ce
EAST attached	10/14/2020	ce

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<i>Search Notes</i> 	Application/Control No. 16/505,283	Applicant(s)/Patent Under Reexamination HADDAD et al.
	Examiner CARIDAD EVERHART	Art Unit 2895

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
EAST	attached	10/14/2020	ce

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L10	307	9 and optoelectronic	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 12:45
L12	125	(nanostructur\$3 near9 etch\$4) and (optoelectronic same sensor)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 13:06
L13	102	1 AND ((B82Y40/00 OR B23K26/355 OR H01L11/3247).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 13:14
L14	72	nanotextur\$5 and (light near9 (sensor or detector or optoelectronic))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 13:18
L15	6	14 AND ((B82Y40/00 OR B23K26/355 OR H01L11/3247).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 13:18
L16	126	nanotextur\$5 and ((light near9 (sensor or detector)) or optoelectronic)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 13:20
L17	19	16 AND ((B82Y40/00 OR B23K26/355 OR H01L11/3247).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 13:20

EAST Search History (Interference)

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10/14/2020 1:22:15 PM

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EAST Search History

EAST Search History (Prior Art)

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L1	1,563	((infra adj red) or infrared) and visible and (nanostructur\$3) and (sensor or camera or photosensitive or imager or detector)) and ((ir or (infra adj red) or infrared) and visible and (textured or texture or microtextur\$3 or nanotextur\$3) and (sensor or camera or photosensitive or imager or detector))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 12:05
L3	98	1 AND ((H01L27/1446 OR H01L27/14625 OR H01L31/0236 OR H01L31/18 OR H01L25/167).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 12:07
L7	31	nanostructured same sti	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 12:38
L9	1,863	nanostructured near5 silicon	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 12:39
L10	307	9 and optoelectronic	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 12:45
L11	401	nanostructur\$3 same optoelectronic same sensor	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 12:57
L12	125	(nanostructur\$3 near9 etch\$4) and (optoelectronic same sensor)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	ON	2020/10/14 13:06

			DERWENT; IBM_TDB			
L13	102	1 AND ((B82Y40/00 OR B23K26/355 OR H01L11/3247).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 13:14
L14	72	nanotextur\$5 and (light near9 (sensor or detector or optoelectronic))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 13:18
L15	6	14 AND ((B82Y40/00 OR B23K26/355 OR H01L11/3247).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 13:18
L16	126	nanotextur\$5 and ((light near9 (sensor or detector)) or optoelectronic)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 13:20
L17	19	16 AND ((B82Y40/00 OR B23K26/355 OR H01L11/3247).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 13:20
L18	1,563	((infra adj red) or infrared) and visible and (nanostructur\$3) and (sensor or camera or photosensitive or imager or detector)) and ((ir or (infra adj red) or infrared) and visible and (textured or texture or microtextur\$3 or nanotextur\$3) and (sensor or camera or photosensitive or imager or detector))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 13:43
L19	98	18 AND ((H01L27/1446 OR H01L27/14625 OR H01L31/0236 OR H01L31/18 OR H01L25/167).CPC.)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/10/14 13:44

EAST Search History (Interference)

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L20	58	HADDAD-HOMAYOON	US-PGPUB; USPAT	OR	ON	2020/10/14 13:52
L21	48	JIANG-JUTAO	US-PGPUB; USPAT	OR	ON	2020/10/14 13:53
L22	6	(20 or 21) and (((infra adj red) or infrared) and visible and (nanostructur\$3) and (sensor or camera or photosensitive or imager or detector)) and ((ir or (infra adj red) or infrared) and visible and (textured or texture or microtextur\$3 or nanotextur\$3) and (sensor or camera or photosensitive or imager or detector)).clm.	US-PGPUB; USPAT	OR	ON	2020/10/14 13:54
L23	15	(((infra adj red) or infrared) and visible and (nanostructur\$3) and (sensor or camera or photosensitive or imager or detector)) and ((ir or (infra adj red) or infrared) and visible and (textured or texture or microtextur\$3 or nanotextur\$3) and (sensor or camera or photosensitive or imager or detector)).clm.	US-PGPUB; USPAT	OR	ON	2020/10/14 13:54

10/14/2020 1:56:54 PM

C:\Users\ceverhart\Documents\EAST\Workspaces\16505283b14.wsp

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From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
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Application	Document	Mailroom Date	Attorney Docket No.
16505283	CTNF	10/22/2020	SXM-060CN3
	INTV.SUM.EX	10/22/2020	SXM-060CN3
	892	10/22/2020	SXM-060CN3

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UNITED STATES PATENT AND TRADEMARK OFFICE
PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: Homayoon Haddad *et al.*

Application No.: 16/505,283

Filed: July 8, 2019

For: SHALLOW TRENCH TEXTURED REGIONS AND
ASSOCIATED METHODS

Confirmation No.: 2766

Art Unit: 2895

Examiner: Everhart, Caridad

VIA EFS-WEB

Commissioner for Patents

P. O. Box 1450

Alexandria, VA 22313-1450

Certificate of Mailing

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January 22, 2021

Dated

Electronic Signature: /Andrew W. Schultz/

Andrew Schultz, Reg. No. 66,869

AMENDMENT AND RESPONSE TO NON-FINAL OFFICE ACTION

Dear Sir,

This paper is filed in response to the non-final Office Action dated October 22, 2020.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 8.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of: Homayoon Haddad *et al.*

Application No.: 16/505,283

Filed: July 8, 2019

For: SHALLOW TRENCH TEXTURED REGIONS AND
ASSOCIATED METHODS

Confirmation No.: 2766

Art Unit: 2895

Examiner: Everhart, Caridad

VIA EFS-WEB

Commissioner for Patents

P. O. Box 1450

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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.

January 22, 2021

Dated

Electronic Signature: /Andrew W. Schultz/

Andrew Schultz, Reg. No. 66,869

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 before the mailing date of a final action under § 1.113 or a notice of allowance under § 1.311 (37 CFR 1.97(c)). A certification statement pursuant to 37 C.F.R. 1.97(e) is not submitted herewith. The fee set forth in § 1.17(p) is 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. In accordance with 37 CFR 1.98(d), Applicant has not

App. No.: 16/505,283
Art Unit: 2895

Docket No.: SXM-060CN3
Examiner: C. Everhart

submitted herewith copies of foreign patents and non-patent literature that were previously provided to the Office in one of U.S. App. No. 15/614,256 (filed June 5, 2017, Atty. Dkt. No. SXM-060CN2), U.S. App. No. 14/884,181 (filed October 15, 2015, Atty. Dkt. No. SXM-060CN), and U.S. App. No. 14/084,392 (filed November 19, 2013, Dkt. No. SXM-060CN), to which the instant application claims priority under 35 USC § 120.

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. 50-1196, under Docket No. SXM-060CN3.

Dated: January 22, 2021

Respectfully submitted,
Electronic Signature: /Andrew W. Schultz/
Andrew W. Schultz, Reg. No. 66,869
Attorney for Applicant
Nelson Mullins Riley & Scarborough LLP
One Financial Center, Suite 3500
Boston, MA 02110
Tel: (617) 217-4674
Fax: (617) 217-4699

Substitute for Form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)				Complete if Known	
				Application No.: 16/505,283	
				Filing Date: 07-08-2019	
				First Named Inventor: Homayoon Haddad	
				Group Art Unit: 2895	
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3	
Sheet	1	of	32		

(a) U. S. PATENT DOCUMENTS						
Examiner's Initials	Cite No.	U.S. Patent Document	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	
		Number Kind Code (if known)				
	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	4105955	Hayashi	8/8/1978		
	A7	4149174	Shannon	4/10/1979		
	A8	4176365	Kroger	11/27/1979		
	A9	4181538	Narayan et al.	1/1/1980		
	A10	4201450	Trapani	5/6/1980		
	A11	4242149	King et al.	12/30/1980		
	A12	4253882	Dalal	3/3/1981		
	A13	4277793	Webb	7/7/1981		
	A14	4322571	Stanbery	3/30/1982		
	A15	4343832	Smith	8/10/1992		
	A16	4346164	Tabarelli et al.	8/24/1982		
	A17	4419533	Czubatyj et al.	12/6/1983		
	A18	4452826	Shields et al.	6/5/1984		
	A19	4493942	Sheng et al.	1/15/1985		
	A20	4514582	Tiedje et al.	4/30/1985		
	A21	4536608	Sheng et al.	8/20/1985		
	A22	4546945	Nessfield	10/15/1985		
	A23	4568960	Petroff et al.	2/4/1986		
	A24	4593303	Dyck et al.	6/3/1986		
	A25	4593313	Nagasaki	6/3/1986		
	A26	4617593	Dudley	10/14/1986		
	A27	4630082	Sakai	12/16/1986		
	A28	4648936	Ashby et al.	3/10/1987		
	A29	4663188	Kane	5/5/1987		
	A30	4672206	Suzuki	6/9/1987		
	A31	4673770	Mandelkorn	6/16/1987		
	A32	4679068	Lillquist et al.	7/7/1987		
	A33	4703996	Glass et al.	11/1/1987		
	A34	4723086	Leibovich et al.	2/2/1988		
	A35	4751571	Lillquist	6/14/1988		

Examiner Signature		Date Considered	
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EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

Substitute for Form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)				Complete if Known			
				Application No.:		16/505,283	
				Filing Date:		07-08-2019	
				First Named Inventor:		Homayoon Haddad	
				Group Art Unit:		2895	
Examiner Name:				Caridad Everhart			
Sheet	2	of	32	Attorney Docket No.:		SXM-060CN3	

	A36	4773944	Nath et al.	9/1/1988		
	A37	4775425	Guha et al.	10/4/1988		
	A38	4777490	Sharma et al.	10/11/1988		
	A39	4829013	Yamazaki	5/9/1989		
	A40	4838952	Dill et al.	6/1/1989		
	A41	4883962	Elliot	11/28/1989		
	A42	4886958	Merryman	12/12/1989		
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	A45	4910568	Taki, et al.	3/20/1990		
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	A50	4999308	Nishiura et al.	3/12/1991		
	A51	5021100	Ishihara et al.	6/4/1991		
	A52	5021854	Huth	6/4/1991		
	A53	5080725	Green et al.	1/14/1992		
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	A55	5089437	Shima et al.	2/1/1992		
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	A57	5101260	Nath	3/31/1992		
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	A61	5182231	Hongo et al.	1/26/1993		
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	A65	5236863	Iranmanesh	8/17/1993		
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	A67	5296045	Banerjee et al.	3/22/1994		
	A68	5309275	Nishimura et al.	5/3/1994		
	A69	5322988	Russell et al.	6/21/1994		
	A70	5346850	Kaschmitter et al.	9/13/1994		
	A71	5351446	Langsdorf	10/4/1994		
	A72	5370747	Noguchi et al.	12/6/1994		
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	A74	5381431	Zayhowski	1/10/1995		
	A75	5383217	Uemura	1/17/1995		
	A76	5390201	Tomono et al.	2/14/1995		
	A77	5410168	Hisa	4/25/1995		
	A78	5413100	Barthelemy et al.	5/9/1995		
	A79	5449626	Hezel	9/12/1995		
Examiner Signature				Date Considered		

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Substitute for Form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)				Complete if Known			
				Application No.:		16/505,283	
				Filing Date:		07-08-2019	
				First Named Inventor:		Homayoon Haddad	
				Group Art Unit:		2895	
Examiner Name:				Caridad Everhart			
Sheet	3	of	32	Attorney Docket No.:		SXM-060CN3	

	A80	5454347	Shibata et al.	10/3/1995		
	A81	5502329	Pezzani	3/26/1996		
	A82	5507881	Sichanugrist et al.	4/16/1996		
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	A85	5569615	Yamazaki et al.	10/29/1996		
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	A94	5626687	Campbell	5/6/1997		
	A95	5627081	Tsuo et al.	5/6/1997		
	A96	5635089	Singh et al.	6/3/1997		
	A97	5640013	Ishikawa, et al.	6/17/1997		
	A98	5641362	Meier	6/24/1997		
	A99	5641969	Cooke et al.	6/24/1997		
	A100	5705413	Harkin et al.	1/6/1998		
	A101	5705828	Noguchi et al.	1/6/1998		
	A102	5708486	Miyawaki et al.	1/13/1998		
	A103	5710442	Watanabe et al.	1/20/1998		
	A104	5714404	Mititsky et al.	2/3/1998		
	A105	5727096	Ghirardi et al	3/10/1998		
	A106	5731213	Ono	3/24/1998		
	A107	5751005	Wyles et al.	5/12/1998		
	A108	5758644	Diab et el.	6/2/1998		
	A109	5766127	Pologe et al.	6/16/1998		
	A110	5766964	Rohatgi et al.	6/16/1998		
	A111	5773820	Osajda, et al.	6/30/1998		
	A112	5779631	Chance	7/14/1998		
	A113	5781392	Clark	7/14/1998		
	A114	5792280	Ruby et al	8/11/1998		
	A115	5802091	Chakrabarti et al	8/1/1998		
	A116	5808350	Jack et al	9/15/1998		
	A117	5859446	Nagasu et al.	1/12/1999		
	A118	5861639	Bernier	1/19/1999		
	A119	5871826	Mei	2/16/1999		
	A120	5898672	Ginzboorg	4/1/1999		
	A121	5918140	Wickboldt et al.	6/29/1999		
	A122	5923071	Saito	7/13/1999		
	A123	5935320	Graf et al.	8/10/1999		
Examiner Signature				Date Considered		

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

Substitute for Form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)				Complete if Known		
				Application No.: 16/505,283		
				Filing Date: 07-08-2019		
				First Named Inventor: Homayoon Haddad		
				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	4	of	32			

	A124	5942789	Morikawa	8/24/1999		
	A125	5943584	Shim et al	8/24/1999		
	A126	5963790	Matsuno et al	10/5/1999		
	A127	5977515	Uraki et al.	11/2/1999		
	A128	5977603	Ishikawa	11/2/1999		
	A129	5995606	Civanlar et al.	11/30/1999		
	A130	6019796	Mei	2/1/2000		
	A131	6048588	Engelsberg	4/11/2000		
	A132	6049058	Dulaney et al.	4/11/2000		
	A133	6071796	Voutsas	6/6/2000		
	A134	6072117	Matsuyama et al.	6/6/2000		
	A135	6080988	Ishizuya et al.	6/27/2000		
	A136	6082858	Grace et al.	7/4/2000		
	A137	6097031	Cole	8/1/2000		
	A138	6106689	Matsuyama	8/22/2000		
	A139	6107618	Fossum et al.	8/22/2000		
	A140	6111300	Cao et al.	8/29/2000		
	A141	6117499	Wong et al.	9/1/2000		
	A142	6121130	Chua et al.	9/1/2000		
	A143	6128379	Smyk	10/1/2000		
	A144	6131511	Wachi et al	10/17/2000		
	A145	6131512	Verlinden et al	10/17/2000		
	A146	6147297	Wettling et al.	11/14/2000		
	A147	6160833	Floyd et al.	12/12/2000		
	A148	6168965	Malinovich, et al.	1/2/2001		
	A149	6194722	Fiorini et al.	2/27/2001		
	A150	6204506	Akahori et al.	3/20/2001		
	A151	6229192	Gu	5/8/2001		
	A152	6242291	Kusumoto et al.	6/1/2001		
	A153	6252256	Ugge et al.	6/26/2001		
	A154	6272768	Danese	8/1/2001		
	A155	6290713	Russell	9/18/2001		
	A156	6291302	Yu	9/18/2001		
	A157	6313901	Cacharelis	11/6/2001		
	A158	6320296	Fujii et al.	11/20/2001		
	A159	6327022	Nishi	12/4/2001		
	A160	6331445	Janz et al	12/18/2001		
	A161	6331885	Nishi	12/18/2001		
	A162	6333485	Haight et al.	12/25/2001		
	A163	6340281	Haraguchi	1/22/2002		
	A164	6372536	Fischer et al.	4/1/2002		
	A165	6372591	Mineji et al.	4/16/2002		
	A166	6372611	Horikawa	4/16/2002		
	A167	6379979	Connolly	4/30/2002		
Examiner Signature				Date Considered		

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Substitute for Form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)				Complete if Known			
				Application No.:		16/505,283	
				Filing Date:		07-08-2019	
				First Named Inventor:		Homayoon Haddad	
				Group Art Unit:		2895	
Examiner Name:				Caridad Everhart			
Sheet	5	of	32	Attorney Docket No.:		SXM-060CN3	

	A168	6413135	Kim et al.	1/2/2002		
	A169	6420706	Lurie, et al.	7/16/2002		
	A170	6429036	Nixon, et al.	8/6/2002		
	A171	6429037	Wenham et al.	8/6/2002		
	A172	6457478	Danese	10/1/2002		
	A173	6465860	Shigenaka, et al.	10/15/2002		
	A174	6475839	Zhang, et al.	11/5/2002		
	A175	6479093	Lauffer et al	11/12/2002		
	A176	6483116	Kozlowski et al.	11/19/2002		
	A177	6483929	Marakami et al.	11/19/2002		
	A178	6486046	Ftjimura et al.	11/1/2002		
	A179	6486522	Bishay et al.	11/26/2002		
	A180	6493567	Krivitski et al.	12/10/2002		
	A181	6498336	Tian et al.	12/24/2002		
	A182	6500690	Yamagishi et al.	12/31/2002		
	A183	6504178	Carlson et al.	1/7/2003		
	A184	6562705	Ohara	5/1/2003		
	A185	6580053	Voutsas	6/17/2003		
	A186	6583936	Kaminsky et al.	6/24/2003		
	A187	6586318	Lu	7/1/2003		
	A188	6597025	Lauter et al	7/22/2003		
	A189	6607927	Ramappa et al.	8/19/2003		
	A190	6624049	Yamazaki	9/23/2003		
	A191	6639253	Duane et al.	10/28/2003		
	A192	6653554	Ishihara	11/25/2003		
	A193	6667528	Cohen et al.	12/23/2003		
	A194	6677655	Fitzgerald	1/13/2004		
	A195	6677656	Francois	1/13/2004		
	A196	6683326	Iguchi, et al.	1/27/2004		
	A197	6689209	Falster et el.	2/10/2004		
	A198	6690968	Mejia	2/10/2004		
	A199	6734455	Li	5/11/2004		
	A200	6753585	Kindt	6/22/2004		
	A201	6756104	Sokol et al.	6/1/2004		
	A202	6759262	Theil et al.	7/6/2004		
	A203	6790701	Shigenaka, et al.	9/14/2004		
	A204	6796144	Shepard et al.	9/1/2004		
	A205	6800541	Okumura	10/5/2004		
	A206	6801799	Mendelson	10/5/2004		
	A207	6803555	Parrish et al.	10/12/2004		
	A208	6815685	Wany	11/9/2004		
	A209	6818535	Lu et al.	11/16/2004		
	A210	6822313	Matsushita	11/23/2004		
	A211	6825057	Heyers, et al.	11/30/2004		
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				Filing Date:		07-08-2019	
				First Named Inventor:		Homayoon Haddad	
				Group Art Unit:		2895	
Examiner Name:				Caridad Everhart			
Sheet	6	of	32	Attorney Docket No.:		SXM-060CN3	

	A212	6864156	Conn	3/8/2005		
	A213	6864190	Han et al.	3/8/2005		
	A214	6867806	Lee et al.	3/15/2005		
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	A216	6897118	Poon et al.	5/24/2005		
	A217	6900839	Kozlowski et al.	5/31/2005		
	A218	6907135	Gifford	6/14/2005		
	A219	6911375	Guarini et al.	6/28/2005		
	A220	6919587	Ballon et al.	7/19/2005		
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	A222	6927432	Holm, et al.	8/9/2005		
	A223	6984816	Holm, et al.	1/10/2006		
	A224	7008854	Forbes	3/7/2006		
	A225	7041525	Clevenger et al.	5/9/2006		
	A226	7057256	Carey, III et al.	6/6/2006		
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	A228	7091411	Falk et al.	8/15/2006		
	A229	7109517	Zaidi	9/19/2006		
	A230	7112545	Railkar et al.	9/1/2006		
	A231	7126212	Enquist et al.	10/24/2006		
	A232	7132724	Merrill	11/7/2006		
	A233	7202102	Yao	4/10/2007		
	A234	7211214	Chou	5/1/2007		
	A235	7211501	Liu et al	5/1/2007		
	A236	7235812	Chu, et al.	6/26/2007		
	A237	7247527	Shimomura et al.	7/24/2007		
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	A242	7285482	Ochi	10/23/2007		
	A243	7314832	Kountz et al.	1/1/2008		
	A244	7315014	Lee et al	1/1/2008		
	A245	7354792	Carey, III et al.	4/8/2008		
	A246	7358498	Geng et al.	4/15/2008		
	A247	7375378	Manivannan et al.	5/20/2008		
	A248	7390689	Mazur et al.	6/24/2008		
	A249	7413909	Hutchens et al.	8/1/2008		
	A250	7425471	Bruland et al.	9/1/2008		
	A251	7432148	Li et al.	10/7/2008		
	A252	7442629	Mazur et al.	10/28/2008		
	A253	7446359	Lee, et al.	11/4/2008		
	A254	7446807	Hong	11/7/2008		
	A255	7456452	Wells et al.	11/25/2008		
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				Filing Date: 07-08-2019		
				First Named Inventor: Homayoon Haddad		
				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	7	of	32			

	A256	7482532	Yi et al.	1/27/2009		
	A257	7498650	Lauxtermann	3/3/2009		
	A258	7504325	Koezuka et al.	3/17/2009		
	A259	7504702	Mazur et al.	3/17/2009		
	A260	7511750	Murakami	3/31/2009		
	A261	7521737	Augusto	4/21/2009		
	A262	7528463	Forbes	5/5/2009		
	A263	7542085	Altice, Jr. et al.	6/2/2009		
	A264	7547616	Fogel et al.	6/16/2009		
	A265	7551059	Farrier	6/23/2009		
	A266	7560750	Niira et al.	7/14/2009		
	A267	7564631	Li, et al.	7/21/2009		
	A268	7569503	Pan	8/4/2009		
	A269	7582515	Choi et al.	9/1/2009		
	A270	7586601	Eb stein	9/8/2009		
	A271	7592593	Kauffman, et al.	9/22/2009		
	A272	7595213	Kwon et al.	9/29/2009		
	A273	7605064	Kizilyalli et al.	10/1/2009		
	A274	7605397	Kindem et al.	10/20/2009		
	A275	7615808	Pain, et al.	11/10/2009		
	A276	7618839	Rhodes	11/17/2009		
	A277	7619269	Ohkawa	11/17/2009		
	A278	7629234	Bruland	12/1/2009		
	A279	7629582	Hoffman, et al.	12/8/2009		
	A280	7648851	Fu, et al.	1/19/2010		
	A281	7649156	Lee	1/19/2010		
	A282	7687740	Bruland et al.	3/1/2010		
	A283	7705879	Kerr et al.	4/27/2010		
	A284	7728274	Pilla et al	6/1/2010		
	A285	7731665	Lee et al	6/8/2010		
	A286	7741666	Nozaki, et al.	6/22/2010		
	A287	7745901	McCaffrey et al	6/29/2010		
	A288	7763913	Fan et al	7/27/2010		
	A289	7772028	Adkisson et al	8/10/2010		
	A290	7781856	Mazur et al.	8/24/2010		
	A291	7800192	Venezia, et al.	9/21/2010		
	A292	7800684	Tatani	9/21/2010		
	A293	7816220	Mazur et al.	10/19/2010		
	A294	7828983	Weber et al	11/9/2010		
	A295	7847253	Carey et al.	12/7/2010		
	A296	7847326	Park, et al.	12/7/2010		
	A297	7855406	Yamaguchi et al	12/21/2010		
	A298	7875498	Elbanhawy, et al.	1/25/2011		
	A299	7880168	Lenchenkov	2/1/2011		
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				Filing Date:		07-08-2019
				First Named Inventor:		Homayoon Haddad
				Group Art Unit:		2895
Examiner Name:				Caridad Everhart		
Sheet	8	of	32	Attorney Docket No.:		SXM-060CN3

	A300	7884439	Mazur et al.	2/8/2011		
	A301	7884446	Mazur et al.	2/8/2011		
	A302	7897942	Bereket	3/1/2011		
	A303	7910964	Kawahito et al.	3/22/2011		
	A304	7923801	Tian et al.	4/12/2011		
	A305	7935941	Bruland et al.	5/1/2011		
	A306	7968834	Veeder	6/28/2011		
	A307	8008205	Fukushima et al.	8/30/2011		
	A308	8013411	Cole	9/6/2011		
	A309	8030726	Sumi	10/4/2011		
	A310	8035343	Seman Jr.	10/11/2011		
	A311	8058615	McCaffrey	11/15/2011		
	A312	8076746	McCarten et al.	12/13/2011		
	A313	8080467	Carey et al.	12/20/2011		
	A314	8088219	Knerer et al.	1/3/2012		
	A315	8093559	Rajavel	1/10/2012		
	A316	8164126	Moon, et al.	4/24/2012		
	A317	8207051	Sickler et al.	6/26/2012		
	A318	8247259	Grolier et al.	8/21/2012		
	A319	8259293	Andreou et al.	9/4/2012		
	A320	8268403	Akiyama et al.	9/18/2012		
	A321	8288702	Veeder	10/16/2012		
	A322	8355545	Corcoran et al.	1/15/2013		
	A323	8445950	Iida et al.	5/21/2013		
	A324	8445985	Hiyama et al.	5/21/2013		
	A325	8456546	Oike	6/4/2013		
	A326	8470619	Bour	6/1/2013		
	A327	8476681	Haddad et al.	7/2/2013		
	A328	8530264	De Munck et al.	9/10/2013		
	A329	8564087	Yamamura et al.	10/22/2013		
	A330	8603902	Mazur et al.	12/10/2013		
	A331	8604405	Liu et al.	12/10/2013		
	A332	8629485	Yamamura et al.	1/14/2014		
	A333	8649568	Sato	2/11/2014		
	A334	8680591	Haddad et al.	3/25/2014		
	A335	8698272	Vineis	4/15/2014		
	A336	8729678	Shim et al.	5/20/2014		
	A337	8742528	Yamamura et al.	6/3/2014		
	A338	8884226	Miyazaki, et al.	11/11/2014		
	A339	8906670	Gray	12/1/2014		
	A340	8916945	Sakamoto et al.	12/23/2014		
	A341	8928784	Watanabe et al.	1/6/2015		
	A342	8994135	Yamamura et al.	6/31/2015		
	A343	9064762	Yamaguchi	6/23/2015		
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				Filing Date: 07-08-2019	
				First Named Inventor: Homayoon Haddad	
				Group Art Unit: 2895	
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3	
Sheet	9	of	32		

	A344	9184204	Hu	11/10/2015		
	A345	9190551	Yamamura et al.	11/17/2015		
	A346	9209345	Haddad	12/1/2015		
	A347	9276143	Mazur	3/1/2016		
	A348	9369641	Hu	6/14/2016		
	A349	9419159	Sakamoto et al.	8/16/2016		
	A350	9478572	Miyanami	10/25/2016		
	A351	9559215	Ahmed	1/31/2017		
	A352	9659984	Ohkubo et al	5/23/2017		
	A353	9673250	Haddad	6/6/2017		
	A354	20010017344	Aebi	8/30/2001		
	A355	20010022768	Takahashi	9/20/2001		
	A356	20010044175	Barret et al.	11/22/2001		
	A357	20010044251	Cho et al.	11/1/2001		
	A358	20010044266	Katsuoka	11/22/2001		
	A359	20020020893	Lhorte	2/21/2002		
	A360	20020024618	Imai	2/28/2002		
	A361	20020034845	Fujimura et al.	3/21/2002		
	A362	20020056845	Iguchi et al.	5/16/2002		
	A363	20020060322	Tanabe et al.	5/23/2002		
	A364	20020079290	Holdermann	6/27/2002		
	A365	20020117699	Francois	8/29/2002		
	A366	20020126333	Hosono et al.	9/12/2002		
	A367	20020148964	Dausch et al.	10/17/2002		
	A368	20020173119	Dietrich et al.	11/21/2002		
	A369	20020176650	Zhao et al.	11/28/2002		
	A370	20020182769	Campbell	12/5/2002		
	A371	20030016708	Albrecht et al.	1/23/2003		
	A372	20030024269	Shepard et al.	2/6/2003		
	A373	20030025156	Yarnazaki et al.	2/6/2003		
	A374	20030029495	Mazur et al.	2/13/2003		
	A375	20030030083	Lee et al.	2/13/2003		
	A376	20030045074	Seibel et al.	3/6/2003		
	A377	20030045092	Shin	3/6/2003		
	A378	20030057357	Uppal et al.	3/27/2003		
	A379	20030111106	Nagano et al.	6/19/2003		
	A380	20030132449	Hosono et al.	7/17/2003		
	A381	20030183270	Falk et al.	10/2/2003		
	A382	20030210332	Frame	11/13/2003		
	A383	20030213515	Sano et al.	11/20/2003		
	A384	20030214595	Mabuchi	11/20/2003		
	A385	20030228883	Kusakari et al.	12/11/2003		
	A386	20040014307	Shin et al.	1/22/2004		
	A387	20040016886	Ringermacher et al.	1/29/2004		
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				Filing Date:		07-08-2019	
				First Named Inventor:		Homayoon Haddad	
				Group Art Unit:		2895	
Examiner Name:				Caridad Everhart			
Sheet	10	of	32	Attorney Docket No.:		SXM-060CN3	

	A388	20040041168	Hembree et al.	3/4/2004		
	A389	20040046224	Rossel et al.	3/11/2004		
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	A391	20040080638	Lee	4/29/2004		
	A392	20040112426	Hagino	6/17/2004		
	A393	20040130020	Kuwabara et al.	7/22/2004		
	A394	20040161868	Hong	8/19/2004		
	A395	20040169834	Richter et al.	9/2/2004		
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	A397	20040252931	Belleville et al.	12/16/2004		
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	A406	20050101100	Kretchmer et al.	5/12/2005		
	A407	20050101160	Garg et al.	5/12/2005		
	A408	20050127401	Mazur et al.	6/16/2005		
	A409	20050134698	Schroeder et al.	6/23/2005		
	A410	20050150542	Madan	7/14/2005		
	A411	20050158969	Binnis et al.	7/21/2005		
	A412	20050184291	Cole et al.	8/25/2005		
	A413	20050184353	Mouli	8/25/2005		
	A414	20050211996	Krishna, et al.	9/29/2005		
	A415	20050226287	Shah et al.	10/13/2005		
	A416	20050227390	Shtein et al.	10/13/2005		
	A417	20050227457	Kondo et al.	10/13/2005		
	A418	20060006482	Rieve, et al.	1/12/2006		
	A419	20060011954	Ueda et al.	1/19/2006		
	A420	20060011955	Baggenstoss	1/19/2006		
	A421	20060060848	Chang et al.	3/23/2006		
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	A423	20060079062	Mazur et al.	4/13/2006		
	A424	20060086956	Furukawa et al.	4/27/2006		
	A425	20060097172	Park	5/11/2006		
	A426	20060097290	Hietanen	5/11/2006		
	A427	20060102901	Im et al.	5/18/2006		
	A428	20060118781	Rhodes	6/8/2006		
	A429	20060121680	Tanaka	6/8/2006		
	A430	20060128087	Bamji et al.	6/15/2006		
	A431	20060132633	Nam, et al.	6/22/2006		
Examiner Signature				Date Considered		

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				First Named Inventor:		Homayoon Haddad	
				Group Art Unit:		2895	
Examiner Name:				Caridad Everhart			
Sheet	11	of	32	Attorney Docket No.:		SXM-060CN3	

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	A438	20060180885	Rhodes	8/17/2006		
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	A442	20060228897	Timans	10/12/2006		
	A443	20060231853	Tanaka	10/19/2006		
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	A445	20060238632	Shah	10/26/2006		
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				First Named Inventor: Homayoon Haddad		
				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	12	of	32			

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				Group Art Unit:		2895
Examiner Name:				Caridad Everhart		
Sheet	13	of	32	Attorney Docket No.:		SXM-060CN3

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				Group Art Unit:		2895	
Examiner Name:				Caridad Everhart			
Sheet	14	of	32	Attorney Docket No.:		SXM-060CN3	

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				Group Art Unit:		2895	
Examiner Name:				Caridad Everhart			
Sheet	15	of	32	Attorney Docket No.:		SXM-060CN3	

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Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	16	of	32			

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Examiner Name:				Caridad Everhart			
Sheet	17	of	32	Attorney Docket No.:		SXM-060CN3	

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				Group Art Unit:		2895	
Examiner Name:				Caridad Everhart			
Sheet	18	of	32	Attorney Docket No.:		SXM-060CN3	

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	B45	JP 2004273886	Hatachi Cable	9/3/2004				
	B46	JP 2004273887	Hatachi Cable Ltd.	9/30/2004				
	B47	JP 2005072097	Sony Corp.	3/17/2005				
	B48	JP 2005339425	Sanyo Electric Co.	12/8/2005				
	B49	JP 2006033493	Matsushita Electric Industrial Co. Ltd.	2/2/2006				
	B50	JP 2006147991	Canon Inc.	6/8/2006				
	B51	JP 2006173381	Toyota Motor Corp.	6/29/2006				
	B52	JP 2006210701	Sanyo Electric Co.	8/10/2006				
	B53	JP 2006255430	Fujitsu Ltd.	9/28/2006				
	B54	JP 2006261372	Sony Corp.	9/28/2006				
	B55	JP 2007122237	Mitsubishi Electric Corp.	5/17/2007				
	B56	JP 2007135005	Cannon KK	5/31/2007				
	B57	JP 2007165909	Icemos Technology Corp.	6/28/2007				
	B58	JP 2007180642	SWCC Showa Device Tech Co. Ltd.	7/12/2007				
	B59	JP 2007180643	Sony Corp.	7/12/2007				
	B60	JP 2007258684	Sony Corp.	10/4/2007				
	B61	JP 2007305675	Sony, Corp.	11/22/2007				
	B62	JP 2008099158	Sony Corp.	4/24/2008				
	B63	JP 2008153361	Hatachi LTD	7/3/2008				
	B64	JP 2008167004	Sony Corp.	7/17/2008				
	B65	JP 2008181468		8/7/2008				
	B66	JP 2008187003	Fujitsu Ltd.	8/14/2008				
	B67	JP 2008283219	Toshiba Corp.	11/20/2008				
	B68	JP 2008294698	Sony Corp.	12/4/2008				

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				Group Art Unit:		2895	
Examiner Name:				Caridad Everhart			
Sheet	19	of	32	Attorney Docket No.:		SXM-060CN3	

	B69	JP 2009021479	Omron Tteisi Electronics Co.	1/29/2009				
	B70	JP 2009026142	Sony Corp.	2/5/2009				
	B71	JP 2009152569	Semiconductor Energy Lab	7/9/2009				
	B72	JP 2009206356	Toshiba Corp.	9/10/2009				
	B73	JP 2009253683	Konica Minolta Holdings Inc.	10/29/2009				
	B74	JP 2010226071	Hamamatsu Photonics KK	10/7/2010				
	B75	JP 2010278472	Sony, Corp.	12/9/2010				
	B76	JP 2011003860	Sony Corp.	1/6/2011				
	B77	JP 2011091128	Cannon KK	5/6/2011				
	B78	JP 2012054321	Sony Corp.	3/15/2012				
	B79	JP 2012169530	Sony Corp.	9/6/2012				
	B80	JP 2012191005	Sony Corp.	10/4/2012				
	B81	JP 2012212349	Hitachi Solutions Ltd.	11/1/2012				
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	B88	JP H06244444	Hatachi Ltd. (Hamamatsu)	9/2/1994				
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Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	20	of	32			

	B104	KR 20060020400	MAGNACHIP SEMICONDUCTOR LTD	3/6/2006				
	B105	KR 20060052278	Sony Corp.	5/16/2016				
	B106	KR 20080014301	Samsung Elec. Co. Ltd.	2/14/2008				
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	B108	KR 20090077274	LG Electronics Inc.	7/15/2009				
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	B113	TW 200627675	Lumileds Lighting U.S. LLC	8/1/2006				
	B114	TW 200818529	Newsouth Innovations PTY. LTD	4/16/2008				
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	B124	WO 2008091242	UVA Patent Foundation	7/31/2008				
	B125	WO 2008099524	Mitsubishi Heavy Industries Ltd.	8/21/2008				
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Sheet	21	of	32	Attorney Docket No.:		SXM-060CN3	

	B134	WO 2012027290	Red.Com, Inc.	3/1/2012				
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	B138	WO 91/14284	Theden, Ulrich	9/19/1991				

OTHER ART (Including Author, Title, Date, Pertinent Pages, Etc.)								
Examiner's 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, page(s), volume-issue number(s), publisher, city and/or county where published						T
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Sheet	22	of	32	Attorney Docket No.:		SXM-060CN3	

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Sheet	24	of	32	Attorney Docket No.:		SXM-060CN3

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Sheet	25	of	32	Attorney Docket No.:		SXM-060CN3

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	C246	Zhong, S. et al. "Excellent Light Trapping in Ultrathin Solar Cells," AFM-Journal, May 2016 pp.	

Examiner Signature		Date Considered	
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EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

Substitute for Form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)				Complete if Known			
				Application No.:		16/505,283	
				Filing Date:		07-08-2019	
				First Named Inventor:		Homayoon Haddad	
				Group Art Unit:		2895	
				Examiner Name:		Caridad Everhart	
Sheet	32	of	32	Attorney Docket No.:		SXM-060CN3	

		1-11.	
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	C248	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.	

Examiner Signature		Date Considered	
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EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to Applicant.

Electronic Patent Application Fee Transmittal

Application Number:	16505283			
Filing Date:	08-Jul-2019			
Title of Invention:	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS			
First Named Inventor/Applicant Name:	Homayoon HADDAD			
Filer:	Andrew W. Schultz/Irene Gommerstadt			
Attorney Docket Number:	SXM-060CN3			
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	260	260
Total in USD (\$)				260

Electronic Acknowledgement Receipt

EFS ID:	41719783
Application Number:	16505283
International Application Number:	
Confirmation Number:	2766
Title of Invention:	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS
First Named Inventor/Applicant Name:	Homayoon HADDAD
Customer Number:	959
Filer:	Andrew W. Schultz
Filer Authorized By:	
Attorney Docket Number:	SXM-060CN3
Receipt Date:	22-JAN-2021
Filing Date:	08-JUL-2019
Time Stamp:	17:27:59
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$260
RAM confirmation Number	E20211LH28157071
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Authorized User	
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Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		Response.pdf	47631	yes	9
			e8c05890ddd2e924593a6a3462783d047c86543b		
	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Applicant Arguments/Remarks Made in an Amendment		8	9	
	Claims		2	7	
	Amendment/Req. Reconsideration-After Non-Final Reject		1	1	
Warnings:					
Information:					
2	Transmittal Letter	IDS.pdf	30537	no	2
			8d384158a940d7e2ba201d35539e53ab35ec2f45		
Warnings:					
Information:					
3	Information Disclosure Statement (IDS) Form (SB08)	SXM_060CN3_SB08.pdf	451734	no	32
			d027a9976ce6cd74a2ebf5840748dabc9d4dc1a6		
Warnings:					
Information:					
This is not an USPTO supplied IDS fillable form					
4	Fee Worksheet (SB06)	fee-info.pdf	30766	no	2
			aa19e192858686c4e0df95a14d413fdbbbd0a2cf		
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Information:					
Total Files Size (in bytes):			560668		

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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.

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.

REMARKS

The pending Office Action addresses claims 21-43, 45-49, 52, and 54-83, of which claims 21-43, 45-49, 52, and 54-79 are allowed and claims 80-83 are rejected.

Applicant thanks Examiner Everhart for the indication that claims 21-43, 45-49, 52, and 54-79 are allowed. In light of the cancellation of claims 80-83, allowance of the application is respectfully requested.

Amendments to the Claims

Applicant presents the following claim amendments in an effort to expedite prosecution. These amendments should not be construed as Applicant's acceptance of the Examiner's rejections. Applicant reserves the right to prosecute any of the former claims in a continuing application.

As shown on the attached sheets, claims 80-83 are hereby canceled. No new matter is added.

Rejections Pursuant to 35 U.S.C. § 103

The Office Action rejects claims 80, 82, and 83 pursuant to 35 U.S.C. § 103 as being obvious over U.S. Patent No. 4,772,335 of Huang ("Huang"). Claim 81 is rejected pursuant to 35 U.S.C. § 103 as being obvious over Huang in view of U.S. Patent Pub. No. 20100310839 of Rey et al. ("Rey").

Claims 80-83 are canceled, thereby obviating the basis of these rejections.

Conclusion

Applicant believe that the claims are in proper condition for allowance and allowance thereof is respectfully requested. The Examiner is encouraged to telephone the undersigned attorney for Applicant if such communication is deemed to expedite prosecution of this application.

No fees are believed to be due with filing. However, 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. 50-1196, under Docket No. SXM-060CN3.

App. No.: 16/505,283
Art Unit: 2895

Docket No.: SXM-060CN3
Examiner: C. Everhart

Dated: January 22, 2021

Respectfully submitted,
Electronic Signature: /Andrew W. Schultz/
Andrew W. Schultz, Reg. No. 66,869
Attorney for Applicant
Nelson Mullins Riley & Scarborough LLP
One Financial Center, Suite 3500
Boston, MA 02110
Tel: (617) 217-4674
Fax: (617) 217-4699

AMENDMENTS TO THE CLAIMS

1-20. (Canceled)

21. (Previously Presented) A photosensitive imager device capable of detecting visible and infrared electromagnetic radiation, comprising:

a semiconductor layer having a light incident side and an opposed side, said semiconductor layer having multiple doped regions forming at least one junction,
a textured region comprising a plurality of surface features configured to interact with incident electromagnetic radiation so as to increase the quantum efficiency of the device, wherein the surface features are arranged according to a pattern,
a support substrate coupled to said semiconductor layer, and
a first bonding layer disposed between the semiconductor layer and the support substrate.

22. (Previously Presented) The device of claim 21, wherein the textured region is located on the light incident side of the semiconductor layer.

23. (Previously Presented) The device of claim 22, further comprising a device layer coupled to the semiconductor layer on said side opposed to the light incident side.

24. (Previously Presented) The device of claim 22, wherein the textured region is formed by etching.

25. (Previously Presented) The device of claim 24, wherein said surface features comprise pyramids.

26. (Previously Presented) The device of claim 22, further comprising a reflector layer disposed between the textured layer and the support substrate.

27. (Previously Presented) The device of claim 21, further comprising deep trench isolation for isolating the device.

28. (Previously Presented) The device of claim 27, wherein said deep trench isolation provides light trapping functionality.

29. (Previously Presented) The device of claim 21, wherein the semiconductor layer is single crystal silicon.
30. (Previously Presented) The device of claim 21, wherein the semiconductor layer comprises silicon and germanium.
31. (Previously Presented) The device of claim 21, wherein the surface features are formed in the semiconductor layer.
32. (Previously Presented) The device of claim 21, wherein the surface features have a substantially uniform height.
33. (Previously Presented) The device of claim 21, wherein the surface features are not uniform in height.
34. (Previously Presented) The device of claim 21, wherein said first bonding layer comprises any of silicon oxide, silicon nitride and amorphous silicon.
35. (Previously Presented) The device of claim 21, wherein said semiconductor layer has a thickness in a range of about 1 micron to about 10 microns.
36. (Previously Presented) The device of claim 35, wherein the device exhibits a quantum efficiency of at least about 35% for electromagnetic radiation at a wavelength of about 940 nm.
37. (Previously Presented) The device of claim 21, wherein said bonding layer has a thickness in a range of about 30 nm to about 3 microns.
38. (Previously Presented) The device of claim 21, wherein said plurality of surface features have a height in a range of about 50 nm to about 2 microns.
39. (Previously Presented) The device of claim 21, wherein said plurality of surface features have a height in a range from about 0.35 microns to about 0.7 microns.
40. (Previously Presented) The device of claim 21, wherein said plurality of surface features are formed by using a patterned mask and photolithography followed by etching.

41. (Previously Presented) The device of claim 21, wherein said plurality of surface features comprise multiple etched levels.
42. (Previously Presented) The device of claim 21, wherein said textured region increases optical absorption of the semiconductor layer over an electromagnetic spectrum range of at least about 700 nm to about 1100 nm.
43. (Previously Presented) The device of claim 21, further comprising a second bonding layer positioned between the first bonding layer and the support substrate.
44. (Canceled)
45. (Previously Presented) The device of claim 21, wherein the pattern is an at least substantially uniform grid.
46. (Previously Presented) The device of claim 21, wherein the pattern is a non-uniform arrangement.
47. (Previously Presented) A method of making a photosensitive image device, comprising:
providing a semiconductor layer having a light incident side and an opposed side, said semiconductor layer having multiple doped regions forming at least one junction;
providing a support substrate;
bonding the semiconductor layer to the support substrate;
creating a plurality of surface features on one of the semiconductor layer and the support substrate, wherein the surface features are formed via etching;
depositing an oxide material within at least a portion of the semiconductor layer or support substrate removed during etching; and
processing the region of the semiconductor layer or support substrate comprising the surface features with CMP after depositing the oxide material.
48. (Previously Presented) The method of claim 47, wherein bonding the semiconductor layer to the support substrate comprises:
depositing a first bonding layer onto the semiconductor layer; and

bonding the first bonding layer to a second bonding layer disposed on the support substrate.

49. (Previously Presented) The method of claim 47, wherein the plurality of surface features are formed on the light incident side of the semiconductor layer.

50. (Canceled)

51. (Canceled)

52. (Previously Presented) The method of claim 47, wherein depositing the oxide material comprises at least partially filling one of trenches, holes, pits, and cones formed in the semiconductor layer during etching.

53. (Canceled)

54. (Previously Presented) The method of claim 47, wherein the surface features are formed by shallow trench isolation etching.

55. (Previously Presented) The method of claim 47, wherein the surface features are formed in the semiconductor layer.

56. (Previously Presented) A photosensitive imager device capable of detecting visible and infrared electromagnetic radiation, comprising:

- a semiconductor layer having a light incident side and an opposed side, said semiconductor layer having multiple doped regions forming at least one junction,
- a textured region comprising a plurality of surface features configured to interact with incident electromagnetic radiation so as to increase the quantum efficiency of the device,
- a support substrate coupled to said semiconductor layer, and
- a first bonding layer disposed between the semiconductor layer and the support substrate, wherein the device exhibits a quantum efficiency of at least about 35% for electromagnetic radiation at a wavelength of about 940.

57. (Previously Presented) The device of claim 56, wherein the textured region is located on the light incident side of the semiconductor layer.

58. (Previously Presented) The device of claim 57, further comprising a device layer coupled to the semiconductor layer on said side opposed to the light incident side.
59. (Previously Presented) The device of claim 57, wherein the textured region is formed by etching.
60. (Previously Presented) The device of claim 59, wherein said surface features comprise pyramids.
61. (Previously Presented) The device of claim 57, further comprising a reflector layer disposed between the textured layer and the support substrate.
62. (Previously Presented) The device of claim 56, further comprising deep trench isolation for isolating the device.
63. (Previously Presented) The device of claim 62, wherein said deep trench isolation provides light trapping functionality.
64. (Previously Presented) The device of claim 56, wherein the semiconductor layer is single crystal silicon.
65. (Previously Presented) The device of claim 56, wherein the semiconductor layer comprises silicon and germanium.
66. (Previously Presented) The device of claim 56, wherein the surface features are formed in the semiconductor layer.
67. (Previously Presented) The device of claim 56, wherein the surface features have a substantially uniform height.
68. (Previously Presented) The device of claim 56, wherein the surface features are not uniform in height.
69. (Previously Presented) The device of claim 56, wherein said first bonding layer comprises any of silicon oxide, silicon nitride and amorphous silicon.

70. (Previously Presented) The device of claim 56, wherein said semiconductor layer has a thickness in a range of about 1 micron to about 10 microns.
71. (Previously Presented) The device of claim 56, wherein said bonding layer has a thickness in a range of about 30 nm to about 3 microns.
72. (Previously Presented) The device of claim 56, wherein said plurality of surface features have a height in a range of about 50 nm to about 2 microns.
73. (Previously Presented) The device of claim 56, wherein said plurality of surface features have a height in a range from about 0.35 microns to about 0.7 microns.
74. (Previously Presented) The device of claim 56, wherein said plurality of surface features are formed by using a patterned mask and photolithography followed by etching.
75. (Previously Presented) The device of claim 56, wherein said plurality of surface features comprise multiple etched levels.
76. (Previously Presented) The device of claim 56, wherein said textured region increases optical absorption of the semiconductor layer over an electromagnetic spectrum range of at least about 700 nm to about 1100 nm.
77. (Previously Presented) The device of claim 56, further comprising a second bonding layer positioned between the first bonding layer and the support substrate.
78. (Previously Presented) The device of claim 56, wherein the surface features are arranged according to a pattern that is an at least substantially uniform grid.
79. (Previously Presented) The device of claim 56, wherein the surface features are arranged according to a pattern that is a non-uniform arrangement.
- 80-83. (Canceled)

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875				Application or Docket Number 16/505,283		Filing Date 07/08/2019		☐ To be Mailed					
ENTITY: ☒ LARGE ☐ SMALL ☐ MICRO													
APPLICATION AS FILED - PART I													
		(Column 1)	(Column 2)										
FOR		NUMBER FILED	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), (l), 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 \$ 100 =								
INDEPENDENT CLAIMS (37 CFR 1.16(h))		minus 3 =	*		x \$ 460 =								
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))		If the specification and drawings exceed 100 sheets of paper, the application size fee due is \$310 (\$155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).											
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))													
* If the difference in column 1 is less than zero, enter "0" in column 2.					TOTAL								
APPLICATION AS AMENDED - PART II													
		(Column 1)	(Column 2)		(Column 3)								
AMENDMENT	01/22/2021	CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR		PRESENT EXTRA		RATE (\$)		ADDITIONAL FEE (\$)				
	Total (37 CFR 1.16(i))	* 55	Minus	** 59	= 0		x \$ 100 =		0				
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 4	= 0		x \$ 480 =		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			
		(Column 1)	(Column 2)		(Column 3)								
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT	HIGHEST NUMBER PREVIOUSLY PAID FOR		PRESENT EXTRA		RATE (\$)		ADDITIONAL FEE (\$)				
	Total (37 CFR 1.16(i))	*	Minus	**	=		x \$ 0 =						
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x \$ 0 =						
	☐ Application Size Fee (37 CFR 1.16(s))												
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))												
								TOTAL ADD'L FEE					
* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.								SLIE					
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".								/AMANDA CHRISTINE LEMUS/					
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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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959 7590 03/25/2021
NELSON MULLINS RILEY & SCARBOROUGH LLP
ONE FINANCIAL CENTER
SUITE 3500
BOSTON, MA 02111

EXAMINER
EVERHART, CARIDAD

ART UNIT PAPER NUMBER
2895

DATE MAILED: 03/25/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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16/505,283 07/08/2019 Homayoon HADDAD SXM-060CN3 2766

TITLE OF INVENTION: SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
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nonprovisional UNDISCOUNTED \$1200 \$0.00 \$0.00 \$1200 06/25/2021

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.

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

Certificate of Mailing or Transmission

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

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

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/505,283	07/08/2019	Homayoon HADDAD	SXM-060CN3	2766

TITLE OF INVENTION: SHALLOW TRENCH TEXTURED REGIONS 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	\$1200	\$0.00	\$0.00	\$1200	06/25/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
EVERHART, CARIDAD	2895	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 ☐ Government4a. 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. _____



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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/505,283	07/08/2019	Homayoon HADDAD	SXM-060CN3	2766
959 7590 03/25/2021 NELSON MULLINS RILEY & SCARBOROUGH LLP ONE FINANCIAL CENTER SUITE 3500 BOSTON, MA 02111			EXAMINER EVERHART, CARIDAD	
			ART UNIT 2895	PAPER NUMBER
DATE MAILED: 03/25/2021				

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.

Notice of Allowability	Application No. 16/505,283	Applicant(s) HADDAD et al.	
	Examiner CARIDAD EVERHART	Art Unit 2895	AIA (FITF) Status Yes

-- 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 filed 1/22/2021.
☐ 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 See Continuation Sheet. As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to PPHfeedback@uspto.gov.

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

Certified copies:

a) ☐ All b) ☐ Some *c) ☐ None of the:

1. ☐ Certified copies of the priority documents have been received.

2. ☐ Certified copies of the priority documents have been received in Application No. _____.

3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

* Certified copies not received: _____.

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

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

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

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

Attachment(s)

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

/CARIDAD EVERHART/
Primary Examiner, Art Unit 2895

Continuation of 3. The allowed claim(s) is/are: 21-43,45-49,52 and 54-79

Notice of Pre-AIA or AIA Status

The present application, filed on or after March 16, 2013, is being examined under the first inventor to file provisions of the AIA.

Allowable Subject Matter

Claims 21-43, 45-49, 52, and 54-79 are allowed.

The following is an examiner's statement of reasons for allowance: Applicant's amendment filed 1/22/2021 has placed the application in condition for allowance.

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

Any inquiry concerning this communication or earlier communications from the examiner should be directed to CARIDAD EVERHART whose telephone number is (571)272-1892. The examiner can normally be reached on M-F 6:00 AM-4:00 PM.

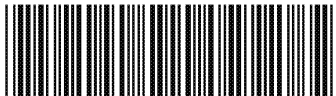
Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at <http://www.uspto.gov/interviewpractice>.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eliseo Ramos-Feliciano can be reached on 571-272-7925. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <https://ppair->

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

/CARIDAD EVERHART/
Primary Examiner, Art Unit 2895

Issue Classification 	Application/Control No. 16/505,283	Applicant(s)/Patent Under Reexamination HADDAD et al.
	Examiner CARIDAD EVERHART	Art Unit 2895

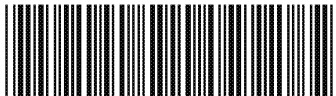
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Symbol					Type	Version
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H01L	/	27	/	14625	I	2013-01-01
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H01L	/	27	/	1464	I	2013-01-01
H01L	/	31	/	02327	I	2013-01-01
B82Y	/	40	/	00	I	2013-01-01
B23K	/	26	/	355	I	2018-08-01
H01L	/	27	/	1463	I	2013-01-01
H01L	/	27	/	14689	I	2013-01-01

CPC Combination Sets					
Symbol				Type	Set
	/		/		

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	55	
/CARIDAD EVERHART/ Primary Examiner, Art Unit 2895	22 March 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office

Part of Paper No.: 20210322

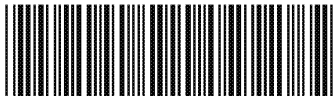
Issue Classification 	Application/Control No. 16/505,283	Applicant(s)/Patent Under Reexamination HADDAD et al.
	Examiner CARIDAD EVERHART	Art Unit 2895

INTERNATIONAL CLASSIFICATION				
CLAIMED				
H01L	/	27	/	146
H01L	/	31	/	18
H01L	/	31	/	028
NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	SUBCLASS

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

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	55	
/CARIDAD EVERHART/ Primary Examiner, Art Unit 2895	22 March 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

Issue Classification 	Application/Control No. 16/505,283	Applicant(s)/Patent Under Reexamination HADDAD et al.
	Examiner CARIDAD EVERHART	Art Unit 2895

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

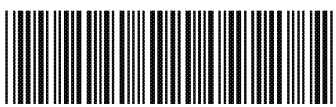
CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
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2	22	11	31	20	40	28	49	34	58	43	67	52	76		
3	23	12	32	21	41		50	35	59	44	68	53	77		
4	24	13	33	22	42		51	36	60	45	69	54	78		
5	25	14	34	23	43	29	52	37	61	46	70	55	79		
6	26	15	35		44		53	38	62	47	71				
7	27	16	36	24	45	30	54	39	63	48	72				
8	28	17	37	25	46	31	55	40	64	49	73				
9	29	18	38	26	47	32	56	41	65	50	74				

NONE (Assistant Examiner) _____ (Date) _____		Total Claims Allowed: 55	
/CARIDAD EVERHART/ Primary Examiner, Art Unit 2895 (Primary Examiner) _____ (Date) _____		22 March 2021 (Date)	O.G. Print Claim(s) 1 O.G. Print Figure 2

U.S. Patent and Trademark Office

Part of Paper No.: 20210322

Search Notes 	Application/Control No. 16/505,283	Applicant(s)/Patent Under Reexamination HADDAD et al.
	Examiner CARIDAD EVERHART	Art Unit 2895

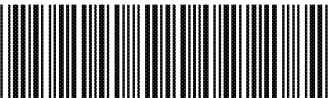
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Symbol	Date	Examiner
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H01L27/14643, 14632, 1464	03/22/2021	ce
H01L31/02327, 028	03/22/2021	ce

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.

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<i>Search Notes</i> 	Application/Control No. 16/505,283	Applicant(s)/Patent Under Reexamination HADDAD et al.
	Examiner CARIDAD EVERHART	Art Unit 2895

Search Notes		
Search Notes	Date	Examiner
EAST attached	02/07/2020	ce
EAST attached	10/14/2020	ce
Reviewed parent	03/22/2021	ce
EAST attached	03/22/2021	ce

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
EAST	attached	10/14/2020	ce
EAST	attached	03/22/2021	ce

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
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EAST Search History (Interference)

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3/22/2021 11:46:32 AM

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EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
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3/22/2021 3:06:58 PM

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EAST Search History

EAST Search History (Prior Art)

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EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
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L2	49	JIANG-JUTAO	US-PGPUB; USPAT	OR	ON	2021/03/22 11:13
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L4	19	(((sensor\$1 or detect\$4) and (texture\$1 or texturing or nanostructure\$1 or nanostructur\$3 or nanotexture\$1 or nanotextur\$3) and junction and bond\$3)).clm.	US-PGPUB; USPAT	OR	ON	2021/03/22 11:15

3/22/2021 11:29:55 AM

C:\Users\ceverhart\Documents\EAST\Workspaces\16505283.wsp

Substitute for Form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)				Complete if Known	
				Application No.: 16/505,283	
				Filing Date: 07-08-2019	
				First Named Inventor: Homayoon Haddad	
				Group Art Unit: 2895	
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3	
Sheet	1	of	32		

(a) U. S. PATENT DOCUMENTS						
Examiner's Initials	Cite No.	U.S. Patent Document	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	
		Number Kind Code (if known)				
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				Application No.: 16/505,283		
				Filing Date: 07-08-2019		
				First Named Inventor: Homayoon Haddad		
				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	2	of	32			

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	A37	4775425	Guha et al.	10/4/1988		
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				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	3	of	32			

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				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	4	of	32			

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	A159	6327022	Nishi	12/4/2001		
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				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	5	of	32			

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A170	6429036	Nixon, et al.	8/6/2002		
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				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	6	of	32			

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				Group Art Unit:	2895
Sheet	7	of	32	Examiner Name:	Caridad Everhart
				Attorney Docket No.:	SXM-060CN3

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A274	7605397	Kindem et al.	10/20/2009		
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				Group Art Unit:	2895
Sheet 8 of 32				Examiner Name:	Caridad Everhart
				Attorney Docket No.:	SXM-060CN3

A300	7884439	Mazur et al.	2/8/2011		
A301	7884446	Mazur et al.	2/8/2011		
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A305	7935941	Bruland et al.	5/1/2011		
A306	7968834	Veeder	6/28/2011		
A307	8008205	Fukushima et al.	8/30/2011		
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A309	8030726	Sumi	10/4/2011		
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A317	8207051	Sickler et al.	6/26/2012		
A318	8247259	Grolier et al.	8/21/2012		
A319	8259293	Andreou et al.	9/4/2012		
A320	8268403	Akiyama et al.	9/18/2012		
A321	8288702	Veeder	10/16/2012		
A322	8355545	Corcoran et al.	1/15/2013		
A323	8445950	Iida et al.	5/21/2013		
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A326	8470619	Bour	6/1/2013		
A327	8476681	Haddad et al.	7/2/2013		
A328	8530264	De Munck et al.	9/10/2013		
A329	8564087	Yamamura et al.	10/22/2013		
A330	8603902	Mazur et al.	12/10/2013		
A331	8604405	Liu et al.	12/10/2013		
A332	8629485	Yamamura et al.	1/14/2014		
A333	8649568	Sato	2/11/2014		
A334	8680591	Haddad et al.	3/25/2014		
A335	8698272	Vineis	4/15/2014		
A336	8729678	Shim et al.	5/20/2014		
A337	8742528	Yamamura et al.	6/3/2014		
A338	8884226	Miyazaki, et al.	11/11/2014		
A339	8906670	Gray	12/1/2014		
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A341	8928784	Watanabe et al.	1/6/2015		
A342	8994135	Yamamura et al.	6/31/2015		
A343	9064762	Yamaguchi	6/23/2015		
Examiner Signature	/CARIDAD EVERHART/		Date Considered	03/22/2021	

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Substitute for Form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)				Complete if Known	
				Application No.: 16/505,283	
				Filing Date: 07-08-2019	
				First Named Inventor: Homayoon Haddad	
				Group Art Unit: 2895	
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3	
Sheet	9	of	32		

	A344	9184204	Hu	11/10/2015		
	A345	9190551	Yamamura et al.	11/17/2015		
	A346	9209345	Haddad	12/1/2015		
	A347	9276143	Mazur	3/1/2016		
	A348	9369641	Hu	6/14/2016		
	A349	9419159	Sakamoto et al.	8/16/2016		
	A350	9478572	Miyanami	10/25/2016		
	A351	9559215	Ahmed	1/31/2017		
	A352	9659984	Ohkubo et al	5/23/2017		
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Examiner Signature	/CARIDAD EVERHART/			Date Considered	03/22/2021	

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				Application No.: 16/505,283		
				Filing Date: 07-08-2019		
				First Named Inventor: Homayoon Haddad		
				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	10	of	32			

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	A412	20050184291	Cole et al.	8/25/2005		
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	A414	20050211996	Krishna, et al.	9/29/2005		
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	A429	20060121680	Tanaka	6/8/2006		
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	A431	20060132633	Nam, et al.	6/22/2006		
Examiner Signature	/CARIDAD EVERHART/			Date Considered	03/22/2021	

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				Filing Date: 07-08-2019		
				First Named Inventor: Homayoon Haddad		
				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	11	of	32			

	A432	20060138396	Lin, et al.	6/29/2006		
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	A445	20060238632	Shah	10/26/2006		
	A446	20060244090	Roy, et al.	11/2/2006		
	A447	20060255340	Manivannan et al.	11/16/2006		
	A448	20060257140	Seeger	11/16/2006		
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	A450	20070035879	Hall, et al.	2/15/2007		
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	A453	20070063219	Sa'ar et al.	3/22/2007		
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	A457	20070115554	Breitung et al.	5/24/2007		
	A458	20070123005	Hiura et al.	5/31/2007		
	A459	20070125951	Snider et al.	6/7/2007		
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	A464	20070187670	Hsu et al.	8/16/2007		
	A465	20070189583	Shimada et al.	8/16/2007		
	A466	20070194356	Moon, et al.	8/23/2007		
	A467	20070194401	Nagai, et al.	8/23/2007		
	A468	20070195056	Lloyd	8/23/2007		
	A469	20070200940	Gruhlke et al.	8/30/2007		
	A470	20070201859	Sarrat	8/30/2007		
	A471	20070204902	Dutta	9/6/2007		
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	A474	20070243701	Ito et al.	10/18/2007		
	A475	20070247414	Roberts	10/25/2007		
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				First Named Inventor: Homayoon Haddad		
				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	12	of	32			

	A476	20070262366	Baek et al.	11/15/2007		
	A477	20070290283	Park et al.	12/20/2007		
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	A479	20070296060	Tanabe et al.	12/27/2007		
	A480	20070298533	Yang et al.	12/27/2007		
	A481	20080002863	Northcott	1/3/2008		
	A482	20080020555	Shimomura et al.	1/24/2008		
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	A485	20080044943	Mazur et al.	2/21/2008		
	A486	20080076240	Yannick Veschtti et al.	3/27/2008		
	A487	20080099804	Venezia	5/1/2008		
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	A492	20080158398	Yaffe et al.	7/3/2008		
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	A496	20080178932	Willem Den Boer et al.	7/31/2008		
	A497	20080179762	Cho et al.	7/31/2008		
	A498	20080191296	Wang et al.	8/14/2008		
	A499	20080191310	Wu et al.	8/14/2008		
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	A519	20090014056	Hockaday	1/15/2009		
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				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	13	of	32			

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	A554	20090242019	Ramamoorthy et al.	10/1/2009		
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				First Named Inventor: Homayoon Haddad		
				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	14	of	32			

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Substitute for Form 1449/PTO INFORMATION DISCLOSURE STATEMENT BY APPLICANT (use as many sheets as necessary)				Complete if Known		
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				First Named Inventor: Homayoon Haddad		
				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	15	of	32			

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				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	16	of	32			

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				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	17	of	32			

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				Filing Date: 07-08-2019	
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				Group Art Unit: 2895	
				Examiner Name: Caridad Everhart	
Sheet	18	of	32	Attorney Docket No.: SXM-060CN3	

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				Group Art Unit: 2895	
				Examiner Name: Caridad Everhart	
Sheet	19	of	32	Attorney Docket No.: SXM-060CN3	

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				Examiner Name: Caridad Everhart	
Sheet	20	of	32	Attorney Docket No.: SXM-060CN3	

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				Group Art Unit: 2895		
Examiner Name: Caridad Everhart				Attorney Docket No.: SXM-060CN3		
Sheet	21	of	32			

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L2	57	("20020173119" "20070204902" "20100181014" "20140352779" "5370747" "20090286347" "20120235268" "5236863" "6413135" "9673250" "20110201177" "5100478" "20120001293" "20140138785" "20150076468" "7828983" "9209345").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/22 11:41
L3	110	("20030228883" "20060086956" "20080284884" "20110194100" "6082858" "7800684" "5370747" "20060128087" "9184204" "20090256226" "20080158398" "20080192133" "20140198240" "5626687" "6204506" "20100059803" "20050093100" "5600130" "20070237504" "20100200658" "5101260" "20110292380" "5635089" "9369641" "20050093100" "20130285130" "5100478" "20030214595" "20070189583" "5727096" "7828983" "9209345" "6907135").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/22 11:44
L4	13	("5100478" "5370747" "7828983").PN.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/03/22 11:48

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APPLICATION NO	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO	CONFIRMATION NO
16/505,283	07/08/2019	Homayoon HADDAD	SXM-060CN3	2766

TITLE OF INVENTION: SHALLOW TRENCH TEXTURED REGIONS 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	\$1,200.00			\$1,200.00	06/25/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
EVERHART, CARIDAD	2895	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. Nelson Mullins Riley & Scarborough LLP 2. Thomas J. Engellenner 3. Reza Mollaaghababa
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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, Massachusetts

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. 50-1196

5. Change of Entity Status (from status indicated above)

☐ Applicant certifying micro entity status. See 37 CFR 1.29. 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.

☐ Applicant asserting small entity status. See 37 CFR 1.27. NOTE: If the application was previously under micro entity status, checking this box will be taken as a notification of loss of entitlement to micro entity status.

☐ Applicant changing to regular undiscounted fee status. NOTE: Checking this box will be taken as 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	June 17, 2021
Typed or printed name	Andrew Schultz	Registration No.	66,869

Electronic Patent Application Fee Transmittal				
Application Number:		16505283		
Filing Date:		08-Jul-2019		
Title of Invention:		SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS		
First Named Inventor/Applicant Name:		Homayoon HADDAD		
Filer:		Andrew W. Schultz/Irene Gommerstadt		
Attorney Docket Number:		SXM-060CN3		
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	1200	1200

Description	Fee Code	Quantity	Amount	Sub-Total in USD(\$)
Extension-of-Time:				
Miscellaneous:				
Total in USD (\$)				1200

Electronic Acknowledgement Receipt

EFS ID:	43013276
Application Number:	16505283
International Application Number:	
Confirmation Number:	2766
Title of Invention:	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS
First Named Inventor/Applicant Name:	Homayoon HADDAD
Customer Number:	959
Filer:	Andrew W. Schultz/Irene Gommerstadt
Filer Authorized By:	Andrew W. Schultz
Attorney Docket Number:	SXM-060CN3
Receipt Date:	17-JUN-2021
Filing Date:	08-JUL-2019
Time Stamp:	13:20:52
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	DA
Payment was successfully received in RAM	\$ 1200
RAM confirmation Number	E20216GD21211522
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	38117	no	1
			1381f174d531712524c200b6d6ab241d5a5c0092		
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	30653	no	2
			db527c41ba4899e7e9c9d6a00af5c19f6b4184fe		
Warnings:					
Information:					
Total Files Size (in bytes):			68770		
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UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/505,283	07/20/2021	11069737	SXM-060CN3	2766

959 7590 06/30/2021

NELSON MULLINS RILEY & SCARBOROUGH LLP
ONE FINANCIAL CENTER
SUITE 3500
BOSTON, MA 02111

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):

SiOnyx, LLC, Beverly, MA;
Homayoon HADDAD, Beaverton, OR;
Jutao JIANG, Tigard, OR;

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.

To: ipboston.docketing@nelsonmullins.com,,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 959

Jul 01, 2021 04:12:45 AM

Dear PAIR Customer:

NELSON MULLINS RILEY & SCARBOROUGH LLP
ONE FINANCIAL CENTER
SUITE 3500
BOSTON, MA 02111
UNITED STATES

The following USPTO patent application(s) associated with your Customer Number, 959 , have new outgoing correspondence. This correspondence is now available for viewing in Private PAIR.

The official date of notification of the outgoing correspondence will be indicated on the form PTOL-90 accompanying the correspondence.

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Application	Document	Mailroom Date	Attorney Docket No.
16505283	ISSUE.NTF	06/30/2021	SXM-060CN3

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 with 'e-Office Action' on the subject line or call 1-866-217-9197 during the following hours:

Monday - Friday 6:00 a.m. to 12:00 a.m.

Thank you for prompt attention to this notice,

UNITED STATES PATENT AND TRADEMARK OFFICE
PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM

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/AIA/82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	16/505,283
Filing Date	08-Jul-2019
First Named Inventor	Homayoon HADDAD
Title	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS
Art Unit	
Examiner Name	
Attorney Docket Number	143705.000367

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.

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:	46535036
Application Number:	16505283
International Application Number:	
Confirmation Number:	2766
Title of Invention:	SHALLOW TRENCH TEXTURED REGIONS AND ASSOCIATED METHODS
First Named Inventor/Applicant Name:	Homayoon HADDAD
Customer Number:	959
Filer:	Gunnar G. Leinberg/Mary Frances Heeks
Filer Authorized By:	Gunnar G. Leinberg
Attorney Docket Number:	SXM-060CN3
Receipt Date:	01-SEP-2022
Filing Date:	08-JUL-2019
Time Stamp:	13:38:06
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
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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_wit h_Transmittal_143705_000367. pdf	328404 db97a1b9f92471e249c81efb3c0d81852b9 1076d	no	2

Warnings:

Information:	
Total Files Size (in bytes):	328404
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. <u>New Applications Under 35 U.S.C. 111</u> 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. <u>National Stage of an International Application under 35 U.S.C. 371</u> 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. <u>New International Application Filed with the USPTO as a Receiving Office</u> 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
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P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/505,283	07/08/2019	Homayoon HADDAD	SXM-060CN3

CONFIRMATION NO. 2766

POWER OF ATTORNEY NOTICE



OC000000136289269

959

NELSON MULLINS RILEY & SCARBOROUGH LLP
ONE FINANCIAL CENTER
SUITE 3500
BOSTON, MA 02111

Date Mailed: 09/20/2022

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.

/lqchau/



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

APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/505,283	07/08/2019	Homayoon HADDAD	143705.000367

CONFIRMATION NO. 2766

POA ACCEPTANCE LETTER



11951

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

Date Mailed: 09/20/2022

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.

/lqchau/

To: USPTOinboxroc@pepperlaw.com,BadumK@pepperlaw.com,
From: PAIR_eOfficeAction@uspto.gov
Cc: PAIR_eOfficeAction@uspto.gov
Subject: Private PAIR Correspondence Notification for Customer Number 11951

Sep 20, 2022 03:19:57 AM

Dear PAIR Customer:

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

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Application	Document	Mailroom Date	Attorney Docket No.
16505283	N570	09/20/2022	143705.000367
	N570	09/20/2022	143705.000367

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PATENT APPLICATION INFORMATION RETRIEVAL SYSTEM