H10F

INORGANIC SEMICONDUCTOR DEVICES SENSITIVE TO INFRARED RADIATION, LIGHT, ELECTROMAGNETIC RADIATION OF SHORTER WAVELENGTH OR CORPUSCULAR RADIATION

Definition statement

This place covers:

Inorganic semiconductor devices that are sensitive to infrared radiation, visible light, ultraviolet radiation, x-ray radiation, gamma radiation or corpuscular radiation, and which are specially adapted for either the conversion of the radiation energy into electrical energy or for the control of electrical energy by such radiation.

This includes the following kinds of devices:

- Photovoltaic devices that convert light into electricity, e.g. photovoltaic cells or photovoltaic modules;
- Radiation-sensitive devices that control the flow of current through the device, e.g. photodiodes or phototransistors.

This place also covers processes and apparatus specially adapted for the manufacture or treatment of such devices.

In this subclass, infrared radiation includes far infrared radiation having wavelengths between about 700 nm and about 1 mm.

In this subclass, the periodic system used is the I to VIII Group system indicated in the Periodic Table under Note (3) of section C.

Relationships with other classification places

Devices, and the constructional details thereof, comprising a combination of inorganic materials and organic materials as the active materials are classified in H10K. If the inorganic part itself is inventive, classification thereof may also be made in H10F.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Production of heat using solar heat	F24S
Measurement of x-ray radiation, gamma radiation, corpuscular radiation or cosmic radiation with semiconductor devices	G01T 1/24
Measurement of radiation intensity with resistance detectors	G01T 1/26
Measurement of neutron radiation with semiconductor detectors	G01T 3/08
Couplings of light guides with optoelectronic elements	G02B 6/42
Obtaining energy from radioactive sources	G21H
Semiconductor radiation-sensitive devices that comprise organic active materials	H10K 30/00, H10K 39/00

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

chip	a piece of a wafer or a substrate that has been processed to contain devices therein or thereon. The expression "diced chip" refers to the result of dicing a wafer or a substrate into a plurality of chips, whereas "undiced chip" refers to a chip before dicing or with no dicing.
device	an electric circuit element (e.g. diode, transistor, LED, etc.); (depending on the context) can also refer to an integrated device (e.g. CMOS-IC, DRAM device, etc.). A device may be in the form of a bare or packaged chip.
dopant	the atoms or compounds added to a material during doping
doping	the intentional addition of a small quantity of atoms or compounds into a material to achieve a desired characteristic, e.g. to produce an n-type or p-type material
individual	refers to: an electric circuit element not being an integrated device; or a component of an integrated device. Examples of individual devices include: diodes, transistors, photovoltaic cells, Josephson-junction devices, light-emitting diodes [LED], organic LEDs or a single LED component within an integrated device.
integrated device	a device consisting of a plurality of semiconductor or other solid-state electric circuit elements formed in or on a common substrate
integrated circuit	an integrated device where all the electric circuit elements (e.g. diodes, transistors, LEDs, etc.) are formed in or on a common substrate, including interconnections between the elements
component	an electric circuit element (e.g. diode, transistor, LED, etc.) that is one of a plurality of elements formed in or on a common substrate, e.g. in an integrated device
wafer	this can be one of the following: (a) a slice of semiconductor or electric solid-state active material. For example: a slice of silicon; a slice of a semiconducting compound, e.g. gallium nitride [GaN]; a slice of lithium tantalate [$LiTaO_3$] for superconductor applications. (b) a multilayered laminate, having at least one layer of semiconductor or electric solid-state active material, the layer being meant to be processed into devices. For example: silicon-on-insulator [SOI]; silicon-on-glass [SOG]; silicon-on-sapphire [SOS]; a composite wafer comprising silicon carbide [SiC] on polycrystalline silicon [Si] support; a layer of semiconducting nanowires on glass. A wafer is typically processed by (e.g.) deposition, etching, doping or diffusion, and is then typically diced into chips.

body	the region of semiconductor (resp. solid-state) material(s) within which, or at the surface of which, the physical effects that are characteristic of the device occur, and any bordering semiconductor (resp. solid-state) material(s) that are contiguous with this region. Examples: in a field-effect transistor [FET], the physical effects occur in the channel region between the source and the drain. The semiconductor body includes the channel region, the source and drain regions, and any contiguous semiconductor material; in a light-emitting diode [LED], the physical effects occur at a junction of active semiconductor layers. The semiconductor body includes these active semiconductor layers and any contiguous semiconductor layers, such as buffer layers, possibly a growth substrate, etc., that are between the cathode and anode electrodes; in a thermoelectric device, the solid-state body includes all solid-state materials in the path of current between the electrodes.
electrode	a conductive region in or on the semiconductor body or solid-state body of a device (and other than the body itself) which exerts an electrical influence on the body, irrespective of whether or not an external electrical connection is made thereto. The term covers metallic regions which exert electrical influence on the body through an insulating region (e.g. in intentional non-parasitic capacitive coupling), or inductive coupling arrangements. In a capacitive coupling arrangement, the dielectric region is regarded as part of the electrode. The overall conductive wiring may comprise multiple portions. In such a case, only the wiring portions that exert an electrical influence on the body are considered portions of the electrode. Examples: conductive layer(s) in direct physical contact with the body; conductive region(s) exerting an inductive coupling onto the body; a multilayer structure which exerts influence on the body through an insulating region, e.g. in intentional non-parasitic capacitive coupling.
interconnection	a conductive arrangement for conducting electric current from an electrode of a circuit element to another part of the circuit. Examples include metal wirings.
container	a solid construction in which (one or more) devices are placed, or which is formed around the devices, for forming packaged devices. A container requires a partial or total enclosure and it may also comprise a filling.
encapsulation	an enclosure consisting of (one or more) layers, e.g. comprising organic polymers, which at least partially enclose the (one or more) devices, thereby protecting them. An encapsulation is often used to hermetically seal devices.
field-effect	refers to semiconductor technology wherein a voltage applied to a gate electrode creates an electric field that allows for control of current near the interface of the gate and the body, e.g. to create an inversion channel between the source and drain of a MOSFET
package	the collection of all elements, which are external to the chip, that protect the chip or connect it to another object. Package therefore covers encapsulations, containers, package substrates, interposers, heatsinks or the like. Package does not include objects at a higher system level, like circuit boards and beyond, e.g. a housing in which the circuit board is enclosed.

unipolar	refers to semiconductor technology that primarily involves one type only of charge carrier, i.e. it involves either holes or electrons but not both
bipolar	refers to semiconductor technology that involves multi-carrier-type operation, i.e. which simultaneously uses both electrons and holes as charge carriers
MIS	metal-insulator-semiconductor
MOS	metal-oxide-semiconductor
FET	field-effect transistor
MISFET	metal-insulator-semiconductor field-effect transistor
TFT	thin-film transistor
active material	material within which the physical effects that are characteristic of the device occur
coating	one or more layers which are formed essentially conformally on and directly associated with at least a portion of the semiconductor device, e.g. having passivating or optical effects
Group IV material	material comprising only Group IV elements, except for dopants or other impurities
Group III-V material	material comprising only Group III and Group V elements, except for dopants or other impurities
Group II-VI material	material comprising only Group II and Group VI elements, except for dopants or other impurities
Group I-III-VI material	material comprising only Group I, Group III and Group VI elements, except for dopants or other impurities
heterojunction	interface between two different materials, the difference lying in the crystal structure and/or the composition (example: p-type amorphous silicon/n-type crystalline silicon)
homojunction	interface between materials having the same composition, the same crystal structure and different dopants or dopant concentrations
hybrid	refers to an image sensor having two substrates that are connected together, wherein the sensing elements are in one substrate and the driving circuitry is in the other substrate
intrinsic region or layer	semiconductor region or layer that is undoped or not intentionally doped such that electron and hole densities are approximately equal
junction box	enclosure attached to a photovoltaic module for electrically connecting modules together
photovoltaic cell, solar cell	photovoltaic device that converts electromagnetic radiation (e.g. light) into direct current electricity for the purpose of providing electrical energy (not for light detection purposes). It is often, but not necessarily, part of a photovoltaic module.
photovoltaic module	assembly of multiple photovoltaic cells that are electrically connected together
PIN, p-i-n	junction having a p-type region/intrinsic region/n-type region structure, wherein the intrinsic layer is the light-absorbing layer. Contrast with SHJ photovoltaic cells, wherein the intrinsic layer is not the light-absorbing layer.

PN, p-n	junction having a p-type region/n-type region structure
Silicon heterojunction [SHJ] photovoltaic cell	heterostructure comprising two silicon materials having different crystalline structure and including a very thin intrinsic interlayer therebetween, which is not the light-absorbing layer
Schottky barrier	metal/semiconductor barrier that is non-ohmic and rectifying
multiple-junction photovoltaic cell, tandem photovoltaic cell	photovoltaic cell comprising multiple photovoltaic subcells formed on one another to form a single integrated structure between a single pair of anode/cathode electrodes. Typically, each subcell has a different spectral sensitivity than each other. Tunnel junctions between subcells usually ensure the electrical connection and the current flow between the subcells.
up-conversion	process wherein two or more lower energy photons are converted to a single high energy photon to be absorbed by the photovoltaic cell. Up conversion layers are electrically isolated from the photovoltaic cell and are usually between the back reflector and the photovoltaic cell.

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

a-Si, α-Si	Amorphous silicon
ARC, AR	Anti-reflective coating
AZO	Aluminium-doped zinc oxide
BSF	Back surface field
BSR	Back surface reflector
c-Si	Crystalline silicon
CIS	Copper indium sulfide [$CuInS_2$]
CISe	Copper indium selenide [$CuInSe_2$]
CIGS	Copper indium gallium sulfide [$CuIn_xGa_{1-x}S_2$]
CIGSe	Copper indium gallium selenide [$CuIn_xGa_{1-x}Se_2$]
CIGSSe	Copper indium gallium sulfur-selenide [$CuIn_{1-x}Ga_xS_{2-y}Se_y$]
EWT	Emitter wrap through
FMWT	Front metal wrap through
FTO	Fluorine-doped tin oxide
GZO	Gallium-doped zinc oxide
HIT	Heterojunction with intrinsic thin layer
IBC photovoltaic cell	Interdigitated back contact photovoltaic cell
IR	Infrared
ITO	Indium tin oxide
mc-Si, µc-Si	Microcrystalline silicon
MPPT	Maximum power point tracking
MQW	Multiple quantum well
MWT	Metal wrap through
PERL photovoltaic cell	Passivated emitter rear locally-diffused photovoltaic cell

Poly-Si	Polycrystalline silicon
PV	Photovoltaic
QW	Quantum well
TCO	Transparent conducting oxide
UV	Ultraviolet

H10F 10/00

Individual photovoltaic cells, e.g. solar cells (electrolytic light-sensitive devices, e.g. dye-sensitised solar cells, H01G 9/20)

Definition statement

This place covers:

Individual inorganic photovoltaic devices that convert electromagnetic radiation (e.g. light) into direct current electricity for the purpose of providing electrical energy (not for light detection purposes). Such devices are often, but not necessarily, part of a photovoltaic module.

References

Limiting references

This place does not cover:

Electrolytic light-sensitive devices, e.g. dye-sensitized photovoltaic cells	H01G 9/20

Informative references

Attention is drawn to the following places, which may be of interest for search:

Integrated devices, or assemblies of multiple devices, comprising at least one device covered by H10F 10/00	H10F 19/00
Individual radiation-sensitive semiconductor devices in which radiation controls the flow of current through the devices, e.g. photodetectors; Integrated devices or assemblies thereof	H10F 30/00; H10F 39/00
Manufacture or treatment of photovoltaic cells	H10F 71/00
Constructional details of photovoltaic cells, e.g. electrodes or coatings	H10F 77/00
Production of heat using solar radiation	F24S
Measurement of X-radiation, gamma radiation, corpuscular radiation or cosmic radiation with semiconductor detectors	G01T 1/24
Measurement of X-radiation, gamma radiation, corpuscular radiation or cosmic radiation with resistance detectors	G01T 1/26
Measurement of neutron radiation with semiconductor detectors	G01T 3/08
Couplings of light guides with optoelectronic elements	G02B 6/42
Arrangements for obtaining electrical energy from radioactive sources	G21H 1/12
Testing of photovoltaic cells during manufacture	H01L 22/00
Electrochemical current or voltage generators	H01M 6/00 - H01M 16/00
PV power plants; Combinations of PV energy systems with other systems for the generation of electric power	H02S 10/00

Supporting structures for PV modules	H02S 20/00
Structural details of PV modules other than those related to light conversion	H02S 30/00
Components or accessories in combination with PV modules, not provided for in groups H02S 10/00 - H02S 30/00	H02S 40/00
Testing of photovoltaic cells after manufacture	H02S 50/10
Organic photovoltaic cells	H10K 30/00

Special rules of classification

Devices including a photovoltaic cell as a power source, wherein the document does not disclose any structural details regarding said photovoltaic cells, should not be classified in this main group.

H10F 10/11

Photovoltaic cells having point contact potential barriers (H10F 10/18 takes precedence)

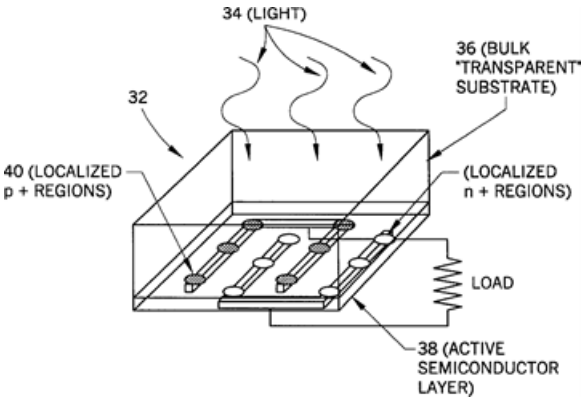
Definition statement

This place covers:

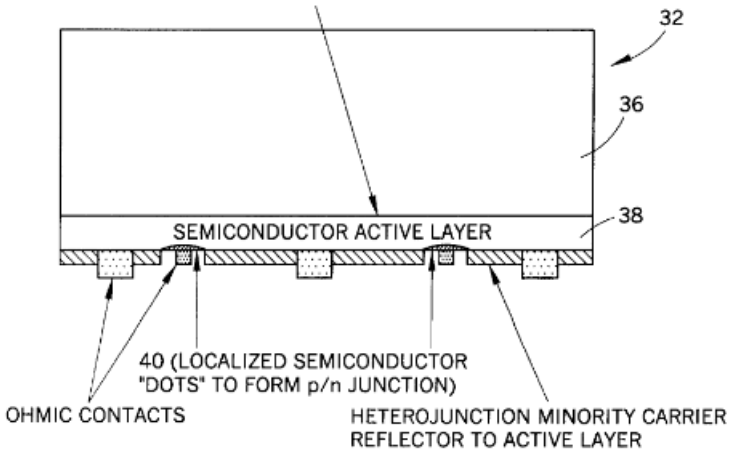
Individual photovoltaic cells wherein electrodes make ohmic contact to the active region at small-area "points."

Illustrative example of subject matter classified in this place:

1a.



1b.



Figures 1a and 1b illustrate a photovoltaic cell (32) having thin, active InGaAs layer (38) formed on a bulk, inactive substrate (36). Localised point p+ and n+ regions (40) facilitate extraction of electrons and holes from the active layer through ohmic contacts.

References

Limiting references

This place does not cover:

Photovoltaic cells having Schottky potential barriers	H10F 10/18

Informative references

Attention is drawn to the following places, which may be of interest for search:

Electrodes	H10F 77/20

H10F 10/12

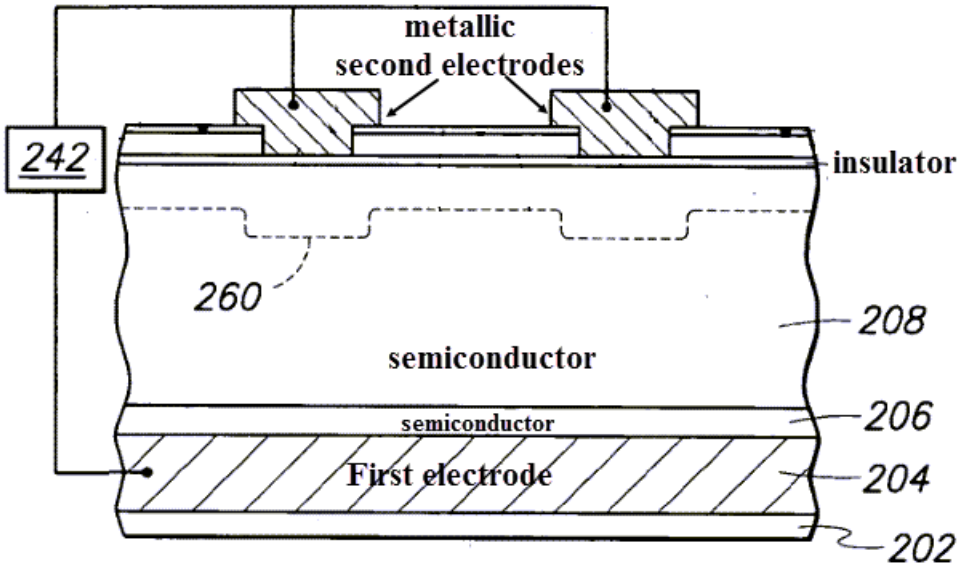
Photovoltaic cells having only metal-insulator-semiconductor [MIS] potential barriers

Definition statement

This place covers:

Individual photovoltaic cells wherein the potential barrier consists of a metal-insulator-semiconductor (MIS) structure.

Illustrative example of subject matter classified in this place:



The Figure illustrates a photovoltaic cell having a MIS structure comprising metallic second electrodes, a thin insulator layer, and a semiconductor (208).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Photodetectors having a conductor-insulator-semiconductor structure	H10F 30/282, H10F 30/298

H10F 10/13

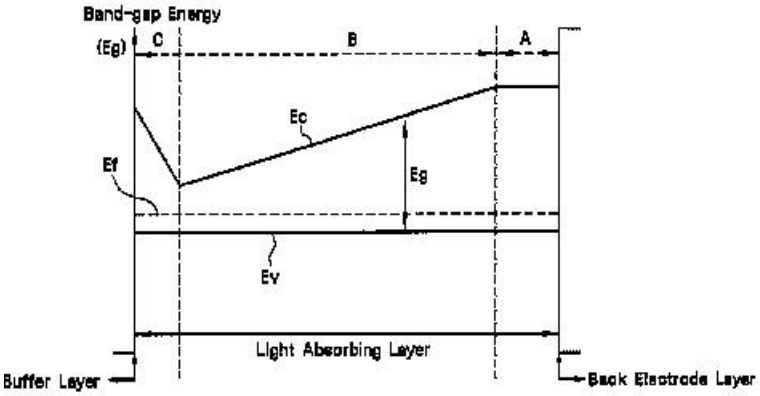
Photovoltaic cells having absorbing layers comprising graded bandgaps

Definition statement

This place covers:

Individual photovoltaic cells wherein the absorbing region or layer has a varying bandgap.

Illustrative example of subject matter classified in this place:



The Figure illustrates a bandgap diagram, wherein the bandgap energy Eg of a CIGSS light absorbing layer (30) is varying in region B, which is caused by adjusting the concentration of gallium or sulfur.

H10F 10/14

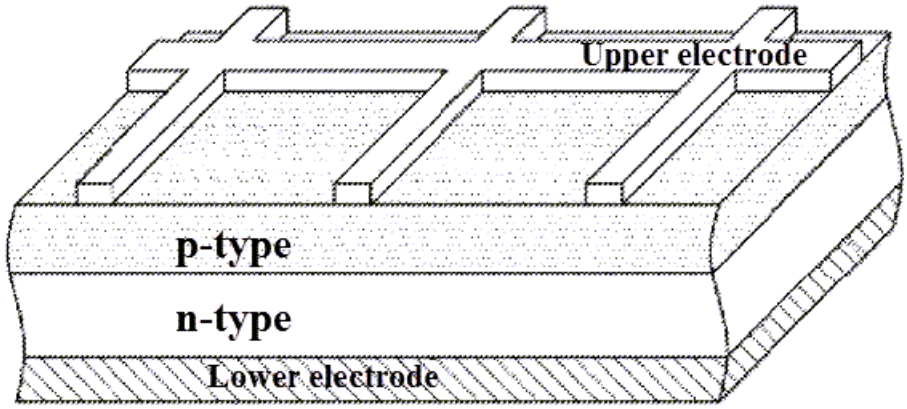
Photovoltaic cells having only PN homojunction potential barriers

Definition statement

This place covers:

Individual photovoltaic cells wherein the potential barrier is a PN junction wherein the p-type and n-type regions are made out of one single material (i.e. having the same composition and the same crystal structure).

Illustrative example of subject matter classified in this place:



The Figure illustrates a photovoltaic cell having a PN homojunction wherein the p-type layer and the n-type layer are made of the same material and have different dopants.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Photovoltaic cells having PN heterojunction barriers, e.g. a-Si/c-Si photovoltaic cell	H10F 10/16
Photodetectors having PN homojunction structure	H10F 30/221
Manufacturing or treatment of photovoltaic cells	H10F 71/00

H10F 10/142

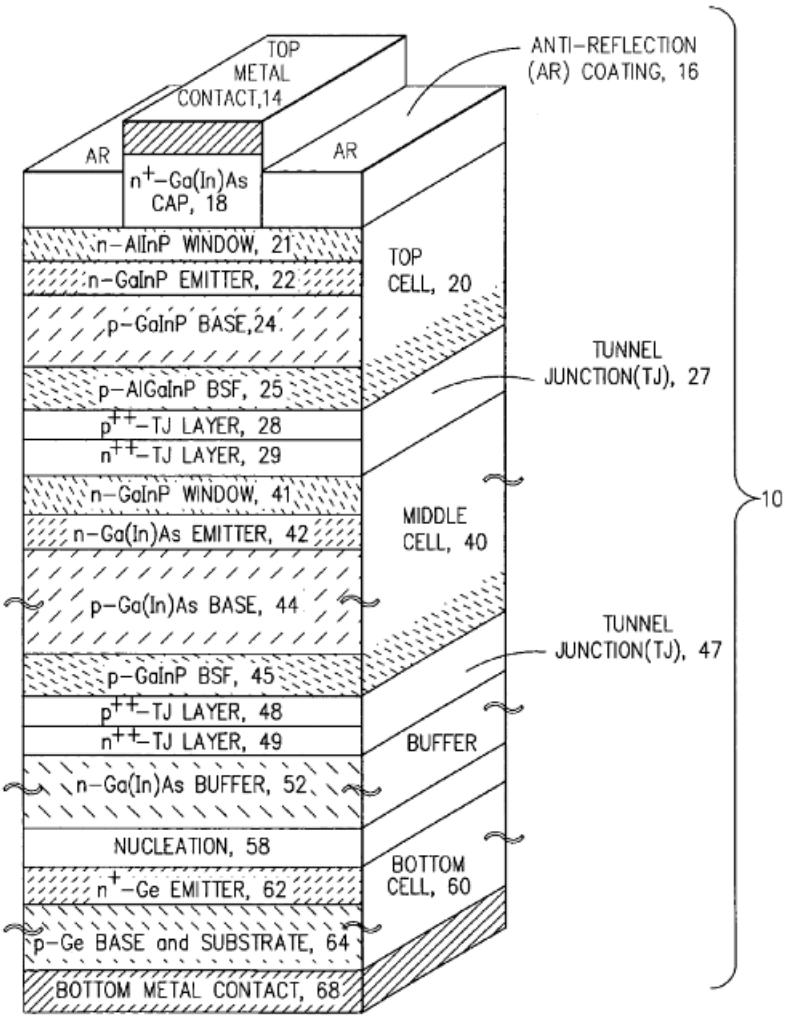
comprising multiple PN homojunctions, e.g. tandem cells

Definition statement

This place covers:

Individual photovoltaic cells having multiple subcells between a single set of anode/cathode electrodes, wherein the subcells each have PN homojunctions.

Illustrative example of subject matter classified in this place:



The Figure illustrates a tandem photovoltaic cell (10) having three subcells (20, 40 and 60) that are connected in series between a pair of anode/cathode electrodes (top metal contact [14] and bottom metal contact [68]). Subcell (20) comprises GaInP regions, subcell (40) comprises GaInAs regions, and subcell (60) comprises Ge regions.

Relationships with other classification places

Group H10F 10/142 covers arrangements wherein subcells are formed monolithically on one another so as to form a single integrated structure. Different photovoltaic cells mechanically stacked on one another, not integrated as a single structure, are covered by H10F 19/40.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Tandem photovoltaic cells having PN heterojunctions	H10F 10/161
Tandem photovoltaic cells having PIN junctions	H10F 10/172
Tandem photovoltaic cells comprising subcells having a different kind of potential barrier	H10F 10/19
Photovoltaic cells laterally integrated on a common substrate	H10F 19/20

Assemblies of multiple different photovoltaic cells, wherein the cells are mechanically stacked on one another, not integrated as a single structure	H10F 19/40

H10F 10/144

comprising only Group III-V materials, e.g. GaAs,AlGaAs, or InP photovoltaic cells

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Heterojunction photovoltaic cells made of Group III-V materials	H10F 10/163

H10F 10/16

Photovoltaic cells having only PN heterojunction potential barriers

Definition statement

This place covers:

Individual photovoltaic cells wherein the junction is a PN structure involving two different materials (i.e. having different composition or crystal structures).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Photodetectors having PN heterojunctions	H10F 30/222
Active materials of the semiconductor bodies	H10F 77/12

H10F 10/161

comprising multiple PN heterojunctions, e.g. tandem cells

Definition statement

This place covers:

Individual photovoltaic cells having multiple subcells between a single set of anode/cathode electrodes, wherein the subcells each have PN heterojunctions.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Tandem photovoltaic cells having PN homojunction barriers	H10F 10/142
Tandem photovoltaic cells having PIN junction barriers	H10F 10/172
Tandem photovoltaic cells comprising sub-cells each having a different kind of potential barrier	H10F 10/19
Photovoltaic cells laterally integrated on a common substrate	H10F 19/20

Assemblies of multiple different photovoltaic cells, wherein the cells are mechanically stacked on one another, not integrated as a single structure	H10F 19/40

H10F 10/166

the Group IV-IV heterojunctions being heterojunctions of crystalline and amorphous materials, e.g. silicon heterojunction [SHJ] photovoltaic cells

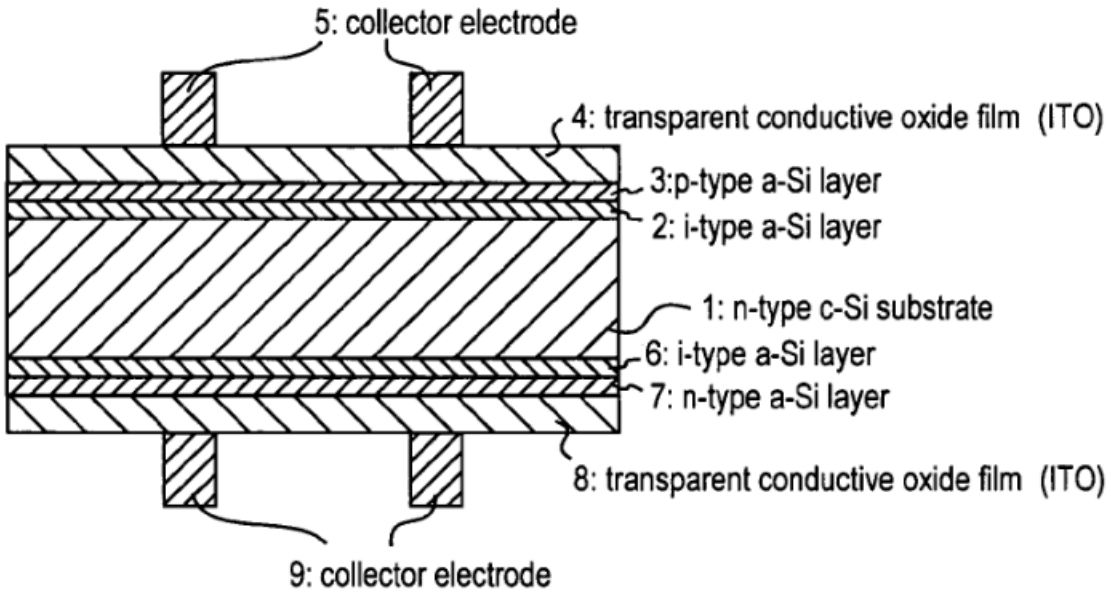
Definition statement

This place covers:

PN heterojunction photovoltaic cells wherein the heterojunction barrier material consists of a heterojunction between crystalline and amorphous materials.

The PN heterojunction may comprise a thin intrinsic buffer layer between the p-type and n-type layers, provided that the intrinsic layer is not the light-absorbing layer.

Illustrative example of subject matter classified in this place:



The Figure illustrates a SHJ photovoltaic cell comprising a heterojunction between n-type crystalline silicon layer (1) and amorphous silicon layers (2 and 3).

Relationships with other classification places

Photovoltaic cells having an intrinsic layer are classified in either H10F 10/166 or in H10F 10/17, based on the properties of the intrinsic layer. H10F 10/17 covers photovoltaic cells wherein the intrinsic layer is the layer where light is absorbed, whereas H10F 10/166 covers photovoltaic cells wherein the intrinsic layer is a thin buffer layer and is not the layer where light is absorbed.

For example, a photovoltaic cell having a PIN structure wherein the intrinsic layer is composed of an amorphous sublayer and a microcrystalline sublayer, wherein both sublayers are absorption layers, is classified in H10F 10/17.

H10F 10/167

comprising Group I-III-VI materials, e.g. $CdS/CuInSe_2$ [CIS] heterojunction photovoltaic cells

Definition statement

This place covers:

PN heterojunction photovoltaic cells wherein the heterojunction barrier includes at least one Group I-III-VI material, e.g. cadmium sulfide/copper indium selenide [$CdS/CuInSe_2$].

H10F 10/17

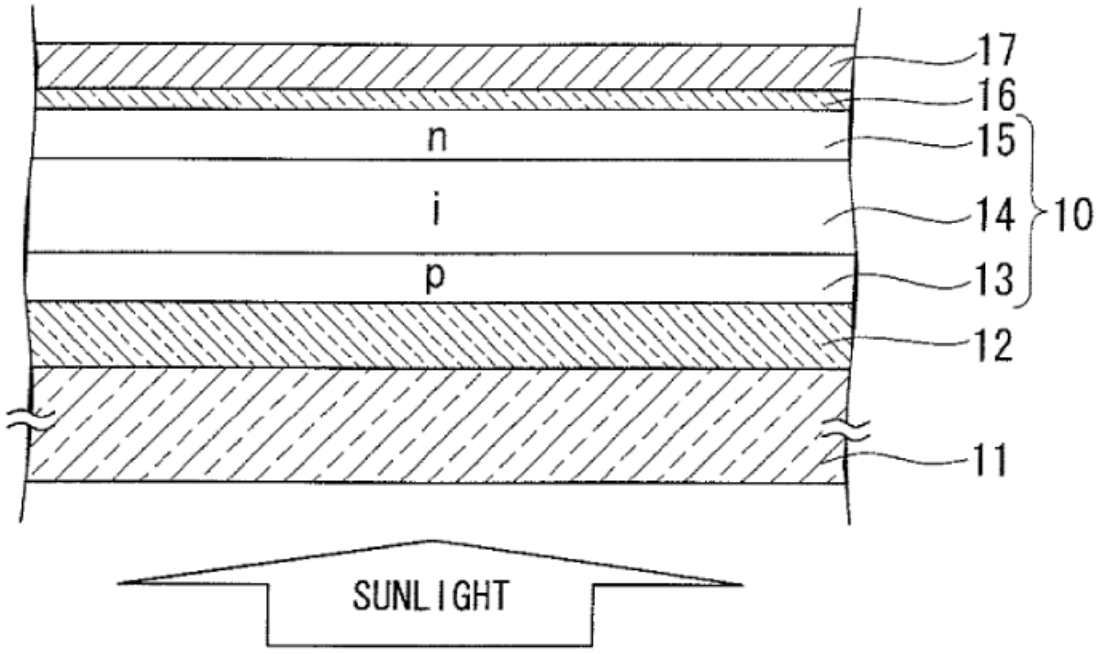
Photovoltaic cells having only PIN junction potential barriers

Definition statement

This place covers:

Photovoltaic cells wherein the potential barrier consists of a PIN structure, wherein the intrinsic layer is the major light-absorbing layer. For example, amorphous silicon PIN photovoltaic cells or perovskite photovoltaic cells having only inorganic active materials.

Illustrative example of subject matter classified in this place:



Relationships with other classification places

Photovoltaic cells having an intrinsic layer are classified in either H10F 10/166 or in H10F 10/17 based on the properties of the intrinsic layer. H10F 10/17 covers photovoltaic cells wherein the intrinsic layer is the layer where light is absorbed, whereas H10F 10/166 covers photovoltaic cells wherein the intrinsic layer is a thin buffer layer and is not the layer where light is absorbed.

For example, a photovoltaic cell wherein the intrinsic layer is composed of an amorphous sublayer and a microcrystalline sublayer, wherein both sublayers are absorption layers, is classified in H10F 10/17.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Photovoltaic cells having a PIN structure, wherein the intrinsic layer is a thin buffer layer and is not the light-absorbing layer	H10F 10/166
Photodetectors having a PIN structure	H10F 30/223
Radiation-sensitive devices comprising a PIN structure having at least one organic active material	H10K 30/40

H10F 10/172

comprising multiple PIN junctions, e.g. tandem cells

Definition statement

This place covers:

Individual photovoltaic cells having multiple subcells, wherein the subcells each have PIN junction barriers.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Tandem photovoltaic cells comprising subcells having different kinds of potential barriers	H10F 10/19
Photovoltaic cells laterally integrated on a common substrate	H10F 19/20
Assemblies of multiple different photovoltaic cells, wherein the cells are mechanically stacked on one another, not integrated as a single structure	H10F 19/40
Photodetectors having a PIN structure	H10F 30/223

H10F 10/18

Photovoltaic cells having only Schottky potential barriers

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Photodetectors with Schottky structure	H10F 30/227

Special rules of classification

For classification purposes, the Schottky metal is to be considered as part of the junction as well as part of the electrode.

H10F 10/19

Photovoltaic cells having multiple potential barriers of different types, e.g. tandem cells having both PN and PIN junctions

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Tandem photovoltaic cells having only PN homojunction barriers	H10F 10/142
Tandem photovoltaic cells having only PN heterojunction barriers	H10F 10/161
Tandem photovoltaic cells having only PIN junction barriers	H10F 10/172

H10F 19/00

Integrated devices, or assemblies of multiple devices, comprising at least one photovoltaic cell covered by group H10F 10/00, e.g. photovoltaic modules

Definition statement

This place covers:

Integrated devices, or assemblies of multiple devices, comprising at least one photovoltaic cell, e.g. photovoltaic arrays, modules or panels. This includes configurations, dispositions or shapes of the photovoltaic cells in the integrated devices or assemblies.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Constructional details specific to photovoltaic modules	H02S
Supporting structure for photovoltaic modules	H02S 20/00
Frame structures of photovoltaic modules	H02S 30/10
Optical components in combination with photovoltaic modules	H02S 40/20
Electrical components in combination with photovoltaic modules	H02S 40/30
Thermal components in combination with photovoltaic modules	H02S 40/40

Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:

- "modules", "panels"

H10F 19/10

comprising photovoltaic cells in arrays in a single semiconductor substrate, the photovoltaic cells having vertical junctions or V-groove junctions

Definition statement

This place covers:

Photovoltaic cells formed in a bulk semiconductor substrate either having a plurality of vertical junctions or having junctions that are at least partly in V-shaped grooves.

Illustrative examples of subject matter classified in this place:

1.

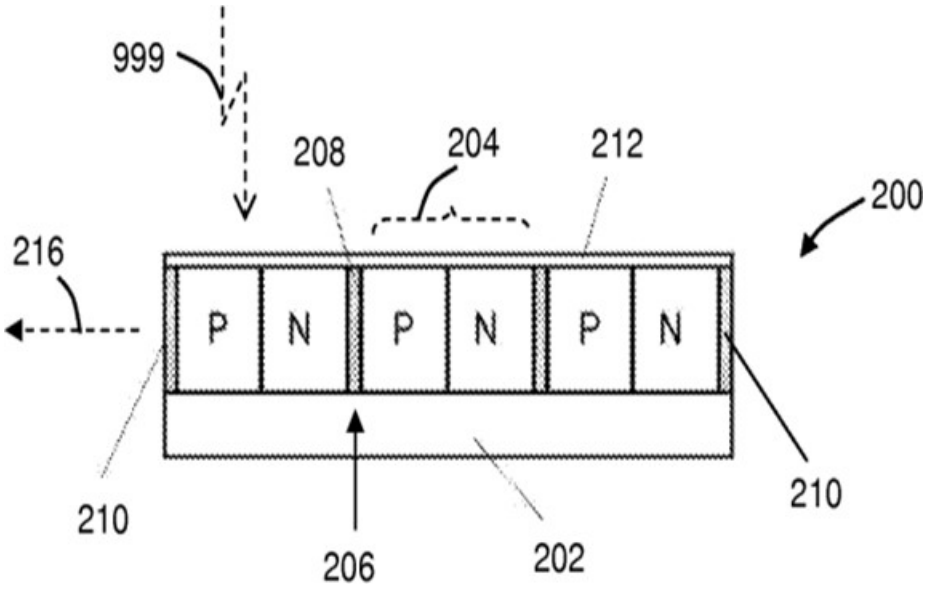


Figure 1 illustrates photovoltaic cells (204) formed on substrate (202), the photovoltaic cells (204) having vertical PN junctions.

2.

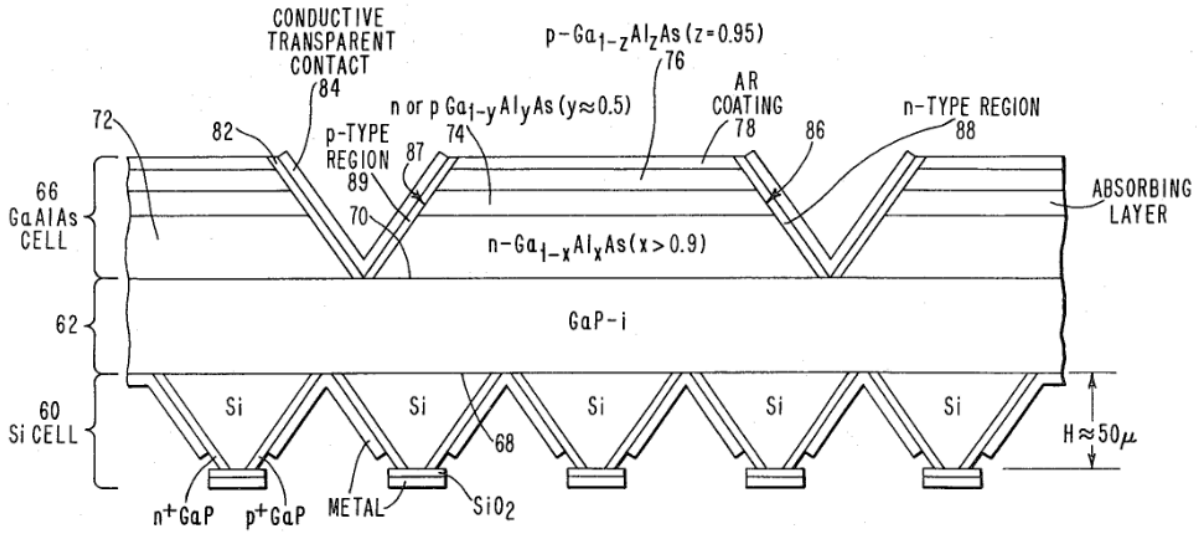


Figure 2 illustrates photovoltaic cell (66) comprising layers GaAlAs layers (72, 74 and 76), and photovoltaic cell (60) comprising Si intrinsic layers between GaP n-type and p-type layers. Both cells are both formed on substrate (62). The subcells of (66) are separated by V-shaped grooves that have been etched into the GaAlAs layers (72, 74 and 76). The subcells of (60) are separated by V-shaped grooves that have been etched into the Si layer.

H10F 19/20

comprising photovoltaic cells in arrays in or on a single semiconductor substrate, the photovoltaic cells having planar junctions (having multiple thin-film photovoltaic cells deposited on the same substrate H10F 19/31)

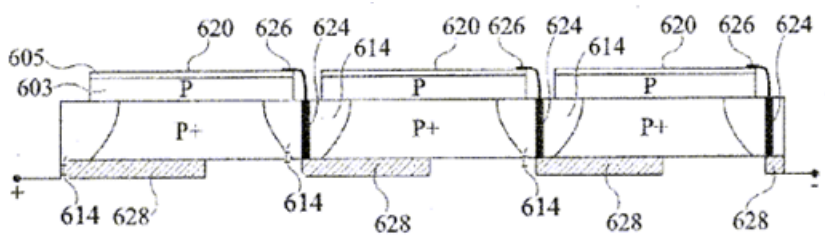
Definition statement

This place covers:

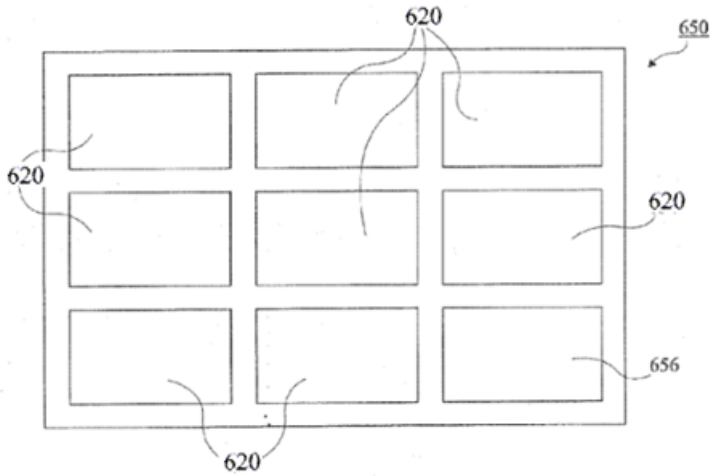
Photovoltaic cells in arrays in or on a single semiconductor substrate, the cells having planar junctions. Often, the cells each comprise a portion of the semiconductor substrate and a layer that is thereon, using the portion of the semiconductor substrate for its electrical properties.

Illustrative examples of subject matter classified in this place:

1a.



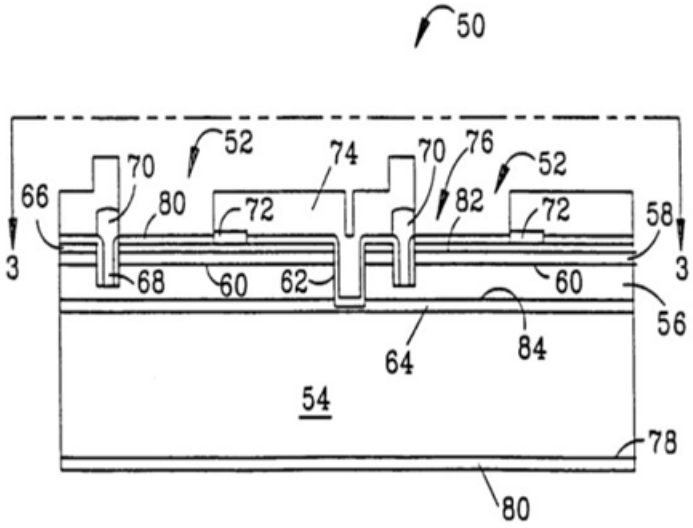
1b.



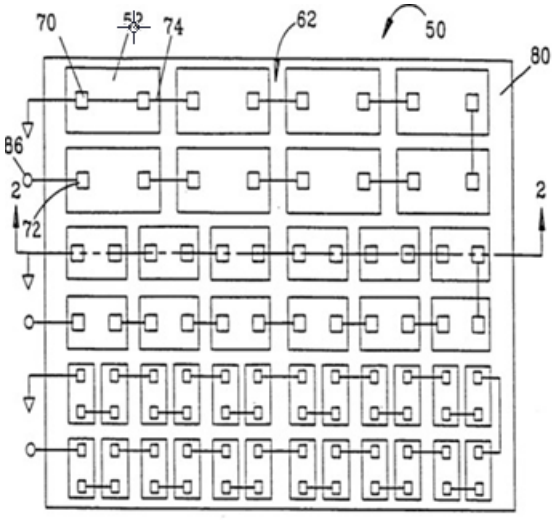
Figures 1a and 1b illustrate an array of photovoltaic cells (620), each having a PN junction between n-type layer (605) and p-type layer (603). The n-type layer (605) was formed by doping the top of a semiconductor layer (603). Trenches are etched between adjacent cells, and SiO_2 isolation regions (614) isolate the cells within the substrate (601). Electrical connections between the cells may be

made by connective wire (626) and conductive vias (624) to electrically connect the cells in series in an array configuration in photovoltaic module (650).

2a.



2b.



Figures 2a and 2b illustrate photovoltaic cells (52) on a substrate (54) in side-view (top picture) and in top-view (bottom picture). The photovoltaic cells have p-type GaAs layers (58) and n-type GaAs layers (56) that form PN junctions (60). The cells form a monolithically integrated microarray (50).

References

Limiting references

This place does not cover:

Photovoltaic modules composed of a plurality of thin film photovoltaic cells deposited on the same substrate	H10F 19/31

H10F 19/30

comprising thin-film photovoltaic cells

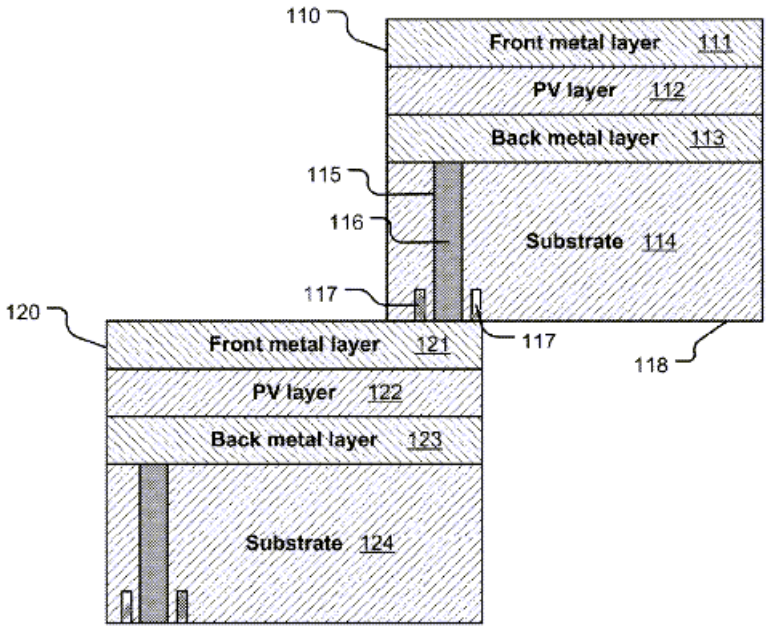
Definition statement

This place covers:

Integrated devices or assemblies including inorganic thin-film photovoltaic cells, e.g. single thin film a-Si, CIS or CdTe photovoltaic cells.

The group H10F 19/30 itself covers an assembly of multiple photovoltaic cells, each formed on its own substrate and interconnected. The groups indented under H10F 19/30 cover integrated devices.

Illustrative example of subject matter classified in this place:



The Figure illustrates a photovoltaic cell (110) comprising PV layer (112) on its own substrate (114) and another photovoltaic cell (120) comprising PV layer (122) on its own substrate (124). The photovoltaic cells (110 and 120) are connected together and electrically connected in series by a conductive via (116).

H10F 19/31

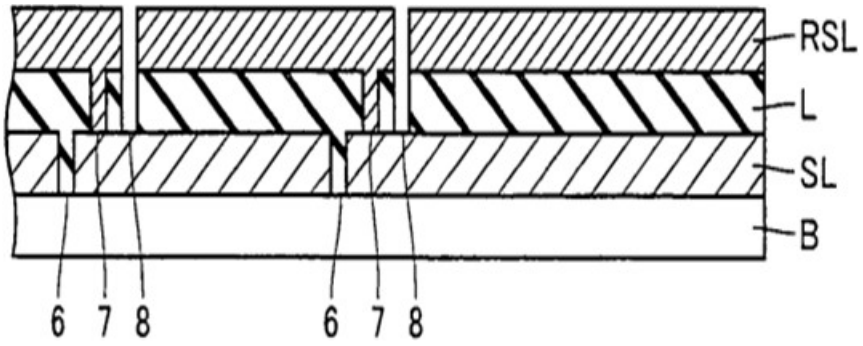
having multiple laterally adjacent thin-film photovoltaic cells deposited on the same substrate

Definition statement

This place covers:

Integrated devices including multiple inorganic thin-film photovoltaic cells deposited on the same substrate. Typically, the substrate is insulating and the cells do not use the substrate for its electrical properties.

Illustrative example of subject matter classified in this place:



The Figure illustrates integrated thin film photovoltaic cells formed of surface electrode SL, semiconductor layer L and rear surface electrode RSL connected in series through contact line (7).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Thin films deposited on metallic or insulating substrates	H10F 77/169

H10F 19/33

Patterning processes to connect the photovoltaic cells, e.g. laser cutting of conductive or active layers

Definition statement

This place covers:

Specific patterning methods (like laser trimming, chemical etching) which aims at forming a module from a plurality of (interconnected) adjacent thin film photovoltaic cells from initially continuous thin films.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Processes or apparatus specially adapted for the manufacture or treatment of PV cells	H10F 71/00
Processes or apparatus specially adapted for the manufacture or treatment of PV cells comprising amorphous semiconductor materials	H10F 71/10

H10F 19/35

Structures for the connecting of adjacent photovoltaic cells, e.g. interconnections or insulating spacers

Definition statement

This place covers:

Structures related to the interconnecting of adjacent thin film photovoltaic cells. Examples include interconnections and insulating spacers that prevent short-circuits between cells.

Illustrative examples of subject matter classified in this place:

1.

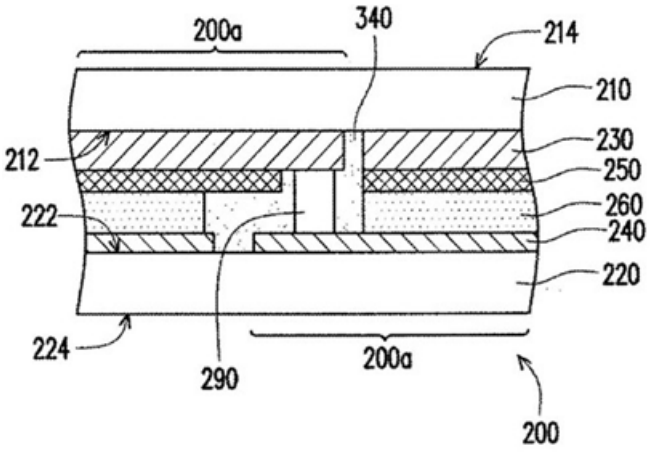


Figure 1 illustrates thin-film based photovoltaic cells (200a) each having absorber layers (260), buffering layers (250), transparent electrode layer (230), and back electrode layer (240), which are sandwiched between first substrate (210) and second substrate (220). Adjacent photovoltaic cells (200a) are electrically isolated by isolative layer (340) and electrically interconnected by a film of conductive paste (290).

2.

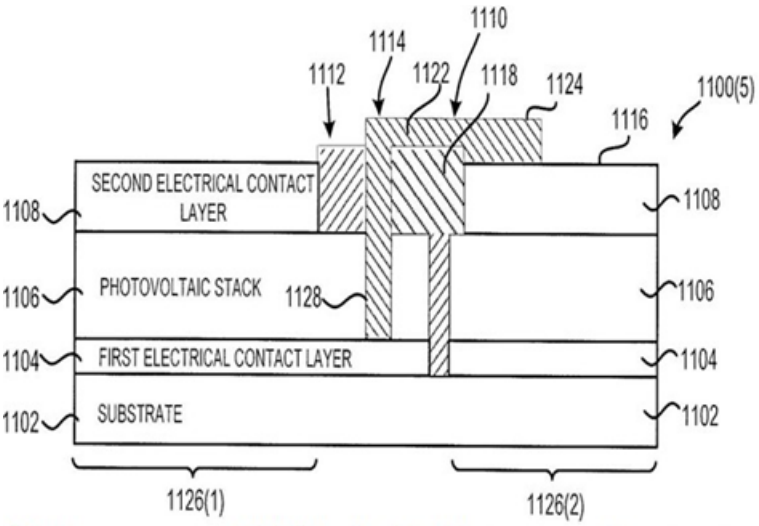


Figure 2 illustrates adjacent photovoltaic cells [1126] (1) and [1126] (2) formed on substrate (1102), wherein the adjacent photovoltaic cells are electrically interconnected by a conductive via (1128) and a conductive grid (1124).

H10F 19/37

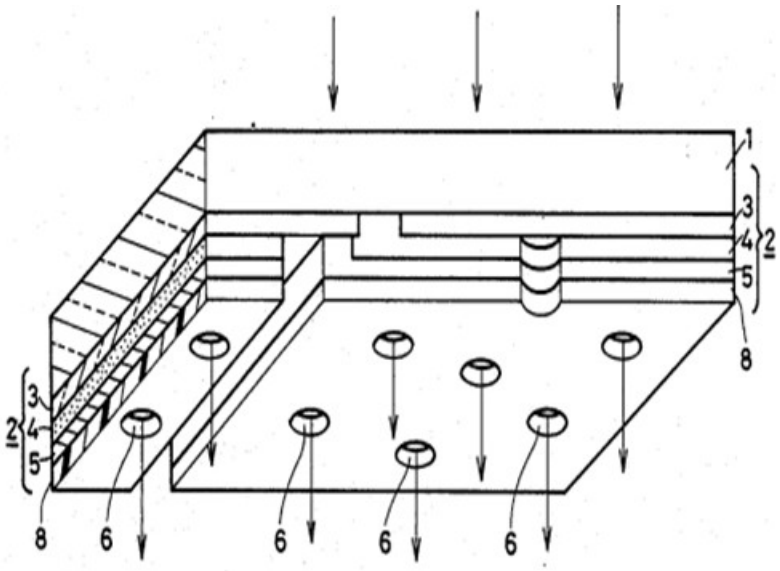
comprising means for obtaining partial light transmission through the integrated devices, or the assemblies of multiple devices, e.g. partially transparent thin-film photovoltaic modules for windows

Definition statement

This place covers:

Means for obtaining partial light transmission through the integrated device or the assembly.

Illustrative example of subject matter classified in this place:



The Figure illustrates light transmitting through the photovoltaic device (2) through openings (6).

H10F 19/40

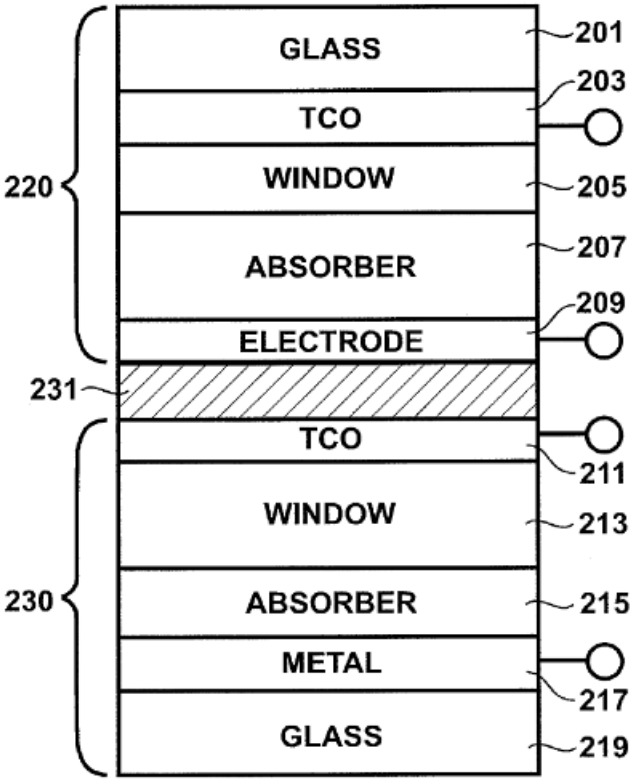
comprising photovoltaic cells in a mechanically stacked configuration

Definition statement

This place covers:

Photovoltaic cells stacked, one on top of the other, each having their own electrodes.

Illustrative example of subject matter classified in this place:



The Figure illustrates an integrated device having two photovoltaic cells formed in a stacked configuration on top of a glass substrate (219). The bottom photovoltaic cell (230) has its own electrodes (211 and 217). The top photovoltaic cell has its own electrodes (203 and 209).

H10F 19/50

Integrated devices comprising at least one photovoltaic cell and other types of semiconductor or solid-state components (H10F 19/75 takes precedence)

Definition statement

This place covers:

Photovoltaic cells integrated or directly associated with one or more electric components in or on the same substrate. Examples include a photovoltaic cell being used as an energy source to drive other semiconductor devices such as a transistor.

Illustrative examples of subject matter classified in this place:

1.

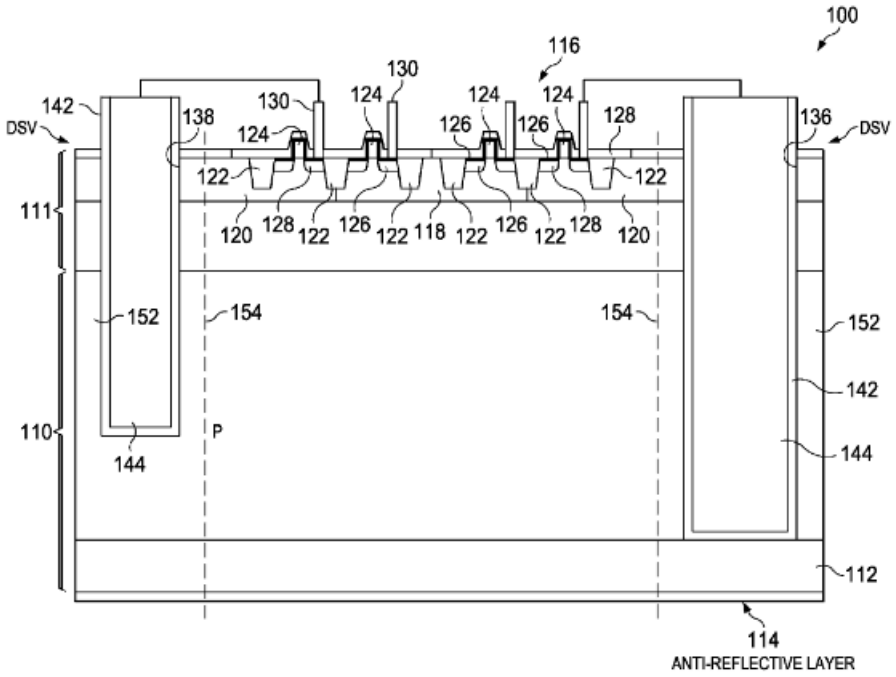


Figure 1 illustrates a device (100) comprising a p-type substrate (110) and an n-type region (112) that define a PN junction of a photovoltaic cell. Transistors and/or other circuit devices (116) are formed in or on the epitaxial layer (111) formed on a front surface of the substrate (110), enabling self-powering of the circuitry portion by the photovoltaic cell portion.

2.

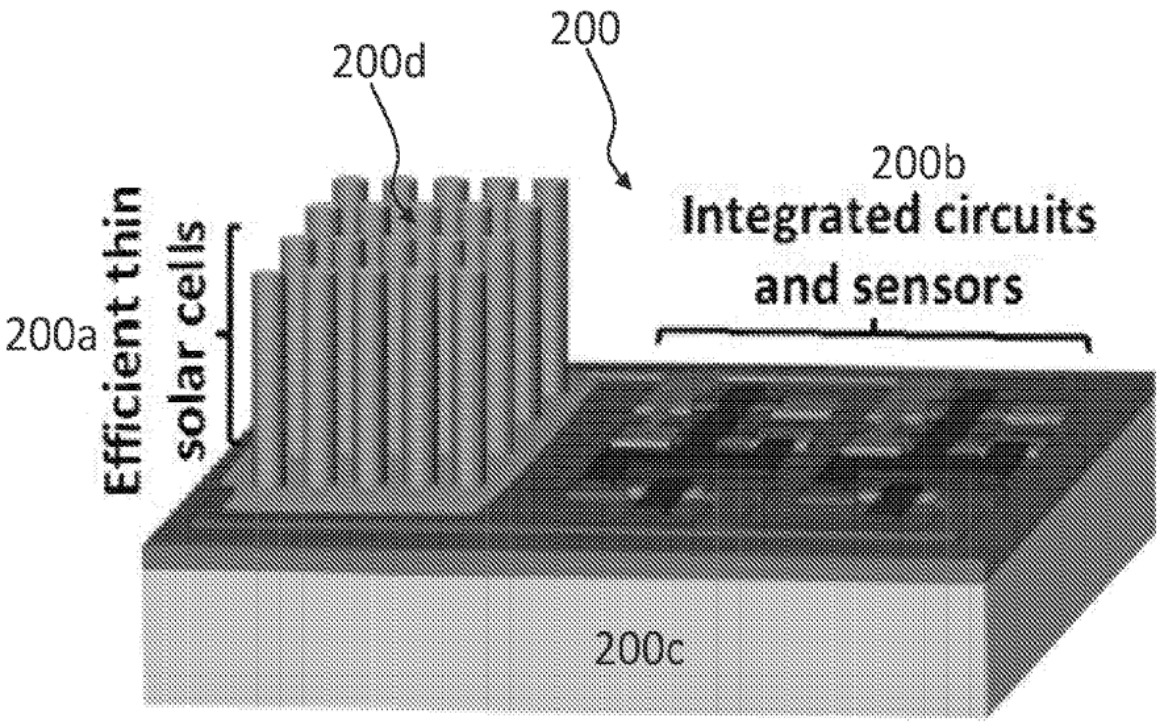


Figure 2 illustrates a solar-powered self-contained integrated device (200) comprising photovoltaic cells (200a) integrated with, and providing power to, thin film sensors and circuits (200b) on substrate (200c).

References

Limiting references

This place does not cover:

Photovoltaic modules or arrays of single photovoltaic cells comprising bypass diodes integrated or directly associated with the devices	H10F 19/75

Informative references

Attention is drawn to the following places, which may be of interest for search:

Organic photovoltaic cells	H10K 30/00

H10F 19/70

comprising bypass diodes (bypass diodes in a junction box H02S 40/34)

References

Limiting references

This place does not cover:

Bypass diodes within junction boxes of PV modules	H02S 40/34

H10F 19/80

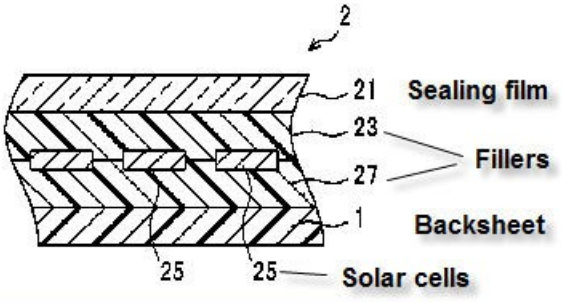
Encapsulations or containers for integrated devices, or assemblies of multiple devices, having photovoltaic cells

Definition statement

This place covers:

Packages, or parts thereof, for protecting the photovoltaic cells in the integrated device or assembly. For example, encapsulations, laminated coatings or materials formed between adjacent photovoltaic cells.

Illustrative example of subject matter classified in this place:



The Figure illustrates sealing film (21) and fillers (23 and 27) used to protect photovoltaic cells (25) in assembly (2).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Manufacture or treatment of integrated devices, or assemblies comprising at least one photovoltaic cell	H10F 71/00
Encapsulation of photodetectors or photodiodes	H10F 77/50
Layered products essentially comprising sheet glass, or glass	B32B 17/00
Synthetic resin laminates	B32B 27/00
Adhesives per se	C09J
Materials for sealing or packing joints or covers	C09K 3/10
Encapsulation of organic photovoltaic cells	H10K 30/88

H10F 19/85

Protective back sheets

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Layered sheets per se	B32B

H10F 19/90

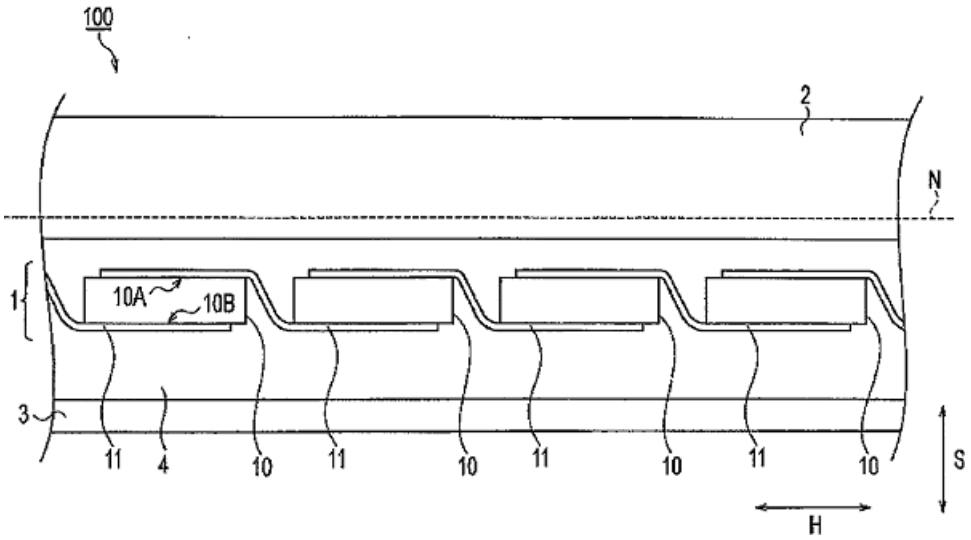
Structures for connecting between photovoltaic cells, e.g. interconnections or insulating spacers (between thin-film photovoltaic cells on a single substrate H10F 19/35)

Definition statement

This place covers:

Means for providing the desired electrical connections between photovoltaic cells. For example, interconnections that provide a serial connection of photovoltaic cells, and insulating spacers that prevent short circuits.

Illustrative example of subject matter classified in this place:



The Figure illustrates interconnections (11) that provide a serial connection of photovoltaic cells (10) in a photovoltaic module (100).

References

Limiting references

This place does not cover:

Particular structures for electrical interconnecting of adjacent thin film photovoltaic	H10F 19/35

Informative references

Attention is drawn to the following places, which may be of interest for search:

Manufacture or treatment of integrated devices, or assemblies comprising at least one photovoltaic cell	H10F 71/00
Electrodes	H10F 77/20
Soldering in general	B23K
Conductive pastes in general	H01B 1/20
Electrical interconnection means specially adapted for electrically connecting two or more photovoltaic modules	H02S 40/36

H10F 30/00

Individual radiation-sensitive semiconductor devices in which radiation controls the flow of current through the devices, e.g. photodetectors

Definition statement

This place covers:

Individual inorganic semiconductor devices sensitive to electromagnetic radiation or corpuscular radiation in which radiation controls the flow of current through the devices, e.g. to detect such radiation.

The group H10F 30/00 itself covers devices sensitive to corpuscular radiation and having no potential barriers. The groups indented under H10F 30/00 cover photoconductive devices or photodetectors having potential barriers.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Image sensors	H10F 39/12
Photometry	G01J 1/00
Pyrometry (infrared radiation measurements)	G01J 5/20, G01J 5/28
Sensors for corpuscular radiation, X-rays or gamma rays as a whole (including circuitry)	G01T 1/00

Glossary of terms

In this place, the following terms or expressions are used with the meaning indicated:

photoconductive	the electrical conductivity of the material changes when light is absorbed by said material

H10F 30/10

the devices being sensitive to infrared radiation, visible or ultraviolet radiation, and having no potential barriers, e.g. photoresistors

Definition statement

This place covers:

Photoconductive devices, having no junction potential barriers, which are sensitive to infrared, visible and UV light.

H10F 30/20

the devices having potential barriers, e.g. phototransistors

Definition statement

This place covers:

Individual inorganic semiconductor devices sensitive to electromagnetic radiation or corpuscular radiation in which radiation controls the flow of current through the devices, e.g. to detect such radiation, and comprising at least one potential barrier.

The groups indented under H10F 30/20 cover photodiodes (one potential barrier), bipolar phototransistors (two potential barriers), photothyristors (three potential barriers) and field-effect phototransistors (junction or MIS potential barriers).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Photovoltaic cells	H10F 10/00
Photoconductors	H10F 30/10
Photometry using radiation detectors	G01J 1/42
Radiation sensors (not just the photosensitive semiconducting part, but also circuitry and other aspects of sensors)	G01T 1/00, G01T 3/00
Semiconductor radiation intensity detectors, e.g. for very short wavelengths	G01T 1/24
Semiconductor neutron detector	G01T 3/08

H10F 39/00

Integrated devices, or assemblies of multiple devices, comprising at least one element covered by group H10F 30/00, e.g. radiation detectors comprising photodiode arrays

Definition statement

This place covers:

- Integrated devices comprising components in which radiation controls the flow of current through the devices. For example, integrated devices used for detection (e.g. photodiode arrays) and integrated devices used for imaging purposes (e.g. image sensors).
- Assemblies of multiple devices, comprising devices in which radiation controls the flow of current through the devices. For example, assembled photodiode arrays and assembled image sensors.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Individual radiation-sensitive devices in which radiation controls the flow of current through the devices	H10F 30/00
Integrated devices, or assemblies of multiple devices, comprising at least one organic radiation-sensitive element	H10K 39/00

H10F 39/018

{of hybrid image sensors}

Definition statement

This place covers:

Manufacture or treatment of hybrid-type imagers, i.e. image sensors having two substrates that are connected together, wherein the sensing elements are in one substrate and the driving circuitry is in the other substrate.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Hybrid-type infrared CMOS or photodiode array image sensors	H10F 39/1843
Hybrid-type X-ray, gamma-ray or corpuscular radiation image sensors	H10F 39/1895
Hybrid-type infrared photoconductor image sensors	H10F 39/1935
Constructional details of hybrid-type image sensors	H10F 39/809

H10F 39/024

{of coatings or optical elements}

Definition statement

This place covers:

Manufacture or treatment of coatings (e.g. antireflective coatings, filters or shielding) or other optical elements (e.g. microlenses).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Coatings	H10F 39/805
Optical elements	H10F 39/806
Coatings in general	C23C 14/00
Lenses in general	G02B 3/00
Optical filters in general	G02B 5/20
Photonic crystals in general	G02B 6/1225

H10F 39/12

Image sensors

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Optical filters	G02B 5/20
Waveguides	G02B 6/00
Cameras or camera modules with electronic image sensors	H04N 23/00
Control circuit arrangements for driving solid-state imagers	H04N 25/00
Image sensors comprising radiation-sensitive components having organic active materials	H10K 39/32

Synonyms and Keywords

In patent documents, the following abbreviations are often used:

APS	Active pixel sensor
CCD	Charge coupled device
PPS	Passive pixel sensor

In patent documents, the following words/expressions are often used with the meaning indicated:

active pixel sensor (APS)	image sensor comprising pixel amplification means, e.g. a source follower transistor
aperture ratio	ratio between light sensitive area of a pixel and the total area occupied by that pixel
backside illumination	illumination of the imagers from the side of the device opposite to the imager circuitry
blooming	spilling over of charges from one pixel to the next one after overexposure
charge injection device	architecture of semiconductor device based on measuring currents induced in MOS capacitors at the moment charge packets are injected into the substrate
dark current	signal generated by the image sensor when the device is in the dark
integration time	time that an image sensor is collecting charges (photon generated and/or dark current generated)
overflow drain	doped region to extract undesired charge resulting from blooming
passive pixel sensor	pixels comprising only a photodiode or a photodiode and an addressing transistor without amplification

H10F 39/15

Charge-coupled device [CCD] image sensors

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Individual charge coupled devices	H10D 44/40

Synonyms and Keywords

In patent documents, the following words/expressions are often used with the meaning indicated:

frame-transfer CCD	two-dimensional architecture of a CCD image sensor that has an analogue memory cell for every pixel below the total array of light sensitive pixels
full-frame CCD	two-dimensional architecture of a CCD image sensor transferring collected charge directly to readout
interline-transfer CCD	two-dimensional architecture of a CCD image sensor wherein each photodiode has a parallel CCD storage region covered by an opaque mask. After image data has been collected and transferred to the adjacent CCD storage region charge is CCD-shifted vertically to the readout IC.
TDI-type CCD-image sensor	time delay and integration [TDI] is a type of CCD wherein a TDI clock is used to synchronize the movement of charged packets in a CCD with that of another movement

H10F 39/151

{Geometry or disposition of pixel elements, address lines or gate electrodes}

Definition statement

This place covers:

- The disposition of the elements within the pixel, such as the transfer, driving, reset transistors, capacitor or photodetector;
- the disposition of electrodes and wiring lines such as the power, bit and data lines; and
- the disposition of doped regions within the pixel.

Illustrative examples of subject matter classified in this place:

1.

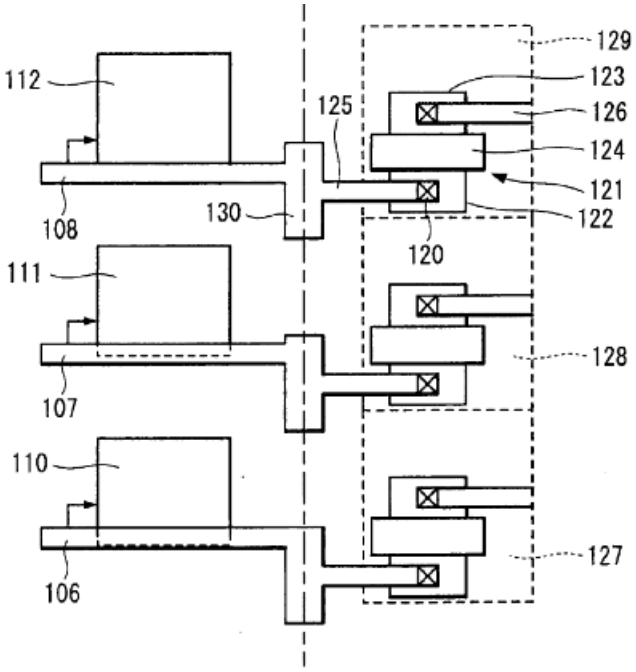


Figure 1 illustrates photoelectric conversion elements (110 - 112) connected to wiring lines (106 - 108), with the disposition thereof being chosen such that the distance between the photoelectric conversion elements and the wiring lines are shifted based on pupil correction (see where [106 and 110] overlap more than [107 and 111] overlap, which overlap more than [106 and 112]).

2.

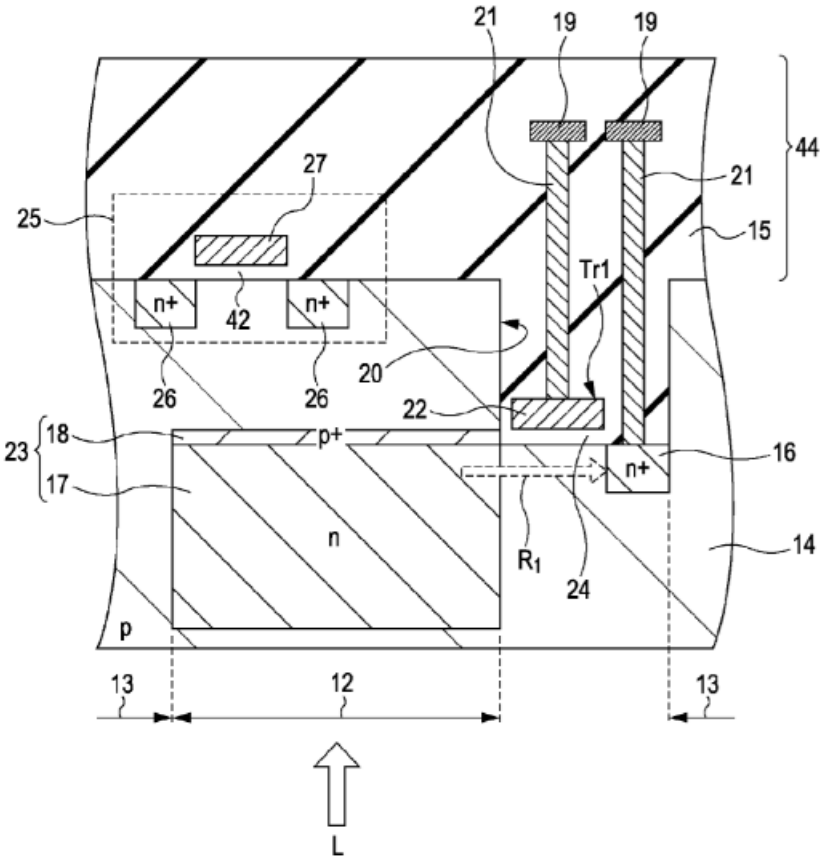


Figure 2 illustrates an image sensor having a buried photodiode (23), buried gate electrode (22) and buried floating diffusion (16) in such a geometry that that buried gate can be used to efficiently transfer charges to the buried floating diffusion through path R1 at a depth equal to that of the photodiode.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Circuit arrangements for driving solid state image sensors	H04N 25/00

H10F 39/1515

{Optical shielding}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Optical shielding in general for image sensors	H10F 39/8057

H10F 39/152

{One-dimensional array CCD image sensors}

Definition statement

This place covers:

CCD-type image sensors having a linear arrangement of the pixels, e.g. fax heads or photocopiers.

H10F 39/153

{Two-dimensional or three-dimensional array CCD image sensors}

Definition statement

This place covers:

CCD-type image sensors having pixels arranged in a 2D matrix or in a 3D matrix.

H10F 39/1532

{Frame-interline transfer}

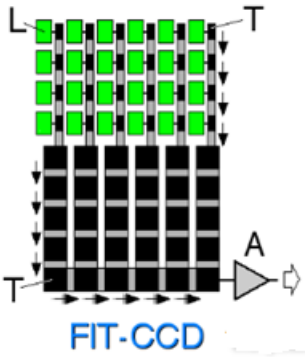
Definition statement

This place covers:

CCD image sensors having a combination of interline transfer together with frame transfer.

Each photodiode has a parallel CCD region which shifts charge vertically to a storage 2D matrix (one storage pixel per one photosensitive pixel). The charges stored in the storage matrix are then read out.

Illustrative example of subject matter classified in this place:



H10F 39/1534

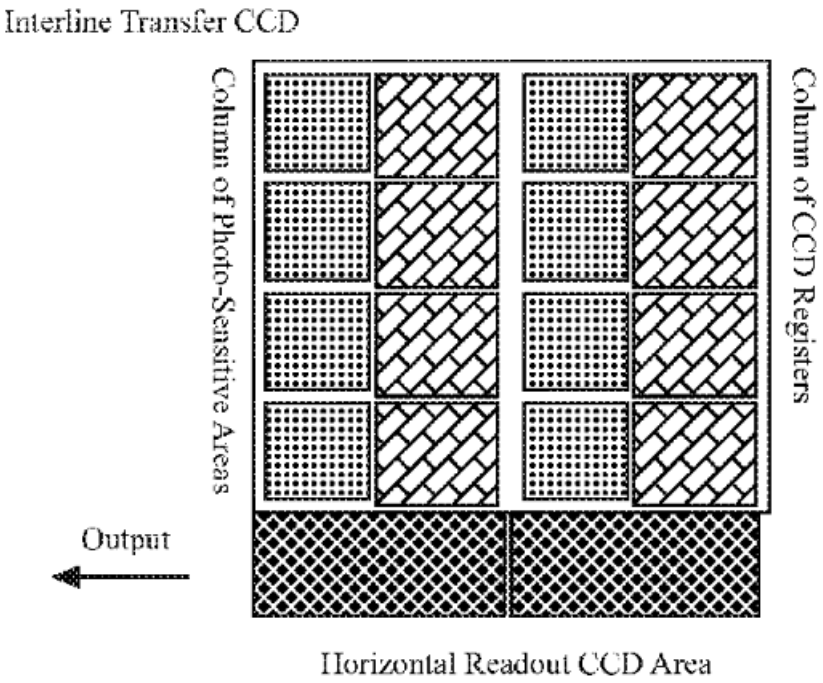
{Interline transfer}

Definition statement

This place covers:

CCD image sensors wherein each photodiode has a parallel CCD storage region covered by an opaque mask. After image data has been collected and transferred to the adjacent CCD storage region charge is CCD-shifted vertically to the readout IC.

Illustrative example of subject matter classified in this place:



The Figure illustrates an image sensor having columns of photo-sensitive areas adjacent to columns of storage regions (denoted "CCD registers").

H10F 39/1536

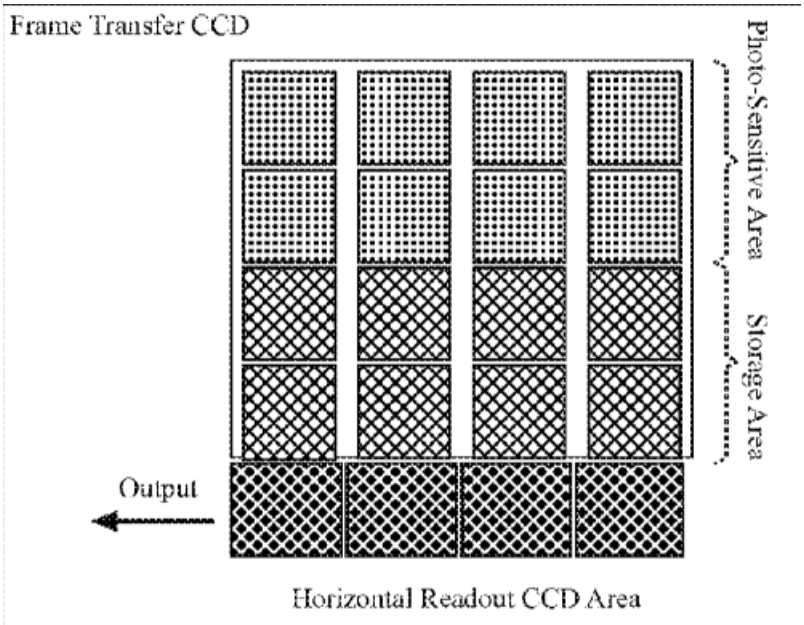
{Frame transfer}

Definition statement

This place covers:

CCD image sensor wherein a 2D storage area is adjacent to the photosensitive 2D array, having a storage pixel per photosensitive pixel. The charges collected are transferred in parallel to the storage area for readout.

Illustrative example of subject matter classified in this place:



The Figure illustrates an image sensor having a 2D storage area adjacent to a 2D photo-sensitive array.

H10F 39/1538

{Time-delay and integration}

Definition statement

This place covers:

CCD image sensors of the time delay and integration (TDI) type, wherein the pixel clock rate must be matched to the image velocity.

H10F 39/154

{Charge-injection device [CID] image sensors (H10F 39/156, H10F 39/157 take precedence)}

Definition statement

This place covers:

Charge-injection device [CID] image sensors wherein the object to be imaged is in contact with the sensor and typically use LEDs for the illumination of the object to be imaged.

References

Limiting references

This place does not cover:

CCD or CID colour image sensors	H10F 39/156
CCD or CID infrared image sensors	H10F 39/157

Informative references

Attention is drawn to the following places, which may be of interest for search:

Contact-type image sensors	H10F 39/198

H10F 39/182

{Colour image sensors}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Colour image sensors having photoconductive layer	H10F 39/192

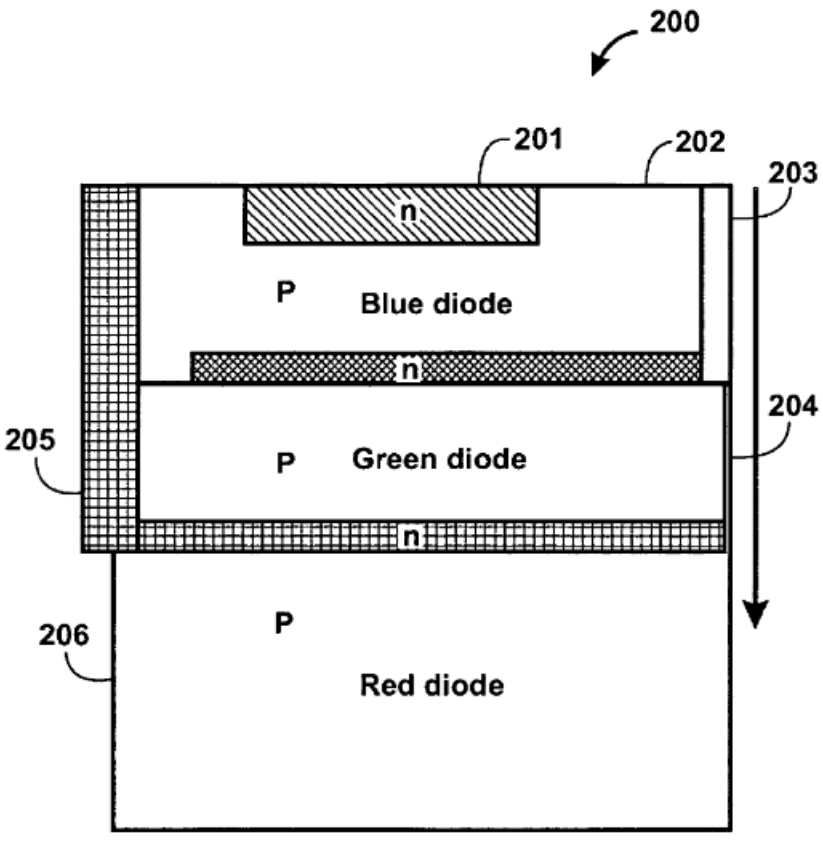
H10F 39/1825

{Multicolour image sensors having stacked structure, e.g. NPN, NPNPN or multiple quantum well [MQW] structures}

Definition statement

This place covers:

Illustrative example of subject matter classified in this place:



The Figure illustrates an image sensor having stacked diodes sense blue, green and red light.

H10F 39/184

{Infrared image sensors}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Infrared image sensors having photoconductive layer	H10F 39/193

H10F 39/1843

{of the hybrid type}

Definition statement

This place covers:

Hybrid image sensors for sensing infrared radiation, having two substrates that are connected together, wherein the sensing elements are in one substrate and the driving circuitry is in the other substrate.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Hybrid-type X-ray, gamma-ray or corpuscular radiation image sensors	H10F 39/1895
Hybrid-type infrared photoconductor image sensors	H10F 39/1935
Constructional details of hybrid-type image sensors	H10F 39/809
Interconnections	H10F 39/811

H10F 39/1847

{Multispectral infrared image sensors having a stacked structure, e.g. NPN, NPNPN or multiple quantum well [MQW] structures}

Definition statement

This place covers:

Image sensors having generally a stacked structure for sensing different parts of the infrared spectrum, e.g. for sensing long-wave IR [LWIR], middle wavelength IR [MWIR] and short wavelength IR [SWIR].

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Stacked colour imagers	H10F 39/1825

H10F 39/186

{having arrangements for blooming suppression}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Blooming suppression in imagers having photoconductive layer	H10F 39/194

H10F 39/1865

{Overflow drain structures}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Overflow drains in photoconductor image sensors	H10F 39/1945

H10F 39/189

{X-ray, gamma-ray or corpuscular radiation imagers}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

X-ray, gamma ray or corpuscular radiation image sensors having a photoconductor layer	H10F 39/195
Measuring X-ray, gamma-ray or corpuscular radiation	G01T 1/00

H10F 39/1892

{Direct radiation image sensors}

Definition statement

This place covers:

X-ray, gamma-ray or corpuscular radiation image sensor wherein the semiconductor layers directly convert the incoming radiation into charges, without need of a scintillator.

H10F 39/1895

{of the hybrid type}

Definition statement

This place covers:

Hybrid image sensors for sensing X-ray, gamma-ray or corpuscular radiation, having two substrates that are connected together, wherein the sensing elements are in one substrate and the driving circuitry is in the other substrate.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Hybrid-type infrared CMOS or photodiode array image sensors	H10F 39/1843
Constructional details of hybrid-type image sensors	H10F 39/809
Interconnections	H10F 39/811

H10F 39/1898

{Indirect radiation image sensors, e.g. using luminescent members}

Definition statement

This place covers:

X-ray, gamma-ray or corpuscular radiation image sensors having a scintillator (e.g. an ionic solid or phosphor) which converts incoming radiation into visible light, which is then detected.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Measuring X-ray radiation with a scintillation-diode combination	G01T 1/2018

H10F 39/191

{Photoconductor image sensors}

Definition statement

This place covers:

Image sensors wherein incoming radiation changes the conductivity of a photoconductive layer and the change in conductivity is measured to determine the incoming radiation.

H10F 39/1935

{of the hybrid type}

Definition statement

This place covers:

Hybrid photoconductive image sensors having two substrates that are connected together, wherein the photoconductive sensing elements are in one substrate and the driving circuitry is in the other substrate.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Hybrid-type infrared CMOS or photodiode array image sensors	H10F 39/1843
Hybrid-type X-ray, gamma-ray or corpuscular radiation image sensors	H10F 39/1895
Constructional details of hybrid-type image sensors	H10F 39/809
Interconnections	H10F 39/811

H10F 39/1945

{Overflow drain structures}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Overflow structures in photodiode array or CMOS type image sensors	H10F 39/1865

H10F 39/195

{X-ray, gamma-ray or corpuscular radiation imagers}

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

X-ray, gamma ray or corpuscular radiation-detecting photodiode or CMOS type image sensors	H10F 39/189
Measuring X-ray, gamma-ray or corpuscular radiation	G01T 1/00

H10F 39/198

{Contact-type image sensors [CIS]}

Definition statement

This place covers:

Image sensors having integrated light sources, wherein the light emitted from the integrated light source is reflected on the object to be detected and enters the image sensors. Examples include scanning heads, photocopier heads and fingerprint detectors.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Charge-injection device [CID]-type image sensors	H10F 39/154
Fingerprint or palmprint sensors	G06V 40/13
Sensors for vascular patterns	G06V 40/145
Scanning, transmission or reproduction of documents or the like, e.g. facsimile transmission	H04N 1/00

H10F 39/199

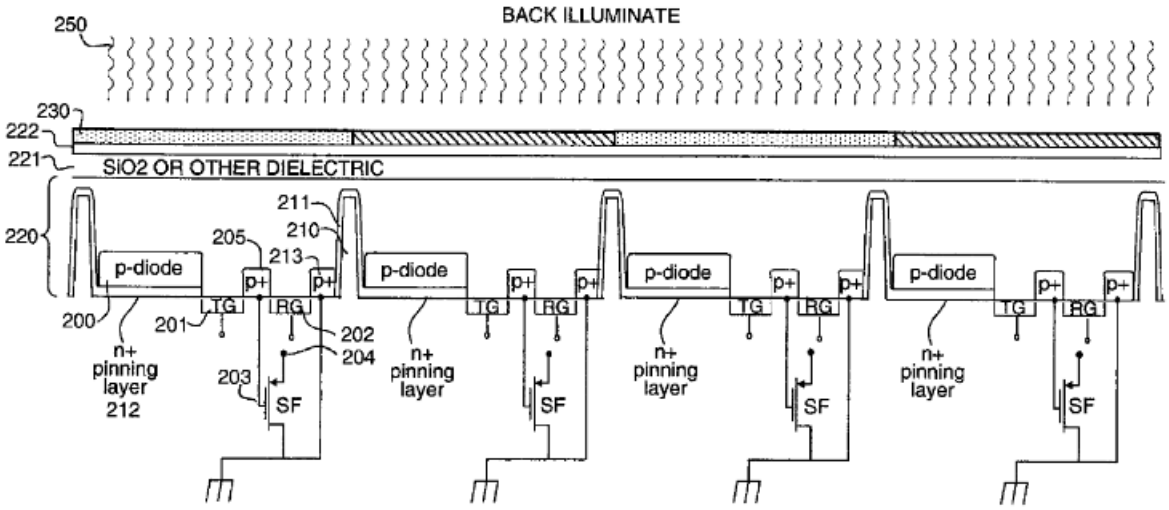
{Back-illuminated image sensors}

Definition statement

This place covers:

Image sensors wherein radiation (e.g. light) impinges from the surface of the semiconductor wafer opposite to the surface having the imaging structure.

Illustrative example of subject matter classified in this place:



The Figure illustrates light (250) illuminated on the surface of the semiconductor wafer that is opposite to the surface having photodiodes (200) therein.

H10F 39/80

{Constructional details of image sensors}

Definition statement

This place covers:

Structural or functional details of semiconductor imaging structures such as encapsulations, geometry of disposition of passive and active elements, lenses, isolation, etc., whenever they are specific for semiconductor imaging devices, i.e. they solve problems specific to semiconductor imaging devices.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Encapsulation of integrated circuits	H01L 23/28

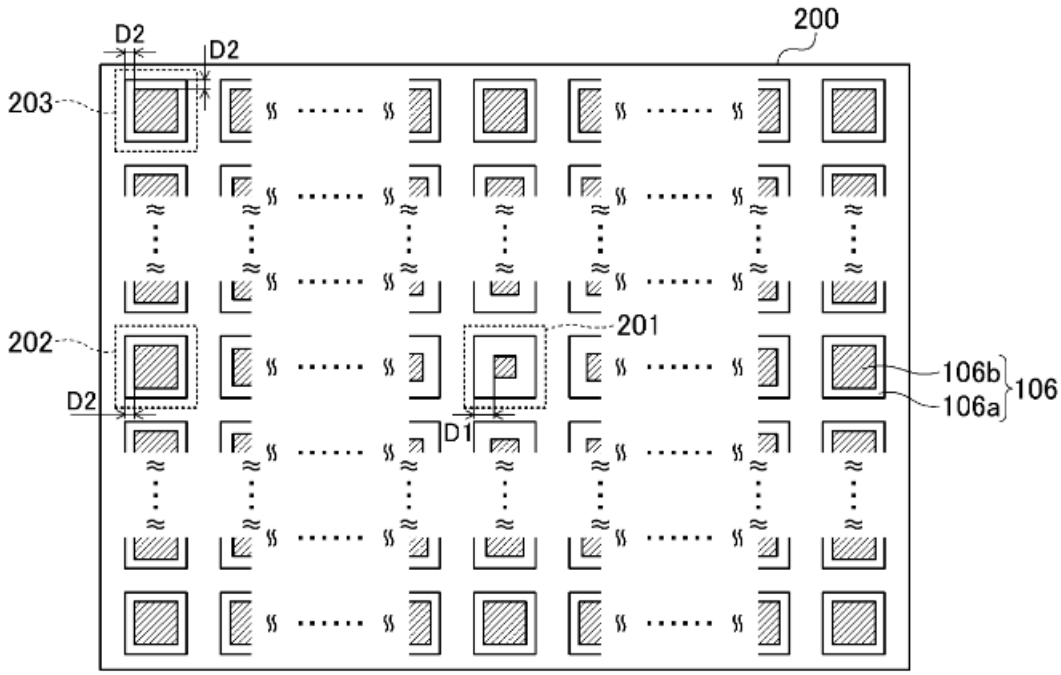
H10F 39/8023

{Disposition of the elements in pixels, e.g. smaller elements in the centre of the imager compared to larger elements at the periphery}

Definition statement

This place covers:

Illustrative example of subject matter classified in this place:



The Figure illustrates an image sensor having optical waveguides (106) having two components (106a and 106b) having differing index of refraction. In the pixels near the periphery of the image sensor, regions (106b) are large, and in the pixels near the middle of the image sensor, regions (106b) are small.

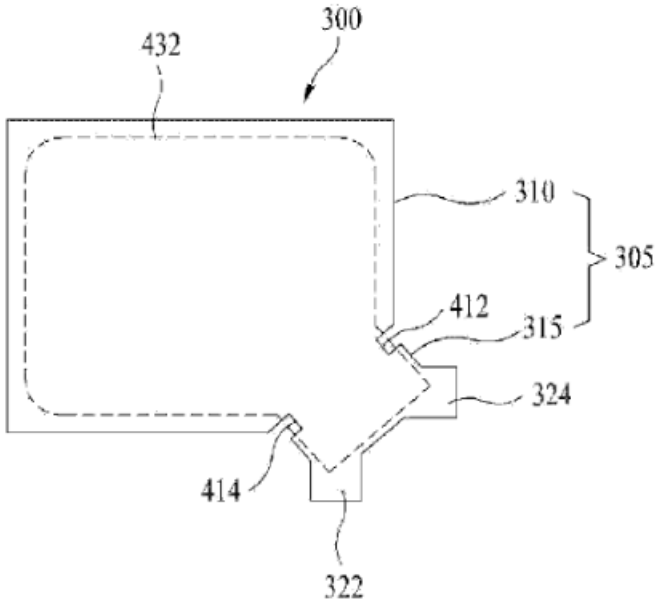
H10F 39/8027

{Geometry of the photosensitive area}

Definition statement

This place covers:

Illustrative example of subject matter classified in this place:



The Figure illustrates the implanted photosensitive region (432) of a photodiode having a shape (see dotted lines) determined by mask (305).

H10F 39/803

{Pixels having integrated switching, control, storage or amplification elements}

Definition statement

This place covers:

Pixels of active pixel sensors [APS], wherein each pixel comprises a photodetecting element and amplifications means.

Illustrative examples of subject matter classified in this place:

1a.

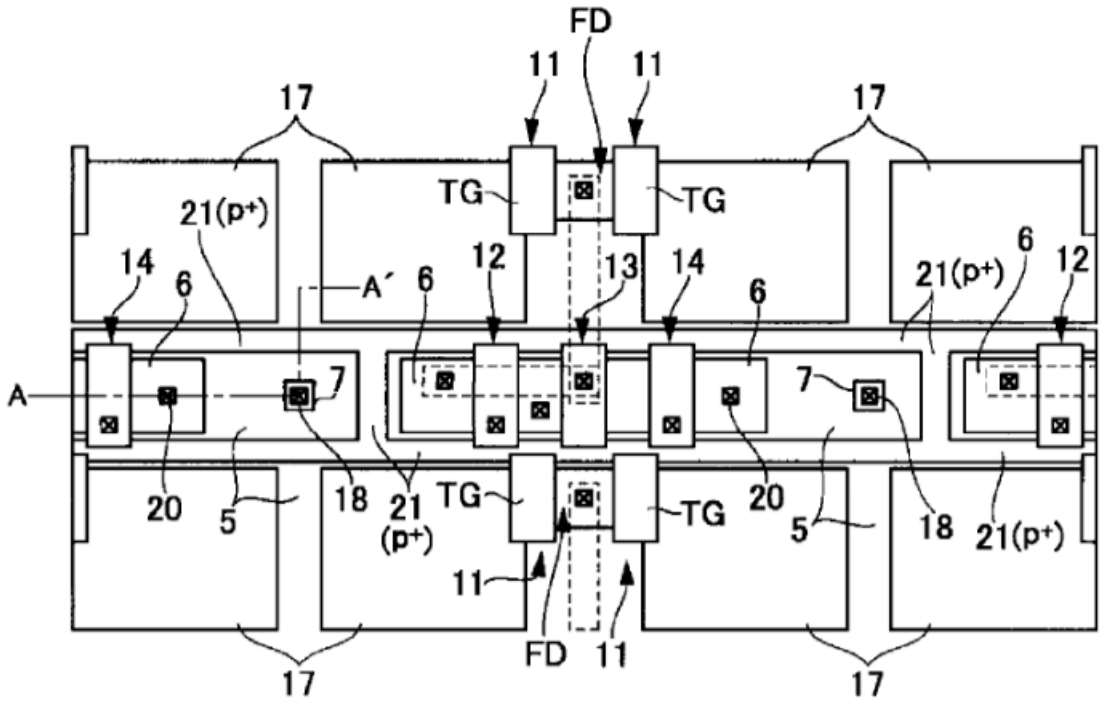


Figure 1a illustrates a top view of an image sensor having photoelectric conversion regions (17) of photodiodes in multiple pixels, with reset transistor (12), amplification transistor (13) and selection transistor (14) formed between rows of photodiodes.

1b.

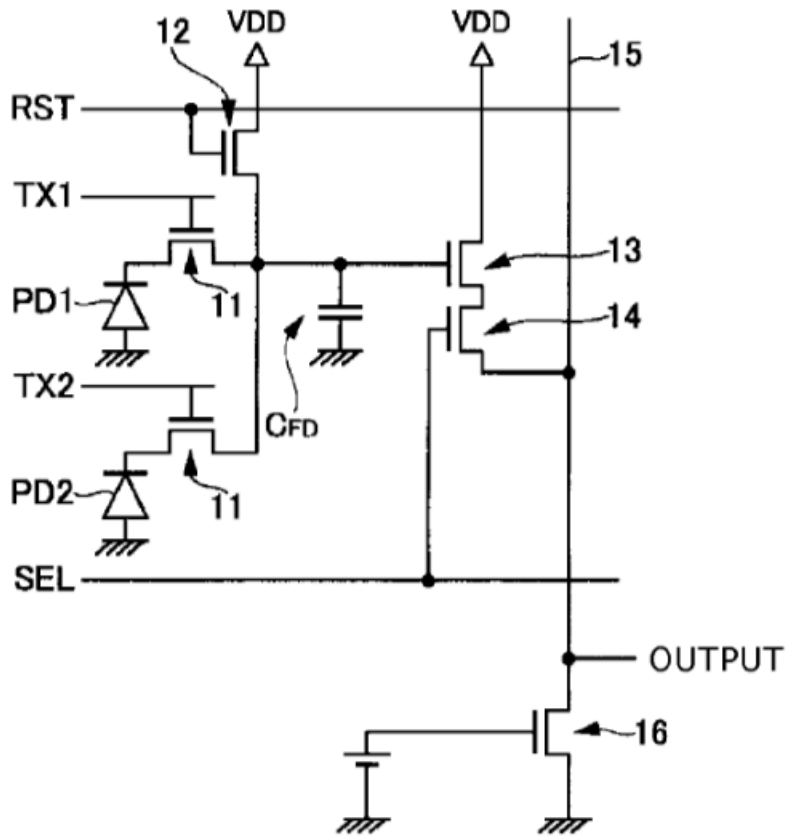


Figure 1b illustrates a corresponding circuit diagram.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Scanning details of image sensors	H04N 25/00
Circuitry of image sensors	H04N 25/70

H10F 39/8033

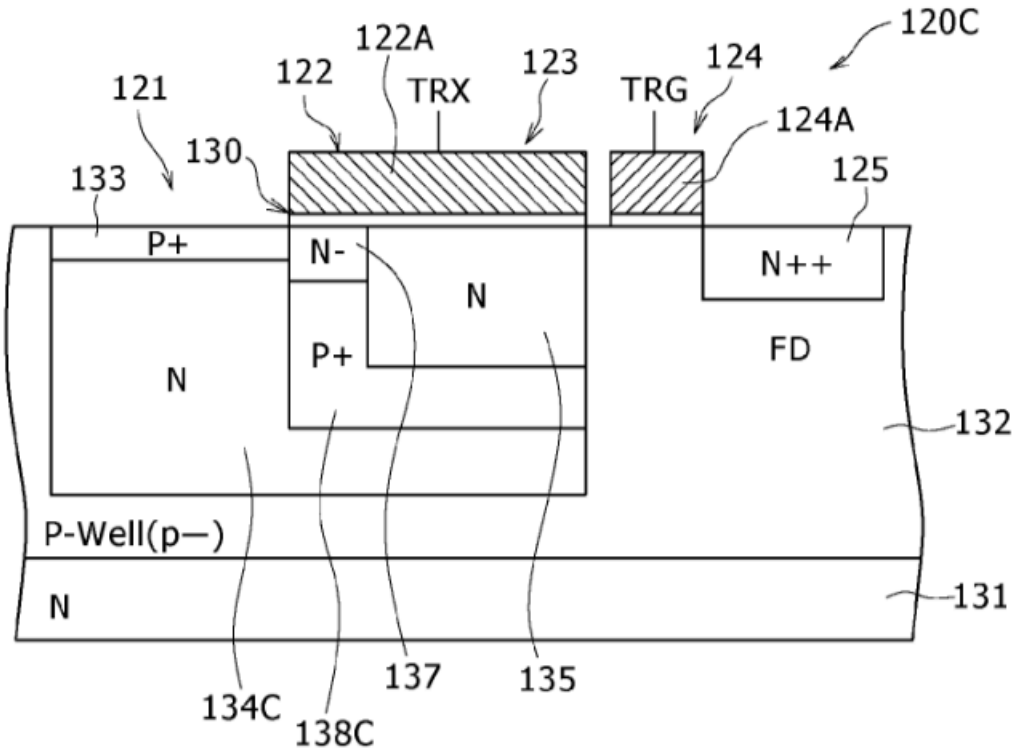
{Photosensitive area}

Definition statement

This place covers:

Details of the photosensitive area of an active pixel sensor, such as doping profiles, etc.

Illustrative example of subject matter classified in this place:



The Figure illustrates a photodiode (121) comprising photosensitive regions (133 and 134C). The region (134) extends below a buried channel (135) in a way that helps prevent charge in (121) from mixing into other regions.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Geometry of the photosensitive area in image sensors	H10F 39/8027

H10F 39/8037

{the integrated elements comprising a transistor}

Definition statement

This place covers:

Active pixel sensors characterised by a transistor (e.g. transfer transistor, reset transistor or source follower) in the pixel.

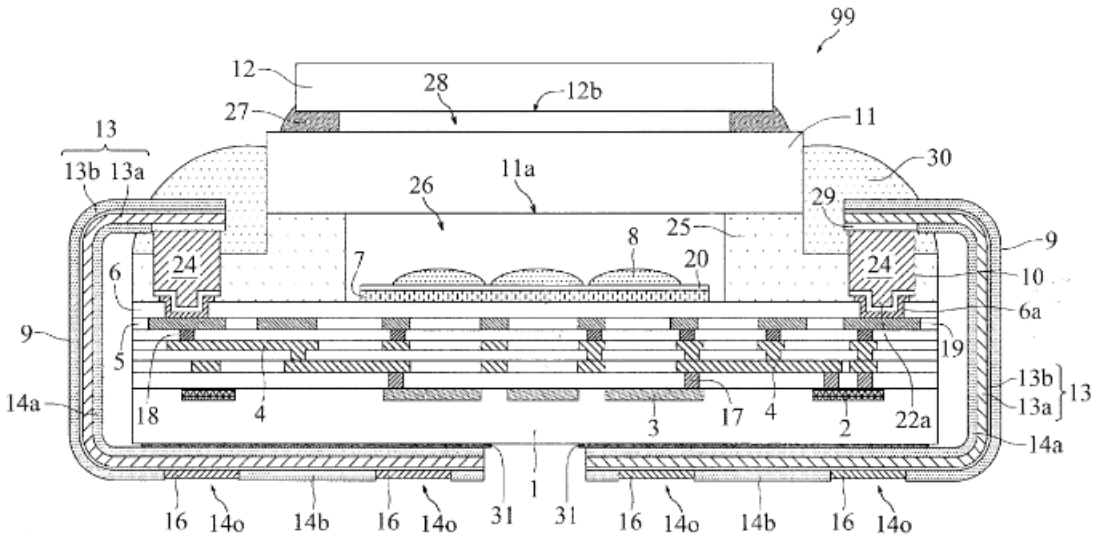
H10F 39/804

{Containers or encapsulations}

Definition statement

This place covers:

Illustrative example of subject matter classified in this place:



The Figure illustrates a flexible container (9) comprising copper (13a), adhesive (13b), and polymer (14a), that is attached to metal pads (24) of an image sensor and is wrapped therearound. It further shows an encapsulation material (30), such as epoxy, that seals the container (9) to the top of the image sensor.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Containers of integrated circuits in general	H01L 23/02
Encapsulation of integrated circuits in general	H01L 23/28

H10F 39/805

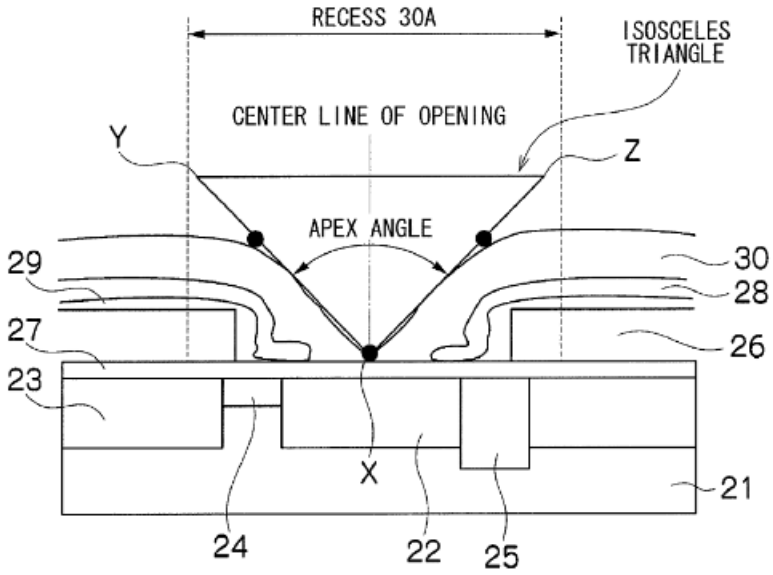
{Coatings}

Definition statement

This place covers:

Coatings within the image sensor, e.g. interlayer dielectrics (ILD) or antireflective coatings (ARC).

Illustrative example of subject matter classified in this place:



The Figure illustrates an image sensor having coatings such as a transparent film (30) having a carefully chosen apex angle such that a lens may be formed thereon by deposition of other thin films.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Coatings in general	C23C 14/00
Optical filters in general	G02B 5/20

H10F 39/8053

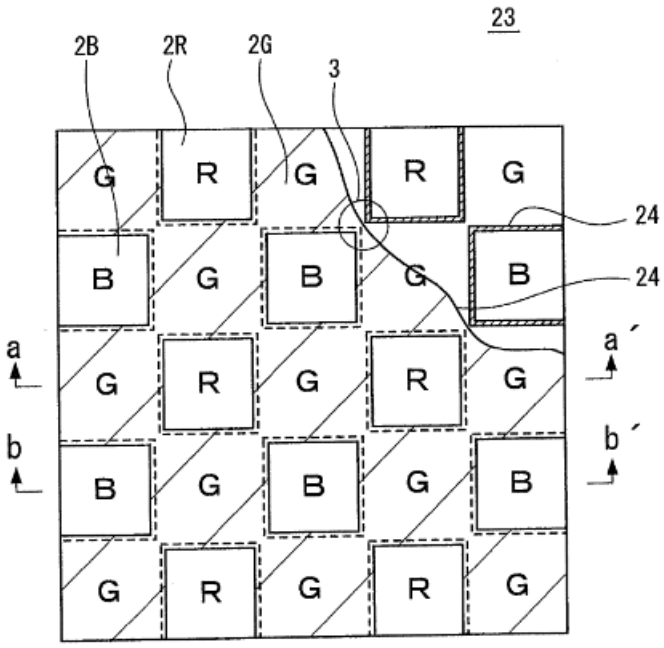
{Colour filters}

Definition statement

This place covers:

Colour filters for image sensors, e.g. arrangement of multiple filters in a Bayer pattern.

Illustrative example of subject matter classified in this place:



The Figure illustrates a colour filter (23) having blue colour filter components (2B), red colour filter components (2R) and green colour filter components (2G), in a pattern known as a Bayer array, wherein each green colour filter component is surrounded by red and blue filter components.

H10F 39/8057

{Optical shielding}

Definition statement

This place covers:

Illustrative examples of subject matter classified in this place:

1.

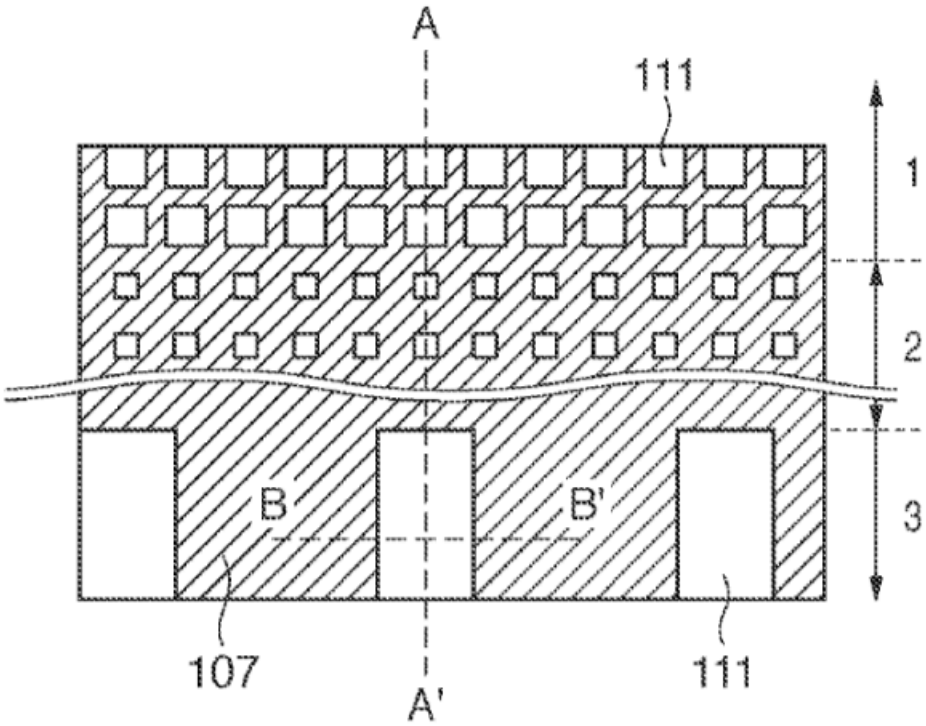


Figure 1 illustrates an image sensor having a light-shielding film (107) having openings (111) that are largest in peripheral region (3), that are smaller in optical black region (2), and that are smallest in effective pixel region (1).

2.

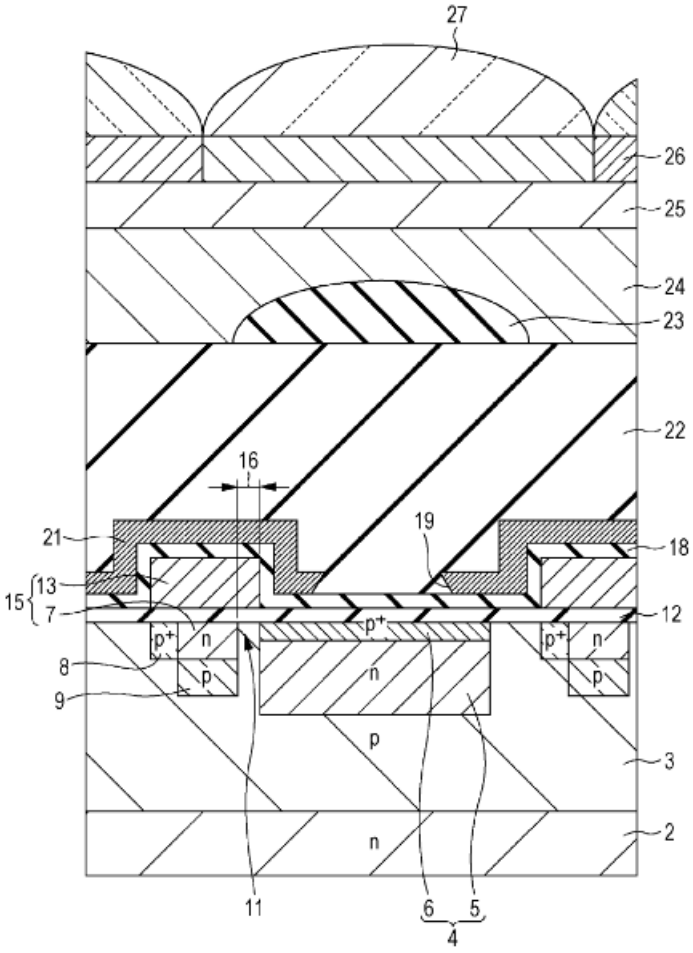


Figure 2 illustrates an image sensor having a light control film (21) having a reverse tapered opening (19) over the photoelectric conversion portion (4).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Shielding in CCD-type image sensors	H10F 39/1515

H10F 39/806

{Optical elements or arrangements associated with the image sensors}

Definition statement

This place covers:

Optical elements such as lenses, reflectors or light-guiding structures within image sensors.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Lenses in general	G02B 3/00
Photonic crystals in general	G02B 6/1225

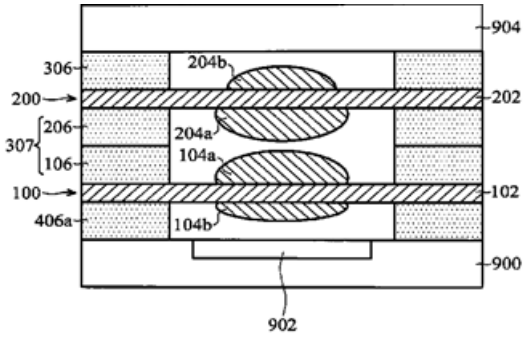
H10F 39/8063

{Microlenses}

Definition statement

This place covers:

Illustrative example of subject matter classified in this place:



The Figure illustrates an image sensor having microlenses (204a, 204b, 104a and 104b), having different sizes than each other.

H10F 39/8067

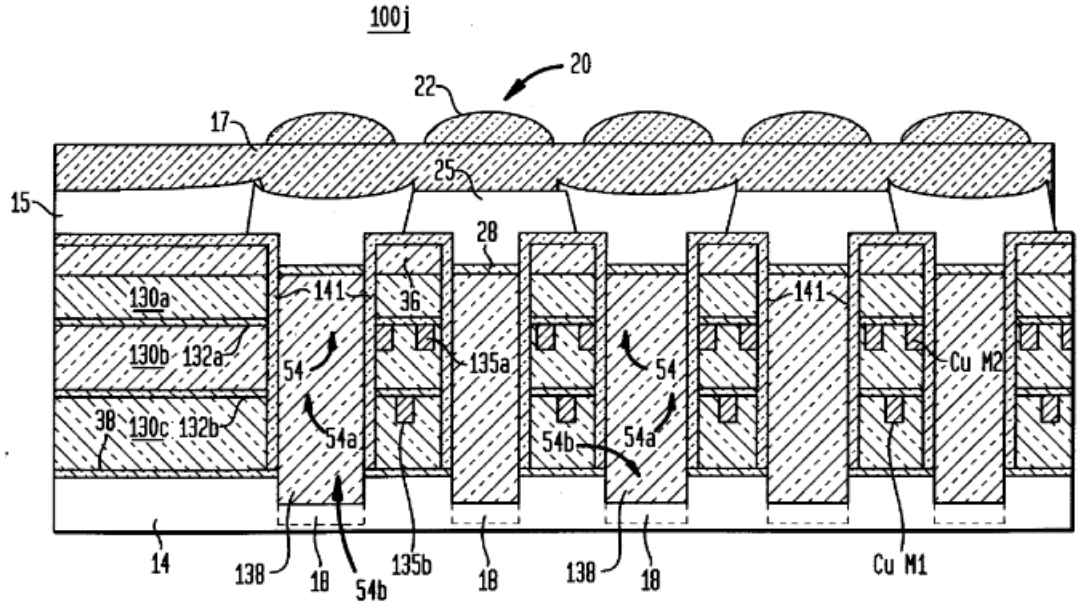
{Reflectors}

Definition statement

This place covers:

Elements that reflect light in the image sensor, for example reflecting light towards the light detecting elements.

Illustrative example of subject matter classified in this place:



The Figure illustrates an image sensor (110j) having reflective thin films of SiN (140) formed above photodiodes (18).

H10F 39/807

{Pixel isolation structures}

Definition statement

This place covers:

Electrical or thermal isolation structures between pixels.

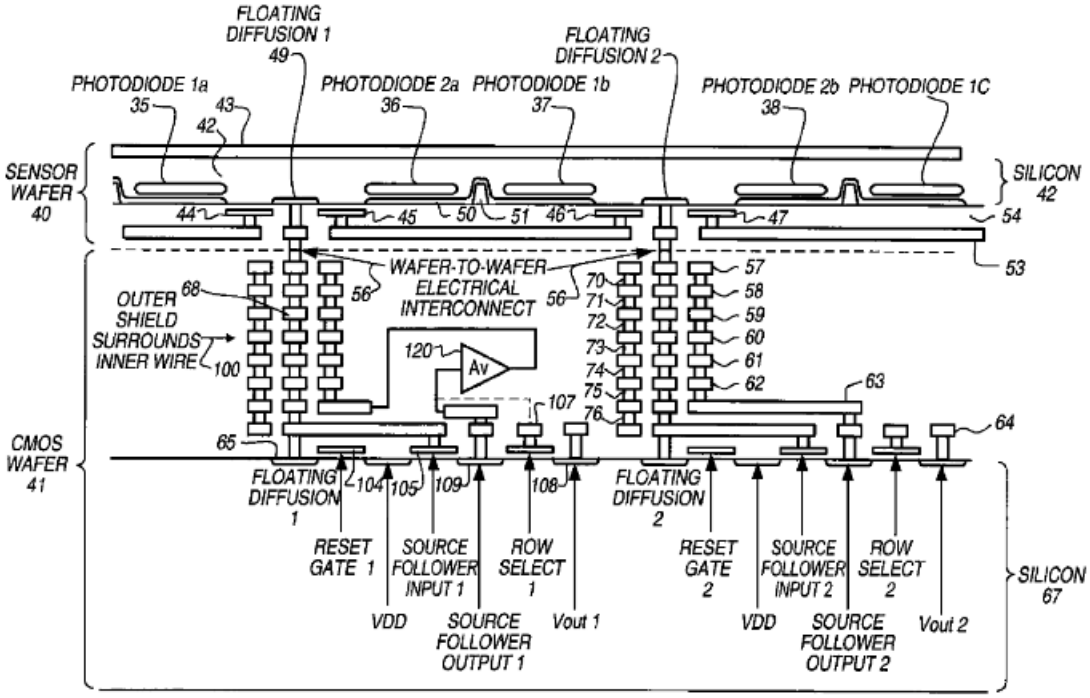
H10F 39/809

{of hybrid image sensors}

Definition statement

This place covers:

Illustrative example of subject matter classified in this place:



The Figure illustrates a hybrid image sensor, having photodiodes in sensor wafer (40), connected to control circuitry in CMOS wafer (41). The details of this hybrid image sensor, such as the wafer-to-wafer interconnection (56) and the metal shield (100), are covered by this subgroup.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Hybrid-type infrared CCD or CID imagers	H10F 39/1575
Hybrid-type infrared CMOS or photodiode array image sensors	H10F 39/1843
Hybrid-type X-ray, gamma-ray or corpuscular radiation image sensors	H10F 39/1895
Interconnections	H10F 39/811

H10F 39/811

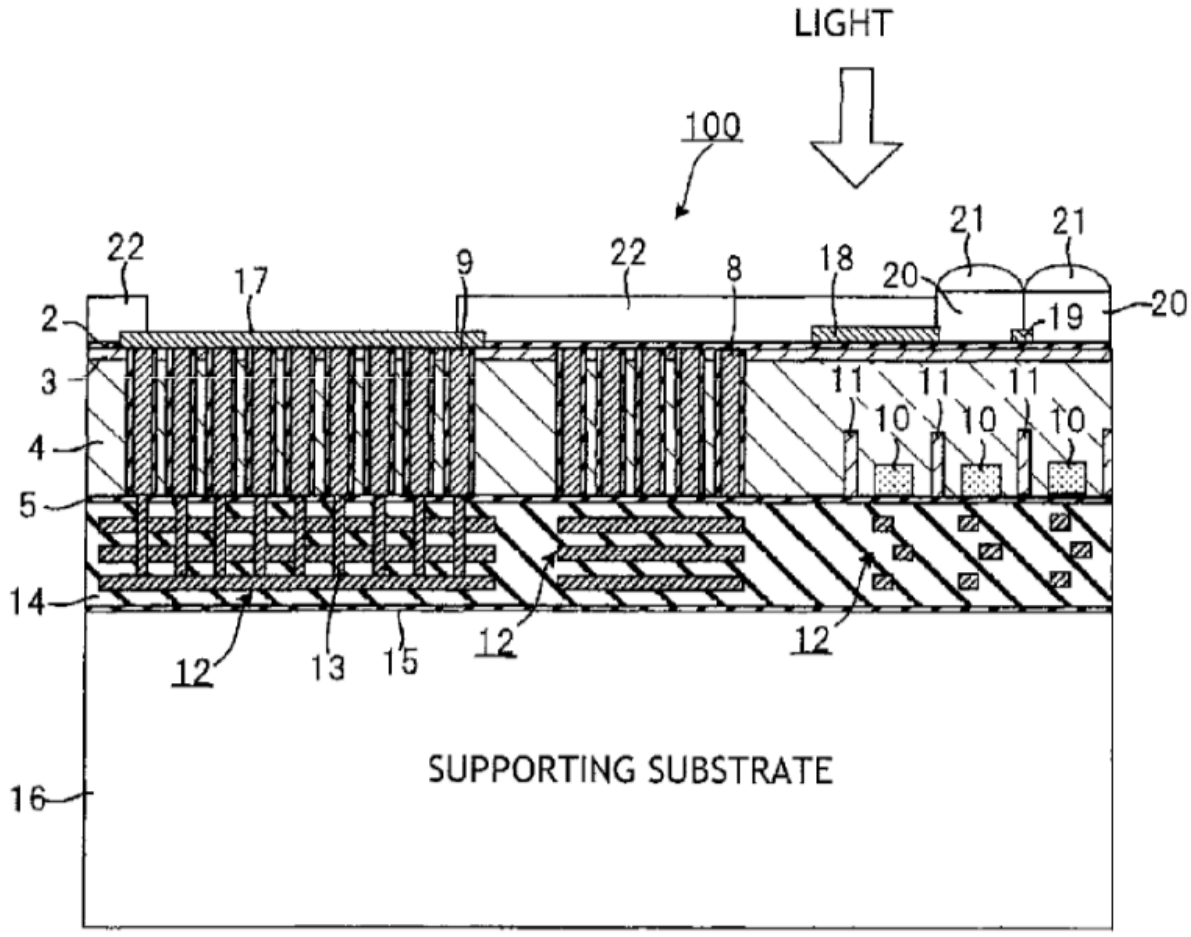
{Interconnections}

Definition statement

This place covers:

Interconnections for image sensors, e.g. wirings that connect an imaging substrate with its driving substrate; or that connect an image sensor with the external driving circuitry; or that connect between various elements within the image sensor.

Illustrative example of subject matter classified in this place:



The Figure illustrates an image sensor (100) having interconnections including wiring portions (12), conductive pillars (9) and pad portions (17).

H10F 39/812

{Arrangements for transferring the charges in the image sensor perpendicular to the imaging plane, e.g. buried regions used to transfer generated charges to circuitry under the photosensitive region}

Definition statement

This place covers:

Arrangements in the image sensor for transferring charges perpendicular to the imaging plane, e.g. circuitry beneath the photosensitive area that move the charges away from the sensing elements.

H10F 39/813

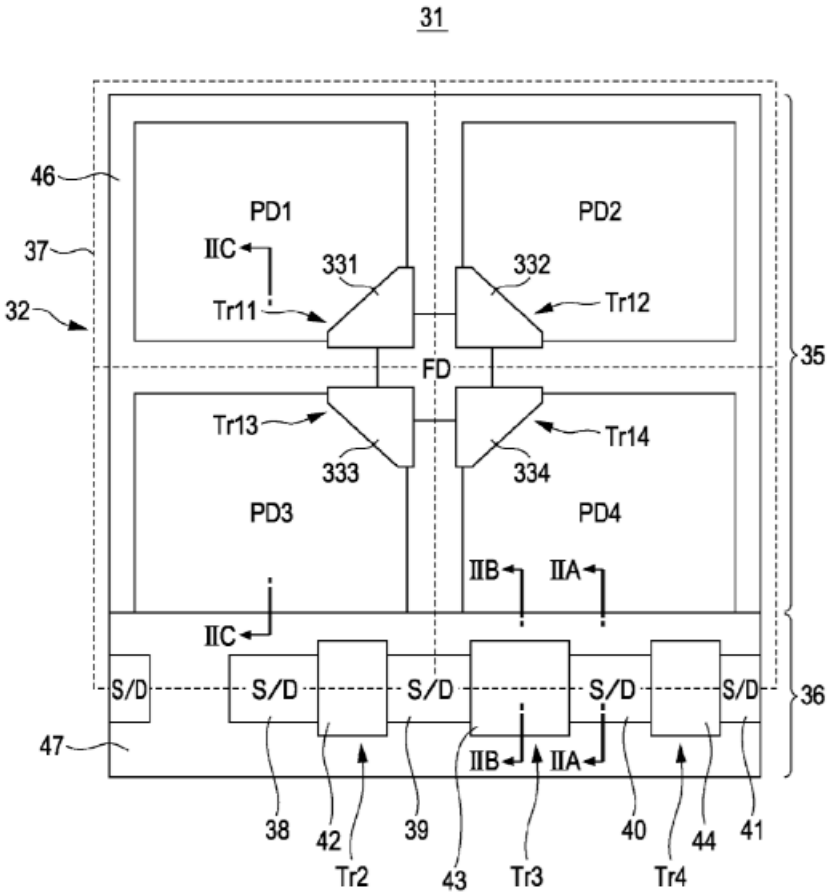
{Electronic components shared by multiple pixels, e.g. one amplifier shared by two pixels}

Definition statement

This place covers:

Electronic components shared by multiple pixels, e.g. transistors or doped regions shared by adjacent pixels.

Illustrative example of subject matter classified in this place:



The Figure illustrates an image sensor (31) having photodiodes PD1 through PD4 that share a floating diffusion region FD, which is connected to the gate of amplifier transistor Tr3.

H10F 55/00

Radiation-sensitive semiconductor devices covered by groups H10F 10/00, H10F 19/00 or H10F 30/00 being structurally associated with electric light sources and electrically or optically coupled thereto

Definition statement

This place covers:

- Integrated devices having at least one light-emitting source and at least one inorganic photodetector optically coupled thereto (e.g. optocouplers).

- Assemblies of at least one light-emitting source and at least one inorganic photodetector optically coupled thereto (e.g. optocouplers).
- Radiation-sensitive semiconductor devices being structurally associated with at least one light-emitting source and being electrically coupled thereto (e.g. image converters).
- The group H10F 55/00 itself covers situations wherein it is not specified if the light-emitting source controls the radiation-sensitive device or if the radiation-sensitive device controls the light-emitting source. Groups indented under H10F 55/00 cover when it is known which device controls the other.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Coupling light guides with opto-electronic elements	G02B 6/42
Amplifiers using electroluminescent elements or photocells	H03F 17/00
Electronic switching using opto-electronic devices	H03K 17/968
Optical interconnects	H04B 10/80
Electroluminescent light sources per se	H05B 33/00
Inorganic semiconductor devices having potential barriers being adapted for light emission	H10H
Integrated devices, or assemblies of multiple devices, comprising at least one organic light-emitting element and at least one organic radiation-sensitive element, e.g. organic optocoupler	H10K 65/00

H10F 55/10

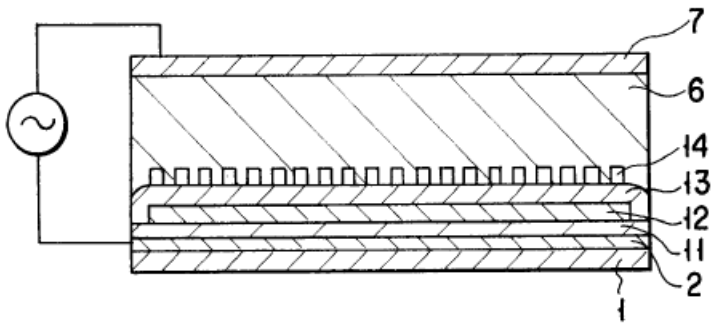
wherein the radiation-sensitive semiconductor devices control the electric light source, e.g. image converters, image amplifiers or image storage devices

Definition statement

This place covers:

Devices wherein the signal from the photodetector is used for controlling the emission of light from the light source (e.g. image converters).

Illustrative example of subject matter classified in this place:



The Figure illustrates an image-converting device having a photoconductive layer (6) associated with an electroluminescent layer (12) between back electrode (7) and transparent electrode (2). Radiation into the image-converting device decreases the resistivity of the photoconductive layer (6) so that the electroluminescent layer (12) emits light by the application of an electric field.

H10F 55/20

wherein the electric light source controls the radiation-sensitive semiconductor devices, e.g. optocouplers

Definition statement

This place covers:

Devices wherein the light from the light source is sent to the photodetector, which provides an electrical signal.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Proximity sensors	G01S 17/04
Coupling light guides with opto-electronic elements	G02B 6/42
Electronic switching or gating using opto-electronic devices	H03K 17/78

H10F 71/00

Manufacture or treatment of devices covered by this subclass (patterning processes to connect thin photovoltaic cells in integrated devices, or assemblies of multiple devices, having photovoltaic cells H10F 19/33; manufacture or treatment of encapsulations or containers for integrated devices, or assemblies of multiple devices, having photovoltaic cells H10F 19/80; manufacture or treatment of integrated devices, or assemblies of multiple devices, comprising at least one element in which radiation controls the flow of current H10F 39/00)

Definition statement

This place covers:

Processes or apparatus specially adapted for the formation of semiconductor devices that are sensitive to infrared radiation, visible light, ultraviolet radiation, x-ray radiation, gamma ray radiation or corpuscular radiation, and which are specially adapted for either the conversion of the radiation energy into electrical energy or for the control of electrical energy by such radiation, having active materials that are inorganic.

This includes the formation, patterning or treatment of the inorganic materials used in active layers or in electrodes.

References

Limiting references

This place does not cover:

Patterning processes to connect thin photovoltaic cells in integrated devices, or assemblies of multiple devices, having photovoltaic cells	H10F 19/33
Manufacture or treatment of encapsulations or containers for integrated devices, or assemblies of multiple devices, having photovoltaic cells	H10F 19/80
Manufacture or treatment of integrated devices, or assemblies of multiple devices, comprising at least one element in which radiation controls the flow of current	H10F 39/00

Informative references

Attention is drawn to the following places, which may be of interest for search:

Manufacture or treatment of semiconductor or solid-state devices	H01L 21/00
Testing of semiconductor devices (e.g. photovoltaic devices) during manufacture	H01L 22/00
Testing of photovoltaic devices, e.g. of PV modules or single PV cells	H02S 50/10

Special rules of classification

Manufacturing of packages, or parts thereof, for protecting photovoltaic cells in integrated devices or assemblies are covered in H10F 19/80.

H10F 77/00

Constructional details of devices covered by this subclass (constructional details of integrated devices, or assemblies of multiple devices, comprising at least one element in which radiation controls the flow of current H10F 39/00)

Definition statement

This place covers:

Constructional details of semiconductor devices that are sensitive to infrared radiation, visible light, ultraviolet radiation, x-ray radiation, gamma ray radiation or corpuscular radiation, and which are specially adapted for either the conversion of the radiation energy into electrical energy or for the control of electrical energy by such radiation, having active materials that are only inorganic.

References

Limiting references

This place does not cover:

Constructional details of integrated devices, or assemblies of multiple devices, comprising at least one element in which radiation controls the flow of current	H10F 39/00

Informative references

Attention is drawn to the following places, which may be of interest for search:

Frame structures of photovoltaic modules	H02S 30/10

Optical components in combination with photovoltaic modules	H02S 40/20
Electrical components in combination with photovoltaic modules	H02S 40/30
Thermal components in combination with photovoltaic modules	H02S 40/40

Special rules of classification

When classifying in this group, the type of device itself, when it is determined to be novel and non-obvious, should be classified in groups H10F 10/00, H10F 19/00, H10F 30/00 or H10F 55/00.

The manufacturing of the constructional details covered by this group are classified together with said constructional details. For instance, a method of fabrication of an electrode for a photovoltaic cell is classified under H10F 77/211.

H10F 77/12

Active materials

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Organic semiconductor materials in bodies of organic radiation-sensitive devices	H10K 85/00

H10F 77/162

Non-monocrystalline materials, e.g. semiconductor particles embedded in insulating materials (H10F 77/169 takes precedence)

Definition statement

This place covers:

Semiconductor particles, e.g. nanoparticles, in a matrix, e.g. the matrix being made of dielectric or of semiconductor material.

References

Limiting references

This place does not cover:

Semiconductor devices including thin films	H10F 77/169

Synonyms and Keywords

In patent documents, the following words/expressions are often used with the meaning indicated:

MGL	Mono-grain layer, also called mono-grain membrane, i.e. powder particles embedded within a polymer membrane

H10F 77/169

Thin semiconductor films on metallic or insulating substrates

Definition statement

This place covers:

Thin semiconductor films on metallic or insulating substrates, e.g. glass, or ceramic substrates, often formed on barrier layers that prevent out-diffusion of impurities from the substrates.

H10F 77/30

Coatings (arrangements for preventing damage to photovoltaic cells caused by corpuscular radiation H10F 77/80)

Definition statement

This place covers:

One or more layers that are formed essentially conformally on, and directly associated with, at least a portion of the semiconductor device. These layers may provide passivating or optical effects.

References

Limiting references

This place does not cover:

Provisions for preventing damage caused by corpuscular radiation, e.g. for space applications	H10F 77/80

Informative references

Attention is drawn to the following places, which may be of interest for search:

Encapsulations or containers for integrated devices, or assemblies of multiple devices, having photovoltaic cells	H10F 19/80
Wavelength conversion means	H10F 77/45
Encapsulations	H10F 77/50
Coatings for organic photosensitive semiconductor devices	H10K 30/88

H10F 77/40

Optical elements or arrangements (surface textures H10F 77/70)

Definition statement

This place covers:

Optical elements or arrangements that are associated with the radiation-sensitive device, e.g. used for focusing, reflecting or diffracting light.

References

Limiting references

This place does not cover:

Surface textures for light trapping effects	H10F 77/70

Informative references

Attention is drawn to the following places, which may be of interest for search:

Light-reflecting or light-concentrating means specially adapted for photovoltaic modules	H02S 40/20

H10F 77/42

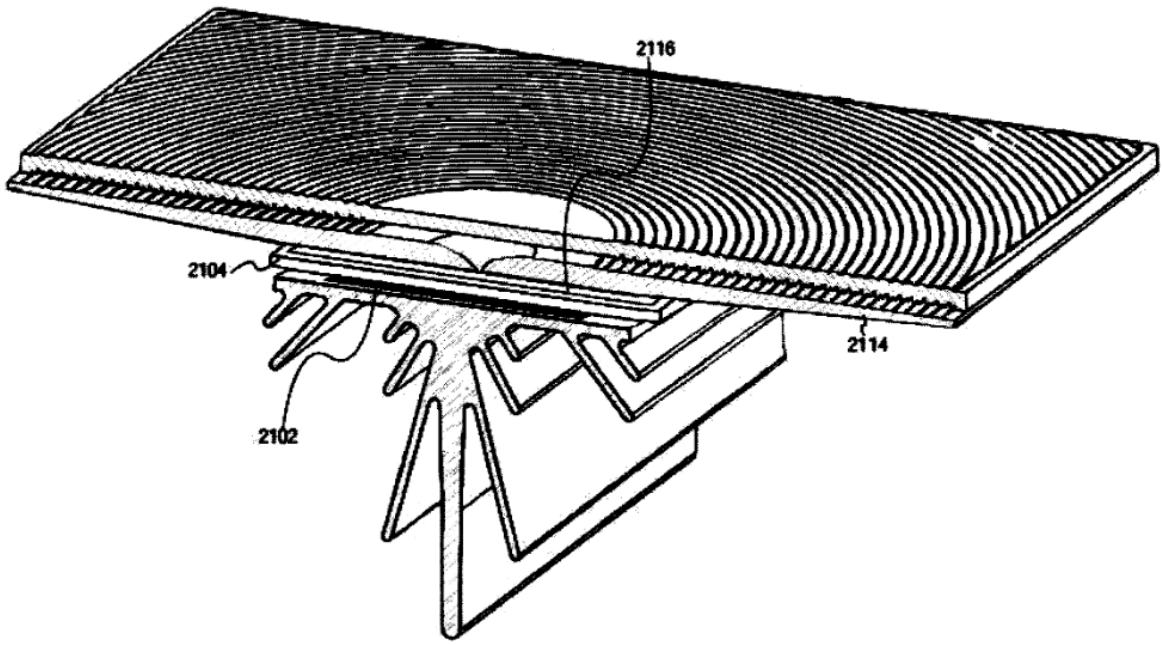
directly associated or integrated with photovoltaic cells, e.g. light-reflecting means or light-concentrating means

Definition statement

This place covers:

Optical elements or arrangements directly associated or integrated with photovoltaic cells, e.g. solar concentrators, lenses, reflectors or Fresnel lenses.

Illustrative example of subject matter classified in this place:



The Figure illustrates glass cover (2104), low refractive index material sheet (2116) and light guide layer (2114) stacked on photovoltaic cell (2102).

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Antireflective coatings for light sensitive devices	H10F 77/30
Concentrating means for semiconductor photodetectors	H10F 77/40
Concentrators for solar heat collectors	F24S 23/00
Optical elements per se	G02B

H10F 77/45

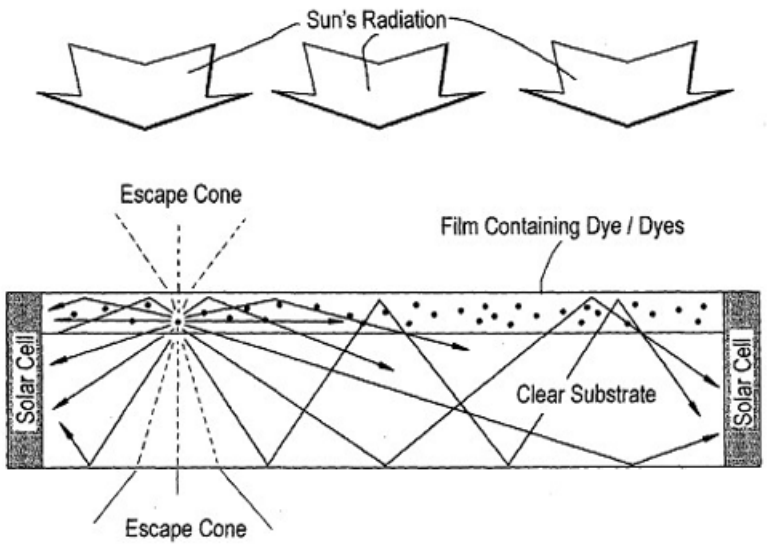
Wavelength conversion means, e.g. by using luminescent material, fluorescent concentrators or up-conversion arrangements

Definition statement

This place covers:

Coatings or separate members, which change the wavelengths of the incident light, making it more suitable for absorption by the photovoltaic cell, e.g. fluorescent concentrators.

Illustrative example of subject matter classified in this place:



References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Wavelength conversion means for photodetectors	H10F 77/496
Luminescent, e.g. electroluminescent, chemiluminescent materials	C09K 11/00

Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:

- "photoluminescent materials", "luminescent materials", "phosphorescent materials"

H10F 77/48

Back surface reflectors [BSR]

Definition statement

This place covers:

Light-reflecting means that reflects the light that already went through the photovoltaic cell back into the cell.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Electrodes for photovoltaic cells	H10F 77/20

H10F 77/50

Encapsulations or containers (for photovoltaic modules H10F 19/80)

Definition statement

This place covers:

Encapsulations or containers, e.g. housings, transparent windows or resins, for individual radiation-sensitive devices.

References

Limiting references

This place does not cover:

Encapsulations or containers for integrated devices or assemblies of multiple devices having at least one photovoltaic cell	H10F 19/80

Informative references

Attention is drawn to the following places, which may be of interest for search:

Containers for semiconductor or solid-state devices	H01L 23/02
Encapsulations for semiconductor or solid-state devices	H01L 23/28
Sealing arrangements of electroluminescent light sources	H05B 33/04
Packages for inorganic light emitting devices	H10H 20/85
Passivation, containers or encapsulations for organic radiation-sensitive devices	H10K 30/88
Encapsulations for organic light emitting devices	H10K 50/844

H10F 77/60

Arrangements for cooling, heating, ventilating or compensating for temperature fluctuations

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Cooling apparatuses in general, e.g. arrangement or mounting of refrigeration units	F25D 19/00
Arrangements for cooling, heating, ventilating or temperature compensation or semiconductor or solid-state devices	H01L 23/34
Means to utilise heat energy directly associated with the PV module	H02S 40/44

H10F 77/63

Arrangements for cooling directly associated or integrated with photovoltaic cells, e.g. heat sinks directly associated with the photovoltaic cells or integrated Peltier elements for active cooling

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Cooling means using Peltier elements for semiconductor devices in general	H01L 23/38
Cooling means for PV modules	H02S 40/42
Thermoelectric devices operating with Peltier or Seebeck-effect only	H10N 10/10

H10F 77/67

including means to utilise heat energy directly associated with the photovoltaic cells, e.g. integrated Seebeck elements

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Using solar heat per se	F24S 20/00
Means to utilise heat energy, the means directly associated with PV modules	H02S 40/44
Thermoelectric devices (e.g. Seebeck elements) per se	H10N 10/00

H10F 77/70

Surface textures, e.g. pyramid structures

Definition statement

This place covers:

Surface textures specially adapted for light trapping effects.

Synonyms and Keywords

In patent documents, the following words/expressions are often used as synonyms:

- "corrugated surface", "protrusions", "projections", "roughened surface", "pyramidal structures (for silicon)", "light trapping"

H10F 77/80

Arrangements for preventing damage to photovoltaic cells caused by corpuscular radiation, e.g. for space applications

Definition statement

This place covers:

Provisions to specially adapt photovoltaic devices for space applications or to improve the radiation resistance to avoid radiation damage.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Semiconductor devices sensitive to very short wavelengths, e.g. X-rays, gamma-rays or corpuscular radiation	H10F 30/29
Space applications, e.g. power supply for satellites made of photovoltaic cell modules	B64G 1/00

H10F 77/90

Energy storage means directly associated or integrated with photovoltaic cells, e.g. capacitors integrated with photovoltaic cells

Definition statement

This place covers:

Energy storage means directly associated or integrated with photovoltaic cells, e.g. batteries to store electrical energy produced by photovoltaic cells.

References

Informative references

Attention is drawn to the following places, which may be of interest for search:

Circuit arrangements for charging batteries with photovoltaic cells	H02J 7/35
Energy storage means associated with the PV module	H02S 40/38