

## SECTION H — ELECTRICITY

### H01 BASIC ELECTRIC ELEMENTS

**H01L SEMICONDUCTOR DEVICES; ELECTRIC SOLID STATE DEVICES NOT OTHERWISE PROVIDED FOR** (use of semiconductor devices for measuring G01; resistors in general H01C; magnets, inductors, transformers H01F; capacitors in general H01G; electrolytic devices H01G 9/00; batteries, accumulators H01M; waveguides, resonators, or lines of the waveguide type H01P; line connectors, current collectors H01R; stimulated-emission devices H01S; electromechanical resonators H03H; loudspeakers, microphones, gramophone pick-ups or like acoustic electromechanical transducers H04R; electric light sources in general H05B; printed circuits, hybrid circuits, casings or constructional details of electrical apparatus, manufacture of assemblages of electrical components H05K; use of semiconductor devices in circuits having a particular application, see the subclass for the application) [2]

#### Note(s)

1. This subclass covers :
  - electric solid state devices which are not covered by any other subclass and details thereof, and includes: semiconductor devices adapted for rectifying, amplifying, oscillating or switching; semiconductor devices sensitive to radiation; electric solid state devices using thermoelectric, superconductive, piezo-electric, electrostrictive, magnetostrictive, galvano-magnetic or bulk negative resistance effects and integrated circuit devices;
  - photoresistors, magnetic field dependent resistors, field effect resistors, capacitors with potential-jump barrier, resistors with potential-jump barrier or surface barrier, incoherent light emitting diodes and thin-film or thick-film circuits;
  - processes and apparatus adapted for the manufacture or treatment of such devices, except where such processes relate to single-step processes for which provision exists elsewhere.
2. In this subclass, the following terms or expressions are used with the meaning indicated:
  - "wafer" means a slice of semiconductor or crystalline substrate material, which can be modified by impurity diffusion (doping), ion implantation or epitaxy, and whose active surface can be processed into arrays of discrete components or integrated circuits;
  - "solid state body" means the body of material within which, or at the surface of which, the physical effects characteristic of the device occur. In thermoelectric devices, it includes all materials in the current path.

Regions in or on the body of the device (other than the solid state body itself), which exert an influence on the solid state body electrically, are considered to be "electrodes" whether or not an external electrical connection is made thereto. An electrode may include several portions and the term includes metallic regions which exert influence on the solid state body through an insulating region (e.g. capacitive coupling) and inductive coupling arrangements to the body. The dielectric region in a capacitive arrangement is regarded as part of the electrode. In arrangements including several portions, only those portions which exert an influence on the solid state body by virtue of their shape, size, or disposition or the material of which they are formed are considered to be part of the electrode. The other portions are considered to be "arrangements for conducting electric current to or from the solid state body" or "interconnections between solid state components formed in or on a common substrate", i.e. leads;

- "device" means an electric circuit element; where an electric circuit element is one of a plurality of elements formed in or on a common substrate it is referred to as a "component";
  - "complete device" is a device in its fully assembled state which may or may not require further treatment, e.g. electroforming, before it is ready for use but which does not require the addition of further structural units;
  - "parts" includes all structural units which are included in a complete device;
  - "container" is an enclosure forming part of the complete device and is essentially a solid construction in which the body of the device is placed, or which is formed around the body without forming an intimate layer thereon. An enclosure which consists of one or more layers formed on the body and in intimate contact therewith is referred to as an "encapsulation";
  - "integrated circuit" is a device where all components, e.g. diodes, resistors, are built up on a common substrate and form the device including interconnections between the components;
  - "assembly" of a device is the building up of the device from its component constructional units and includes the provision of fillings in containers.
3. In this subclass, both the process or apparatus for the manufacture or treatment of a device and the device itself are classified, whenever both of these are described sufficiently to be of interest.
  4. Attention is drawn to Note (3) after the title of section C, which Note indicates to which version of the periodic table of chemical elements the IPC refers. In this subclass, the Periodic System used is the 8 group system indicated by Roman numerals in the Periodic Table thereunder.

#### Subclass index

##### SEMICONDUCTOR DEVICES

Devices adapted for rectifying, amplifying, oscillating, or switching.....29/00

Devices sensitive to, or emitting, radiation.....31/00, 33/00

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##### OTHER SOLID STATE DEVICES

Thermoelectric or thermomagnetic devices.....35/00, 37/00

Superconductive or hyperconductive devices.....	39/00
Piezo-electric, electrostrictive or magnetostrictive elements in general.....	41/00
Galvano-magnetic devices.....	43/00
Devices without a potential-jump or a surface barrier; bulk negative resistance effect devices; devices not otherwise provided for.....	45/00, 47/00, 49/00
<b>ASSEMBLIES OF SEMICONDUCTOR OR OTHER SOLID STATE DEVICES</b>	
Assemblies of individual devices.....	25/00
Integrated circuits.....	27/00
DETAILS.....	23/00
MANUFACTURE.....	21/00

**21/00 Processes or apparatus specially adapted for the manufacture or treatment of semiconductor or solid state devices or of parts thereof [2, 2006.01]**

**Note(s)**

Group H01L 21/70 takes precedence over groups H01L 21/02-H01L 21/67.

- 21/02 • Manufacture or treatment of semiconductor devices or of parts thereof [2, 2006.01]
- 21/027 • • Making masks on semiconductor bodies for further photolithographic processing, not provided for in group H01L 21/18 or H01L 21/34 [5]
- 21/033 • • • comprising inorganic layers [5]
- 21/04 • • the devices having at least one potential-jump barrier or surface barrier, e.g. PN junction, depletion layer, carrier concentration layer [2]
- 21/06 • • • the devices having semiconductor bodies comprising selenium or tellurium in uncombined form other than as impurities in semiconductor bodies of other materials [2]
- 21/08 • • • • Preparation of the foundation plate [2]
- 21/10 • • • • Preliminary treatment of the selenium or tellurium, its application to the foundation plate, or the subsequent treatment of the combination [2]
- 21/103 • • • • • Conversion of the selenium or tellurium to the conductive state [2]
- 21/105 • • • • • Treatment of the surface of the selenium or tellurium layer after having been made conductive [2]
- 21/108 • • • • • Provision of discrete insulating layers, i.e. non-genetic barrier layers [2]
- 21/12 • • • • Application of an electrode to the exposed surface of the selenium or tellurium after the selenium or tellurium has been applied to the foundation plate [2]
- 21/14 • • • • Treatment of the complete device, e.g. by electroforming to form a barrier [2]
- 21/145 • • • • • Ageing [2]
- 21/16 • • • the devices having semiconductor bodies comprising cuprous oxide or cuprous iodide [2]
- 21/18 • • • the devices having semiconductor bodies comprising elements of group IV of the Periodic System or  $A_mB_n$  compounds with or without impurities, e.g. doping materials [2, 6, 7]

**Note(s)**

This group covers also processes and apparatus which, by using the appropriate technology, are clearly suitable for manufacture or treatment of devices whose bodies comprise elements of Group IV of the Periodic System or  $A_mB_n$  compounds, even if the material used is not explicitly specified.

- 21/20 • • • • Deposition of semiconductor materials on a substrate, e.g. epitaxial growth [2]
- 21/203 • • • • • using physical deposition, e.g. vacuum deposition, sputtering [2]
- 21/205 • • • • • using reduction or decomposition of a gaseous compound yielding a solid condensate, i.e. chemical deposition [2]
- 21/208 • • • • • using liquid deposition [2]
- 21/22 • • • • Diffusion of impurity materials, e.g. doping materials, electrode materials, into, or out of, a semiconductor body, or between semiconductor regions; Redistribution of impurity materials, e.g. without introduction or removal of further dopant [2]
- 21/223 • • • • • using diffusion into, or out of, a solid from or into a gaseous phase [2]
- 21/225 • • • • • using diffusion into, or out of, a solid from or into a solid phase, e.g. a doped oxide layer [2]
- 21/228 • • • • • using diffusion into, or out of, a solid from or into a liquid phase, e.g. alloy diffusion processes [2]
- 21/24 • • • • Alloying of impurity materials, e.g. doping materials, electrode materials, with a semiconductor body [2]
- 21/26 • • • • Bombardment with wave or particle radiation [2]
- 21/261 • • • • • to produce a nuclear reaction transmuting chemical elements [6]
- 21/263 • • • • • with high-energy radiation (H01L 21/261 takes precedence) [2, 6]
- 21/265 • • • • • producing ion implantation [2]
- 21/266 • • • • • • using masks [5]
- 21/268 • • • • • using electromagnetic radiation, e.g. laser radiation [2]
- 21/28 • • • • Manufacture of electrodes on semiconductor bodies using processes or apparatus not provided for in groups H01L 21/20-H01L 21/268 [2]
- 21/283 • • • • • Deposition of conductive or insulating materials for electrodes [2]
- 21/285 • • • • • from a gas or vapour, e.g. condensation [2]
- 21/288 • • • • • from a liquid, e.g. electrolytic deposition [2]
- 21/30 • • • • Treatment of semiconductor bodies using processes or apparatus not provided for in groups H01L 21/20-H01L 21/26 (manufacture of electrodes thereon H01L 21/28) [2]
- 21/301 • • • • • to subdivide a semiconductor body into separate parts, e.g. making partitions (cutting H01L 21/304) [6]

- 21/302 • • • • • to change the physical characteristics of their surfaces, or to change their shape, e.g. etching, polishing, cutting [2]
- 21/304 • • • • • • Mechanical treatment, e.g. grinding, polishing, cutting [2]
- 21/306 • • • • • • Chemical or electrical treatment, e.g. electrolytic etching (to form insulating layers H01L 21/31; after-treatment of insulating layers H01L 21/3105) [2]
- 21/3063 • • • • • • • Electrolytic etching [6]
- 21/3065 • • • • • • • Plasma etching; Reactive-ion etching [6]
- 21/308 • • • • • • • using masks (H01L 21/3063, H01L 21/3065, take precedence) [2, 6]
- 21/31 • • • • • • to form insulating layers thereon, e.g. for masking or by using photolithographic techniques (encapsulating layers H01L 21/56); After-treatment of these layers; Selection of materials for these layers [2, 5]
- 21/3105 • • • • • • • After-treatment [5]
- 21/311 • • • • • • • Etching the insulating layers [5]
- 21/3115 • • • • • • • Doping the insulating layers [5]
- 21/312 • • • • • • • Organic layers, e.g. photoresist (H01L 21/3105, H01L 21/32 take precedence) [2, 5]
- 21/314 • • • • • • • Inorganic layers (H01L 21/3105, H01L 21/32 take precedence) [2, 5]
- 21/316 • • • • • • • composed of oxides or glassy oxides or oxide-based glass [2]
- 21/318 • • • • • • • composed of nitrides [2]
- 21/32 • • • • • • • using masks [2, 5]
- 21/3205 • • • • • • • Deposition of non-insulating-, e.g. conductive- or resistive-, layers, on insulating layers; After-treatment of these layers (manufacture of electrodes H01L 21/28) [5]
- 21/321 • • • • • • • After-treatment [5]
- 21/3213 • • • • • • • Physical or chemical etching of the layers, e.g. to produce a patterned layer from a pre-deposited extensive layer [6]
- 21/3215 • • • • • • • • Doping the layers [5]
- 21/322 • • • • • • • to modify their internal properties, e.g. to produce internal imperfections [2]
- 21/324 • • • • • • • Thermal treatment for modifying the properties of semiconductor bodies, e.g. annealing, sintering (H01L 21/20-H01L 21/288, H01L 21/302-H01L 21/322 take precedence) [2]
- 21/326 • • • • • • • Application of electric currents or fields, e.g. for electroforming (H01L 21/20-H01L 21/288, H01L 21/302-H01L 21/324 take precedence) [2]
- 21/328 • • • • • • • Multistep processes for the manufacture of devices of the bipolar type, e.g. diodes, transistors, thyristors [5]
- 21/329 • • • • • • • the devices comprising one or two electrodes, e.g. diodes [5]
- 21/33 • • • • • • the devices comprising three or more electrodes [5]
- 21/331 • • • • • • • Transistors [5]
- 21/332 • • • • • • • Thyristors [5]
- 21/334 • • • • • • • Multistep processes for the manufacture of devices of the unipolar type [5]
- 21/335 • • • • • • • Field-effect transistors [5]
- 21/336 • • • • • • • with an insulated gate [5]
- 21/337 • • • • • • • with a PN junction gate [5]
- 21/338 • • • • • • • with a Schottky gate [5]
- 21/339 • • • • • • • Charge transfer devices [5, 6]
- 21/34 • • • • the devices having semiconductor bodies not provided for in groups H01L 21/06, H01L 21/16, and H01L 21/18 with or without impurities, e.g. doping materials [2]
- 21/36 • • • • • Deposition of semiconductor materials on a substrate, e.g. epitaxial growth [2]
- 21/363 • • • • • • using physical deposition, e.g. vacuum deposition, sputtering [2]
- 21/365 • • • • • • using reduction or decomposition of a gaseous compound yielding a solid condensate, i.e. chemical deposition [2]
- 21/368 • • • • • • using liquid deposition [2]
- 21/38 • • • • • Diffusion of impurity materials, e.g. doping materials, electrode materials, into, or out of, a semiconductor body, or between semiconductor regions [2]
- 21/383 • • • • • • using diffusion into, or out of, a solid from or into a gaseous phase [2]
- 21/385 • • • • • • using diffusion into, or out of, a solid from or into a solid phase, e.g. a doped oxide layer [2]
- 21/388 • • • • • • using diffusion into, or out of, a solid from or into a liquid phase, e.g. alloy diffusion processes [2]
- 21/40 • • • • • Alloying of impurity materials, e.g. doping materials, electrode materials, with a semiconductor body [2]
- 21/42 • • • • • Bombardment with radiation [2]
- 21/423 • • • • • • with high-energy radiation [2]
- 21/425 • • • • • • • producing ion implantation [2]
- 21/426 • • • • • • • • using masks [5]
- 21/428 • • • • • • • using electromagnetic radiation, e.g. laser radiation [2]
- 21/44 • • • • • Manufacture of electrodes on semiconductor bodies using processes or apparatus not provided for in groups H01L 21/36-H01L 21/428 [2]
- 21/441 • • • • • • Deposition of conductive or insulating materials for electrodes [2]
- 21/443 • • • • • • • from a gas or vapour, e.g. condensation [2]
- 21/445 • • • • • • • from a liquid, e.g. electrolytic deposition [2]
- 21/447 • • • • • • • involving the application of pressure, e.g. thermo-compression bonding (H01L 21/607 takes precedence) [2]
- 21/449 • • • • • • • involving the application of mechanical vibrations, e.g. ultrasonic vibrations [2]
- 21/46 • • • • • Treatment of semiconductor bodies using processes or apparatus not provided for in groups H01L 21/36-H01L 21/428 (manufacture of electrodes thereon H01L 21/44) [2]
- 21/461 • • • • • • to change their surface-physical characteristics or shape, e.g. etching, polishing, cutting [2]
- 21/463 • • • • • • Mechanical treatment, e.g. grinding, ultrasonic treatment [2]
- 21/465 • • • • • • Chemical or electrical treatment, e.g. electrolytic etching (to form insulating layers H01L 21/469) [2]
- 21/467 • • • • • • • using masks [2]

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- 21/469 • • • • • to form insulating layers thereon, e.g. for masking or by using photolithographic techniques (encapsulating layers H01L 21/56); After-treatment of these layers [2, 5]
- 21/47 • • • • • • Organic layers, e.g. photoresist (H01L 21/475, H01L 21/4757 take precedence) [2, 5]
- 21/471 • • • • • • Inorganic layers (H01L 21/475, H01L 21/4757 take precedence) [2, 5]
- 21/473 • • • • • • • composed of oxides or glassy oxides or oxide-based glass [2]
- 21/475 • • • • • • • using masks [2, 5]
- 21/4757 • • • • • • • After-treatment [5]
- 21/4763 • • • • • • Deposition of non-insulating-, e.g. conductive-, resistive-, layers on insulating layers; After-treatment of these layers (manufacture of electrodes H01L 21/28) [5]
- 21/477 • • • • • Thermal treatment for modifying the properties of semiconductor bodies, e.g. annealing, sintering (H01L 21/36-H01L 21/449, H01L 21/461-H01L 21/475 take precedence) [2]
- 21/479 • • • • • Application of electric currents or fields, e.g. for electroforming (H01L 21/36-H01L 21/449, H01L 21/461-H01L 21/477 take precedence) [2]
- 21/48 • • • Manufacture or treatment of parts, e.g. containers, prior to assembly of the devices, using processes not provided for in a single one of the groups H01L 21/06-H01L 21/326 [2]
- 21/50 • • • Assembly of semiconductor devices using processes or apparatus not provided for in a single one of the groups H01L 21/06-H01L 21/326 [2]
- 21/52 • • • • Mounting semiconductor bodies in containers [2]
- 21/54 • • • • Providing fillings in containers, e.g. gas fillings [2]
- 21/56 • • • • Encapsulations, e.g. encapsulating layers, coatings [2]
- 21/58 • • • • Mounting semiconductor devices on supports [2]
- 21/60 • • • • Attaching leads or other conductive members, to be used for carrying current to or from the device in operation [2]
- 21/603 • • • • • involving the application of pressure, e.g. thermo-compression bonding (H01L 21/607 takes precedence) [2]
- 21/607 • • • • • involving the application of mechanical vibrations, e.g. ultrasonic vibrations [2]
- 21/62 • • the devices having no potential-jump barriers or surface barriers [2]
- 21/64 • Manufacture or treatment of solid state devices other than semiconductor devices, or of parts thereof, not specially adapted for a single type of device provided for in groups H01L 31/00-H01L 51/00 [2, 2006.01]
- 21/66 • Testing or measuring during manufacture or treatment [2]
- 21/67 • Apparatus specially adapted for handling semiconductor or electric solid state devices during manufacture or treatment thereof; Apparatus specially adapted for handling wafers during manufacture or treatment of semiconductor or electric solid state devices or components [2006.01]
- 21/673 • • using specially adapted carriers [2006.01]
- 21/677 • • for conveying, e.g. between different work stations [2006.01]
- 21/68 • • for positioning, orientation or alignment [2, 2006.01]
- 21/683 • • for supporting or gripping (for positioning, orientation or alignment H01L 21/68) [2006.01]
- 21/687 • • • using mechanical means, e.g. chucks, clamps or pinches [2006.01]
- 21/70 • Manufacture or treatment of devices consisting of a plurality of solid state components or integrated circuits formed in or on a common substrate or of specific parts thereof; Manufacture of integrated circuit devices or of specific parts thereof (manufacture of assemblies consisting of preformed electrical components H05K 3/00, H05K 13/00) [2]
- 21/71 • • Manufacture of specific parts of devices defined in group H01L 21/70 (H01L 21/28, H01L 21/44, H01L 21/48 take precedence) [6]
- 21/74 • • • Making of buried regions of high impurity concentration, e.g. buried collector layers, internal connections [2]
- 21/76 • • • Making of isolation regions between components [2]
- 21/761 • • • • PN junctions [6]
- 21/762 • • • • Dielectric regions [6]
- 21/763 • • • • Polycrystalline semiconductor regions [6]
- 21/764 • • • • Air gaps [6]
- 21/765 • • • • by field-effect [6]
- 21/768 • • • Applying interconnections to be used for carrying current between separate components within a device [6]
- 21/77 • • Manufacture or treatment of devices consisting of a plurality of solid state components or integrated circuits formed in, or on, a common substrate [6]
- 21/78 • • • with subsequent division of the substrate into plural individual devices (cutting to change the surface-physical characteristics or shape of semiconductor bodies H01L 21/304) [2, 6]
- 21/782 • • • • to produce devices, each consisting of a single circuit element (H01L 21/82 takes precedence) [6]
- 21/784 • • • • • the substrate being a semiconductor body [6]
- 21/786 • • • • • the substrate being other than a semiconductor body, e.g. insulating body [6]
- 21/82 • • • • to produce devices, e.g. integrated circuits, each consisting of a plurality of components [2]
- 21/822 • • • • • the substrate being a semiconductor, using silicon technology (H01L 21/8258 takes precedence) [6]
- 21/8222 • • • • • • Bipolar technology [6]
- 21/8224 • • • • • • comprising a combination of vertical and lateral transistors [6]
- 21/8226 • • • • • • comprising merged transistor logic or integrated injection logic [6]
- 21/8228 • • • • • • Complementary devices, e.g. complementary transistors [6]
- 21/8229 • • • • • • Memory structures [6]
- 21/8232 • • • • • • Field-effect technology [6]
- 21/8234 • • • • • • MIS technology [6]
- 21/8236 • • • • • • • Combination of enhancement and depletion transistors [6]
- 21/8238 • • • • • • • Complementary field-effect transistors, e.g. CMOS [6]
- 21/8239 • • • • • • • Memory structures [6]

- 21/8242 • • • • • Dynamic random access memory structures (DRAM) [6]
- 21/8244 • • • • • Static random access memory structures (SRAM) [6]
- 21/8246 • • • • • Read-only memory structures (ROM) [6]
- 21/8247 • • • • • electrically-programmable (EPROM) [6]
- 21/8248 • • • • • Combination of bipolar and field-effect technology [6]
- 21/8249 • • • • • Bipolar and MOS technology [6]
- 21/8252 • • • • • the substrate being a semiconductor, using III-V technology (H01L 21/8258 takes precedence) [6]
- 21/8254 • • • • • the substrate being a semiconductor, using II-VI technology (H01L 21/8258 takes precedence) [6]
- 21/8256 • • • • • the substrate being a semiconductor, using technologies not covered by one of groups H01L 21/822, H01L 21/8252 or H01L 21/8254 (H01L 21/8258 takes precedence) [6]
- 21/8258 • • • • • the substrate being a semiconductor, using a combination of technologies covered by H01L 21/822, H01L 21/8252, H01L 21/8254 or H01L 21/8256 [6]
- 21/84 • • • • • the substrate being other than a semiconductor body, e.g. being an insulating body [2, 6]
- 21/86 • • • • • the insulating body being sapphire, e.g. silicon on sapphire structure, i.e. SOS [2, 6]
- 21/98 • • Assembly of devices consisting of solid state components formed in or on a common substrate; Assembly of integrated circuit devices (H01L 21/50 takes precedence) [2, 5]
- 23/00 Details of semiconductor or other solid state devices**  
(H01L 25/00 takes precedence) [2, 5]
- Note(s)**
- This group **does not cover**:
- details of semiconductor bodies or of electrodes of devices provided for in group H01L 29/00, which details are covered by that group;
  - details peculiar to devices provided for in a single main group of groups H01L 31/00-H01L 51/00, which details are covered by those groups.
- 23/02 • Containers; Seals (H01L 23/12, H01L 23/34, H01L 23/48, H01L 23/552 take precedence) [2, 5]
- 23/04 • • characterised by the shape [2]
- 23/043 • • • the container being a hollow construction and having a conductive base as a mounting as well as a lead for the semiconductor body [5]
- 23/045 • • • the other leads having an insulating passage through the base [5]
- 23/047 • • • the other leads being parallel to the base [5]
- 23/049 • • • the other leads being perpendicular to the base [5]
- 23/051 • • • another lead being formed by a cover plate parallel to the base plate, e.g. sandwich type [5]
- 23/053 • • • the container being a hollow construction and having an insulating base as a mounting for the semiconductor body [5]
- 23/055 • • • the leads having a passage through the base [5]
- 23/057 • • • the leads being parallel to the base [5]
- 23/06 • • characterised by the material of the container or its electrical properties [2]
- 23/08 • • • the material being an electrical insulator, e.g. glass [2]
- 23/10 • • characterised by the material or arrangement of seals between parts, e.g. between cap and base of the container or between leads and walls of the container [2]
- 23/12 • Mountings, e.g. non-detachable insulating substrates [2]
- 23/13 • • characterised by the shape [5]
- 23/14 • • characterised by the material or its electrical properties [2]
- 23/15 • • • Ceramic or glass substrates [5]
- 23/16 • Fillings or auxiliary members in containers, e.g. centering rings (H01L 23/42, H01L 23/552 take precedence) [2, 5]
- 23/18 • • Fillings characterised by the material, its physical or chemical properties, or its arrangement within the complete device [2]
- Note(s)**
- Group H01L 23/26 takes precedence over groups H01L 23/20-H01L 23/24.
- 23/20 • • • gaseous at the normal operating temperature of the device [2]
- 23/22 • • • liquid at the normal operating temperature of the device [2]
- 23/24 • • • solid or gel, at the normal operating temperature of the device [2]
- 23/26 • • • including materials for absorbing or reacting with moisture or other undesired substances [2]
- 23/28 • Encapsulation, e.g. encapsulating layers, coatings (H01L 23/552 takes precedence) [2, 5]
- 23/29 • • characterised by the material [5]
- 23/31 • • characterised by the arrangement [5]
- 23/32 • Holders for supporting the complete device in operation, i.e. detachable fixtures (H01L 23/40 takes precedence) [2, 5]
- 23/34 • Arrangements for cooling, heating, ventilating or temperature compensation [2, 5]
- 23/36 • • Selection of materials, or shaping, to facilitate cooling or heating, e.g. heat sinks [2]
- 23/367 • • • Cooling facilitated by shape of device [5]
- 23/373 • • • Cooling facilitated by selection of materials for the device [5]
- 23/38 • • Cooling arrangements using the Peltier effect [2]
- 23/40 • • Mountings or securing means for detachable cooling or heating arrangements [2]
- 23/42 • • Fillings or auxiliary members in containers selected or arranged to facilitate heating or cooling [2, 5]
- 23/427 • • • Cooling by change of state, e.g. use of heat pipes [5]
- 23/433 • • • Auxiliary members characterised by their shape, e.g. pistons [5]
- 23/44 • • the complete device being wholly immersed in a fluid other than air (H01L 23/427 takes precedence) [2, 5]
- 23/46 • • involving the transfer of heat by flowing fluids (H01L 23/42, H01L 23/44 take precedence) [2]
- 23/467 • • • by flowing gases, e.g. air [5]
- 23/473 • • • by flowing liquids [5]

## H01L

- 23/48 • Arrangements for conducting electric current to or from the solid state body in operation, e.g. leads or terminal arrangements [2]
- 23/482 • • consisting of lead-in layers inseparably applied to the semiconductor body [5]
- 23/485 • • • consisting of layered constructions comprising conductive layers and insulating layers, e.g. planar contacts [5]
- 23/488 • • consisting of soldered or bonded constructions [5, 2006.01]
- 23/49 • • • wire-like [5]
- 23/492 • • • Bases or plates [5]
- 23/495 • • • Lead-frames [5]
- 23/498 • • • Leads on insulating substrates [5]
- 23/50 • • for integrated circuit devices (H01L 23/482-H01L 23/498 take precedence) [2, 5]
- 23/52 • Arrangements for conducting electric current within the device in operation from one component to another [2]
- 23/522 • • including external interconnections consisting of a multilayer structure of conductive and insulating layers inseparably formed on the semiconductor body [5]
- 23/525 • • • with adaptable interconnections [5]
- 23/528 • • • Layout of the interconnection structure [5]
- 23/532 • • • characterised by the materials [5]
- 23/535 • • including internal interconnections, e.g. cross-under constructions [5]
- 23/538 • • the interconnection structure between a plurality of semiconductor chips being formed on, or in, insulating substrates [5]
- 23/544 • Marks applied to semiconductor devices, e.g. registration marks, test patterns [5]
- 23/552 • Protection against radiation, e.g. light [5]
- 23/556 • • against alpha rays [5]
- 23/58 • Structural electrical arrangements for semiconductor devices not otherwise provided for [5]
- 23/60 • • Protection against electrostatic charges or discharges, e.g. Faraday shields [5]
- 23/62 • • Protection against overcurrent or overload, e.g. fuses, shunts [5]
- 23/64 • • Impedance arrangements [5]
- 23/66 • • • High-frequency adaptations [5]
- 25/00 **Assemblies consisting of a plurality of individual semiconductor or other solid state devices** (devices consisting of a plurality of solid state components formed in or on a common substrate H01L 27/00; photovoltaic modules or arrays of photovoltaic cells H01L 31/042) [2, 5]
- 25/03 • all the devices being of a type provided for in the same subgroup of groups H01L 27/00-H01L 51/00, e.g. assemblies of rectifier diodes [5, 2006.01]
- 25/04 • • *the devices not having separate containers* [2, 2014.01]
- 25/065 • • • the devices being of a type provided for in group H01L 27/00 [5]
- 25/07 • • • the devices being of a type provided for in group H01L 29/00 [5]
- 25/075 • • • the devices being of a type provided for in group H01L 33/00 [5]
- 25/10 • • the devices having separate containers [2]
- 25/11 • • • the devices being of a type provided for in group H01L 29/00 [5]
- 25/13 • • • the devices being of a type provided for in group H01L 33/00 [5]
- 25/16 • the devices being of types provided for in two or more different main groups of groups H01L 27/00-H01L 51/00, e.g. forming hybrid circuits [2, 2006.01]
- 25/18 • the devices being of types provided for in two or more different subgroups of the same main group of groups H01L 27/00-H01L 51/00 [5, 2006.01]
- 27/00 **Devices consisting of a plurality of semiconductor or other solid-state components formed in or on a common substrate** (details thereof H01L 23/00, H01L 29/00-H01L 51/00; assemblies consisting of a plurality of individual solid state devices H01L 25/00) [2, 2006.01]
- Note(s)**  
In groups H01L 27/01-H01L 27/28, in the absence of an indication to the contrary, classification is made in the last appropriate place.
- 27/01 • comprising only passive thin-film or thick-film elements formed on a common insulating substrate [3]
- 27/02 • including semiconductor components specially adapted for rectifying, oscillating, amplifying or switching and having at least one potential-jump barrier or surface barrier; including integrated passive circuit elements with at least one potential-jump barrier or surface barrier [2]
- 27/04 • • the substrate being a semiconductor body [2]
- 27/06 • • • including a plurality of individual components in a non-repetitive configuration [2]
- 27/07 • • • • the components having an active region in common [5]
- 27/08 • • • including only semiconductor components of a single kind [2]
- 27/082 • • • • including bipolar components only [5]
- 27/085 • • • • including field-effect components only [5]
- 27/088 • • • • the components being field-effect transistors with insulated gate [5]
- 27/092 • • • • • complementary MIS field-effect transistors [5]
- 27/095 • • • • • the components being Schottky barrier gate field-effect transistors [5]
- 27/098 • • • • • the components being PN junction gate field-effect transistors [5]
- 27/10 • • • including a plurality of individual components in a repetitive configuration [2]
- 27/102 • • • • including bipolar components [5]
- 27/105 • • • • including field-effect components [5]
- 27/108 • • • • • Dynamic random access memory structures [5]
- 27/11 • • • • • Static random access memory structures [5]
- 27/112 • • • • • Read-only memory structures [5]
- 27/115 • • • • • Electrically programmable read-only memories [5]
- 27/118 • • • • Masterslice integrated circuits [5]
- 27/12 • • the substrate being other than a semiconductor body, e.g. an insulating body [2]
- 27/13 • • • combined with thin-film or thick-film passive components [3]

27/14	<ul style="list-style-type: none"> <li>including semiconductor components sensitive to infra-red radiation, light, electromagnetic radiation of shorter wavelength or corpuscular radiation and specially adapted either for the conversion of the energy of such radiation into electrical energy or for the control of electrical energy by such radiation (radiation-sensitive components structurally associated with one or more electric light sources only H01L 31/14; couplings of light guides with optoelectronic elements G02B 6/42) [2]</li> </ul>		
27/142	<ul style="list-style-type: none"> <li>• <i>Energy conversion devices (photovoltaic modules or arrays of single photovoltaic cells comprising bypass diodes integrated or directly associated with the devices H01L 31/0443; photovoltaic modules composed of a plurality of thin film solar cells deposited on the same substrate H01L 31/046) [5, 2014.01]</i></li> </ul>	29/06	<ul style="list-style-type: none"> <li>• characterised by their shape; characterised by the shapes, relative sizes, or dispositions of the semiconductor regions [2]</li> </ul>
27/144	<ul style="list-style-type: none"> <li>• • Devices controlled by radiation [5]</li> </ul>	29/08	<ul style="list-style-type: none"> <li>• • • with semiconductor regions connected to an electrode carrying current to be rectified, amplified, or switched and such electrode being part of a semiconductor device which comprises three or more electrodes [2]</li> </ul>
27/146	<ul style="list-style-type: none"> <li>• • • Imager structures [5]</li> </ul>	29/10	<ul style="list-style-type: none"> <li>• • • with semiconductor regions connected to an electrode not carrying current to be rectified, amplified, or switched and such electrode being part of a semiconductor device which comprises three or more electrodes [2]</li> </ul>
27/148	<ul style="list-style-type: none"> <li>• • • • Charge coupled imagers [5]</li> </ul>	29/12	<ul style="list-style-type: none"> <li>• • characterised by the materials of which they are formed [2]</li> </ul>
27/15	<ul style="list-style-type: none"> <li>including semiconductor components with at least one potential-jump barrier or surface barrier, specially adapted for light emission [2]</li> </ul>	29/15	<ul style="list-style-type: none"> <li>• • • Structures with periodic or quasi periodic potential variation, e.g. multiple quantum wells, superlattices (such structures applied for the control of light G02F 1/017, applied in semiconductor lasers H01S 5/34) [6]</li> </ul>
27/16	<ul style="list-style-type: none"> <li>including thermoelectric components with or without a junction of dissimilar materials; including thermomagnetic components (using the Peltier effect only for cooling of semiconductor or other solid state devices H01L 23/38) [2]</li> </ul>		
27/18	<ul style="list-style-type: none"> <li>including components exhibiting superconductivity [2]</li> </ul>		
27/20	<ul style="list-style-type: none"> <li>including piezo-electric components; including electrostrictive components; including magnetostrictive components [2, 7]</li> </ul>		
27/22	<ul style="list-style-type: none"> <li>including components using galvano-magnetic effects, e.g. Hall effect; using similar magnetic field effects [2]</li> </ul>	29/16	<ul style="list-style-type: none"> <li>• • • including, apart from doping materials or other impurities, only elements of Group IV of the Periodic System in uncombined form [2]</li> </ul>
27/24	<ul style="list-style-type: none"> <li>including solid state components for rectifying, amplifying, or switching without a potential-jump barrier or surface barrier [2]</li> </ul>	29/161	<ul style="list-style-type: none"> <li>• • • • including two or more of the elements provided for in group H01L 29/16 [2]</li> </ul>
27/26	<ul style="list-style-type: none"> <li>including bulk negative resistance effect components [2]</li> </ul>	29/165	<ul style="list-style-type: none"> <li>• • • • • in different semiconductor regions [2]</li> </ul>
27/28	<ul style="list-style-type: none"> <li>including components using organic materials as the active part, or using a combination of organic materials with other materials as the active part [2006.01]</li> </ul>	29/167	<ul style="list-style-type: none"> <li>• • • • further characterised by the doping material [2]</li> </ul>
27/30	<ul style="list-style-type: none"> <li>• with components specially adapted for sensing infra-red radiation, light, electromagnetic radiation of shorter wavelength, or corpuscular radiation; with components specially adapted for either the conversion of the energy of such radiation into electrical energy or for the control of electrical energy by such radiation [2006.01]</li> </ul>	29/18	<ul style="list-style-type: none"> <li>• • • Selenium or tellurium only, apart from doping materials or other impurities [2]</li> </ul>
27/32	<ul style="list-style-type: none"> <li>• with components specially adapted for light emission, e.g. flat-panel displays using organic light-emitting diodes [2006.01]</li> </ul>	29/20	<ul style="list-style-type: none"> <li>• • • including, apart from doping materials or other impurities, only A<sub>III</sub>B<sub>V</sub> compounds [2, 6]</li> </ul>
29/00	<b>Semiconductor devices specially adapted for rectifying, amplifying, oscillating or switching and having at least one potential-jump barrier or surface barrier; Capacitors or resistors with at least one potential-jump barrier or surface barrier, e.g. PN-junction depletion layer or carrier concentration layer; Details of semiconductor bodies or of electrodes thereof (H01L 31/00-H01L 47/00, H01L 51/05 take precedence; details other than of semiconductor bodies or of electrodes thereof H01L 23/00; devices consisting of a plurality of solid state components formed in or on a common substrate H01L 27/00) [2, 6]</b>	29/201	<ul style="list-style-type: none"> <li>• • • • including two or more compounds [2]</li> </ul>
		29/205	<ul style="list-style-type: none"> <li>• • • • • in different semiconductor regions [2]</li> </ul>
		29/207	<ul style="list-style-type: none"> <li>• • • • further characterised by the doping material [2]</li> </ul>
		29/22	<ul style="list-style-type: none"> <li>• • • including, apart from doping materials or other impurities, only A<sub>II</sub>B<sub>VI</sub> compounds [2]</li> </ul>
		29/221	<ul style="list-style-type: none"> <li>• • • • including two or more compounds [2]</li> </ul>
		29/225	<ul style="list-style-type: none"> <li>• • • • • in different semiconductor regions [2]</li> </ul>
		29/227	<ul style="list-style-type: none"> <li>• • • • further characterised by the doping material [2]</li> </ul>
		29/24	<ul style="list-style-type: none"> <li>• • • including, apart from doping materials or other impurities, only inorganic semiconductor materials not provided for in groups H01L 29/16, H01L 29/18, H01L 29/20 or H01L 29/22 [2]</li> </ul>
		29/26	<ul style="list-style-type: none"> <li>• • • including, apart from doping materials or other impurities, elements provided for in two or more of the groups H01L 29/16, H01L 29/18, H01L 29/20, H01L 29/22, H01L 29/24 [2]</li> </ul>
		29/267	<ul style="list-style-type: none"> <li>• • • • in different semiconductor regions [2]</li> </ul>
		29/30	<ul style="list-style-type: none"> <li>• characterised by physical imperfections; having polished or roughened surface [2]</li> </ul>

**Note(s)**

In this main group, classification is made in all of groups H01L 29/02, H01L 29/40 and H01L 29/66 if all of these groups are relevant.

29/02 • Semiconductor bodies [2]

29/04 • • characterised by their crystalline structure, e.g. polycrystalline, cubic or particular orientation of crystalline planes (characterised by physical imperfections H01L 29/30) [2]

29/06 • • characterised by their shape; characterised by the shapes, relative sizes, or dispositions of the semiconductor regions [2]

29/08 • • • with semiconductor regions connected to an electrode carrying current to be rectified, amplified, or switched and such electrode being part of a semiconductor device which comprises three or more electrodes [2]

29/10 • • • with semiconductor regions connected to an electrode not carrying current to be rectified, amplified, or switched and such electrode being part of a semiconductor device which comprises three or more electrodes [2]

29/12 • • characterised by the materials of which they are formed [2]

29/15 • • • Structures with periodic or quasi periodic potential variation, e.g. multiple quantum wells, superlattices (such structures applied for the control of light G02F 1/017, applied in semiconductor lasers H01S 5/34) [6]

**Note(s)**

Group H01L 29/15 takes precedence over groups H01L 29/16-H01L 29/26.

29/16 • • • including, apart from doping materials or other impurities, only elements of Group IV of the Periodic System in uncombined form [2]

29/161 • • • • including two or more of the elements provided for in group H01L 29/16 [2]

29/165 • • • • • in different semiconductor regions [2]

29/167 • • • • further characterised by the doping material [2]

29/18 • • • Selenium or tellurium only, apart from doping materials or other impurities [2]

29/20 • • • including, apart from doping materials or other impurities, only A<sub>III</sub>B<sub>V</sub> compounds [2, 6]

29/201 • • • • including two or more compounds [2]

29/205 • • • • • in different semiconductor regions [2]

29/207 • • • • further characterised by the doping material [2]

29/22 • • • including, apart from doping materials or other impurities, only A<sub>II</sub>B<sub>VI</sub> compounds [2]

29/221 • • • • including two or more compounds [2]

29/225 • • • • • in different semiconductor regions [2]

29/227 • • • • further characterised by the doping material [2]

29/24 • • • including, apart from doping materials or other impurities, only inorganic semiconductor materials not provided for in groups H01L 29/16, H01L 29/18, H01L 29/20 or H01L 29/22 [2]

29/26 • • • including, apart from doping materials or other impurities, elements provided for in two or more of the groups H01L 29/16, H01L 29/18, H01L 29/20, H01L 29/22, H01L 29/24 [2]

29/267 • • • • in different semiconductor regions [2]

29/30 • characterised by physical imperfections; having polished or roughened surface [2]

## H01L

- 29/32 • • • the imperfections being within the semiconductor body [2]
- 29/34 • • • the imperfections being on the surface [2]
- 29/36 • • characterised by the concentration or distribution of impurities [2]
- 29/38 • • characterised by combination of features provided for in two or more of the groups H01L 29/04, H01L 29/06, H01L 29/12, H01L 29/30, H01L 29/36 [2]
- 29/40 • Electrodes [2]
- 29/41 • • characterised by their shape, relative sizes or dispositions [6]
- 29/417 • • • carrying the current to be rectified, amplified or switched [6]
- 29/423 • • • not carrying the current to be rectified, amplified or switched [6]
- 29/43 • • characterised by the materials of which they are formed [6]
- 29/45 • • • Ohmic electrodes [6]
- 29/47 • • • Schottky barrier electrodes [6]
- 29/49 • • • Metal-insulator semiconductor electrodes [6]
- 29/51 • • • • Insulating materials associated therewith [6]
- 29/66 • Types of semiconductor device [2]
- 29/68 • • controllable by only the electric current supplied, or only the electric potential applied, to an electrode which does not carry the current to be rectified, amplified, or switched (H01L 29/96 takes precedence) [2]
- 29/70 • • • Bipolar devices [2]
- 29/72 • • • • Transistor-type devices, i.e. able to continuously respond to applied control signals [2]
- 29/73 • • • • • Bipolar junction transistors [5]
- 29/732 • • • • • • Vertical transistors [6]
- 29/735 • • • • • • Lateral transistors [6]
- 29/737 • • • • • • Hetero-junction transistors [6]
- 29/739 • • • • • • controlled by field effect [6]
- 29/74 • • • • • Thyristor-type devices, e.g. having four-zone regenerative action [2]
- 29/744 • • • • • Gate-turn-off devices [6]
- 29/745 • • • • • • with turn-off by field effect [6]
- 29/747 • • • • • • Bidirectional devices, e.g. triacs [2]
- 29/749 • • • • • • with turn-on by field effect [6]
- 29/76 • • • Unipolar devices [2]
- 29/762 • • • • Charge transfer devices [6]
- 29/765 • • • • • Charge-coupled devices [6]
- 29/768 • • • • • • with field effect produced by an insulated gate [6]
- 29/772 • • • • • Field-effect transistors [6]
- 29/775 • • • • • • with one-dimensional charge carrier gas channel, e.g. quantum wire FET [6]
- 29/778 • • • • • • with two-dimensional charge carrier gas channel, e.g. HEMT [6]
- 29/78 • • • • • • with field effect produced by an insulated gate [2]
- 29/786 • • • • • • Thin-film transistors [6]
- 29/788 • • • • • • with floating gate [5]
- 29/792 • • • • • • with charge trapping gate insulator, e.g. MNOS-memory transistor [5]
- 29/80 • • • • • • with field effect produced by a PN or other rectifying junction gate [2]
- 29/808 • • • • • • with a PN junction gate [5]
- 29/812 • • • • • • with a Schottky gate [5]
- 29/82 • • • controllable by variation of the magnetic field applied to the device (H01L 29/96 takes precedence) [2, 6]
- 29/84 • • • controllable by variation of applied mechanical force, e.g. of pressure (H01L 29/96 takes precedence) [2, 6]
- 29/86 • • • controllable only by variation of the electric current supplied, or only the electric potential applied, to one or more of the electrodes carrying the current to be rectified, amplified, oscillated, or switched (H01L 29/96 takes precedence) [2]
- 29/8605 • • • Resistors with PN junction [6]
- 29/861 • • • Diodes [6]
- 29/862 • • • • Point contact diodes [6]
- 29/864 • • • • Transit-time diodes, e.g. IMPATT, TRAPATT diodes [6]
- 29/866 • • • • Zener diodes [6]
- 29/868 • • • • PIN diodes [6]
- 29/87 • • • • Thyristor diodes, e.g. Shockley diodes, break-over diodes [6]
- 29/872 • • • • Schottky diodes [6]
- 29/88 • • • • Tunnel-effect diodes [2]
- 29/885 • • • • • Esaki diodes [6]
- 29/92 • • • Capacitors with potential-jump barrier or surface barrier [2]
- 29/93 • • • • Variable-capacitance diodes, e.g. varactors [2]
- 29/94 • • • • Metal-insulator-semiconductors, e.g. MOS [2]
- 29/96 • • of a type covered by more than one of groups H01L 29/68, H01L 29/82, H01L 29/84 or H01L 29/86 [2]
- 31/00 **Semiconductor devices sensitive to infra-red radiation, light, electromagnetic radiation of shorter wavelength, or corpuscular radiation and specially adapted either for the conversion of the energy of such radiation into electrical energy or for the control of electrical energy by such radiation; Processes or apparatus specially adapted for the manufacture or treatment thereof or of parts thereof; Details thereof** (H01L 51/42 takes precedence; devices consisting of a plurality of solid state components formed in, or on, a common substrate, other than combinations of radiation-sensitive components with one or more electric light sources, H01L 27/00) [2, 6, 2006.01]
- 31/02 • Details [2]
- 31/0203 • • Containers; Encapsulations (for photovoltaic devices H01L 31/048; for organic photosensitive devices H01L 51/44) [5, 2014.01]
- 31/0216 • • Coatings (H01L 31/041 takes precedence) [5, 2014.01]
- 31/0224 • • Electrodes [5]
- 31/0232 • • Optical elements or arrangements associated with the device (H01L 31/0236 takes precedence; for photovoltaic cells H01L 31/054; for photovoltaic modules H02S 40/20) [5, 2014.01]
- 31/0236 • • Special surface textures [5]
- 31/024 • • Arrangements for cooling, heating, ventilating or temperature compensation (for photovoltaic devices H01L 31/052) [5, 2014.01]
- 31/0248 • characterised by their semiconductor bodies [5]
- 31/0256 • • characterised by the material [5]
- 31/0264 • • • Inorganic materials [5]
- 31/0272 • • • • Selenium or tellurium [5]



- 31/028 • • • • including, apart from doping material or other impurities, only elements of Group IV of the Periodic System [5]
- 31/0288 • • • • • characterised by the doping material [5]
- 31/0296 • • • • • including, apart from doping material or other impurities, only  $A_{II}B_{VI}$  compounds, e.g. CdS, ZnS, HgCdTe [5]
- 31/0304 • • • • • including, apart from doping materials or other impurities, only  $A_{III}B_V$  compounds [5]
- 31/0312 • • • • • including, apart from doping materials or other impurities, only  $A_{IV}B_{IV}$  compounds, e.g. SiC [5]
- 31/032 • • • • • including, apart from doping materials or other impurities, only compounds not provided for in groups H01L 31/0272-H01L 31/0312 [5]
- 31/0328 • • • • • including, apart from doping materials or other impurities, semiconductor materials provided for in two or more of groups H01L 31/0272-H01L 31/032 [5]
- 31/0336 • • • • • in different semiconductor regions, e.g.  $Cu_2X/CdX$  hetero-junctions, X being an element of Group VI of the Periodic System [5]
- 31/0352 • • • characterised by their shape or by the shapes, relative sizes or disposition of the semiconductor regions [5]
- 31/036 • • • characterised by their crystalline structure or particular orientation of the crystalline planes [5]
- 31/0368 • • • • including polycrystalline semiconductors (H01L 31/0392 takes precedence) [5]
- 31/0376 • • • • including amorphous semiconductors (H01L 31/0392 takes precedence) [5]
- 31/0384 • • • • including other non-monocrystalline materials, e.g. semiconductor particles embedded in an insulating material (H01L 31/0392 takes precedence) [5]
- 31/0392 • • • • including thin films deposited on metallic or insulating substrates [5]
- 31/04 • • adapted as photovoltaic [PV] conversion devices (testing thereof during manufacture H01L 21/66; testing thereof after manufacture H02S 50/10) [2, 2014.01]
- 31/041 • • • Provisions for preventing damage caused by corpuscular radiation, e.g. for space applications [2014.01]
- 31/042 • • • PV modules or arrays of single PV cells (supporting structures for PV modules H02S 20/00) [5, 2014.01]
- 31/043 • • • • Mechanically stacked PV cells [2014.01]
- 31/044 • • • • including bypass diodes (bypass diodes in the junction box H02S 40/34) [2014.01]
- 31/0443 • • • • • comprising bypass diodes integrated or directly associated with the devices, e.g. bypass diodes integrated or formed in or on the same substrate as the photovoltaic cells [2014.01]
- 31/0445 • • • • including thin film solar cells, e.g. single thin film a-Si, CIS or CdTe solar cells [2014.01]
- 31/046 • • • • • PV modules composed of a plurality of thin film solar cells deposited on the same substrate [2014.01]
- 31/0463 • • • • • characterised by special patterning methods to connect the PV cells in a module, e.g. laser cutting of the conductive or active layers [2014.01]
- 31/0465 • • • • • comprising particular structures for the electrical interconnection of adjacent PV cells in the module (H01L 31/0463 takes precedence) [2014.01]
- 31/0468 • • • • • comprising specific means for obtaining partial light transmission through the module, e.g. partially transparent thin film solar modules for windows [2014.01]
- 31/047 • • • • PV cell arrays including PV cells having multiple vertical junctions or multiple V-groove junctions formed in a semiconductor substrate [2014.01]
- 31/0475 • • • • PV cell arrays made by cells in a planar, e.g. repetitive, configuration on a single semiconductor substrate; PV cell microarrays (PV modules composed of a plurality of thin film solar cells deposited on the same substrate H01L 31/046) [2014.01]
- 31/048 • • • • Encapsulation of modules [5, 2014.01]
- 31/049 • • • • • Protective back sheets [2014.01]
- 31/05 • • • • Electrical interconnection means between PV cells inside the PV module, e.g. series connection of PV cells (electrodes H01L 31/0224; electrical interconnection of thin film solar cells formed on a common substrate H01L 31/046; particular structures for electrical interconnecting of adjacent thin film solar cells in the module H01L 31/0465; electrical interconnection means specially adapted for electrically connecting two or more PV modules H02S 40/36) [5, 2014.01]
- 31/052 • • • • Cooling means directly associated or integrated with the PV cell, e.g. integrated Peltier elements for active cooling or heat sinks directly associated with the PV cells (cooling means in combination with the PV module H02S 40/42) [5, 2014.01]
- 31/0525 • • • • including means to utilise heat energy directly associated with the PV cell, e.g. integrated Seebeck elements [2014.01]
- 31/053 • • • • Energy storage means directly associated or integrated with the PV cell, e.g. a capacitor integrated with a PV cell (energy storage means associated with the PV module H02S 40/38) [2014.01]
- 31/054 • • • • Optical elements directly associated or integrated with the PV cell, e.g. light-reflecting means or light-concentrating means [2014.01]
- 31/055 • • • • • where light is absorbed and re-emitted at a different wavelength by the optical element directly associated or integrated with the PV cell, e.g. by using luminescent material, fluorescent concentrators or up-conversion arrangements [5, 2014.01]
- 31/056 • • • • • the light-reflecting means being of the back surface reflector [BSR] type [2014.01]
- 31/06 • • • characterised by at least one potential-jump barrier or surface barrier [2, 2012.01]
- 31/061 • • • • the potential barriers being of the point-contact type (H01L 31/07 takes precedence) [2012.01]
- 31/062 • • • • the potential barriers being only of the metal-insulator-semiconductor type [5, 2012.01]
- 31/065 • • • • the potential barriers being only of the graded gap type [5, 2012.01]
- 31/068 • • • • the potential barriers being only of the PN homojunction type, e.g. bulk silicon PN homojunction solar cells or thin film polycrystalline silicon PN homojunction solar cells [5, 2012.01]

- 31/0687 • • • • Multiple junction or tandem solar cells [2012.01]
- 31/0693 • • • • the devices including, apart from doping material or other impurities, only  $A_{III}B_V$  compounds, e.g. GaAs or InP solar cells [2012.01]
- 31/07 • • • • the potential barriers being only of the Schottky type [5, 2012.01]
- 31/072 • • • • the potential barriers being only of the PN heterojunction type [5, 2012.01]
- 31/0725 • • • • Multiple junction or tandem solar cells [2012.01]
- 31/073 • • • • comprising only  $A_{II}B_{VI}$  compound semiconductors, e.g. CdS/CdTe solar cells [2012.01]
- 31/0735 • • • • comprising only  $A_{III}B_V$  compound semiconductors, e.g. GaAs/AlGaAs or InP/GaInAs solar cells [2012.01]
- 31/074 • • • • comprising a heterojunction with an element of Group IV of the Periodic System, e.g. ITO/Si, GaAs/Si or CdTe/Si solar cells [2012.01]
- 31/0745 • • • • comprising a  $A_{IV}B_{IV}$  heterojunction, e.g. Si/Ge, SiGe/Si or Si/SiC solar cells [2012.01]
- 31/0747 • • • • comprising a heterojunction of crystalline and amorphous materials, e.g. heterojunction with intrinsic thin layer or HIT® solar cells [2012.01]
- 31/0749 • • • • including a  $A_I B_{III} C_{VI}$  compound, e.g. CdS/CuInSe2 [CIS] heterojunction solar cells [2012.01]
- 31/075 • • • • the potential barriers being only of the PIN type, e.g. amorphous silicon PIN solar cells [5, 2012.01]
- 31/076 • • • • Multiple junction or tandem solar cells [2012.01]
- 31/077 • • • • the devices comprising monocrystalline or polycrystalline materials [2012.01]
- 31/078 • • • • including different types of potential barriers provided for in two or more of groups H01L 31/061-H01L 31/075 [5, 2012.01]
- 31/08 • • • • in which radiation controls flow of current through the device, e.g. photoresistors [2]
- 31/09 • • • • Devices sensitive to infra-red, visible or ultra-violet radiation (H01L 31/101 takes precedence) [5]
- 31/10 • • • • characterised by at least one potential-jump barrier or surface barrier, e.g. phototransistors [2]
- 31/101 • • • • Devices sensitive to infra-red, visible or ultra-violet radiation [5]
- 31/102 • • • • characterised by only one potential barrier or surface barrier [5]
- 31/103 • • • • the potential barrier being of the PN homojunction type [5]
- 31/105 • • • • the potential barrier being of the PIN type [5]
- 31/107 • • • • the potential barrier working in avalanche mode, e.g. avalanche photodiode [5]
- 31/108 • • • • the potential barrier being of the Schottky type [5]
- 31/109 • • • • the potential barrier being of the PN heterojunction type [5]
- 31/11 • • • • characterised by two potential barriers or surface barriers, e.g. bipolar phototransistor [5]
- 31/111 • • • • characterised by at least three potential barriers, e.g. photothyristor [5]
- 31/112 • • • • characterised by field-effect operation, e.g. junction field-effect photo-transistor [5]
- 31/113 • • • • being of the conductor-insulator-semiconductor type, e.g. metal-insulator-semiconductor field-effect transistor [5]
- 31/115 • • • • Devices sensitive to very short wavelength, e.g. X-rays, gamma-rays or corpuscular radiation [5]
- 31/117 • • • • of the bulk effect radiation detector type, e.g. Ge-Li compensated PIN gamma-ray detectors [5]
- 31/118 • • • • of the surface barrier or shallow PN junction detector type, e.g. surface barrier alpha-particle detectors [5]
- 31/119 • • • • characterised by field-effect operation, e.g. MIS type detectors [5]
- 31/12 • • • • structurally associated with, e.g. formed in or on a common substrate with, one or more electric light sources, e.g. electroluminescent light sources, and electrically or optically coupled thereto (electroluminescent light sources *per se* H05B 33/00) [2, 5]
- 31/14 • • • • the light source or sources being controlled by the semiconductor device sensitive to radiation, e.g. image converters, image amplifiers, image storage devices [2]
- 31/147 • • • • the light sources and the devices sensitive to radiation all being semiconductor devices characterised by at least one potential or surface barrier [5]
- 31/153 • • • • formed in, or on, a common substrate [5]
- 31/16 • • • • the semiconductor device sensitive to radiation being controlled by the light source or sources [2]
- 31/167 • • • • the light sources and the devices sensitive to radiation all being semiconductor devices characterised by at least one potential or surface barrier [5]
- 31/173 • • • • formed in, or on, a common substrate [5]
- 31/18 • • • • Processes or apparatus specially adapted for the manufacture or treatment of these devices or of parts thereof [2]
- 31/20 • • • • such devices or parts thereof comprising amorphous semiconductor material [5]
- 33/00 Semiconductor devices with at least one potential-jump barrier or surface barrier specially adapted for light emission; Processes or apparatus specially adapted for the manufacture or treatment thereof or of parts thereof; Details thereof** (H01L 51/50 takes precedence; devices consisting of a plurality of semiconductor components formed in or on a common substrate and including semiconductor components with at least one potential-jump barrier or surface barrier, specially adapted for light emission H01L 27/15; semiconductor lasers H01S 5/00) [2, 2006.01, 2010.01]
- Note(s) [2010.01]**
  1. This group covers light emitting diodes [LEDs] or superluminescent diodes [SLDs], including LEDs or SLDs emitting infra-red [IR] light or ultra-violet [UV] light.
  2. In this group, at each hierarchical level, in the absence of an indication to the contrary, classification is made in the first appropriate place.
- 33/02 • • • • characterised by the semiconductor bodies [2010.01]

- 33/04 • • with a quantum effect structure or superlattice, e.g. tunnel junction [2010.01]
- 33/06 • • • within the light emitting region, e.g. quantum confinement structure or tunnel barrier [2010.01]
- 33/08 • • with a plurality of light emitting regions, e.g. laterally discontinuous light emitting layer or photoluminescent region integrated within the semiconductor body (H01L 27/15 takes precedence) [2010.01]
- 33/10 • • with a light reflecting structure, e.g. semiconductor Bragg reflector [2010.01]
- 33/12 • • with a stress relaxation structure, e.g. buffer layer [2010.01]
- 33/14 • • with a carrier transport control structure, e.g. highly-doped semiconductor layer or current-blocking structure [2010.01]
- 33/16 • • with a particular crystal structure or orientation, e.g. polycrystalline, amorphous or porous [2010.01]
- 33/18 • • • within the light emitting region [2010.01]

**Note(s) [2010.01]**

When classifying in this group, classification is also made in group H01L 33/26 or one of its subgroups in order to identify the chemical composition of the light emitting region.

- 33/20 • • with a particular shape, e.g. curved or truncated substrate [2010.01]
- 33/22 • • • Roughened surfaces, e.g. at the interface between epitaxial layers [2010.01]
- 33/24 • • • of the light emitting region, e.g. non-planar junction [2010.01]
- 33/26 • • Materials of the light emitting region [2010.01]
- 33/28 • • • containing only elements of group II and group VI of the periodic system [2010.01]
- 33/30 • • • containing only elements of group III and group V of the periodic system [2010.01]
- 33/32 • • • • containing nitrogen [2010.01]
- 33/34 • • • containing only elements of group IV of the periodic system [2010.01]
- 33/36 • characterised by the electrodes [2010.01]
- 33/38 • • with a particular shape [2010.01]
- 33/40 • • Materials therefor [2010.01]
- 33/42 • • • Transparent materials [2010.01]
- 33/44 • characterised by the coatings, e.g. passivation layer or anti-reflective coating [2010.01]
- 33/46 • • Reflective coating, e.g. dielectric Bragg reflector [2010.01]
- 33/48 • characterised by the semiconductor body packages [2010.01]

**Note(s) [2010.01]**

This group covers elements in intimate contact with the semiconductor body or integrated with the package.

- 33/50 • • Wavelength conversion elements [2010.01]
- 33/52 • • Encapsulations [2010.01]
- 33/54 • • • having a particular shape [2010.01]
- 33/56 • • • Materials, e.g. epoxy or silicone resin [2010.01]
- 33/58 • • Optical field-shaping elements [2010.01]
- 33/60 • • • Reflective elements [2010.01]
- 33/62 • • Arrangements for conducting electric current to or from the semiconductor body, e.g. leadframe, wire-bond or solder balls [2010.01]
- 33/64 • • Heat extraction or cooling elements [2010.01]

- 35/00 **Thermoelectric devices comprising a junction of dissimilar materials, i.e. exhibiting Seebeck or Peltier effect with or without other thermoelectric effects or thermomagnetic effects; Processes or apparatus specially adapted for the manufacture or treatment thereof or of parts thereof; Details thereof** (devices consisting of a plurality of solid state components formed in or on a common substrate H01L 27/00) [2]

- 35/02 • Details [2]
- 35/04 • • Structural details of the junction; Connections of leads [2]
- 35/06 • • • detachable, e.g. using a spring [2]
- 35/08 • • • non-detachable, e.g. cemented, sintered, soldered [2]
- 35/10 • • • Connections of leads [2]
- 35/12 • Selection of the material for the legs of the junction [2]
- 35/14 • • using inorganic compositions [2]
- 35/16 • • • comprising tellurium or selenium or sulfur [2]
- 35/18 • • • comprising arsenic or antimony or bismuth (H01L 35/16 takes precedence) [2]
- 35/20 • • • comprising metals only (H01L 35/16, H01L 35/18 take precedence) [2]
- 35/22 • • • comprising compounds containing boron, carbon, oxygen, or nitrogen [2]
- 35/24 • • using organic compositions [2]
- 35/26 • • using compositions changing continuously or discontinuously inside the material [2]
- 35/28 • operating with Peltier or Seebeck effect only [2]
- 35/30 • • characterised by the heat-exchanging means at the junction [2]
- 35/32 • • characterised by the structure or configuration of the cell or thermo-couple forming the device [2]
- 35/34 • Processes or apparatus specially adapted for the manufacture or treatment of these devices or of parts thereof [2]

- 37/00 **Thermoelectric devices without a junction of dissimilar materials; Thermomagnetic devices, e.g. using Nernst-Ettinghausen effect; Processes or apparatus specially adapted for the manufacture or treatment thereof or of parts thereof** (devices consisting of a plurality of solid state components formed in or on a common substrate H01L 27/00) [2]
- 37/02 • using thermal change of dielectric constant, e.g. working above and below the Curie point [2]
- 37/04 • using thermal change of magnetic permeability, e.g. working above and below the Curie point [2]

- 39/00 **Devices using superconductivity or hyperconductivity; Processes or apparatus specially adapted for the manufacture or treatment thereof or of parts thereof** (devices consisting of a plurality of solid state components formed in or on a common substrate H01L 27/00; superconductors characterised by the ceramic-forming technique or the ceramic composition C04B 35/00; superconductive or hyperconductive conductors, cables, or transmission lines H01B 12/00; superconductive coils or windings H01F; amplifiers using superconductivity H03F 19/00) [2, 4]
- 39/02 • Details [2]
- 39/04 • • Containers; Mountings [2]
- 39/06 • • characterised by the current path [2]
- 39/08 • • characterised by the shape of the element [2]
- 39/10 • • characterised by the means for switching [2]
- 39/12 • • characterised by the material [2]
- 39/14 • Permanent superconductor devices [2]

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- 39/16 • Devices switchable between superconductive and normal states [2]
- 39/18 • • Cryotrons [2]
- 39/20 • • • Power cryotrons [2]
- 39/22 • Devices comprising a junction of dissimilar materials, e.g. Josephson-effect devices [2]
- 39/24 • Processes or apparatus specially adapted for the manufacture or treatment of devices provided for in group H01L 39/00 or of parts thereof [2]

**41/00 Piezo-electric devices in general; Electrostrictive devices in general; Magnetostrictive devices in general; Processes or apparatus specially adapted for the manufacture or treatment thereof or of parts thereof; Details thereof** (devices consisting of a plurality of solid-state components formed in or on a common substrate H01L 27/00) [2, 2013.01]

### Note(s)

1. This group does not cover adaptations for particular purposes, which are covered by the relevant places.
2. Attention is drawn to the following such places:

B06B.....for adaptations for generating or transmitting mechanical vibrations

G01.....for transducers as sensing elements for measuring

G04C, G04F.....for transducers adapted for use in time-pieces

G10K.....for adaptations for generating or transmitting sound

H02N.....for arrangements of elements in electric machines

H03H 9/00.....for networks comprising electro-mechanical or electro-acoustic elements, e.g. resonant circuits

H04R.....for loudspeakers, microphones, gramophone pick-ups or like transducers.

- 41/02 • Details [2]
- 41/04 • • of piezo-electric or electrostrictive elements [2]
- 41/047 • • • Electrodes [6]
- 41/053 • • • Mounts, supports, enclosures or casings [6]
- 41/06 • • of magnetostrictive elements [2]
- 41/08 • Piezo-electric or electrostrictive elements [2]
- 41/083 • • having a stacked or multilayer structure [6]
- 41/087 • • formed as coaxial cables [6]

### Note(s)

Groups H01L 41/083 and H01L 41/087 take precedence over groups H01L 41/09-H01L 41/113.

- 41/09 • • with electrical input and mechanical output [5]
- 41/107 • • with electrical input and electrical output [5]
- 41/113 • • with mechanical input and electrical output [5]
- 41/12 • Magnetostrictive elements [2]
- 41/16 • Selection of materials [2]
- 41/18 • • for piezo-electric or electrostrictive elements [2]
- 41/187 • • • Ceramic compositions [5]
- 41/193 • • • Macromolecular compositions [5]
- 41/20 • • for magnetostrictive elements [2]

- 41/22 • Processes or apparatus specially adapted for the assembly, manufacture or treatment of piezo-electric or electrostrictive devices or of parts thereof [2, 2013.01]

- 41/23 • • Forming enclosures or casings [2013.01]

- 41/25 • • Assembling devices that include piezo-electric or electrostrictive parts [2013.01]

- 41/253 • • Treating devices or parts thereof to modify a piezo-electric or electrostrictive property, e.g. polarisation characteristics, vibration characteristics or mode tuning [2013.01]

- 41/257 • • • by polarising [2013.01]

- 41/27 • • Manufacturing multilayered piezo-electric or electrostrictive devices or parts thereof, e.g. by stacking piezo-electric bodies and electrodes [2013.01]

- 41/273 • • • by integrally sintering piezo-electric or electrostrictive bodies and electrodes [2013.01]

- 41/277 • • • by stacking bulk piezo-electric or electrostrictive bodies and electrodes [2013.01]

- 41/29 • • Forming electrodes, leads or terminal arrangements [2013.01]

### Note(s) [2013.01]

The integral arrangement of individual layer electrodes and connection electrodes is classified in both groups H01L 41/293 and H01L 41/297.

- 41/293 • • • Connection electrodes of multilayered piezo-electric or electrostrictive parts [2013.01]

- 41/297 • • • Individual layer electrodes of multilayered piezo-electric or electrostrictive parts [2013.01]

- 41/31 • • Applying piezo-electric or electrostrictive parts or bodies onto an electrical element or another base [2013.01]

- 41/311 • • • Mounting of piezo-electric or electrostrictive parts together with semiconductor elements, or other circuit elements, on a common substrate [2013.01]

- 41/312 • • • by laminating or bonding of piezo-electric or electrostrictive bodies [2013.01]

- 41/313 • • • by metal fusing or with adhesives [2013.01]

- 41/314 • • • by depositing piezo-electric or electrostrictive layers, e.g. aerosol or screen printing [2013.01]

- 41/316 • • • • by vapour phase deposition [2013.01]

- 41/317 • • • • by liquid phase deposition [2013.01]

- 41/318 • • • • by sol-gel deposition [2013.01]

- 41/319 • • • • using intermediate layers, e.g. for growth control [2013.01]

- 41/33 • • Shaping or machining of piezo-electric or electrostrictive bodies [2013.01]

- 41/331 • • • by coating or depositing using masks, e.g. lift-off [2013.01]

- 41/332 • • • by etching, e.g. lithography [2013.01]

- 41/333 • • • by moulding or extrusion [2013.01]

- 41/335 • • • by machining [2013.01]

- 41/337 • • • • by polishing or grinding [2013.01]

- 41/338 • • • • by cutting or dicing [2013.01]

- 41/339 • • • • by punching [2013.01]

- 41/35 • • Forming piezo-electric or electrostrictive materials [2013.01]

- 41/37 • • • Composite materials [2013.01]

- 41/39 • • • Inorganic materials [2013.01]

- 41/41 • • • • by melting [2013.01]

- 41/43 • • • • by sintering [2013.01]

- 41/45 • • • Organic materials [2013.01]

- 41/47 • Processes or apparatus specially adapted for the assembly, manufacture or treatment of magnetostrictive devices or of parts thereof [2013.01]
- 43/00 Devices using galvano-magnetic or similar magnetic effects; Processes or apparatus specially adapted for the manufacture or treatment thereof or of parts thereof** (devices consisting of a plurality of solid state components formed in or on a common substrate H01L 27/00) [2]
  - 43/02 • Details [2]
  - 43/04 • • of Hall-effect devices [2]
  - 43/06 • Hall-effect devices [2]
  - 43/08 • Magnetic-field-controlled resistors [2]
  - 43/10 • Selection of materials [2]
  - 43/12 • Processes or apparatus specially adapted for the manufacture or treatment of these devices or of parts thereof [2]
  - 43/14 • • for Hall-effect devices [2]
- 45/00 Solid state devices specially adapted for rectifying, amplifying, oscillating, or switching without a potential-jump barrier or surface barrier, e.g. dielectric triodes; Ovshinsky-effect devices; Processes or apparatus specially adapted for the manufacture or treatment thereof or of parts thereof** (devices consisting of a plurality of solid state components formed in or on a common substrate H01L 27/00; devices using superconductivity or hyperconductivity H01L 39/00; piezo-electric elements H01L 41/00; bulk negative resistance effect devices H01L 47/00) [2]
  - 45/02 • Solid state travelling-wave devices [2]
- 47/00 Bulk negative resistance effect devices, e.g. Gunn-effect devices; Processes or apparatus specially adapted for the manufacture or treatment thereof or of parts thereof** (devices consisting of a plurality of solid state components formed in or on a common substrate H01L 27/00) [2]
  - 47/02 • Gunn-effect devices [2]
- 49/00 Solid state devices not provided for in groups H01L 27/00-H01L 47/00 and H01L 51/00 and not provided for in any other subclass; Processes or apparatus specially adapted for the manufacture or treatment thereof or of parts thereof [2, 2006.01]**
- 49/02 • Thin-film or thick-film devices [2]
- 51/00 Solid state devices using organic materials as the active part, or using a combination of organic materials with other materials as the active part; Processes or apparatus specially adapted for the manufacture or treatment of such devices, or of parts thereof** (devices consisting of a plurality of components formed in or on a common substrate H01L 27/28; thermoelectric devices using organic material H01L 35/00, H01L 37/00; piezo-electric, electrostrictive or magnetostrictive elements using organic material H01L 41/00) [6, 2006.01]
  - 51/05 • specially adapted for rectifying, amplifying, oscillating or switching and having at least one potential-jump barrier or surface barrier; Capacitors or resistors with at least one potential-jump barrier or surface barrier [2006.01]
  - 51/10 • • Details of devices [6]
  - 51/30 • • Selection of materials [6]
  - 51/40 • • Processes or apparatus specially adapted for the manufacture or treatment of such devices or of parts thereof [6, 2006.01]
  - 51/42 • specially adapted for sensing infra-red radiation, light, electromagnetic radiation of shorter wavelength, or corpuscular radiation; specially adapted either for the conversion of the energy of such radiation into electrical energy or for the control of electrical energy by such radiation [2006.01]
  - 51/44 • • Details of devices [2006.01]
  - 51/46 • • Selection of materials [2006.01]
  - 51/48 • • Processes or apparatus specially adapted for the manufacture or treatment of such devices or of parts thereof [2006.01]
  - 51/50 • specially adapted for light emission, e.g. organic light emitting diodes (OLED) or polymer light emitting devices (PLED) (organic semiconductor lasers H01S 5/36) [2006.01]
  - 51/52 • • Details of devices [2006.01]
  - 51/54 • • Selection of materials [2006.01]
  - 51/56 • • Processes or apparatus specially adapted for the manufacture or treatment of such devices or of parts thereof [2006.01]