H01S

DEVICES USING THE PROCESS OF LIGHT AMPLIFICATION BY STIMULATED EMISSION OF RADIATION [LASER] TO AMPLIFY OR GENERATE LIGHT; DEVICES USING STIMULATED EMISSION OF ELECTROMAGNETIC RADIATION IN WAVE RANGES OTHER THAN OPTICAL

Definition statement

This place covers:

Devices using stimulated emission, for the generation or amplification of coherent electromagnetic waves or other forms of wave energy, e.g. masers, lasers, X-ray lasers, gamma lasers, optical amplifiers.

Constructional details or arrangements, e.g. housings, packages, cooling, electrodes.

Configuration of the resonators, or shape of the active media.

Processes or apparatus for pumping (exciting) said devices.

Such functions as modulating, demodulating, frequency-changing, controlling, or stabilising of said coherent electromagnetic waves, insofar these functions are performed by elements being part of the optical resonators or amplifier's arrangements; this includes particularly:

- Frequency multiplying, e.g. harmonic generation
- Pulse-techniques, e.g. Q-switching, mode-locking, or gain-switching.

The special choice or adaptation of materials as active media.

Devices using non-linear amplification effects, e.g. stimulated Raman or Brillouin scattering

Relationships with other classification places

This subclass covers functions as modulating, demodulating, frequency-changing, controlling, or stabilising of coherent electromagnetic waves, insofar these functions are performed by elements being part of the optical resonators or amplifier's arrangements, e.g. inside-cavity harmonic generation. Said functions when performed outside the resonators or amplifier's arrangement, e.g. harmonic generation, are covered by subclass G02F.

With regard to the housing or package of a laser or maser, distinction is done between first and second level housing/packages.

A first level housing is considered to be the housing of the laser/maser directly enclosing the (cooled) device. An example for a first level housing is a semiconductor laser or a microlaser in a TO-can (H01S 5/022 and H01S 3/025).

A second level package or housing is considered to be a housing where this TO-can, for example, is integrated like a DVD recorder or a lamp or a beamer.

Second level packages are generally not covered by this subclass but should be in a subclass relating to the application of the device.

References

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

Eye surgery using laser	A61F 9/008

Radiation therapy using laser light	A61N 5/067
Sintering by using laser light	B22F 3/105
Working by laser beam, e.g. welding, cutting or, boring	B23K 26/00
Joining of preformed parts by using laser light	B29C 65/16
Laser printers	B41J 2/44, B41J 2/455
Ring laser gyrometers; fibre laser gyrometers	G01C 19/66, G01C 19/72
Investigating or analysing colour or spectral properties of materials by using tunable lasers	G01N 21/39
Apparatus specially adapted for photomechanical, e.g. photolithographic, production of textured or patterned surfaces	G03F 7/20
Laser heads for recording or reproducing	G11B 7/125
Laser recording associated with non-optical reproducing, or laser reproducing associated with non-optical recording	G11B 11/00
Trimming by laser in the manufacture of resistors	H01C 17/242
Photolithographic processing on semiconductor bodies	H01L 21/027
Transmission systems employing light, e.g. all-optical repeaters	H04B 10/00, H04B 10/291 - H04B 10/299

Informative references

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

Lamps	F21K 9/00 - F21K 99/00
Measurements using light	G01C
Measurement of light	G01J 11/00
Optical spectroscopy	G01N 21/00
LIDAR	G01S 17/00
Coupling light guides with opto-electronic elements	G02B 6/42
Laser speckle optics	G02B 27/48
Control of light beams in general	G02F
Non-linear optics per se	G02F 1/35
Photolithography	G03F 7/00
Scanning	G06K 15/00
Semiconductor devices specially adapted for light emission	H01L 33/00
Reproduction	H04N 1/00
Displays	H04N 9/00
X-ray generation	H05G 2/00
Plasma generation	H05H 1/00

Special rules of classification

In H01S a document is classified according to the features disclosed, i.e. a similar strategy is applied as used for the F-terms of the Japanese patent documentation. Such features can be found, for example, in the figures depicting the embodiments and in the corresponding discussion of these

figures in the description. Classification in H01S is not restricted to the wording of the claims or the summary of the invention. Even a detailed prior art device discussed into detail in the disclosure may be classified correspondingly.

In H01S it should be carefully distinguished between defining (e.g. H01S 3/08 or H01S 5/10), controlling (e.g. H01S 3/10 or H01S 5/06-H01S 5/065) and stabilising (e.g. H01S 3/13 or H01S 5/068). This is illustrated with the following example: A grating as one end mirror of the cavity of a laser defines and therefore fixes the wavelength of the laser. As long as it is not disclosed that this grating is intentionally rotated, such a grating will be classified as being a part of the resonator only, e.g. in H01S 3/08009 or in H01S 5/141. As soon as it is disclosed, that the grating is rotated to tune the wavelength, this is considered to fall under a wavelength control by a grating which is classified in H01S 3/1055, for example. When finally a feed-back loop is disclosed, e.g. with the help of a wavelength sensitive detector the intensity at a given wavelength is monitored and kept stable with the help of the feed-back loop, then a group in H01S 3/139 will be allocated. As however in the H01S 3/139 and sub-groups the nature of the wavelength defining reflector is not included, further classes in H01S 3/08 and sub-groups should be used to characterize the resonator details, e.g. the reflector being a grating and the number of resonator mirrors present.

This subclass does not cover light emitting devices where it is merely stated that they are a laser or maser, i.e. where the laser or maser is simply a "black box" without any specific details on the electromagnetic wave generation or feedback on it.

Glossary of terms

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

active medium	A medium providing for optical gain by the stimulated emission effect when excited by an excitation (pump) energy source.
laser	It is the acronym for "light amplification by stimulated emission of radiation" but it also refers, in broader sense, to any device using stimulated emission of radiation by excited atoms.Hence, for example, the expressions "semiconductor laser", "dye laser", "optical fibre laser" or "X-ray laser".
pumping	The process of providing the active medium for excitation energy.

Synonyms and Keywords

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

- active medium: gain medium, lasing medium excitation: pump(ing)

In patent documents, the word/expression in the first column is often used instead of the word/ expression in the second column, which is used in the classification scheme of this place:

LASER	Light Amplification by Stimulated Emission of Radiation
MASER	Microwave Amplification By Stimulated Emission Of Radiation also known as Microwave Laser
EDFA	Erbium Doped Fibre Amplifier
SOA	Semiconductor Optical Amplifier
DBR Laser	Distributed Bragg Reflector Laser
DFB Laser	Distributed Feed-Back Laser

H01S 1/00

Masers, i.e. devices using stimulated emission of electromagnetic radiation in the microwave range

Definition statement

This place covers:

Masers, i.e. devices generating or amplifying light by stimulated emission from the infrared to the far-infrared/THz part of the electromagnetic wave spectrum, i.e. wavelengths longer than about 10 microns, e.g. CO2 laser.

References

Informative references

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

Far-infrared and THz-lasers based on semiconductor lasers	H01S 5/00
Quantum cascade lasers with for example intra-band transitions	H01S 5/34
THz sources where stimulated emission is not explicitly involved, e.g. a fs-laser pulse illuminates an Auston switch or a Josephson contact and THz emission results from accelerating electrons according to the local amplitude of the applied electromagnetic field	G02F 1/35, H01L 31/00, H01Q

H01S 1/06

Gaseous {, i.e. beam masers}

References

Informative references

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

Atomic clocks	G04F 5/14
Circuits using beam masers as a reference frequency for regulating frequency of oscillators	H03L 7/26
Molecular or atomic beam generation	H05H 3/02

H01S 3/00

Lasers, i.e. devices using stimulated emission of electromagnetic radiation in the infrared, visible or ultraviolet wave range (semiconductors lasers H01S 5/00)

Definition statement

This place covers:

Devices generating or amplifying light by stimulated emission from the infrared to the ultraviolet part of the spectrum.

Laser media including gaseous, liquid and solid gain media as a matrix and comprising generally atoms, ions or molecules as dopants having discrete spectral absorption and emission lines or bands.

References

Limiting references

This place does not cover:

Semiconductor lasers	H01S 5/00

Informative references

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

Optical components for lasers per se are classified in the following groups/subclasses:

Laser crystal materials	C09K 11/00
Manufacturing of solid laser materials	C30B
Cooling means	F28F 3/00
Optical components like lenses, mirrors, gratings	G02B 1/00
Optical fibres	G02B 6/00
Linear and nonlinear optical components for control, modulation and frequency conversion of light	G02F 1/00

H01S 3/02

Constructional details {(housings or packages of fibre lasers H01S 3/06704)}

References

Limiting references

This place does not cover:

Housings or packages of fibre lasers	H01S 3/06704

H01S 3/03

of gas laser discharge tubes

References

Informative references

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

Gas discharge tubes in general	H01J 17/00, H01J 61/00

H01S 3/034

Optical devices within, or forming part of, the tube, e.g. windows, mirrors (reflectors having variable properties or positions for initial adjustment of the resonator H01S 3/086)

References

Limiting references

This place does not cover:

Reflectors having variable properties or position for initial adjustment of the resonator	H01S 3/086

H01S 3/036

Means for obtaining or maintaining the desired gas pressure within the tube, e.g. by gettering, replenishing; Means for circulating the gas, e.g. for equalising the pressure within the tube {(H01S 3/031 takes precedence)}

References

Limiting references

This place does not cover:

Metal vapour lasers	H01S 3/031

Informative references

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

Cooling arrangements for gas lasers	H01S 3/041
Gas dynamic lasers	H01S 3/0979
Means for obtaining or maintaining the desired gas pressure within the tube in general	H01J 17/22, H01J 61/24

H01S 3/0612

{Non-homogeneous structure (H01S 3/07 takes precedence)}

Definition statement

This place covers:

Stepwise change of a dimension or a doping profile, e.g. undoped end caps on a doped laser rod or end flanges having a larger diameter than the part in between

References

Limiting references

This place does not cover:

Construction or shape of active medium consisting of a plurality of parts	H01S 3/07

H01S 3/0617

{having a varying composition or cross-section in a specific direction}

Definition statement

This place covers:

Devices having a dopant gradient or a changing dimension of the laser crystal, i.e. there must a gradual change in the dopant profile or at least one of the laser material dimensions (e.g. tapering)

H01S 3/067

Fibre lasers

References

Informative references

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

Optical pumping thereof	H01S 3/094003
Controlling the output parameters	H01S 3/10
Stabilisation of the output parameters	H01S 3/13
Scattering effects, i.e. stimulated Brillouin or Raman effects	H01S 3/302
Optical fibres and packages comprising optical fibres	G02B 6/00
Transmission using light	H04B 10/00

Special rules of classification

Fibre lasers are not classified in H01S 3/0602-H01S 3/0627

As soon as details specific to amplification by stimulated emission are disclosed, a corresponding group in H01S 3/00 should be given, e.g. details on the amplification bandwidth, control or stabilisation of the fibre amplifier. The fact that for example merely a fibre amplifier is comprised by a device should not result in the allocation of a group in H01S 3/00.

H01S 3/06754

{Fibre amplifiers (H01S 3/06708 takes precedence)}

References

Limiting references

This place does not cover:

Constructional details of the fibre	H01S 3/06708

Special rules of classification

Fibre amplifiers are generally not double classified by allocating in addition H01S 3/2308, only in the case of for example double passes etc. a respective coding in H01S 3/2325 and sub-groups is given.

Cascaded fibre amplifiers are only classified in H01S 3/06758 and not in H01S 3/2316.

H01S 3/07

consisting of a plurality of parts, e.g. segments (H01S 3/067 takes precedence)

References

Limiting references

This place does not cover:

Fibre lasers	H01S 3/067

H01S 3/08

Construction or shape of optical resonators or components thereof

References

Informative references

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

Waveguide lasers	H01S 3/063
Controlling the laser output	H01S 3/10
Stabilising	H01S 3/13

H01S 3/08022

Longitudinal modes (mode suppression using a plurality of resonators H01S 3/082)

References

Limiting references

This place does not cover:

Mode suppression using a plurality of resonators	H01S 3/082

H01S 3/08086

{Multiple-wavelength emission}

Definition statement

This place covers:

Laser generates having more than one laser wavelength, e.g. by internal frequency conversion

Outcoupling mirrors being at least partly transmissive for the at least two wavelengths, i.e. at least two laser beams at different wavelengths must be intentionally out-coupled

H01S 3/08095

{Zig-zag travelling beam through the active medium}

Definition statement

This place covers:

Devices with multiple bounces off of lateral, non-end mirror surfaces

References

Limiting references

This place does not cover:

"Active mirror" lasers with a singly folded path through the laser medium,	H01S 3/0602, H01S 3/0619

H01S 3/081

comprising three or more reflectors

References

Informative references

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

Folded-path gas lasers	H01S 3/076

H01S 3/082

defining a plurality of resonators, e.g. for mode selection or suppression

References

Informative references

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

Longitudinal mode control, e.g. specifically multimode	H01S 3/08022

H01S 3/083

Ring lasers {(fibre ring lasers H01S 3/06791)}

References

Limiting references

This place does not cover:

Fibre ring lasers	H01S 3/06791

Informative references

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

Ring laser gyrometers	G01C 19/66

H01S 3/086

One or more reflectors having variable properties or positions for initial adjustment of the resonator (varying a parameter of the laser output during operation H01S 3/10; stabilisation of the laser output H01S 3/13)

References

Limiting references

This place does not cover:

Varying a parameter of the laser output during operation	H01S 3/10
Stabilisation of the laser output	H01S 3/13

H01S 3/094076

{Pulsed or modulated pumping (H01S 3/1024 takes precedence)}

Definition statement

This place covers:

Pulsed or modulated coherent pumping and no explicit effect of the pumping itself on a pulse forming, e.g. frequently Q-switched lasers are pumped in a pulsed way but the pulse duration is determined by the Q-switch and/or the resonator length and not the pumping means

References

Limiting references

This place does not cover:

Pulse generation	H01S 3/1024

H01S 3/0941

of a laser diode

References

Limiting references

This place does not cover:

Details of laser diodes	H01S 5/00

H01S 3/095

using chemical or thermal pumping

References

Informative references

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

Generating plasma, e.g. by combustion	H02K 44/00, H05H 1/24

H01S 3/0955

using pumping by high energy particles {(H01S 3/0903, H01S 3/0906, H01S 3/09707 take precedence)}

References

Limiting references

This place does not cover:

Free-electron laser	H01S 3/0903
Electrical, electrochemical, or electron-beam pumping of a dye laser	H01S 3/0906
Gas discharge using an electron or ion beam	H01S 3/09707

H01S 3/0971

transversely excited (H01S 3/0975 takes precedence)

References

Limiting references

This place does not cover:

Gas discharge using inductive or capacitive excitation	H01S 3/0975

H01S 3/0977

having auxiliary ionisation means {(H01S 3/09713 takes precedence)}

References

Limiting references

This place does not cover:

Auxiliary ionisation means for transversely excited lasers, e.g. double discharge excitation	H01S 3/09713

H01S 3/10

Controlling the intensity, frequency, phase, polarisation or direction of the emitted radiation, e.g. switching, gating, modulating or demodulating

References

Informative references

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

Controlling of light beams, frequency-changing, non-linear optics, optical logic elements, in general	G02F

Special rules of classification

Group H01S 3/10007 takes precedence over groups H01S 3/102 - H01S 3/104

H01S 3/10046

{Pulse repetition rate control (H01S 3/11 takes precedence)}

Definition statement

This place covers:

Control as defined in the subclass H01S, i.e. the pulse repetition rate is controlled and not merely defined or fixed

References

Limiting references

This place does not cover:

Pulse generation, e.g. Q-switching, mode locking	H01S 3/11

H01S 3/101

Lasers provided with means to change the location from which, or the direction in which, laser radiation is emitted

References

Informative references

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

Optical-mechanical scanning systems in general	G02B 26/10
Electro-, magneto- or acousto-optical deflection	G02F 1/29
Control of position or direction of light beam generating device in general	G05D 3/00

H01S 3/102

by controlling the active medium, e.g. by controlling the processes or apparatus for excitation (H01S 3/13 takes precedence)

References

Limiting references

This place does not cover:

Stabilisation of laser output parameters, e.g. frequency, amplitude	H01S 3/13

H01S 3/1024

{for pulse generation}

Definition statement

This place covers:

the control of the pulse duration by the intensity or the duration of the coherent or non-coherent pulsed pump source, i.e. the duration of the generated pulse is changed with pump intensity/duration,

References

Informative references

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

Details of laser diodes e.g. housing, cooling, electric circuitry	H01S 5/00

H01S 3/108

using non-linear optical devices, e.g. exhibiting Brillouin or Raman scattering {(mode locking using a non-linear element H01S 3/1112)}

References

Limiting references

This place does not cover:

Mode locking using a non-linear element	H01S 3/1112

H01S 3/11

Mode locking; Q-switching; Other giant-pulse techniques, e.g. cavity dumping

Definition statement

This place covers:

Q-switching per se without any details of the kind of Q-switching

H01S 3/1628

{characterised by a semiconducting matrix}

Definition statement

This place covers:

Devices with dopants in a bulk semiconductor matrix with discrete absorption / emission lines

H01S 3/1685

{Ceramics}

Definition statement

This place covers:

Ceramic lasers

Special rules of classification

The solid laser material is additionally classified in H01S 3/163 and the doping in H01S 3/1601.

In the case a laser material is characterized by the (measured and depicted) amplification, H01S 3/2308 should be allocated besides the laser material and doping if appropriate.

H01S 3/17

amorphous, e.g. glass

References

Informative references

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

Glass manufacture, shaping or supplementary processes	C03B
Compositions for laserable glass	C03C 4/0071

H01S 4/00

Devices using stimulated emission of electromagnetic radiation in wave ranges other than those covered by groups H01S 1/00, H01S 3/00 or H01S 5/00, e.g. phonon masers, X-ray lasers or gamma-ray lasers

Definition statement

This place covers:

All devices generating or amplifying light by stimulated emission in spectral ranges with wavelengths longer than far-infrared/THz and shorter than ultraviolet.

References

Informative references

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

X-ray sources where for example a plasma is initiated by a focused femtosecond laser pulse which results in the generation of X-rays	H05G 2/00

H01S 5/00

Semiconductor lasers (superluminescent diodes H01L 33/00)

Definition statement

This place covers:

Semiconductor lasers which are characterized by having a valence and a conduction band with a band-gap in between and light emission due to a transition across at least part of a band-gap or within a band in the case of quantum cascade lasers. In order to tune the laser transition, the composition of the semiconductor and its doping can be designed.

One exception to this rule relates to "organic laser diodes". These devices have generally a layer structure similar to a laser diode comprising a semiconductor substrate and laminate, but the active region comprises an organic material.

Because it is frequently not disclosed whether the transition responsible for light emission is across a bandgap or in between discrete energy states, all such devices are classified in H01S 5/36 because the involvement of the semiconductor layers and the resonator structure being similar to that of a laser diode.

Relationships with other classification places

Semiconductor laser can be integrated with other electrical or optical components and has electrical circuitry for driving the laser diode. Details of such components per se are classified in for example the following main groups:

Optical components like lenses, mirrors, gratings	G02B 1/00
Optical fibres, packaging of semiconductor light sources and fibres	G02B 6/00
Beam manipulation and combination	G02B 26/00
Growth of semiconductors	H01L 21/02365
Cooling of semiconductors	H01L 23/34
Assemblies of semiconductors	H01L 25/00
Integration of semiconductors on a substrate	H01L 27/00
Photodiodes	H01L 31/00
Light emitting diodes (LED)	H01L 33/00
Organic light emitting devices (OLED)	H10K 50/00
Electrical circuits	H03K 3/00
Displays	H04N 9/00

References

Limiting references

This place does not cover:

Semiconductor devices with at least one potential-jump barrier or surface barrier specially adapted for light emission	H01L 33/00

Informative references

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

Details of external cavity components; Control or stabilisation acting on laser components	H01S 3/08, H01S 3/10, H01S 3/13
Construction or shape of optical resonators or components thereof	H01S 3/08
Optical pumping by coherent light of a laser diode	H01S 3/0941
Controlling the intensity, frequency, phase, polarisation or direction of the emitted radiation	H01S 3/10
Stabilisation of laser output parameters	H01S 3/13

H01S 5/0087

{for illuminating phosphorescent or fluorescent materials, e.g. using optical arrangements specifically adapted for guiding or shaping laser beams illuminating these materials}

Definition statement

This place covers:

- Optical arrangements that are specific for illuminating fluorescent or phosphorescent materials with radiation emitted from laser diodes.
- Specific arrangements of optical components that are used to guide laser diode beams onto fluorescent or phosphorescent materials like mirrors, lenses or waveguides or specific laser diode arrangements used to illuminate a fluorescent or phosphorescent material. Alternatively, the fluorescent or phosphorescent material may be part of the window of a laser diode package.

Relationships with other classification places

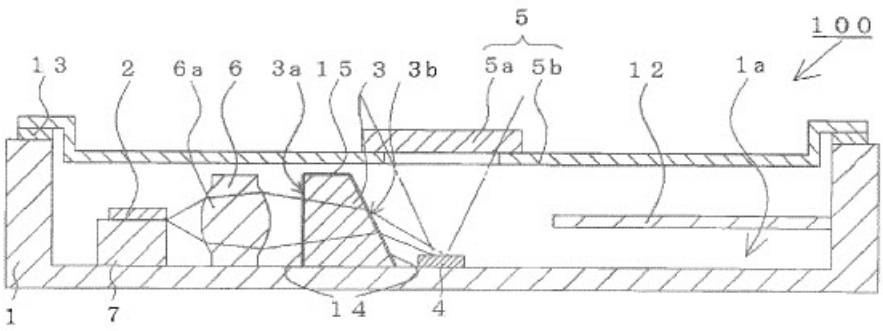
This subgroup does not cover specific compositions of phosphors or fluorescent materials. Neither does it cover specific applications of such a light source, like vehicle lamps comprising a laser diode as a black box, without any specific details on how the laser diode emission illuminates the fluorescent or phosphorescent material.

Multi-aspect classification of documents in different sub-classes is considered appropriate in case they disclose, for example, specific details of the laser diode arrangements to illuminate phosphors, a specific manufacturing of phosphors, as well as specific vehicle lamps comprising such light sources in the respective places of classification.

Examples of subject matter to be classified in H01S 5/0087:

- Optical arrangements that are specific for illuminating fluorescent or phosphorescent materials with radiation emitted from laser diodes.

FIG. 2



- Specific arrangements of optical components.

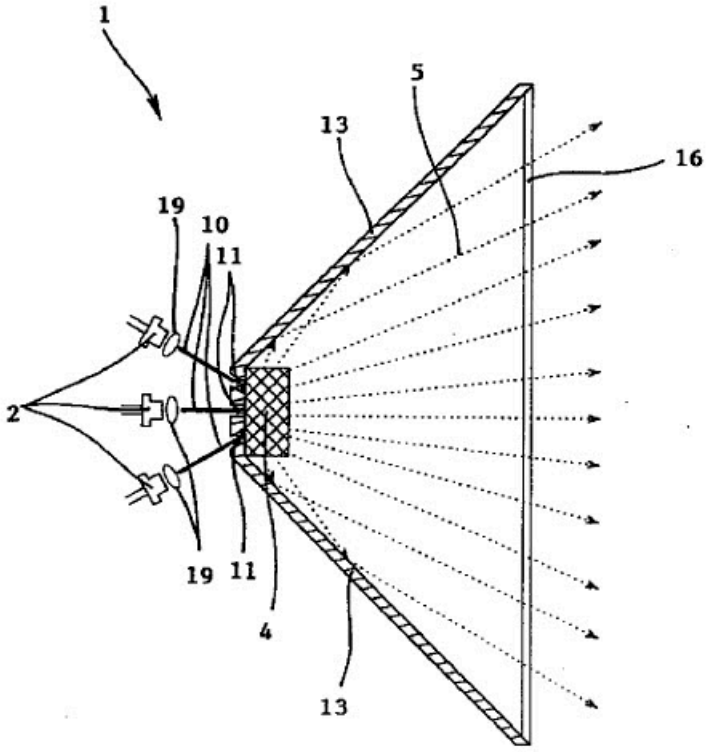


FIG.3

References

Application-oriented references

Examples of places where the subject matter of this place is covered when specially adapted, used for a particular purpose, or incorporated in a larger system:

Light sources using semiconductor devices, as light- generating elements, using wavelength conversion distinct from the light-generating elements	F21K 9/64
Lighting devices or systems specially adapted for vehicles with specific type of light source for headlamps	F21S 41/16

Informative references

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

Luminescent materials containing rare earth elements	C09K 11/77
Lighting devices or systems specially adapted for vehicles with specific type of light source for headlamps with phosphor and source being spaced apart	F21S 41/176
Light filters with selection of luminescent materials for screens for lightning devices, e.g. luminaires or lightning modules	F21V 9/30
Light generating elements of semiconductor light sources being semiconductor laser screens for lightning devices, e.g. luminaires or lightning modules	F21Y 2115/30
Projectors or projections type viewers with lamp houses characterized by using LED or laser light sources and secondary light emission	G03B 21/204

H01S 5/0092

{for nonlinear frequency conversion, e.g. second harmonic generation [SHG] or sum- or difference-frequency generation outside the laser cavity}

References

Informative references

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

Nonlinear frequency conversion per se	G02F 1/35

H01S 5/022

Mountings; Housings

Definition statement

This place covers:

First level packages, e.g. a laser diode in a TO can or a butterfly housing.

References

Informative references

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

Packaging and electrical lead-through per se	H01L 23/00

H01S 5/0225

Out-coupling of light

Definition statement

This place covers:

Specific optical components in the laser beamline with the optical components being located inside the laser diode housing or forming part of the housing, e.g. the laser diode emission leaves the housing along a specific optical component.

References

Informative references

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

Optical components external to the laser cavity, specially adapted therefor, e.g. for homogenisation or merging of the beams or for manipulating laser pulses, e.g. pulse shaping	H01S 5/005
Mountings or housings characterised by the shape of the housings	H01S 5/02208

H01S 5/02253

using lenses

Definition statement

This place covers:

Out-coupling of light using lenses that are in the laser beamline and are located inside the laser diode housing or form part of the housing.

Relationships with other classification places

The way of classifying optical components inside a laser diode housing is explained with the help of the following example as depicted in the figure below:

The lens 350 is an optical component in the laser beamline and forming part of the housing 130 and is classified in group H01S 5/02253.

The beam steering mirrors 316,317 following the laser diodes 310 are classified in group H01S 5/02255.

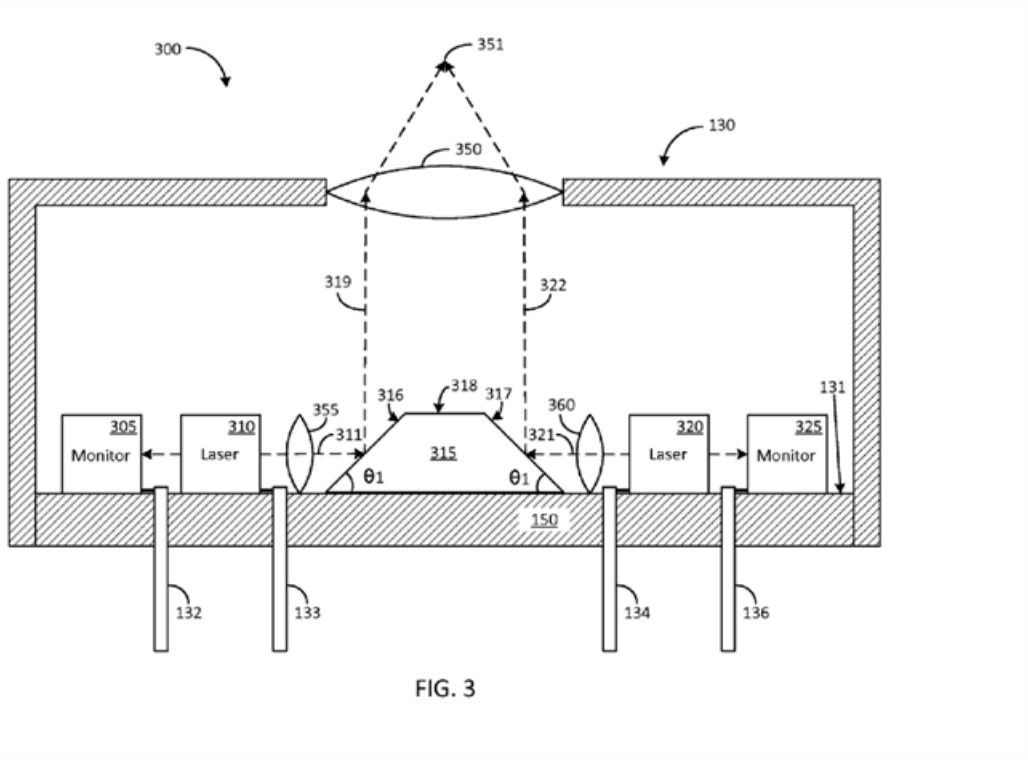


FIG. 3

H01S 5/02255

using beam deflecting elements

Definition statement

This place covers:

Out-coupling of light using beam deflecting elements that are in the laser beamline and are located inside the housing or form part of the housing.

H01S 5/02257

using windows, e.g. specially adapted for back-reflecting light to a detector inside the housing

Definition statement

This place covers:

Out-coupling of light using windows that are in the laser beamline and form part of the housing.

Relationships with other classification places

The relationship with other classification places is explained with the help of the following example as depicted in the figure below:

The phosphor forming part of the window is classified in group H01S 5/0087.

The window 110 comprises a phosphor 111 and is part of the laser diode housing 100 and is classified in group H01S 5/02257.

The beam steering mirrors 40 following the laser diodes 20 are classified in group H01S 5/02255.

The specific lenses 90 in the beamline inside the housing are classified in group H01S 5/02253.

FIG. 1

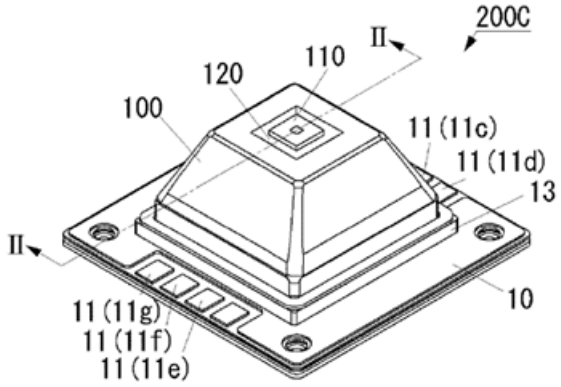
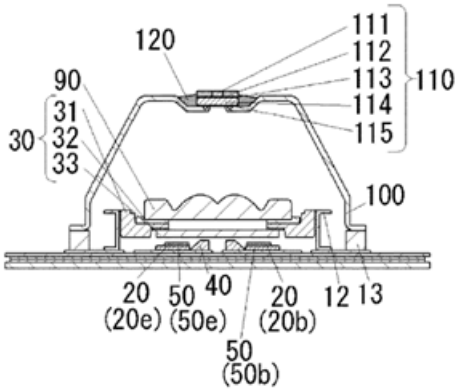


FIG. 2



H01S 5/0231

Stems

Definition statement

This place covers:

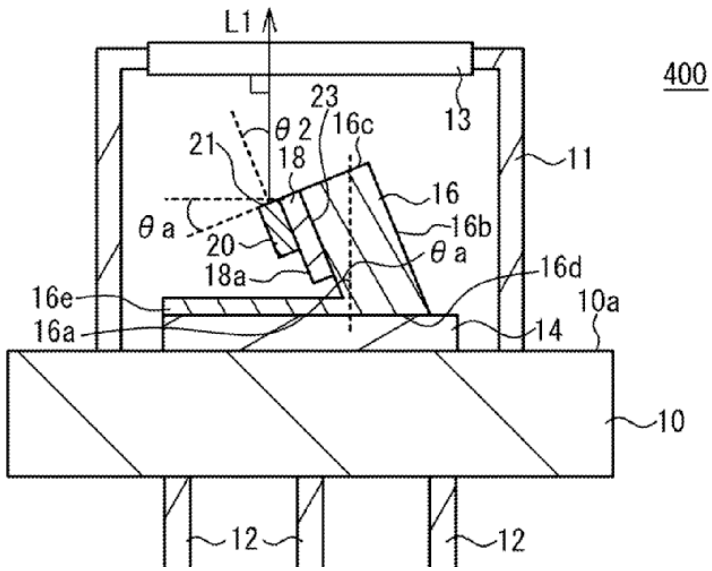
Stems being a portion of a package that is offset or at an angle to the remainder in order to mount the laser diode.

Stems made from a specific material or having specific dimensions or shape. Stems are frequently part of the mounting of laser diodes in a TO-CAN package. This symbol is not allocated for the mere presence of a stem where the packaged laser diode is mounted on and the stem having a shape without any specific function.

Stems made from a material so that it takes the function of a heat spreader should also be classified for that aspect in group H01S 5/02476.

An example of a stem which should be classified in this group is stem 16 having a very specific shape.

FIG. 11



References

Informative references

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

Can-type, e.g. TO-CAN housings with emission along or parallel to symmetry axis	H01S 5/02212
Heat spreaders, i.e. improving heat flow between laser chip and heat dissipating elements	H01S 5/02476

H01S 5/02315

Support members, e.g. bases or carriers

Definition statement

This place covers:

Support members which carry only a laser diode and which are made from a specific material or having specific dimensions or shape.

Support members made from a material so that it takes the function of a heat spreader should also be classified for that aspect in group H01S 5/02476.

This symbol is not allocated for a support member which carries besides the laser diode further specific optical or electrical elements. Such arrangements are classified in groups H01S 5/02325, H01S 5/02326 and H01S 5/0239 if applicable.

References

Informative references

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

Heat spreaders, i.e. improving heat flow between laser chip and heat dissipating elements	H01S 5/02476

H01S 5/0232

Lead-frames

Definition statement

This place covers:

Laser diodes which are mounted directly or via sub-mounts on a lead-frame.

A lead-frame is a thin sheet of metal with a central pad and outer leads to facilitate electrical connection between a device on the central pad and other devices.

A non-exclusive list of exemplary lead-frame packages include quad flat no-leads packages (QFN), quad flat packages (QFP), dual in-line packages (DIP) and dual-flat no-leads (DFN).

An example for a lead-frame 220 which should be classified in this group is shown below.

Fig. 2 depicts an array of laser diodes mounted on a lead frame with one common electrode on the central pad.

Fig. 5B shows for clarification lead frames without the mounted laser diodes in a stage of manufacturing before singularization into single lead frames.

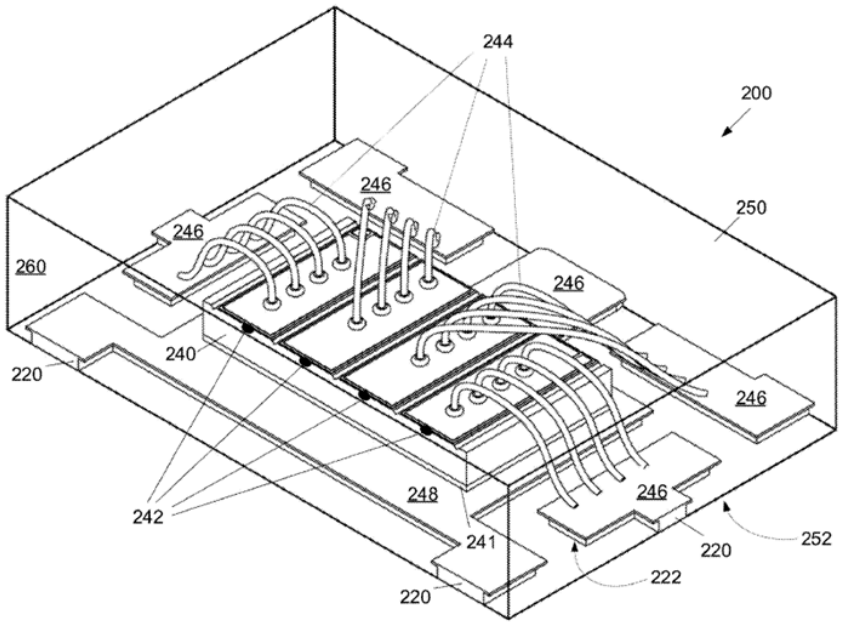


FIG. 2

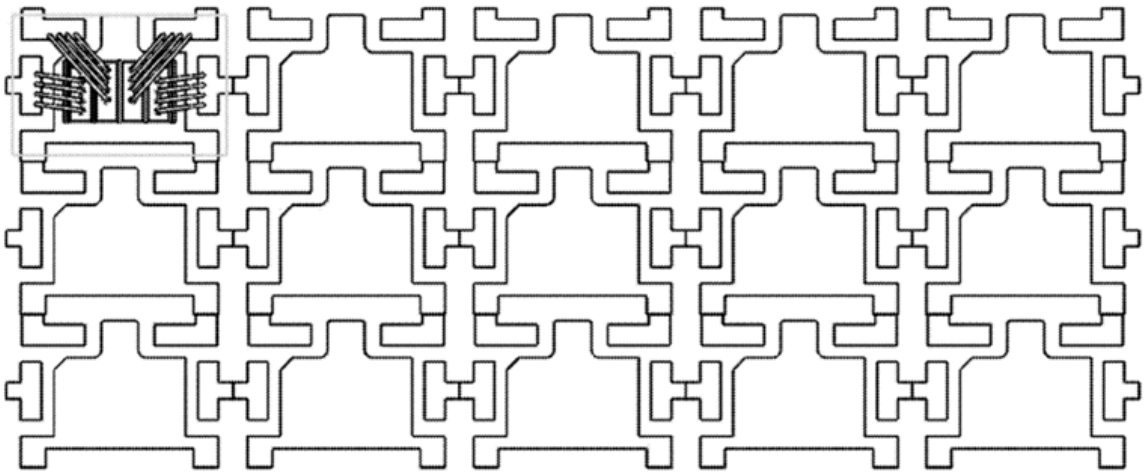


FIG. 5B

H01S 5/02375

Positioning of the laser chips

Definition statement

This place covers:

Positioning of a laser diode on a mount with the help of for example marks on the mounting surface or marks on the semiconductor chip. A mark can also be implemented by correspondingly shaped contact surfaces on the mounting surface of a mount, e.g. self-alignment.

Relationships with other classification places

Specific positioning of the laser diode relative to optical components being also mounted on the same mount with the help of for example grooves or stops formed in the surface of the mount is classified in group H01S 5/02326.

References

Informative references

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

Support members, e.g. bases or carriers	H01S 5/02315

H01S 5/0239

Combinations of electrical or optical elements

Definition statement

This place covers:

Combinations of electrical elements and/or combinations of optical elements on the same mount or in the same housing as the laser diode. Such combinations should only be classified in this place if the mount or the housing are specially adapted for the combinations or if a particular layout is provided.

H01S 5/024

Arrangements for thermal management

References

Informative references

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

Non-optical elements	H01S 5/0261
Cooling solid state junction devices	H01L 23/34

H01S 5/026

Monolithically integrated components, e.g. waveguides, monitoring photo-detectors, drivers (stabilisation of output H01S 5/06)

References

Limiting references

This place does not cover:

Stabilisation of output	H01S 5/06

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
Devices consisting of a plurality of semiconductor or other solid state components formed in or on a common substrate, adapted for light emission	H01L 27/15

H01S 5/04

Processes or apparatus for excitation, e.g. pumping, {e.g. by electron beams} (H01S 5/06 takes precedence)

References

Limiting references

This place does not cover:

Arrangements for controlling the laser output parameters	H01S 5/06

H01S 5/04254

{characterised by the shape}

Definition statement

This place covers:

- Electrodes of a semiconductor laser with at least one electrode having a specific shape.
- Electrodes having a geometrical shape like a square, triangular or a circular shape for specific reasons given in the document.
- Electrodes having defined dimensions, e.g. a specific electrode diameter is disclosed.

Relationships with other classification places

Additional symbols may be allocated if appropriate for further specific aspects of electrodes from the following places H01S 5/04252, H01S 5/04253, H01S 5/04256 and H01S 5/04257.

H01S 5/04256

{characterised by the configuration}

Definition statement

This place covers:

- Electrodes of a semiconductor laser with at least one electrode having a specific configuration, e.g. the placement of the electrode within an electric circuit.
- Electrodes having specific geometric arrangement, e.g. electrodes with specific distances or specific geometric arrangements between/among them, e.g. an array of VCSEL with the electrodes arranged in the shape of a honeycomb or concentric circles.

Relationships with other classification places

Additional symbols may be allocated if appropriate for further specific aspects of electrodes from the following places H01S 5/04252, H01S 5/04253, H01S 5/04254 and H01S 5/04257.

H01S 5/06

Arrangements for controlling the laser output parameters, e.g. by operating on the active medium

Definition statement

This place covers:

Control/stabilisation by applying voltages to the electrodes of the semiconductor laser chip or temperature tuning of the laser diode itself;

References

Informative references

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

Control/stabilisation of the external cavity elements	H01S 3/10, H01S 3/13
Transmission systems employing light	H04B 10/00

H01S 5/0604

{comprising a non-linear region, e.g. generating harmonics of the laser frequency}

Definition statement

This place covers:

Frequency conversion inside the semiconductor laser chip

References

Limiting references

This place does not cover:

SHG in an external cavity is	H01S 3/109

H01S 5/062

by varying the potential of the electrodes (H01S 5/065 takes precedence)

References

Limiting references

This place does not cover:

Mode locking; Mode suppression; Mode selection; Self pulsating	H01S 5/065

H01S 5/068

Stabilisation of laser output parameters (H01S 5/0625 takes precedence)

References

Limiting references

This place does not cover:

Multi-section lasers	H01S 5/0625

H01S 5/06825

{Protecting the laser, e.g. during switch-on/off, detection of malfunctioning or degradation}

Definition statement

This place covers:

Circuitry comprising diodes for overvoltage or surge protection

References

Informative references

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

Monolithic integration	H01S 5/0261

H01S 5/10

Construction or shape of the optical resonator {, e.g. extended or external cavity, coupled cavities, bent-guide, varying width, thickness or composition of the active region (H01S 5/20 takes precedence)}

References

Limiting references

This place does not cover:

Structure or shape of the semi-conductor body to guide the optical wave; Confining structures perpendicular to the optical axis, e.g. index- or gain-guiding, stripe geometry, broad area lasers, gain tailoring, transverse or lateral reflectors, special cladding structures, MQW barrier reflection layers	H01S 5/20

H01S 5/1003

{Waveguide having a modified shape along the axis, e.g. branched, curved, tapered, voids}

Definition statement

This place covers:

Structures of the laser diode chip (and its waveguide)

H01S 5/1071

{Ring-lasers}

References

Limiting references

This place does not cover:

Laser diode with an external ring resonator for wavelength definition	H01S 5/14

H01S 5/12

the resonator having a periodic structure, e.g. in distributed feedback [DFB] lasers (comprising a photonic bandgap structure H01S 5/11; surface-emitting lasers H01S 5/18)

References

Limiting references

This place does not cover:

Comprising a photonic bandgap structure	H01S 5/11
Surface-emitting lasers	H01S 5/18

Informative references

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

Forward coupled structures, i.e. DFC lasers	H01S 5/1028

H01S 5/14

External cavity lasers (H01S 5/18 takes precedence; mode locking H01S 5/065)

References

Limiting references

This place does not cover:

Mode locking; Mode suppression; Mode selection	H01S 5/065
Surface-emitting [SE] lasers	H01S 5/18

Informative references

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

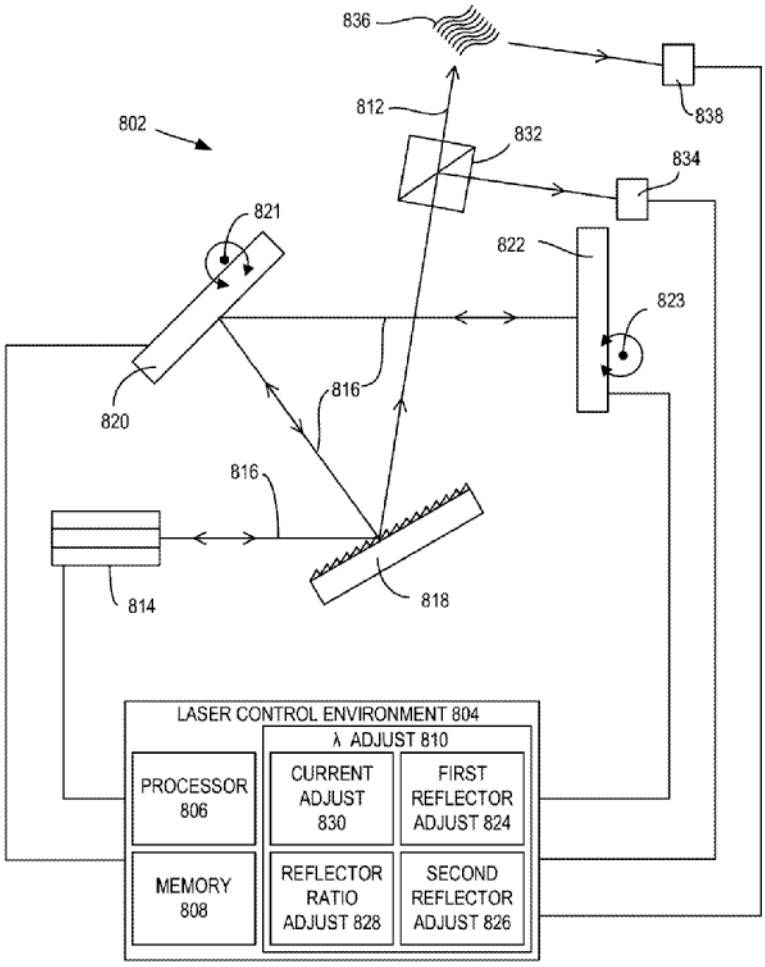
Construction or shape of optical resonators or components thereof	H01S 3/08
Controlling the intensity, frequency, phase, polarisation or direction of the emitted radiation	H01S 3/10
Stabilisation of laser output parameters	H01S 3/13

Special rules of classification

For external cavity lasers covered by H01S 5/14 the group H01S 5/06 is additionally allocated for the control/stabilisation by applying voltages to the electrodes of the semiconductor laser chip or temperature tuning of the laser diode itself.

In this group external cavity elements correspond to elements inside the laser cavity or forming part of the cavity but outside of the semiconductor laser chip. Specific optical elements forming part of the external cavity and their control should also be classified in H01S 3/08, H01S 3/10 and H01S 3/13.

As an example, Fig. 8 is discussed.



H01S 5/143: The ECLD is in a Littman-Metcalf configuration, this is the basic configuration of the laser.

Details of the external cavity elements are classified in H01S 3/00:

H01S 3/105: The tilt of one mirror is used for wavelength control;

H01S 3/139: The tilt of one mirror is controlled with a feed-back loop for stabilisation of the set wavelength; and H01S 3/0816: The resonator has 4 reflectors counting also the reflecting back facet of the laser diode chip.

H01S 5/16

Window-type lasers, i.e. with a region of non-absorbing material between the active region and the reflecting surface (H01S 5/14 takes precedence)

References

Limiting references

This place does not cover:

External cavity lasers	H01S 5/14

H01S 5/183

having only vertical cavities, e.g. vertical cavity surface-emitting lasers [VCSEL]

Definition statement

This place covers:

Surface emitting lasers having only a vertical cavity.

In case of so called "half VCSEL" which are used as a gain medium in for example external cavity laser diodes or in case the VCSEL is coupled to resonator elements integrated into a photonic circuit still the details of the VCSEL chip itself are classified in group H01S 5/183 independent of the geometrical arrangement of the external cavity.

H01S 5/18319

{comprising a periodical structure in lateral directions}

References

Informative references

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

Comprising a photonic bandgap structure	H01S 5/11

H01S 5/185

having only horizontal cavities, e.g. horizontal cavity surface-emitting lasers [HCSEL] (comprising a photonic bandgap structure H01S 5/11)

Definition statement

This place covers:

Surface emitting lasers having only a horizontal cavity. The surface emission may be realized by a beam deflecting mirror external to the semiconductor laser chip but manufactured into the semiconductor layer structure by for example etching. I.e., the beam deflecting element is an integral part of the semiconductor laser structure.

Relationships with other classification places

Surface emission resulting from an edge-emitting semiconductor laser and a separate beam deflecting element both being arranged on a mount is classified in group H01S 5/02255.

In case the output coupling is performed with the help of a photonic bandgap structure in addition classification in group H01S 5/11 should be considered.

References

Limiting references

This place does not cover:

Construction or shape of the optical resonator comprising a photonic bandgap structure	H01S 5/11

Informative references

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

Support members, e.g. bases or carriers	H01S 5/02315

H01S 5/187

using Bragg reflection

References

Informative references

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

Surface-emitting [SE] lasers having only vertical cavities, e.g. vertical cavity surface-emitting lasers [VCSEL]	H01S 5/183

H01S 5/20

Structure or shape of the semiconductor body to guide the optical wave {; Confining structures perpendicular to the optical axis, e.g. index or gain guiding, stripe geometry, broad area lasers, gain tailoring, transverse or lateral reflectors, special cladding structures, MQW barrier reflection layers}

Definition statement

This place covers:

Specific layers of the laser diode chip or materials provided therein or structures manufactured into the semiconductor body that have an impact on the wave-guiding properties of the laser diode. Both alternatives are covered here: index guiding or anti-guiding as well as gain guiding. See the corresponding entries for the correct classification of a document.

Relationships with other classification places

The range H01S 5/2004 - H01S 5/205 restricts itself to structures having a wave-guiding effect in a direction being perpendicular to the layer structure, which equals in most cases a wave-guiding impact along the growth direction.

Gain guiding in the perpendicular direction by shaping the active region by a thickness variation along the optical axis is in H01S 5/106.

Wave-guiding in a direction being parallel to the layer structure can be found in for example:

- H01S 5/1003 - H01S 5/1017 (index guiding)
- H01S 5/1064 (gain guiding)

H01S 5/2004

{Confining in the direction perpendicular to the layer structure}

Definition statement

This place covers:

Structures or layers having a wave-guiding effect in a direction being perpendicular to the layer structure, which equals in most cases a wave-guiding impact along the growth direction. Often used for selecting or suppressing optical modes inside the laser diode chip.

Relationships with other classification places

The range H01S 5/2004 - H01S 5/205 restricts itself to structures having a wave-guiding effect in a direction being perpendicular to the layer structure, which equals in most cases a wave-guiding impact along the growth direction. Gain guiding in the perpendicular direction by shaping the active region by a thickness variation along the optical axis is in H01S 5/106.

H01S 5/2009

{by using electron barrier layers}

Definition statement

This place covers:

Electron barrier layers that are used to confine the electrical charges into a certain zone comprising the active region. This confinement results in a confined gain region, which in turn is responsible for an impact of gain guiding on the modes propagating inside the laser diode chip. Electron barrier layers manifest themselves frequently by being a highly doped and thin semiconductor layer with a thickness in the few nanometer range.

Relationships with other classification places

Gain guiding in the perpendicular direction by shaping the active region by a thickness variation along the optical axis is in H01S 5/106.

H01S 5/223

Buried stripe structure {(H01S 5/227 takes precedence)}

References

Limiting references

This place does not cover:

Buried mesa structure; Striped active layer	H01S 5/227

H01S 5/2238

{with a terraced structure}

Definition statement

This place covers:

Asymmetric protrusions comprised in the layer structure, i.e. only one step in the height of the substrate or the laminate,

H01S 5/32

comprising PN junctions, e.g. hetero- or double- heterostructures (H01S 5/34, H01S 5/36 take precedence)

References

Limiting references

This place does not cover:

The active region comprising quantum well, quantum wire, quantum box or supperlattice structures, e.g. single quantum well lasers (SQW lasers), multiple quantum well lasers (MQW lasers), graded index separate confinement hetrostructure lasers (GRINSCH lasers)	H01S 5/34
The active region comprising organic materials	H01S 5/36

H01S 5/32358

{containing very small amounts, usually less than 1%, of an additional III or V compound to decrease the bandgap strongly in a non-linear way by the bowing effect}

Definition statement

This place covers:

Doping with small amounts of group III or V compounds

H01S 5/34

comprising quantum well or superlattice structures, e.g. single quantum well [SQW] lasers, multiple quantum well [MQW] lasers or graded index separate confinement heterostructure [GRINSCH] lasers (H01S 5/36 takes precedence)

References

Limiting references

This place does not cover:

The active region comprising organic materials	H01S 5/36

H01S 5/343

in $A_{III}B_{V}$ compounds, e.g. AlGaAs-laser {, InP-based laser}

References

Informative references

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

Doping with small amounts of group III or V compounds	H01S 5/32358

H01S 5/36

comprising organic materials

References

Informative references

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

Dye lasers	H01S 3/213

H01S 5/40

Arrangement of two or more semiconductor lasers, not provided for in groups H01S 5/02 - H01S 5/30 (H01S 5/50 takes precedence)

References

Limiting references

This place does not cover:

Structural details or components not essential to laser action	H01S 5/02
Processes or apparatus for excitation	H01S 5/04
Arrangements for controlling the laser output parameters	H01S 5/06
Construction or shape of the optical resonator	H01S 5/10
Structure or shape of the semi-conductor body to guide the optical wave; Confining structures perpendicular to the optical axis	H01S 5/20
Structure or shape of the active region; Materials used for the active region	H01S 5/30
Amplifier structures not provided for in groups H01S 5/02 - H01S 5/30	H01S 5/50

H01S 5/4006

{Injection locking}

Definition statement

This place covers:

Master oscillator and (power) amplifier arrangements (MOPA), i.e. the wavelength of the amplifier is the same as of the laser diode acting as the oscillator

H01S 5/4025

{Array arrangements, e.g. constituted by discrete laser diodes or laser bar (H01S 5/42 takes precedence)}

Definition statement

This place covers:

Laser diode arrays / bars

References

Limiting references

This place does not cover:

Cooling of laser diode bars	H01S 5/024
Arrays of surface emitting lasers	H01S 5/42

H01S 5/4062

{with an external cavity or using internal filters, e.g. Talbot filters}

Special rules of classification

External cavity lasers are additionally classified in group H01S 5/06 and sub-groups when the control/ stabilisation by applying voltages to the electrodes of the semiconductor laser chip or temperature tuning of the laser diode itself is of interest.

H01S 5/42

Arrays of surface emitting lasers

Definition statement

This place covers:

Arrays of surface emitting lasers as classified in groups H01S 5/18, H01S 5/185 and H01S 5/187.

Special rules of classification

In order to be able to distinguish between arrays of horizontal or folded cavity surface emitting lasers classification in group H01S 5/42 should always be accompanied by the additional classification in appropriate groups H01S 5/18, H01S 5/185 or H01S 5/187.

H01S 5/423

{having a vertical cavity}

Definition statement

This place covers:

Arrays of vertical cavity surface emitting lasers as classified in group H01S 5/183.

References

Informative references

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

Measuring arrangements for measuring contours or curvatures	G01B 11/24
Systems according to group G01S 17/00 using multiple transmitters	G01S 7/4815
3D imaging with simultaneous measurement of time-of-flight at a 2D array of receiver pixels, e.g. time-of-flight cameras or flash lidar	G01S 17/894

H01S 5/50

Amplifier structures not provided for in groups H01S 5/02 - H01S 5/30

References

Informative references

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

Amplifier structures as repeaters in transmission systems	H04B 10/291