

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 |
|-------------------------|----------------------------|

Application-oriented references

| | |
|---|--|
| Radiation therapy using laser light | A61N 2005/067 |
| 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

Special rules of classification

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
{(waveguide lasers [H01S 3/063](#))}

References**Limiting references**

This place does not cover:

| | |
|------------------|----------------------------|
| Waveguide lasers | H01S 3/063 |
|------------------|----------------------------|

Informative references

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

| | |
|------------------------------|---------------------------|
| Controlling the laser output | H01S 3/10 |
| Stabilising | H01S 3/13 |

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 3/082

defining a plurality of resonators, e.g. for mode selection {(single longitudinal mode control [H01S 3/08022](#))}

References

Limiting references

This place does not cover:

| | |
|--|------------------------------|
| 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 a non-linear optical device, e.g. exhibiting Brillouin- or Raman-scattering
{(mode locking using a non-linear element [H01S 3/112](#))}

References

Limiting references

This place does not cover:

| | |
|---|----------------------------|
| Mode locking using a non-linear element | H01S 3/112 |
|---|----------------------------|

H01S 3/11

{Pulse generation, e.g. Q-switching, mode locking}

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 |

Relationships with other classification places

| | |
|--|----------------------------|
| 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) | H01L 51/50 |
| 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.

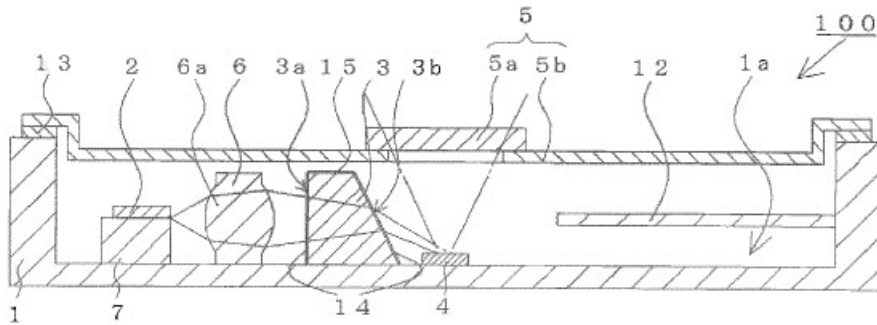
Relationships with other classification places

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.

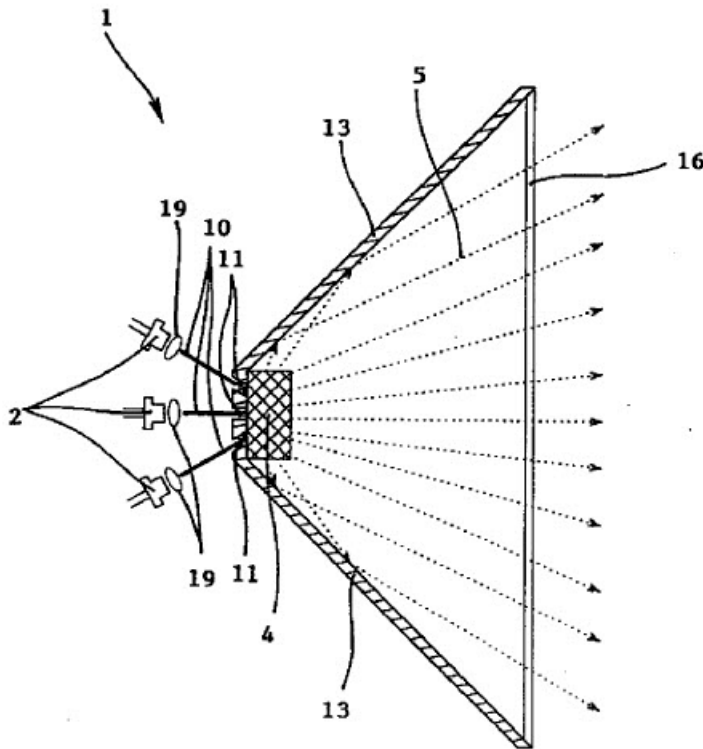


FIG. 3

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 5/024

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.

Definition statement

- 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

In this group external cavity elements correspond to elements inside the laser cavity but outside the monolithic semiconductor body. These elements correspond to intra cavity elements in [H01S 3/00](#).

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.

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 5/18319**{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 5/187**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 superlattice structures, e.g. single quantum well lasers (SQW lasers), multiple quantum well lasers (MQW lasers), graded index separate confinement heterostructure 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 lasers [SQW-lasers], multiple quantum well lasers [MQW-lasers] or graded index separate confinement heterostructure lasers [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 5/50

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 |
|---|-----------------------------|